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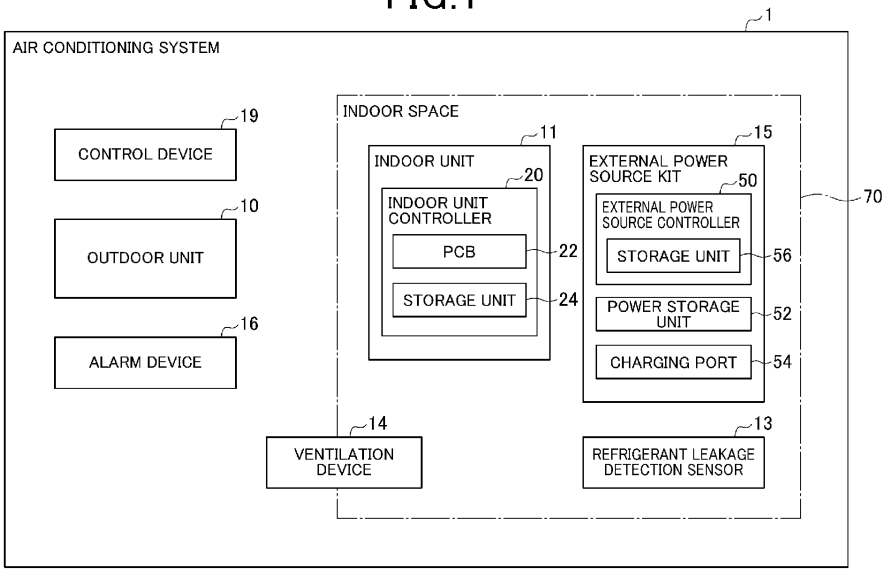
(54) **AIR CONDITIONING SYSTEM**

(57) Provided is an air conditioning system capable of efficiently driving a device for a countermeasure against refrigerant leakage with power of a power storage unit, when power supply from a commercial power source is not available. The air conditioning system includes a refrigeration cycle to circulate a slightly flammable refrigerant or a flammable refrigerant, an indoor unit 11 including a heat exchanger connected to the refrigeration cycle, the indoor unit being installed in an indoor space 70, a refrigerant sensor that detects the refrigerant leaking from the indoor unit 11, a ventilation device 14 that ventilates the indoor space 70, a power storage unit 52 that is charged by a commercial power source, and a controller, the refrigerant sensor and the ventilation device 14 are operated by the commercial power source, and the controller operates the ventilation device 14 with power of the power storage unit 52, in a case where supply from the commercial power source is stopped.

FIG.1



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an air conditioning system.

Description of the Related Art

[0002] Japanese Patent Laid-Open No. 2015-117931 discloses an indoor unit that maximizes a detectable time when a detection sensor is activated by a power storage unit for use as an emergency power source during power failure. This indoor unit includes a casing, a heat exchanger through which a flammable refrigerant flows, the power storage unit for use as the emergency power source when power supply from a commercial power source is not available, the detection sensor that detects leakage of the refrigerant, and a controller that controls energization from the commercial power source or the power storage unit to the detection sensor. The controller controls the energization from the power storage unit to the detection sensor to intermittently activate the detection sensor.

[0003] The present invention provides an air conditioning system capable of efficiently driving a device for a countermeasure against refrigerant leakage by use of power of a power storage unit, when power supply from a commercial power source is not available.

SUMMARY OF THE INVENTION

[0004] An air conditioning system 1 in the present disclosure includes a refrigeration cycle to circulate a slightly flammable refrigerant or a flammable refrigerant, an indoor unit including a heat exchanger connected to the refrigeration cycle, the indoor unit being installed in an indoor space, a refrigerant sensor that detects the refrigerant leaking from the indoor unit, a ventilation device that ventilates the indoor space, a power storage unit that is charged by a commercial power source, and a controller, wherein the refrigerant sensor and the ventilation device are operated by the commercial power source, and the controller operates the ventilation device with power of the power storage unit, in a case where supply from the commercial power source is stopped.

[0005] According to the present invention, a device for a countermeasure against refrigerant leakage can be efficiently driven by using power of a power storage unit, when power supply from a commercial power source is not available.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

Fig. 1 is a block diagram showing a configuration of an air conditioning system according to Embodiment 1 of the present invention;

Fig. 2 is a diagram showing a configuration of the air conditioning system in an indoor space;

Fig. 3 is a flowchart showing an operation of the air conditioning system in a case where a commercial power source is in a power failure state;

Fig. 4 is a flowchart showing the operation of the air conditioning system in the case where the commercial power source is in the power failure state;

Fig. 5 is a block diagram showing a configuration of an air conditioning system according to Embodiment 2 of the present invention; and

Fig. 6 is a flowchart showing an operation of the air conditioning system in a case where a commercial power source is in a power failure state.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Fundamental Knowledge of present Disclosure)

[0007] At the time when the inventors came up with the present disclosure, there was a technology of maximizing a detectable time, when activating a detection sensor with a power storage unit for use as an emergency power source, for a countermeasure against refrigerant leakage during power failure in an indoor unit of an air conditioning system 1.

[0008] This indoor unit includes a heat exchanger through which a flammable refrigerant flows, a battery that is the power storage unit for use as the emergency power source when power supply from a commercial power source is not available, a detection sensor that detects leakage of the flammable refrigerant, and a control device corresponding to a controller that controls energization from the commercial power source or the battery to the detection sensor. The control device controls the energization from the battery to the detection sensor to intermittently activate the detection sensor.

[0009] Additionally, in a case where the commercial power source is stopped (in a state of so-called power failure) due to earthquake or the like, a refrigerant might leak from a refrigerant pipe due to damages on the pipe. Therefore, in the case where the commercial power source is stopped, it is highly necessary to drive a refrigerant sensor and a ventilation device with an external power source. However, power consumption of the ventilation device is larger than that of the refrigerant sensor, and hence these devices for the countermeasure against the refrigerant leakage could not be operated with the external power source for a long time.

[0010] To solve the problem, the present disclosure provides an air conditioning system 1 capable of efficiently driving a ventilation device with power of a power storage unit, when power supply from a commercial power source is stopped.

[0011] Hereinafter, embodiments will be described in detail with reference to the drawings. However, an unnecessarily detailed description may not be made. For example, a detailed description of already well known matter or a redundant description of about the same configuration may not be made. This avoids making the following description unnecessarily redundant, and facilitates understanding of a person skilled in the art.

[0012] Note that the accompanying drawings and the following description are provided for the person skilled in the art to sufficiently understand the present disclosure, and are not intended to limit a subject described in claims.

(Embodiment 1)

[0013] Hereinafter, Embodiment 1 will be described with reference to Figs. 1 to 4.

[1-1. Configuration]

[1-1-1. Configuration of Air Conditioning System]

[0014] Fig. 1 is a block diagram showing a configuration of an air conditioning system 1 according to the present embodiment.

[0015] Fig. 2 is a diagram showing a configuration of the air conditioning system 1 in an indoor space 70.

[0016] The air conditioning system 1 includes a refrigeration cycle formed by an indoor heat exchanger 29 and a decompression device that are housed in an indoor unit 11, and a compressor, a decompression device, an outdoor heat exchanger and others that are housed in an outdoor unit 10. Furthermore, the air conditioning system 1 performs air conditioning of the indoor space 70 by circulating a refrigerant in this refrigeration cycle, the indoor space being a space to be conditioned that is provided with the indoor unit 11.

[0017] In the present embodiment, R32 that is a slightly flammable refrigerant is for use as the refrigerant of the air conditioning system 1. Note that the refrigerant is not limited to this example, and various alternative chlorofluorocarbons such as hydrocarbons and ammonias may be used in the refrigerant of the air conditioning system 1.

[0018] As shown in Figs. 1 and 2, the air conditioning system 1 of the present embodiment includes the outdoor unit 10 and the indoor unit 11, and the system is configured by connecting the outdoor unit 10 and the indoor unit 11 by refrigerant pipes 2 and 4.

[0019] The outdoor unit 10 includes the compressor, a heat source side heat exchanger, an expansion valve, and a switching valve that switches a heating operation and a cooling operation. In addition, the outdoor unit 10 may include an accumulator, a pressure sensor or the like.

[0020] The indoor unit 11 is installed in the indoor space 70, and performs the air conditioning of the indoor space 70. That is, the indoor space 70 is the space to be conditioned in the indoor unit 11.

[0021] The air conditioning system 1 performs the cooling operation or the heating operation to the indoor space 70. For this purpose, the refrigerant flows through two refrigerant pipes 2 and 4 between the outdoor unit 10 and the indoor unit 11. A high pressure gas refrigerant flows through one of the refrigerant pipes 2 and 4, and a low pressure gas or liquid refrigerant flows through the other refrigerant pipe. The refrigerant pipes 2 and 4 branch from each other and are connected to a refrigerant circuit 21 included in the indoor unit 11. A direction in which the refrigerant flows through the refrigerant pipes 2 and 4 during the cooling operation is reverse to that during the heating operation in the air conditioning system 1.

[0022] The air conditioning system 1 includes a refrigerant leakage detection sensor 13 corresponding to a detection sensor that detects the refrigerant. The refrigerant leakage detection sensor 13 detects the refrigerant leaking from the refrigerant circuit 21, a connected part of the refrigerant circuit 21 to the refrigerant pipe 2 or 4, and the like.

[0023] In the present embodiment, the refrigerant leakage detection sensor 13 is installed in the indoor space 70. In a case where the refrigerant for use in the air conditioning system 1 is a gas with a specific gravity larger than that of air, it is desirable that the refrigerant leakage detection sensor 13 is installed in a lower part of the indoor space 70.

[0024] Alternatively, the refrigerant leakage detection sensor 13 may be disposed in a housing of the indoor unit 11.

[0025] The air conditioning system 1 includes a ventilation device 14. In the ventilation device 14, a blower including any type of fan such as an axial fan or a centrifugal fan is used, and the device is a so-called mechanical ventilation device that ventilates, with the fan, the indoor space where the device is installed.

[0026] The ventilation device 14 of the present embodiment discharges the refrigerant that leaks into the indoor space 70 to outside of the indoor space 70.

[0027] The ventilation device 14 is connected to a commercial alternating current power source 9 as a commercial power source via a feed line 32. The commercial AC power source 9 is a power source connected to the ventilation device 14 in the indoor space 70. Consequently, power of AC 200V is supplied from the commercial AC power source 9 to the ventilation device 14. The ventilation device 14 can be driven with this power.

[0028] The air conditioning system 1 of the present embodiment is provided with an external power source kit 15 that is disposed in the indoor space.

[0029] The external power source kit 15 includes a power storage unit 52 that stores a supplied current. The external power source kit 15 discharges and supplies power stored in each part of the air conditioning system 1, when the supply of the current is stopped.

[0030] The air conditioning system 1 includes an alarm device 16. The alarm device 16 issues an alarm to the outside, and notifies a management center of various types of information depending on a state of the air conditioning system 1 in the present embodiment. For example, in a case where driving of the refrigerant leakage detection sensor 13 or the ventilation device 14 cannot be confirmed, the alarm device 16 notifies the management center that it is necessary to repair these units.

[0031] Note that the alarm device 16 may issue an alarm not only to the outside but also to those who are in the indoor space 70. Also, in this case, the alarm device may be disposed integrally in a remote control device or the like that is capable of operating the air conditioning system 1.

[0032] The air conditioning system 1 includes a control device 19. The control device 19 controls an operation of the air conditioning system 1. The control device 19 executes, for example, control of operation start and operation stop of the outdoor unit 10, control of operations of the compressor and the switching valve included in the outdoor unit 10, and detection of an operating state of each of the outdoor unit 10 and the indoor unit 11.

[1-1-2. Configuration of Indoor Unit]

[0033] As shown in Fig. 2, the indoor unit 11 includes an indoor heat exchanger 29 that forms the refrigerant circuit 21, and an indoor fan 28 that blows air to the indoor heat exchanger 29.

[0034] The indoor unit 11 includes the refrigerant circuit 21 in which the refrigerant supplied from the outdoor unit 10 circulates. The refrigerant circuit 21 includes, for example, the indoor heat exchanger 29 that is a user side heat exchanger, and another pipe.

[0035] The indoor unit 11 is connected to the commercial AC power source 9 as the commercial power source via a feed line 33. The commercial AC power source 9 is a power source connected to the indoor unit 11 in the indoor space 70. The commercial AC power source 9 is a common power source that is also connected to the ventilation device 14 as described above. Consequently, the power of AC 200V is supplied from the commercial AC power source 9 to the indoor unit 11.

[0036] Note that in the present embodiment, an example where the commercial AC power source 9 of AC 200V is connected to the indoor unit 11 is described, but the present disclosure is not limited to this example. For example, another power source of AC 100V or the like may be connected to the indoor unit 11. Similarly, the power source connected to the ventilation device 14 as described above is not limited to the power source of AC 200V, and may be, for example, another power source of AC 100V or the like.

[0037] The indoor unit 11 includes an indoor unit controller 20. The indoor unit controller 20 includes a computer including a processor such as a CPU or MPU and a memory device such as a ROM, RAM or the like, and the controller functions as a controller that controls each part of the air conditioning system 1. Alternatively, the indoor unit controller 20 may include a plurality of processors, or semiconductor chips.

[0038] The indoor unit controller 20 includes a printed circuit board (PCB) 22. The PCB 22 is a so-called printed circuit board, and the PCB 22 is a circuit board on which a microcomputer and the processor forming the indoor unit controller 20, a power source circuit and others are mounted.

[0039] The indoor unit controller 20 controls an operation of the indoor unit 11, and controls each electrically connected part of the air conditioning system 1. For example, the indoor unit controller 20 operates a fan motor of the indoor fan 28 with the power supplied through the feed line 33.

[0040] The PCB 22 may be connected to a remote control light receiving unit or an operation panel. In this case, the indoor unit controller 20 performs, for example, change of a target temperature based on an operation of a remote controller or the operation panel, and controls the operation of the indoor unit 11 at the target temperature. Furthermore, the indoor unit controller 20 may include a function of transmitting data concerning the operating state to the control device 19.

[0041] A feed line 34 is disposed between the PCB 22 and the refrigerant leakage detection sensor 13. The feed line 34 branches and outputs power fed through the feed line 33 to the refrigerant leakage detection sensor 13. Therefore, the power of AC 200V is supplied to the refrigerant leakage detection sensor 13.

[0042] The feed line 33 is connected to the PCB 22. Consequently, for example, the power of AC 200V is supplied from the commercial AC power source 9 to the PCB 22.

[0043] The refrigerant leakage detection sensor 13 is connected to the PCB 22 through a signal line 41.

[0044] A control signal generated by the PCB 22 is transmitted to the refrigerant leakage detection sensor 13 via the signal line 41. A specific form of the signal line 41 is arbitrary, and may be, for example, a line electrically connecting the PCB 22 and the refrigerant leakage detection sensor 13, or a communication line via which the control signal is transmitted based on a predetermined communication protocol. Alternatively, the connection may be performed via a wireless communication circuit. Note that in the present embodiment, a form of another signal line to be described later is the same as in the signal line 41.

[0045] Alternatively, the refrigerant leakage detection sensor 13 may be connected to the commercial AC power source 9 without being connected via the PCB 22. In this case, the refrigerant leakage detection sensor 13 is connected to the PCB 22 in a wireless or wired manner, and the refrigerant leakage detection sensor 13 may be controlled by the PCB 22.

[0046] Further, in this case, a controller may be mounted in the refrigerant leakage detection sensor 13, and

the refrigerant leakage detection sensor 13 may be controlled by this controller.

[0047] The control signal is a signal to instruct driving or stopping of the refrigerant leakage detection sensor 13 via the signal line 41. Upon receiving this control signal, the refrigerant leakage detection sensor 13 is driven to detect refrigerant leakage, or stops the driving.

[0048] Also, the indoor unit controller 20 monitors a detecting state of the refrigerant leakage detection sensor 13 via the signal line 41, and detects the leakage of the refrigerant by use of the refrigerant leakage detection sensor 13. Furthermore, the indoor unit controller 20 determines, via the signal line 41, whether or not the refrigerant leakage detection sensor 13 can normally detect the leakage of the refrigerant.

[0049] The PCB 22 is connected to the ventilation device 14 through a signal line 43. The signal line 43 transmits, to the ventilation device 14, a control signal generated by the indoor unit controller 20. This control signal is a signal for the indoor unit controller 20 to instruct the ventilation device 14 to start or stop driving. Upon receiving this control signal, the ventilation device 14 is driven to perform ventilation of the indoor space 70, or stops the ventilation of the indoor space 70.

[0050] A feed line 35 is disposed between the PCB 22 and the external power source kit 15. The feed line 35 branches and outputs power fed through the feed line 33 to the external power source kit 15. Therefore, power of AC 200V is supplied to the external power source kit 15.

[0051] The PCB 22 is connected to the external power source kit 15 through a signal line 44. The indoor unit controller 20 transmits a control signal via the signal line 44 to control the external power source kit 15.

[0052] The indoor unit controller 20 includes a storage unit 24 that stores various types of data concerning an operation of each part of the air conditioning system 1, and the operation of the indoor unit 11.

[1-1-3. Configuration of External Power Source kit]

[0053] As shown in Fig. 1, the external power source kit 15 includes an external power source controller 50, the power storage unit 52, and a charging port 54.

[0054] The power storage unit 52 is charged with a current supplied from the PCB 22 through the feed line 35. The power storage unit 52 stores power, and maintains a charged state, while the current is supplied from the commercial AC power source 9 via the PCB 22.

[0055] Also, the power storage unit 52 discharges in a case where the supplied current is stopped, and feeds, via a plurality of feed lines 36, power to each part connected to the external power source kit 15. The case where the supplied current is stopped corresponds to a case where output of the PCB 22 is stopped, for example, a case where power failure of the commercial AC power source 9 occurs.

[0056] In the present embodiment, the external power source kit 15 is connected to the refrigerant leakage detection sensor 13, the ventilation device 14, and the alarm device 16 via the respective feed lines 36. For example, in the case where the power failure of the commercial AC power source 9 occurs, the power storage unit 52 of the external power source kit 15 supplies power to these devices. Consequently, in the air conditioning system 1, even in the case where the power failure of the commercial AC power source 9 occurs, the refrigerant leakage detection sensor 13, the ventilation device 14 and the alarm device 16 can be driven with the power from the external power source kit 15.

[0057] The power storage unit 52 stores power in a secondary battery or a capacitor. In a configuration where the power storage unit 52 includes the secondary battery, such as a metallic hydrogen battery, a lithium battery or a lithium ion battery, a power storage capacity can be increased. Also, in a configuration where the power storage unit 52 includes the capacitor, immediate charging and discharging are possible. Further, a complicated circuit configuration such as a charging and discharging control circuit required for the secondary battery can be omitted, which is advantageous in terms of cost. It is desirable that the secondary battery or capacitor of the power storage unit 52 can store an amount of power that can operate, for a predetermined time, the respective devices connected to the power storage unit 52 via the feed lines 36.

[0058] The charging port 54 included in the external power source kit 15 can be connected to an external battery, a power generator or the like to supply power to the power storage unit 52. In the present embodiment, for example, in a case where the power failure of the commercial AC power source 9 continues for a long time, the power can be supplied to the power storage unit 52 by connecting, to the charging port 54, a power source other than the commercial AC power source 9, for example, a battery.

[0059] As described above, the external power source kit 15 includes the external power source controller 50. The external power source controller 50 includes a computer including a processor such as a CPU or MPU, and a memory device such as a ROM or RAM in the same manner as in the indoor unit controller 20. Alternatively, the external power source controller 50 may include a plurality of processors or semiconductor chips.

[0060] The external power source controller 50 functions as a controller that controls each part of the external power source kit 15, for example, the power storage unit 52.

[0061] Also, as described above, the external power source kit 15 is connected to the PCB 22 via the signal line 44. The external power source controller 50 functions as a determination unit that determines, by acquiring a predetermined signal via the signal line 44, whether or not the commercial AC power source 9 is in a power supply available state, that is, whether or not the commercial power source is in a power failure state.

[0062] In the present embodiment, the external power

source kit 15 is connected to the refrigerant leakage detection sensor 13, the ventilation device 14, and the alarm device 16 via respective signal lines 45.

[0063] Then, the external power source controller 50 functions as a controller that controls each part connected to the external power source kit 15 via each signal line 45, in a case where the current supplied from the commercial AC power source 9 is stopped, the power storage unit 52 discharges, and the power is supplied to each part connected to the external power source kit 15 via a plurality of feed lines 36.

[0064] Specifically, the external power source controller 50 transmits a control signal generated by the external power source controller 50 to the refrigerant leakage detection sensor 13 via the signal line 45.

[0065] The control signal is a signal to instruct driving or stopping of the refrigerant leakage detection sensor 13 via the signal line 45. Upon receiving this control signal, the refrigerant leakage detection sensor 13 is driven to perform detection of refrigerant leakage, or stops the driving.

[0066] In the present embodiment, the external power source controller 50 drives the refrigerant leakage detection sensor 13 in a case where the driving of the ventilation device 14 is stopped, and stops the refrigerant leakage detection sensor 13 in a case where the ventilation device 14 is driven.

[0067] In the case where the ventilation device 14 is driven, the leaked refrigerant is diffused in the indoor space 70 by the ventilation device 14. Consequently, a concentration of refrigerant in the indoor space 70 is diluted. Therefore, the driving of the refrigerant leakage detection sensor 13 can be stopped, and power consumption of the power storage unit 52 can be effectively reduced.

[0068] Also, the external power source controller 50 intermittently drives the refrigerant leakage detection sensor 13, in a case where a predetermined time or more elapses after start of power supply of the power storage unit 52 to the refrigerant leakage detection sensor 13.

[0069] In detail, for a predetermined time after the driving of the ventilation device 14 is stopped, the concentration of the refrigerant in the indoor space 70 indicates a diluted state. Therefore, in the air conditioning system 1, the driving of the refrigerant leakage detection sensor 13 can be stopped for the predetermined time after the driving of the ventilation device 14 is stopped. Then, in the air conditioning system 1, the driving of the refrigerant leakage detection sensor 13 is stopped for the predetermined time, so that the power consumption of the power storage unit 52 can be effectively reduced.

[0070] Furthermore, it is further preferable that the external power source controller 50 intermittently drives the refrigerant leakage detection sensor 13, in a case where a predetermined time or more elapses after the start of the power supply of the power storage unit 52 to the refrigerant leakage detection sensor 13. Consequently, in the air conditioning system 1, the power consumption of the power storage unit 52 can be effectively reduced.

[0071] In addition, in the case of intermittently driving the refrigerant leakage detection sensor 13, the external power source controller 50 controls the refrigerant leakage detection sensor 13 such that a ratio of a stop time to a drive time in the refrigerant leakage detection sensor 13 increases as a predetermined time elapses after start of the intermittent driving.

[0072] In detail, as time elapses long after stop of the power supply from the commercial AC power source 9, the refrigerant is less likely to leak into the indoor space 70. Thus, in the air conditioning system 1, as time elapses after the commercial power source is stopped, control is performed to increase the ratio of the stop time of the refrigerant leakage detection sensor 13 with the above elapse of time, so that the power consumption of the power storage unit 52 can be effectively reduced.

[0073] Furthermore, the external power source controller 50 monitors the detecting state of the refrigerant leakage detection sensor 13 via the signal line 45, to detect the leakage of the refrigerant by use of the refrigerant leakage detection sensor 13. Additionally, the external power source controller 50 determines, via the signal line 45, whether or not the refrigerant leakage detection sensor 13 can normally detect the leakage of the refrigerant.

[0074] The external power source controller 50 is connected to the ventilation device 14 through the signal line 45. Via the signal line 45, a control signal generated by the external power source controller 50 is transmitted to the ventilation device 14. This control signal is a signal for the external power source controller 50 to instruct the ventilation device 14 to start or stop driving. Upon receiving this control signal, the ventilation device 14 is driven to ventilate the indoor space 70, or stops the ventilation of the indoor space 70. That is, the external power source controller 50 controls the driving of the ventilation device 14 via the signal line 45.

[0075] The external power source controller 50 is connected to the alarm device 16 through the signal line 45. Via the signal line 45, a control signal generated by the external power source controller 50 is transmitted to the alarm device 16. This control signal is a signal to instruct the alarm device 16 to notify the management center that it is necessary to repair the refrigerant leakage detection sensor 13 or the ventilation device 14, in a case where the driving of the sensor or the device cannot be confirmed. Upon receiving this control signal, the alarm device 16 notifies the management center that it is necessary to repair the sensor or the device.

[0076] Also, the external power source controller 50 transmits, via the signal line 45 to the alarm device 16, a control signal to instruct the alarm device 16 to notify the management center that the refrigerant leakage detection sensor 13 detects the refrigerant. Upon receiving this control signal, the alarm device 16 notifies the management center that the refrigerant leakage detection sensor 13 detects the refrigerant.

[0077] The external power source controller 50 includes a storage unit 56 that stores various types of data concerning each part of the external power source kit 15, and control of each part connected to the external power source kit 15. For example, the storage unit 56 stores a floor area S (m^2), leakage height H (m), LFL (vol%) and the like, and the external power source controller 50 acquires these values from the storage unit 56.

[0078] Note that in the present embodiment, various numeric values of the floor area S (m^2), leakage height H (m), LFL (vol%) and the like are inputted into the storage unit 56 by an operator when installing the air conditioning system 1.

[1-2. Operation]

[0079] Hereinafter, the operation of the air conditioning system 1 including the above configuration will be described.

[0080] Figs. 3 and 4 are flowcharts showing the operation of the air conditioning system 1 in a case where the commercial AC power source 9 is in the power failure state.

[0081] As described above, in the air conditioning system 1, power of AC 200V from the commercial AC power source 9 is supplied from the commercial AC power source 9 to the indoor unit 11, the refrigerant leakage detection sensor 13, the ventilation device 14, the external power source kit 15, and the alarm device 16.

[0082] However, for example, power failure due to lightning strike occurs, and the power supply from the commercial AC power source 9 to the air conditioning system 1 stops. Thus, so-called power failure might occur.

[0083] In the case where the commercial AC power source 9 is in the power failure state, the external power source controller 50 detects that the power supply from the PCB 22 to the external power source kit 15 is stopped. Then, the external power source controller 50 controls the power storage unit 52 to start the power supply to the ventilation device 14, and drives the ventilation device 14 to perform ventilation with a predetermined ventilation amount (step SA1).

[0084] Thus, during the power failure, the ventilation device 14 is immediately driven regardless of whether or not the refrigerant is detected by the refrigerant leakage detection sensor 13, so that the air conditioning system 1 can reliably respond to the refrigerant leakage without delay, if the refrigerant leaks with the occurrence of the power failure. Consequently, the air conditioning system 1 can suppress increase in concentration of the refrigerant that leaks into the indoor space 70.

[0085] Afterward, the external power source controller 50 determines whether or not the commercial AC power source 9 recovers from the power failure (step SA2). Specifically, the external power source controller 50 acquires a predetermined signal via the signal line 44 connected to the PCB 22, to determine whether or not the commercial AC power source 9 is in the power failure state.

[0086] Note that in the step SA2, the external power source controller 50 may temporarily stop the ventilation device 14.

[0087] When the external power source controller 50 determines that the commercial AC power source 9 recovers from the power failure (YES in step SA2), the external power source controller 50 stops the power supply from the power storage unit 52 to the ventilation device 14, and also restarts the power supply from the commercial AC power source 9 to each part.

[0088] Next, the external power source controller 50 determines whether or not the refrigerant leakage detection sensor 13 normally functions (step SA3).

[0089] Specifically, the external power source controller 50 communicates with the refrigerant leakage detection sensor 13 via the signal line 45, and determines whether or not a normal signal can be received from the refrigerant leakage detection sensor 13.

[0090] In a case where it is determined that the refrigerant leakage detection sensor 13 normally functions (YES in step SA3), that is, in a case where the normal signal can be received from the refrigerant leakage detection sensor 13, the external power source controller 50 drives the refrigerant leakage detection sensor 13, and determines whether or not the refrigerant leakage detection sensor 13 detects the leakage of the refrigerant (step SA4). Specifically, the external power source controller 50 acquires the detection result of the refrigerant leakage detection sensor 13 via the signal line 45, to determine whether or not the refrigerant leakage detection sensor 13 detects the refrigerant.

[0091] When the refrigerant leakage detection sensor 13 detects the leakage of the refrigerant (YES in step SA4), the external power source controller 50 continues driving the ventilation device 14, and also drives the alarm device 16 (step SA5). The alarm device 16 notifies the management center that the refrigerant leakage detection sensor 13 detects the refrigerant.

[0092] Then, an operator is instructed by the management center to repair a refrigerant leakage portion (step SA6).

[0093] When the refrigerant leakage detection sensor 13 does not detect the leakage of the refrigerant in the step SA4 (NO in step SA4), the external power source controller 50 stops the ventilation device 14 (step SA7), and then the external power source controller 50 returns each part of the air conditioning system 1 to a usual operation (step SA8).

[0094] When it is determined in the step SA3 that the refrigerant leakage detection sensor 13 does not function normally (NO in step SA3), the external power source controller 50 continues driving the ventilation device 14, and also drives the alarm device 16 (step SA5). The alarm device 16 notifies the management center that the refrigerant leakage detection sensor 13 detects the refrigerant.

[0095] Then, the operator is instructed by the management center to repair the refrigerant leakage portion (step

SA6).

[0096] Note that in the case where the external power source controller 50 determines in the step SA2 that the commercial AC power source 9 recovers from the power failure (YES in step SA2), the control of each part of the air conditioning system 1 may be switched from the external power source controller 50 to the PCB 22.

[0097] When the external power source controller 50 determines in the step SA2 that the commercial AC power source 9 does not recover from the power failure (NO in step SA 2), the external power source controller 50 determines whether or not the refrigerant leakage detection sensor 13 normally functions (step SA9).

[0098] In a case where it is determined that the refrigerant leakage detection sensor 13 normally functions (YES in step SA9), that is, in a case where the normal signal can be received from the refrigerant leakage detection sensor 13, the external power source controller 50 continues the operation of the ventilation device 14 for a predetermined time (step SA10).

[0099] Here, description is made as to a ventilation time that is the predetermined time for which the external power source controller 50 continues the operation of the ventilation device 14 in the step SA10.

[0100] In a case where the external power source controller 50 determines that the power failure of the commercial AC power source 9 occurs and that the refrigerant leakage detection sensor 13 can normally detect the leakage of the refrigerant, a time to drive the ventilation device 14, that is, the ventilation time (predetermined time) is determined by using a remaining amount of power in the power storage unit 52, and set time T1 or T2.

[0101] The set time T1 is calculated by using the following equation (1).

$$T1 = Vr/M \qquad (1)$$

[0102] In Equation (1), T1 (s) is the ventilation time, Vr (m^3) is a predetermined volume in the indoor space 70, and M (m^3/s) is a ventilation amount of the ventilation device 14 per unit time.

[0103] In detail, T1 is a time when the ventilation device 14 can ventilate an indoor volume or air that is a volume of the indoor space 70 (time required for the ventilation of the indoor volume of air).

[0104] In the present embodiment, the volume Vr (m^3) is determined by a product of the floor area S (m^2) and the leakage height H (m). Note that the leakage height H is a height from a floor surface of the indoor space 70 to a portion into which the refrigerant is assumed to leak.

[0105] The set time T2 is a ventilation time by the ventilation device 14 until a concentration of the indoor space 70 reaches a concentration (1/2 LFL) of a half of a lower flammability limit (LFL).

[0106] Note that the set time T2 is calculated as a time to reach 1/2 LFL in the indoor volume, but the present disclosure is not limited to this example. For example, in a case where it is supposed that the refrigerant leaks into the indoor space 70 during the power failure of the commercial AC power source 9, the ventilation may be performed until the refrigerant concentration of the indoor space 70 reaches a predetermined concentration or less. The time required until the refrigerant concentration of the indoor space 70 reaches the predetermined concentration or less may be, for example, a ventilation time required until the concentration decreases to be less than 1/4 LFL in the indoor volume.

[0107] Furthermore, a lower limit value of the ventilation time required by the ventilation device 14 is not limited to the above T2, and may be acquired, for example, from a necessity determination tool disposed in the indoor space 70 or the like. With the necessity determination tool, it is determined whether or not an R32 safety device is necessary.

[0108] The external power source controller 50 sets the set time T1 as an upper limit value of the ventilation time by the ventilation device 14, and sets the set time T2 as a lower limit value of the ventilation time by the ventilation device 14. Then, the external power source controller 50 determines the ventilation time between the set time T1 and the set time T2 depending on the remaining amount of power in the power storage unit 52, and the controller drives the ventilation device 14 for the ventilation time.

[0109] Note that the set time T1 or T2 may be calculated in consideration of a refrigerant leakage speed.

[0110] Also, the external power source controller 50 intermittently drives the ventilation device 14, in a case where the predetermined time or more elapses after the start of the power supply from the power storage unit 52 to the ventilation device 14. Specifically, the external power source controller 50 intermittently supplies the power of the power storage unit 52 to the ventilation device 14, in the case where the predetermined time or more elapses after the start of the power supply from the power storage unit 52 to the ventilation device 14.

[0111] Additionally, in the case of intermittently driving the ventilation device 14, the external power source controller 50 stops the ventilation device 14 for a longer time as time elapses. Specifically, the external power source controller 50 lengthens a time to stop the power supply from the power storage unit 52 to the ventilation device 14, with increase in operation times of the ventilation device 14.

[0112] Alternatively, in the case of intermittently driving the ventilation device 14, the external power source controller 50 may decrease the ventilation amount of the ventilation device 14 as time elapses.

[0113] As shown in Fig. 4, the external power source controller 50 stops the ventilation device 14, when the above ventilation time elapses (step SA11). Furthermore, the external power source controller 50 drives the refrigerant leakage detection sensor 13, when the predetermined time elapses after the stop of the ventilation device 14 (step SA12).

[0114] In detail, the refrigerant concentration of the indoor space 70 is diluted immediately after the stop of the operation of the ventilation device 14, and hence the refrigerant leakage detection sensor 13 is less likely to be driven. Therefore, in the air conditioning system 1, in the step SA12, the refrigerant leakage detection sensor 13 is not energized immediately after the stop of the operation of the ventilation device 14, so that a power amount to energize the refrigerant leakage detection sensor 13 can be reduced.

[0115] Furthermore, the refrigerant leakage detection sensor 13 is driven when the predetermined time elapses after the ventilation is performed by the ventilation device 14, and the refrigerant leakage detection sensor 13 performs the detection in a state where a predetermined amount of refrigerant is retained in a case where the leakage of the refrigerant occurs. Consequently, in the air conditioning system 1, missing detection by the refrigerant leakage detection sensor 13 can be inhibited, the drive time of the refrigerant leakage detection sensor 13 can be shortened, and decrease in amount of power stored in the power storage unit 52 can be suppressed.

[0116] Note that in the present embodiment, the predetermined time required until the refrigerant leakage detection sensor 13 is driven after the stop of the ventilation device 14 is a time calculated from the leakage speed and LFL, the leakage speed of the refrigerant being set to 10 kg/h.

[0117] As shown in Fig. 4, the external power source controller 50 drives the refrigerant leakage detection sensor 13, and then determines whether or not the refrigerant leakage detection sensor 13 detects the leakage of the refrigerant (step SA13).

[0118] In a case where the refrigerant leakage detection sensor 13 detects the leakage of the refrigerant (YES in step SA13), the external power source controller 50 stops the driving of the refrigerant leakage detection sensor 13, and drives the ventilation device 14 and the alarm device 16 (step SA14). The alarm device 16 notifies the management center that the refrigerant leakage detection sensor 13 detects the refrigerant.

[0119] In the case where the refrigerant leakage detection sensor 13 detects the leakage of the refrigerant, the external power source controller 50 drives the ventilation device 14 as in the step SA14, so that in the air conditioning system 1, the refrigerant that leaks into the indoor space 70 is diffused, and the concentration of the refrigerant can be effectively diluted.

[0120] Hereinafter, continuously driving the ventilation device 14 over a predetermined time as in the step SA14 will be referred to as a first ventilating operation of the ventilation device 14.

[0121] Further, in the step SA14, the refrigerant leakage detection sensor 13 and the ventilation device 14 are inhibited from being simultaneously driven. Consequently, in the air conditioning system 1, decrease in amount of power stored in the power storage unit 52 can be suppressed.

[0122] The external power source controller 50 controls the ventilation device 14 to perform a so-called intermittent operation of alternately repeating driving and stopping of the ventilation device 14, when a predetermined time elapses after the first ventilating operation of the ventilation device 14 is executed (step SA15).

[0123] Consequently, in the air conditioning system 1, the decrease in amount of power stored in the power storage unit 52 can be suppressed more than in a case of continuously driving the ventilation device 14.

[0124] Hereinafter, the intermittent operation of the ventilation device 14 to be performed when the predetermined time elapses after the first ventilating operation of the ventilation device 14 is executed will be referred to as a second ventilating operation of the ventilation device 14.

[0125] In the case where the refrigerant leakage occurs, an amount of the refrigerant that leaks decreases with elapse of time. Specifically, in the air conditioning system 1, a required ventilation amount decreases with elapse of time.

[0126] Consequently, in the step SA15, the external power source controller 50 more relatively extends a stop time than a drive time in the intermittent operation of the ventilation device 14, with elapse of time after the ventilation device 14 is driven. In other words, the external power source controller 50 extends the stop time of the ventilation device 14 more than in the second ventilating operation, while continuing the intermittent operation of the ventilation device 14, when the predetermined time elapses after the second ventilating operation of the ventilation device 14 is executed.

[0127] Thus, in the air conditioning system 1, the drive time of the ventilation device 14 can be shortened, and the decrease in amount of power stored in the power storage unit 52 can be suppressed, before the refrigerant leakage portion is repaired.

[0128] Hereinafter, driving the ventilation device 14 to extend the stop time of the ventilation device 14 more than in the second ventilating operation while continuing the intermittent operation of the ventilation device 14 when the predetermined time elapses after the second ventilating operation of the ventilation device 14 is executed will be referred to as a third ventilating operation of the ventilation device 14.

[0129] Note that instead of extending the stop time of the ventilation device 14 with the above elapse of time, the external power source controller 50 may decrease the ventilation amount in the case of driving the ventilation device 14 with the elapse of time. In this case, power consumption of the ventilation device 14 can be reduced, and the decrease in amount of power stored in the power storage unit 52 can be suppressed.

[0130] Hereinafter, driving the ventilation device 14 to decrease the ventilation amount with the elapse of time will be referred to as a fourth ventilating operation of the ventilation device 14.

[0131] Furthermore, the external power source con-

troller 50 may control the ventilation device 14 both to more relatively extend the stop time of the ventilation device 14 than the drive time and to decrease the ventilation amount of the ventilation device 14, with elapse of time. In other words, the external power source controller 50 may control the ventilation device 14 to simultaneously execute the third ventilating operation and the fourth ventilating operation.

[0132] Afterward, the operator is instructed by the management center to perform the repair of the refrigerant leakage portion (step SA16). Upon completing the repair of the refrigerant leakage portion by the operator, the ventilation device 14 is stopped, for example, by the operator.

[0133] In the step SA13, even in a case where the refrigerant leakage detection sensor 13 does not detect the leakage of the refrigerant (NO in step SA13), the refrigerant leakage speed is low, that is, so-called slow leak might occur.

[0134] To solve this problem, in the present embodiment, in a case where the slow leak of the refrigerant occurs, when the refrigerant leakage detection sensor 13 does not detect the leakage of the refrigerant (YES in step SA17 and NO in step SA18) even with elapse of time required until the concentration of the refrigerant in the indoor space 70 decreases to the concentration of a half of LFL (1/2 LFL) due to the slow leak, the refrigerant leakage detection sensor 13 is intermittently driven (step SA19). Consequently, in the air conditioning system 1, the decrease in amount of power stored in the power storage unit 52 can be suppressed more than in the case of continuously driving the refrigerant leakage detection sensor 13.

[0135] Note that in the present embodiment, when time elapses to obtain 1/2 LFL, the refrigerant leakage detection sensor 13 is intermittently driven, but the present disclosure is not limited to this example. Specifically, in the case where the slow leak of the refrigerant occurs in the indoor space 70, time may elapse such that the refrigerant leakage detection sensor 13 can detect the refrigerant.

[0136] Further, in the step SA19, the external power source controller 50 may extend the stop time of the refrigerant leakage detection sensor 13, with elapse of time. Consequently, in the air conditioning system 1, the time to drive the refrigerant leakage detection sensor 13 can be shortened, and the decrease in amount of power stored in the power storage unit 52 can be suppressed, before the commercial AC power source 9 recovers.

[0137] In a case where the refrigerant leakage detection sensor 13 detects the leakage of the refrigerant (YES in step SA18), the external power source controller 50 controls each part of the air conditioning system 1 to perform the above steps SA14 to SA16.

[0138] In a case where it is determined in the step SA9 that the refrigerant leakage detection sensor 13 does not function normally (NO in step SA9), the external power source controller 50 controls the ventilation device 14 to perform the same driving as in the step SA15. That is, the second ventilating operation by the ventilation device 14 is executed. Also, the external power source controller 50 drives the alarm device 16 (step SA21). The alarm device 16 notifies the management center that the refrigerant leakage detection sensor 13 detects the refrigerant.

[0139] Note that the present disclosure is not limited to this example, and the first ventilating operation of the ventilation device 14 may be executed in the step SA21 in the same manner as in the step SA14.

[0140] Consequently, in the air conditioning system 1, the drive time of the ventilation device 14 can be shortened, and the decrease in amount of power stored in the power storage unit 52 can be suppressed, before the refrigerant leakage portion is repaired.

[0141] Then, the operator is instructed by the management center to perform the repair of the refrigerant leakage portion (step SA22).

[1-3. Effects]

[0142] As described above, in the present embodiment, the air conditioning system 1 includes the refrigeration cycle to circulate the refrigerant, the indoor unit 11 including the indoor heat exchanger 29 connected to the refrigeration cycle, the indoor unit being installed in the indoor space 70, the refrigerant leakage detection sensor 13 that detects the refrigerant leaking from the indoor unit 11, the ventilation device 14 that ventilates the indoor space, the power storage unit 52 that is charged by the external power source kit 15, and the external power source controller 50. The refrigerant leakage detection sensor 13 and the ventilation device 14 are operated by the commercial AC power source 9, and the external power source controller 50 operates the refrigerant leakage detection sensor 13 and the ventilation device 14 with the power of the power storage unit 52 depending on the remaining amount of power in the power storage unit 52, in the case where the supply from the commercial AC power source 9 is stopped.

[0143] Consequently, in the air conditioning system 1, the refrigerant leakage detection sensor 13 and the ventilation device 14 are driven depending on the remaining amount of power in the power storage unit 52 in the case where the commercial AC power source 9 is in the power failure state.

[0144] Therefore, in the air conditioning system 1, a plurality of devices for the countermeasures against the refrigerant leakage can be driven for a predetermined time, even if the commercial AC power source 9 is in the power failure state.

[0145] As in the present embodiment, the external power source controller 50 may operate the ventilation device 14 with the power of the power storage unit 52, to ventilate an indoor volume of air in the indoor space 70, in the case where the supply from the commercial AC power source 9 is stopped.

[0146] Consequently, in the air conditioning system 1,

the ventilation device 14 is driven with the amount of the power in the power storage unit 52 in the case where the commercial AC power source 9 is in the power failure state.

[0147] Therefore, in the air conditioning system 1, even if the commercial AC power source 9 is in the power failure state, the ventilation device 14 is driven to diffuse the refrigerant that leaks into the indoor space 70, and the concentration of the refrigerant can be effectively diluted.

[0148] As in the present embodiment, the external power source controller 50 may operate the ventilation device 14 for a predetermined time, depending on the remaining amount of power in the power storage unit 52 and a ventilation amount of the ventilation device 14, when operating the refrigerant leakage detection sensor 13 and the ventilation device 14 with the power of the power storage unit 52.

[0149] Consequently, in the air conditioning system 1, the drive time of the ventilation device 14 is determined depending on the concentration of the refrigerant and the ventilation amount of the ventilation device 14 in the indoor space 70 provided with the indoor unit 11, and the remaining amount of power in the power storage unit 52.

[0150] Therefore, in the air conditioning system 1 can suppress the decrease in amount of power in the power storage unit 52, while driving the ventilation device 14 with the ventilation amount that can sufficiently decrease the concentration of the refrigerant that leaks into the indoor space 70 provided with the indoor unit 11.

[0151] As in the present embodiment, the external power source controller 50 may operate the ventilation device 14 for a time or more when a refrigerant concentration in the indoor space 70 decreases to the predetermined value or less, in the case where it is supposed that the refrigerant leaks into the indoor space 70 during power failure.

[0152] Consequently, in the air conditioning system 1, in the case where the commercial AC power source 9 is in the power failure state and the refrigerant leaks into the indoor space 70, the ventilation device 14 is driven with the power of the power storage unit 52 over the time or more when the refrigerant concentration in the indoor space can decrease.

[0153] Therefore, in the air conditioning system 1, even if the commercial AC power source 9 is in the power failure state, the ventilation device 14 can be driven to diffuse the refrigerant that leaks into the indoor space 70, and the concentration of the refrigerant can be more reliably diluted.

[0154] As in the present embodiment, the time when the refrigerant concentration in the indoor space 70 decreases to the predetermined value or less may be equal to or less than a time required for the ventilation device 14 to ventilate the indoor volume of air.

[0155] Consequently, in the air conditioning system 1, in the case where the refrigerant leaks into the indoor space 70, the ventilation device 14 is driven in the drive time equal to or less than the time required to ventilate the whole indoor volume that is the volume of the indoor space.

[0156] Therefore, in the air conditioning system 1, the ventilation device 14 is driven to diffuse the refrigerant that leaks into the indoor space 70 while suppressing the decrease in amount of power stored in the power storage unit 52, so that the refrigeration concentration in the indoor space 70 can be diluted to the predetermined value or less.

[0157] As in the present embodiment, the external power source controller 50 may operate the refrigerant leakage detection sensor 13 with the power of the power storage unit 52, in the case where the supply from the commercial AC power source 9 is stopped and may execute a first ventilating operation, the first ventilating operation including operating the ventilation device 14 with the power of the power storage unit 52, in at least one of a case where the refrigerant leakage detection sensor 13 detects the leakage of the refrigerant and the case where it is determined that the refrigerant leakage detection sensor 13 does not function normally.

[0158] Consequently, in the air conditioning system 1, the ventilation device 14 is driven depending on the detection result or the detecting state of the refrigerant leakage detection sensor 13, in the case where the refrigerant leakage detection sensor 13 and the ventilation device 14 are driven with the power of the power storage unit 52. Therefore, in the air conditioning system 1, the ventilation device 14 is driven, while suppressing the decrease in amount of power stored in the power storage unit 52, so that the refrigerant that leaks into the indoor space 70 can be more reliably diffused.

[0159] As in the present embodiment, the external power source controller 50 may execute a second ventilating operation, the second ventilating operation including alternately repeating driving and stopping of the ventilation device 14, when a predetermined time elapses after the first ventilating operation is started.

[0160] Consequently, in the air conditioning system 1, the time to drive the ventilation device 14 in the predetermined time can be shortened, and the decrease in amount of power stored in the power storage unit 52 can be suppressed.

[0161] Therefore, in the air conditioning system 1, the ventilation device 14 can be driven over a long period.

[0162] As in the present embodiment, the external power source controller 50 may execute a third ventilating operation, the third ventilating operation including alternately repeating the driving and stopping of the ventilation device 14, and lengthening the stop time of the ventilation device 14 more than in the second ventilating operation, when the predetermined time elapses after the second ventilating operation is executed.

[0163] Consequently, in the air conditioning system 1, the time to drive the ventilation device 14 in the predetermined time can be shortened more, and the decrease in amount of power stored in the power storage unit 52

can be suppressed.

[0164] Therefore, in the air conditioning system 1, the ventilation device 14 can be driven over a longer period.

[0165] As in the present embodiment, the external power source controller 50 may execute a fourth ventilating operation, the fourth ventilating operation including decreasing a ventilation amount of the ventilation device 14, when a predetermined time elapses after the first ventilating operation is started.

[0166] Consequently, in the air conditioning system 1, a drive amount of the ventilation device 14 in the predetermined time can be reduced, and the consumption of the power stored in the power storage unit 52 can be reduced.

[0167] Therefore, in the air conditioning system 1, the ventilation device 14 can be driven over a longer period.

[0168] As in the present embodiment, the external power source controller 50 may operate the ventilation device 14, in a state where supply of power to the refrigerant leakage detection sensor 13 is stopped, in a case of operating the refrigerant leakage detection sensor 13 and the ventilation device 14 with the power of the power storage unit 52.

[0169] Consequently, the refrigerant leakage detection sensor 13 and the ventilation device 14 are inhibited from being simultaneously driven.

[0170] Therefore, in the air conditioning system 1, the decrease in amount of power stored in the power storage unit 52 can be suppressed.

[0171] As in the present embodiment, the external power source controller 50 may operate the refrigerant leakage detection sensor 13 when a predetermined time elapses after the ventilation device 14 is stopped, in a case of operating the refrigerant leakage detection sensor 13 and the ventilation device 14 with the power of the power storage unit 52.

[0172] Consequently, the refrigerant leakage detection sensor 13 performs detection in the state where the predetermined amount of refrigerant is retained, in the case where the leakage of the refrigerant occurs. Therefore, in the air conditioning system 1, the missing detection by the refrigerant leakage detection sensor 13 can be inhibited, the drive time of the refrigerant leakage detection sensor 13 can be shortened, and the decrease in amount of power stored in the power storage unit 52 can be suppressed.

[0173] As in the present embodiment, the external power source controller 50 may intermittently operate the refrigerant leakage detection sensor 13, when a time elapses until the refrigerant reaches a predetermined concentration, after one of stop of the ventilation device 14 and start of the operation of the refrigerant leakage detection sensor 13, in the case where the supply from the commercial AC power source 9 is stopped.

[0174] Consequently, in the air conditioning system 1, the time to drive the refrigerant leakage detection sensor 13 in the predetermined time can be shortened, and the decrease in amount of power stored in the power storage unit 52 can be suppressed.

[0175] Therefore, in the air conditioning system 1, the refrigerant leakage detection sensor 13 can be driven over a longer period.

(Embodiment 2)

[0176] Hereinafter, Embodiment 2 will be described with reference to Fig. 5.

[0177] Fig. 5 is a block diagram showing a configuration of an air conditioning system 100 according to Embodiment 2.

[0178] In Fig. 5, the same part as in Fig. 1 is denoted with the same reference sign and description thereof is omitted.

[2-1. Configuration]

[0179] The air conditioning system 100 according to Embodiment 2 is different from the air conditioning system 1 according to Embodiment 1 in that at least a heat source sensing sensor 80 is disposed. The heat source sensing sensor 80 is an example of a device that detects whether or not a person or a thing that may be affected by a refrigerant that leaks into an indoor space 70 provided with indoor unit 11 of the air conditioning system 100.

[2-1-2. Configuration of Heat Source Sensing Sensor]

[0180] In the present embodiment, the heat source sensing sensor 80 is disposed in the indoor space 70. The heat source sensing sensor 80 may be disposed integrally with the indoor unit 11.

[0181] The heat source sensing sensor 80 is a heat sensor that senses a heat source emitting a predetermined or more temperature in the indoor space, for example, an infrared detector or a thermistor. The heat source sensing sensor 80 of the present embodiment senses the heat source at a temperature equal to or more than a temperature at which the heat source can be an ignition source of a refrigerant for use in the air conditioning system 100. Examples of this heat source include fire of a lighter, and an electric heater.

[0182] Note that the air conditioning system 100 is not limited to the heat sensor, and the heat source may be detected with a camera or the like.

[0183] The heat source sensing sensor 80 is configured to communicate with each of an indoor unit controller 20 and an external power source controller 50. Each of the indoor unit controller 20 and the external power source controller 50 can acquire the detection result of the heat source sensing sensor 80.

[2-2. Operation]

[0184] Hereinafter, an operation of the air conditioning system 100 including the above configuration will be de-

scribed.

[0185] Fig. 6 is a flowchart showing the operation of the air conditioning system 100 in a case where a commercial AC power source 9 is in a power failure state.

[0186] As described above, in the air conditioning system 100, in the case where the commercial AC power source 9 is in the power failure state, the external power source controller 50 detects that power supply from a PCB 22 to an external power source kit 15 is stopped. Then, the external power source controller 50 drives a refrigerant leakage detection sensor 13, and determines whether or not the refrigerant leakage detection sensor 13 detects leakage of the refrigerant (step SB1).

[0187] In a case where it is determined that the refrigerant leakage detection sensor 13 detects the leakage of the refrigerant (YES in step SB1), the external power source controller 50 drives a ventilation device 14, stops the driving of the refrigerant leakage detection sensor 13, and drives an alarm device 16 (step SB2). The alarm device 16 notifies a management center that the refrigerant leakage detection sensor 13 detects the refrigerant.

[0188] Also, the refrigerant leakage detection sensor 13 and the ventilation device 14 are inhibited from being simultaneously driven, and decrease in amount of power stored in a power storage unit 52 is accordingly suppressed.

[0189] Then, an operator is instructed by the management center to repair a refrigerant leakage portion (step SB3).

[0190] In a case where it is determined in the step SB1 that the refrigerant leakage detection sensor 13 does not detect the leakage of the refrigerant (NO in step SB1), the external power source controller 50 drives the heat source sensing sensor 80, to detect from the detection result of the heat source sensing sensor 80 whether or not the heat source at the temperature equal to or more than the temperature at which the heat source can be the ignition source of the refrigerant is present (step SB4).

[0191] In a case where it is determined that the heat source is present (YES in step SB4), the external power source controller 50 drives the ventilation device 14, and stops the driving of the refrigerant leakage detection sensor 13 (step SB5).

[0192] Then, the external power source controller 50 operates the ventilation device 14 for a predetermined time, and then stops the ventilation device (step SB6). Here, this predetermined time is a ventilation time between a set time T1 that is an upper limit value and a set time T2 that is a lower limit value as described in Embodiment 1, the ventilation time being determined by the external power source controller 50 depending on a remaining amount of power in the power storage unit 52.

[0193] The external power source controller 50 stops the ventilation device 14, and then drives the refrigerant leakage detection sensor 13, to determine whether or not the refrigerant leakage detection sensor 13 detects the leakage of the refrigerant (step SB7).

[0194] In a case where it is determined that the refrigerant leakage detection sensor 13 detects the leakage of the refrigerant (YES in step SB7), the external power source controller 50 controls each part of the air conditioning system 100, to perform the steps SB2 and SB3.

[0195] In a case where it is determined in the step SB7 that the refrigerant leakage detection sensor 13 does not detect the leakage of the refrigerant (NO in step SB7), the external power source controller 50 stops the driving of the refrigerant leakage detection sensor 13 (step SB8). Then, it is determined whether or not the commercial AC power source 9 recovers from the power failure state (step SB9). In a case where it is determined that the commercial AC power source 9 recovers from the power failure state, the external power source controller 50 returns the air conditioning system 100 to a usual operation (step SB10).

[0196] In a case where it is determined in the step SB4 that the heat source is present in the indoor space 70 (NO in step SB11), the external power source controller 50 continuously stops the ventilation device 14, and drives the refrigerant leakage detection sensor 13 (step SB11). Then, the refrigerant leakage detection sensor 13 performs the step SB7 to determine whether or not the refrigerant leakage detection sensor 13 detects the leakage of the refrigerant.

[0197] Note that in Embodiment 2, the air conditioning system 100 is controlled by determining whether or not the heat source is present in the indoor space 70 by use of the heat source sensing sensor 80. However, the present disclosure is not limited to this example. For example, the air conditioning system 100 may be controlled depending on a detection result obtained by detecting whether or not and how many persons are present in the indoor space 70, by use of a camera, an objective sensor, a human detection sensor or the like. Furthermore, when making these determinations, the predetermined volume Vr in the indoor space 70, the volume of the whole indoor space 70 or the like may be reflected.

(Another Embodiment)

[0198] As above, Embodiments 1 and 2 have been described as illustration of a technology disclosed in the present application. However, the technology in the present disclosure is not limited to this illustration, and is also applicable to an embodiment subjected to change, replacement, addition, omission or the like. Also, respective constituent elements described above in Embodiments 1 and 2 may be combined, to form a new embodiment.

[0199] Then, the other embodiment will be illustrated hereinafter.

[0200] In the above embodiments, there are not restrictions on the numbers of units of the outdoor unit 10 and the indoor unit 11 included in the air conditioning systems 1 and 100. For example, the air conditioning system 1 may include a configuration where one unit of the outdoor unit 10 is connected to one unit of the indoor unit 11.

[0201] In the above embodiments, in the configurations of Figs. 1 and 5, power is supplied from the common commercial AC power source 9 to the device to which commercial power supply is available, but the present disclosure is not limited to this example, and the commercial AC power sources 9 may be provided independently to some or all of the devices, respectively. That is, a plurality of commercial AC power sources 9 may be connected to each of the air conditioning systems 1 and 100.

[0202] The refrigerant leakage detection sensor 13 may be disposed in the housing of the indoor unit 11. In this case, in the above step SA12, the refrigerant leakage detection sensor 13 may be driven immediately after the ventilation device 14 is stopped. Further, in this case, the step SA17 may be omitted.

[0203] Note that the above embodiments are described to illustrate the technology in the present disclosure, and may be therefore subjected to various changes, replacements, additions, omissions and the like in the scope of claims or the equal scope.

[Industrial Applicability]

[0204] The present disclosure is applicable to an air conditioning system including a plurality of devices for countermeasures against refrigerant leakage. Specifically, the present disclosure is applicable, for example, to an air conditioning system that drives the plurality of devices for the countermeasures against refrigerant leakage even under power failure.

[Reference Signs List]

[0205]

1, 100	air conditioning system
9	commercial AC power source (commercial power source)
11	indoor unit
13	refrigerant leakage detection sensor (detection sensor)
14	ventilation device
15	external power source kit
29	indoor heat exchanger (heat exchanger)
80	heat source sensing sensor
50	external power source controller
52	power storage unit
70	indoor space

Claims

1. An air conditioning system comprising:

a refrigeration cycle to circulate a slightly flammable refrigerant or a flammable refrigerant, and

an indoor unit (11) including a heat exchanger (29) connected to the refrigeration cycle, the indoor unit being installed in an indoor space (70), the air conditioning system **characterized by** comprising:

a refrigerant sensor (13) that detects the refrigerant leaking from the indoor unit,
a ventilation device (14) that ventilates the indoor space,
a power storage unit (52) that is charged by a commercial power source (9), and
a controller (50), wherein the refrigerant sensor and the ventilation device are operated by the commercial power source, and the controller operates the ventilation device with power of the power storage unit, in a case where supply from the commercial power source is stopped.

2. The air conditioning system according to claim 1, wherein the controller operates the ventilation device with the power of the power storage unit, to ventilate an indoor volume of air, in the case where the supply from the commercial power source is stopped.

3. The air conditioning system according to claim 1 or 2, wherein the controller operates the ventilation device for a predetermined time, depending on a remaining amount of power in the power storage unit and a ventilation amount of the ventilation device.

4. The air conditioning system according to any one of claims 1 to 3, wherein the controller operates the ventilation device for a time or more when a refrigerant concentration in the indoor space decreases to a predetermined value or less, in a case where it is supposed that the refrigerant leaks into the indoor space during power failure.

5. The air conditioning system according to claim 4, wherein the time when the refrigerant concentration in the indoor space decreases to the predetermined value or less is equal to or less than a time required for the ventilation device to ventilate the indoor volume of air.

6. The air conditioning system according to any one of claims 1 to 5, wherein the controller

operates the refrigerant sensor with the power of the power storage unit, in the case where the supply from the commercial power source is stopped, and
executes a first ventilating operation, the first ventilating operation comprising:
operating the ventilation device with the power of the power storage unit, in at least one of a

case where the refrigerant sensor detects the leakage of the refrigerant and a case where it is determined that the refrigerant sensor does not function normally.

7. The air conditioning system according to claim 6, wherein the controller executes a second ventilating operation comprising alternately repeating driving and stopping of the ventilation device, when a predetermined time elapses after the first ventilating operation is started.

8. The air conditioning system according to claim 7, wherein the controller executes a third ventilating operation, the third ventilating operation comprising alternately repeating the driving and stopping of the ventilation device, and lengthening a stop time of the ventilation device more than in the second ventilating operation, when a predetermined time elapses after the second ventilating operation is executed.

9. The air conditioning system according to any one of claims 6 to 8, wherein the controller executes a fourth ventilating operation, the fourth ventilating operation comprising decreasing a ventilation amount of the ventilation device, when a predetermined time elapses after the first ventilating operation is started.

10. The air conditioning system according to any one of claims 1 to 9, wherein the controller operates the ventilation device, in a state where supply of power to the refrigerant sensor is stopped, in a case of operating the refrigerant sensor and the ventilation device with the power of the power storage unit.

11. The air conditioning system according to any one of claims 1 to 10, wherein the controller operates the refrigerant sensor when a predetermined time elapses after the ventilation device is stopped, in a case of operating the refrigerant sensor and the ventilation device with the power of the power storage unit.

12. The air conditioning system according to any one of claims 1 to 11, wherein the controller intermittently operates the refrigerant sensor, when a time elapses until the refrigerant reaches a predetermined concentration, after one of stop of the ventilation device and start of the operation of the refrigerant sensor, in the case where the supply from the commercial power source is stopped.

FIG. 1

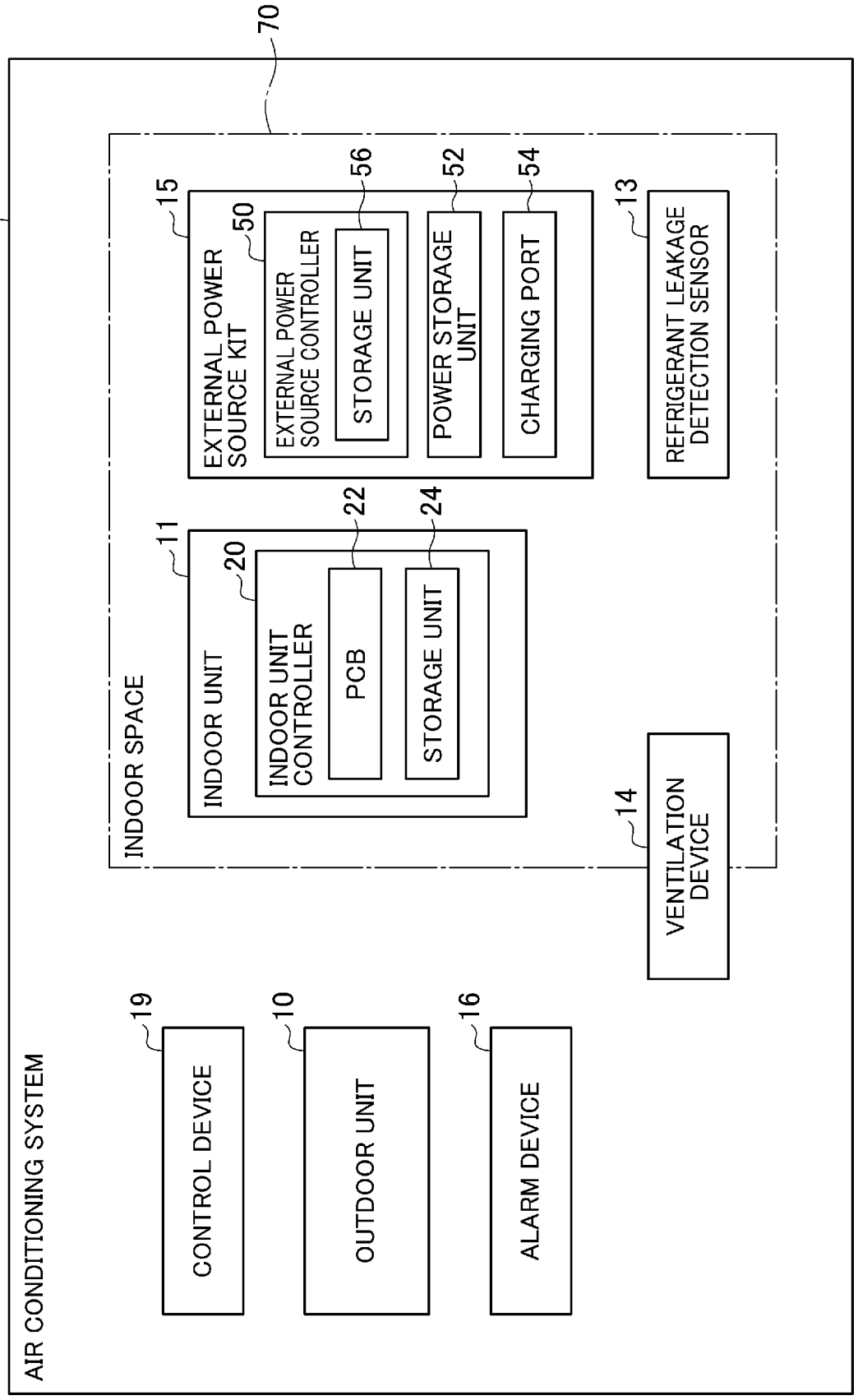

1
70
AIR CONDITIONING SYSTEM
INDOOR SPACE
15
EXTERNAL POWER SOURCE KIT
50
EXTERNAL POWER SOURCE CONTROLLER
56
STORAGE UNIT
52
POWER STORAGE UNIT
54
CHARGING PORT
13
REFRIGERANT LEAKAGE DETECTION SENSOR
11
INDOOR UNIT
20
INDOOR UNIT CONTROLLER
22
PCB
24
STORAGE UNIT
14
VENTILATION DEVICE
19
CONTROL DEVICE
10
OUTDOOR UNIT
16
ALARM DEVICE

FIG.2

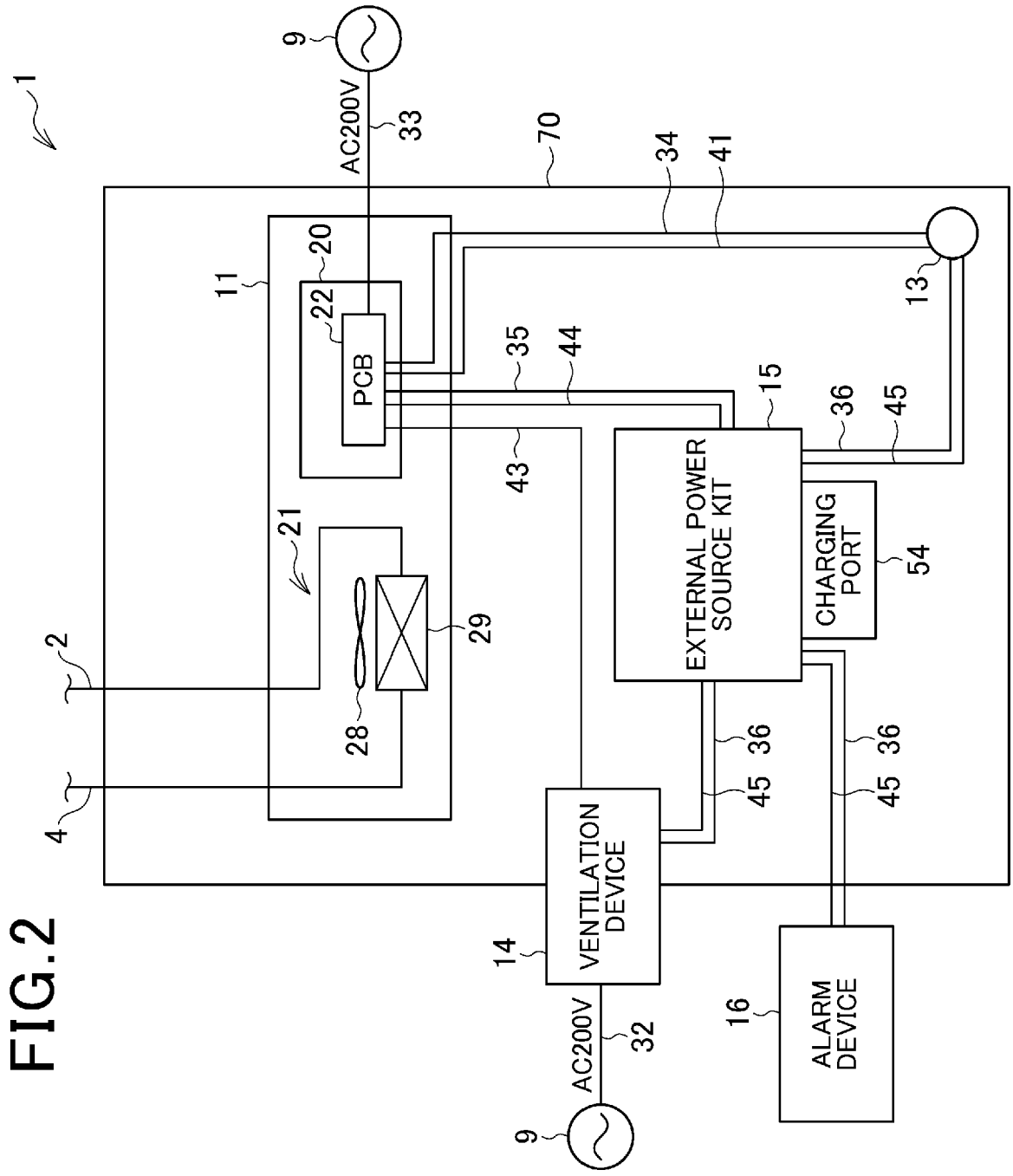

1
9
AC200V
33
70
34
41
11
20
22
PCB
35
44
15
36
45
13
43
21
29
28
2
4
EXTERNAL POWER SOURCE KIT
CHARGING PORT
54
36
45
36
45
VENTILATION DEVICE
14
AC200V
32
9
16
ALARM DEVICE

FIG.3

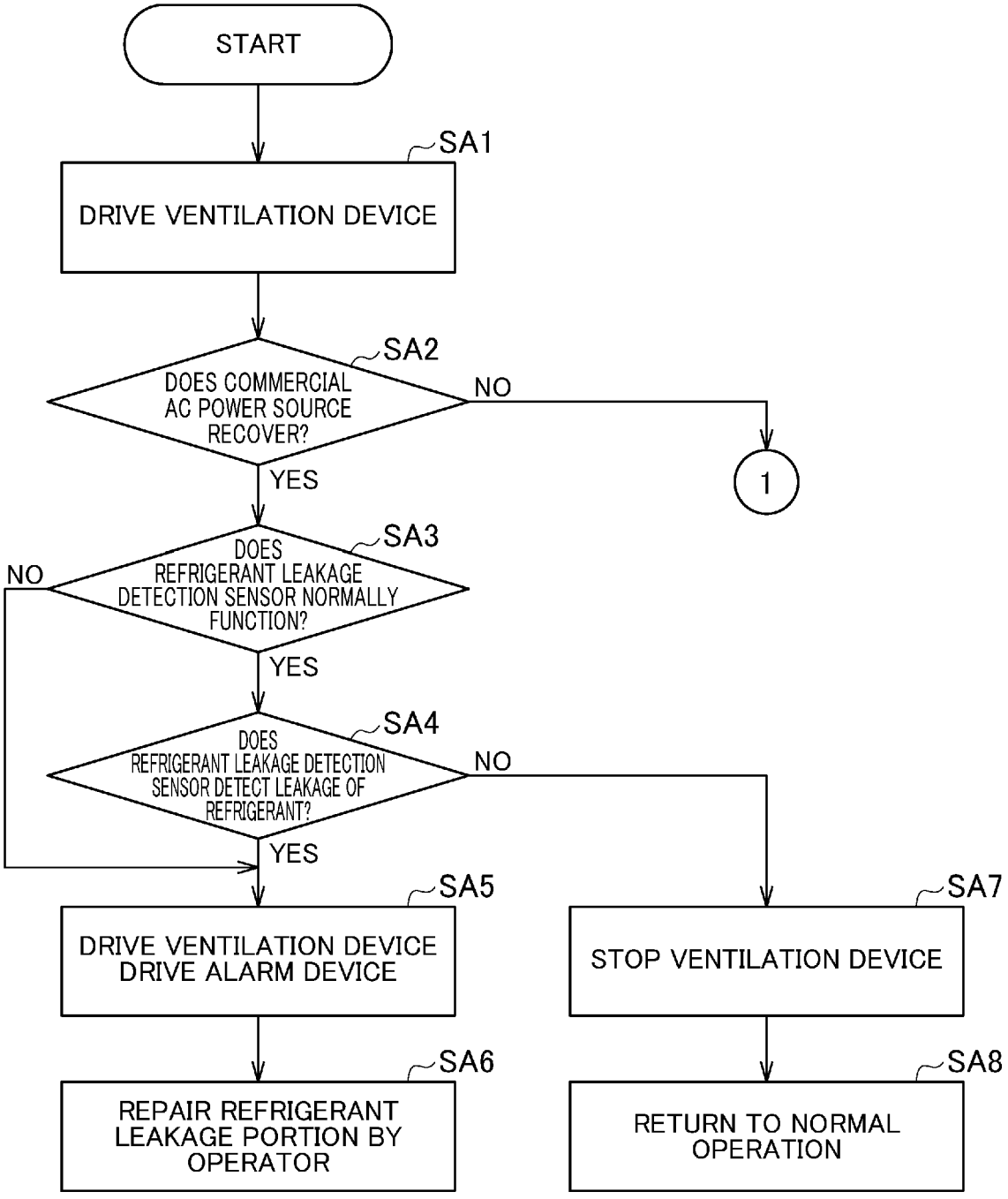

START
SA1
DRIVE VENTILATION DEVICE
SA2
DOES COMMERCIAL AC POWER SOURCE RECOVER?
NO
1
YES
SA3
DOES REFRIGERANT LEAKAGE DETECTION SENSOR NORMALLY FUNCTION?
NO
YES
SA4
DOES REFRIGERANT LEAKAGE DETECTION SENSOR DETECT LEAKAGE OF REFRIGERANT?
NO
YES
SA5
DRIVE VENTILATION DEVICE DRIVE ALARM DEVICE
SA6
REPAIR REFRIGERANT LEAKAGE PORTION BY OPERATOR
SA7
STOP VENTILATION DEVICE
SA8
RETURN TO NORMAL OPERATION

FIG.4

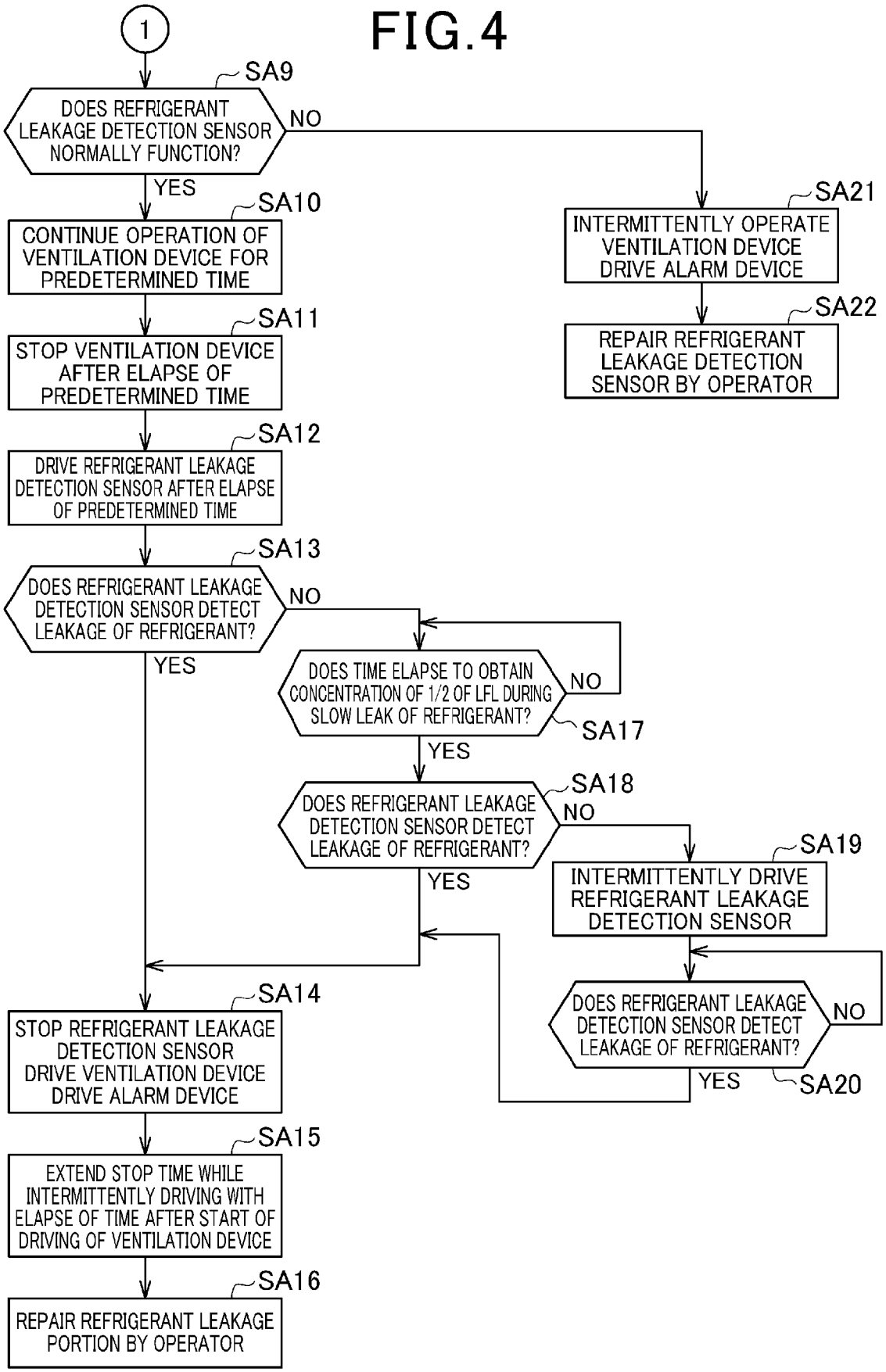

1
SA9
DOES REFRIGERANT LEAKAGE DETECTION SENSOR NORMALLY FUNCTION?
NO
YES
SA10
CONTINUE OPERATION OF VENTILATION DEVICE FOR PREDETERMINED TIME
SA11
STOP VENTILATION DEVICE AFTER ELAPSE OF PREDETERMINED TIME
SA12
DRIVE REFRIGERANT LEAKAGE DETECTION SENSOR AFTER ELAPSE OF PREDETERMINED TIME
SA13
DOES REFRIGERANT LEAKAGE DETECTION SENSOR DETECT LEAKAGE OF REFRIGERANT?
NO
YES
DOES TIME ELAPSE TO OBTAIN CONCENTRATION OF 1/2 OF LFL DURING SLOW LEAK OF REFRIGERANT?
NO
SA17
YES
SA18
DOES REFRIGERANT LEAKAGE DETECTION SENSOR DETECT LEAKAGE OF REFRIGERANT?
NO
SA19
INTERMITTENTLY DRIVE REFRIGERANT LEAKAGE DETECTION SENSOR
YES
DOES REFRIGERANT LEAKAGE DETECTION SENSOR DETECT LEAKAGE OF REFRIGERANT?
NO
YES
SA20
SA14
STOP REFRIGERANT LEAKAGE DETECTION SENSOR DRIVE VENTILATION DEVICE DRIVE ALARM DEVICE
SA15
EXTEND STOP TIME WHILE INTERMITTENTLY DRIVING WITH ELAPSE OF TIME AFTER START OF DRIVING OF VENTILATION DEVICE
SA16
REPAIR REFRIGERANT LEAKAGE PORTION BY OPERATOR
SA21
INTERMITTENTLY OPERATE VENTILATION DEVICE DRIVE ALARM DEVICE
SA22
REPAIR REFRIGERANT LEAKAGE DETECTION SENSOR BY OPERATOR

FIG.5

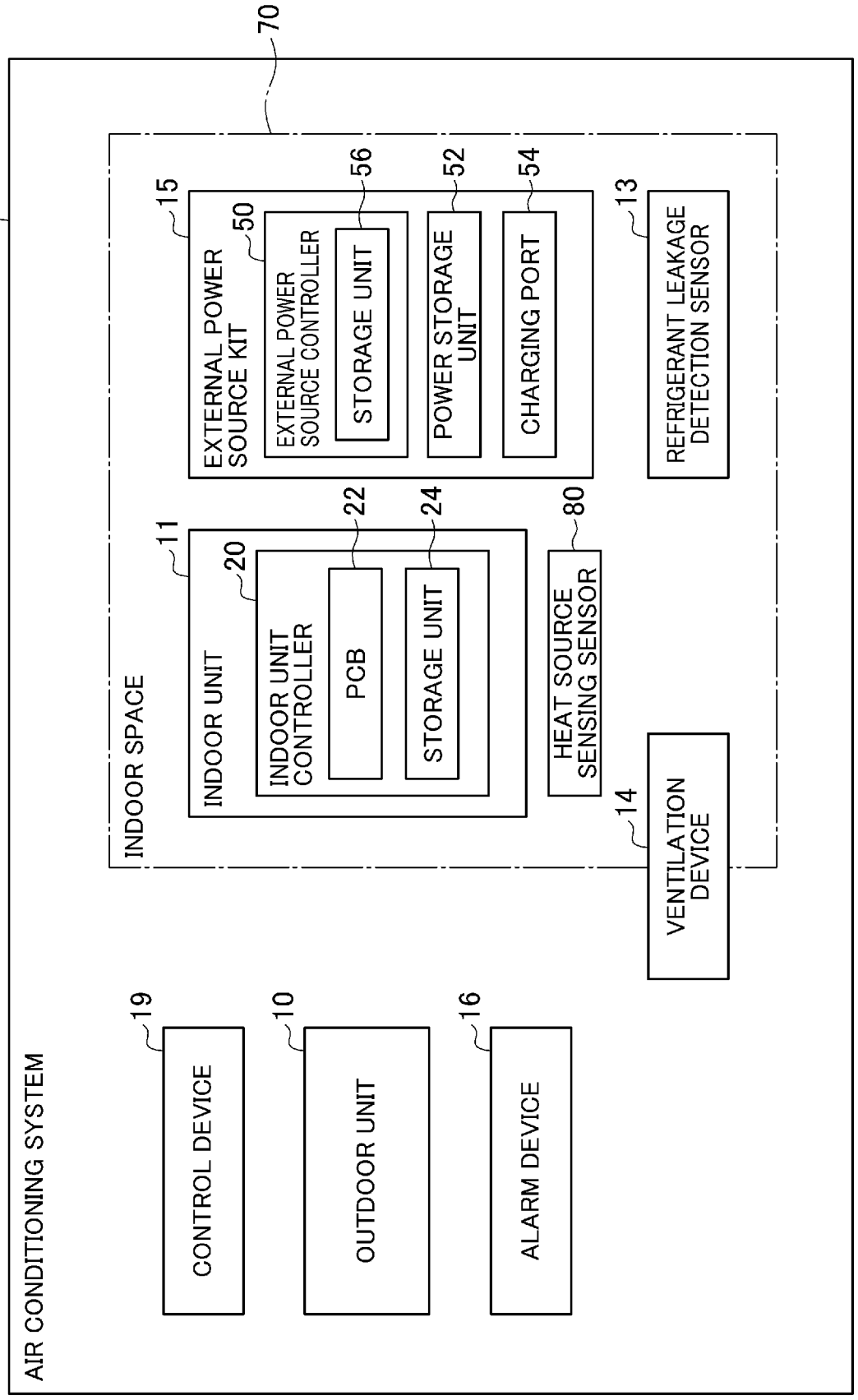
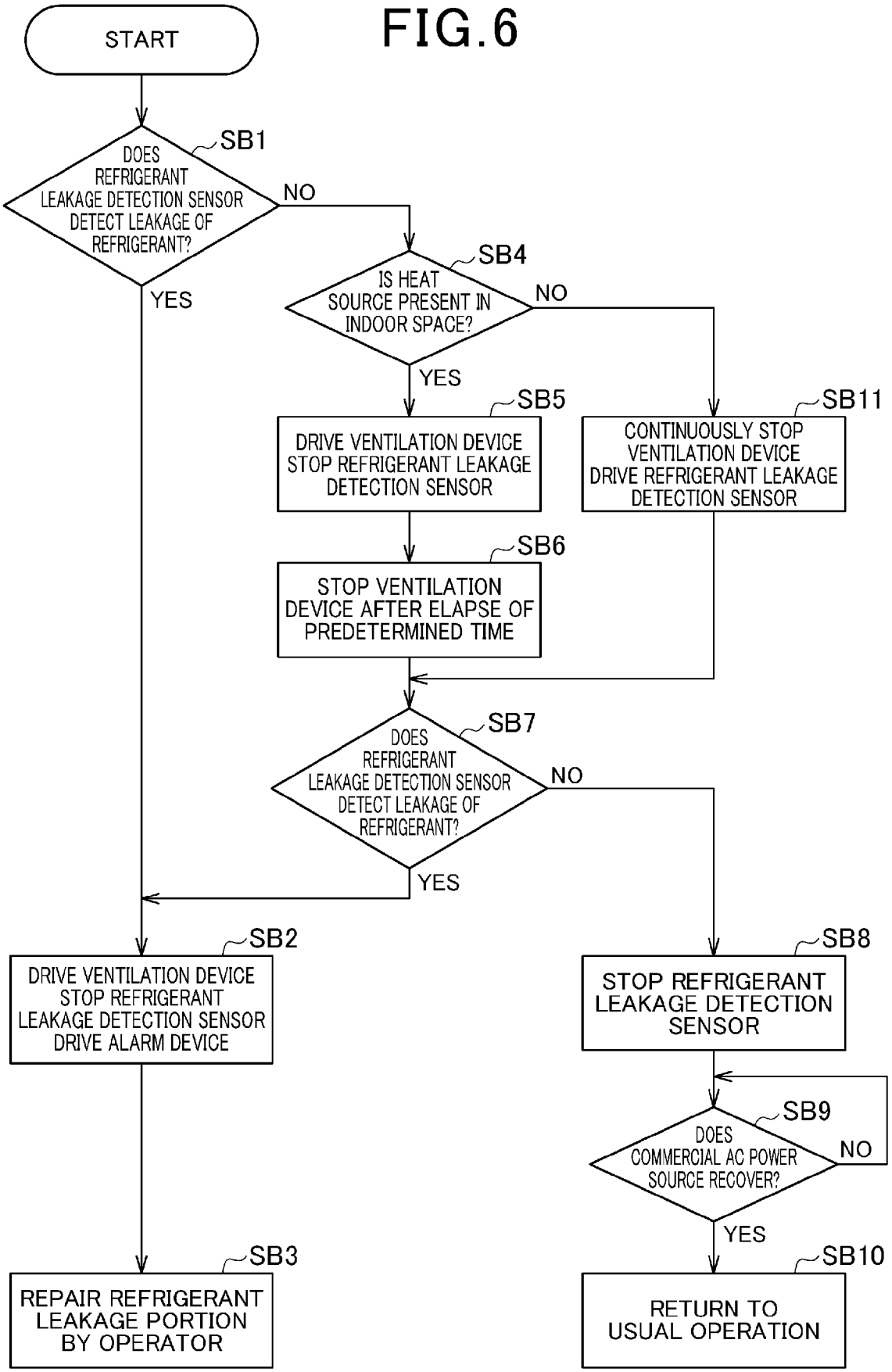

AIR CONDITIONING SYSTEM
100
70
INDOOR SPACE
INDOOR UNIT
11
INDOOR UNIT CONTROLLER
20
PCB
22
STORAGE UNIT
24
EXTERNAL POWER SOURCE KIT
15
EXTERNAL POWER SOURCE CONTROLLER
50
STORAGE UNIT
56
POWER STORAGE UNIT
52
CHARGING PORT
54
REFRIGERANT LEAKAGE DETECTION SENSOR
13
HEAT SOURCE SENSING SENSOR
80
VENTILATION DEVICE
14
CONTROL DEVICE
19
OUTDOOR UNIT
10
ALARM DEVICE
16

FIG.6


START
SB1
DOES REFRIGERANT LEAKAGE DETECTION SENSOR DETECT LEAKAGE OF REFRIGERANT?
NO
YES
SB4
IS HEAT SOURCE PRESENT IN INDOOR SPACE?
NO
YES
SB5
DRIVE VENTILATION DEVICE STOP REFRIGERANT LEAKAGE DETECTION SENSOR
SB11
CONTINUOUSLY STOP VENTILATION DEVICE DRIVE REFRIGERANT LEAKAGE DETECTION SENSOR
SB6
STOP VENTILATION DEVICE AFTER ELAPSE OF PREDETERMINED TIME
SB7
DOES REFRIGERANT LEAKAGE DETECTION SENSOR DETECT LEAKAGE OF REFRIGERANT?
NO
YES
SB2
DRIVE VENTILATION DEVICE STOP REFRIGERANT LEAKAGE DETECTION SENSOR DRIVE ALARM DEVICE
SB8
STOP REFRIGERANT LEAKAGE DETECTION SENSOR
SB9
DOES COMMERCIAL AC POWER SOURCE RECOVER?
NO
YES
SB3
REPAIR REFRIGERANT LEAKAGE PORTION BY OPERATOR
SB10
RETURN TO USUAL OPERATION

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EUROPEAN SEARCH REPORT

Application Number
EP 21 21 0744

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 589 900 A1 (PANASONIC CORP [JP]) 8 May 2013 (2013-05-08) * paragraphs [0027] - [0039]; figures 4-9 * -----	1-12	INV. F24F11/36 F24F11/77 F24F11/00
A	WO 2020/110424 A1 (HITACHI JOHNSON CONTROLS AIR CONDITIONING INC [JP]) 4 June 2020 (2020-06-04) * paragraphs [0029] - [0057]; figure 7 * -----	1	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 April 2022	Lienhard, Dominique

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