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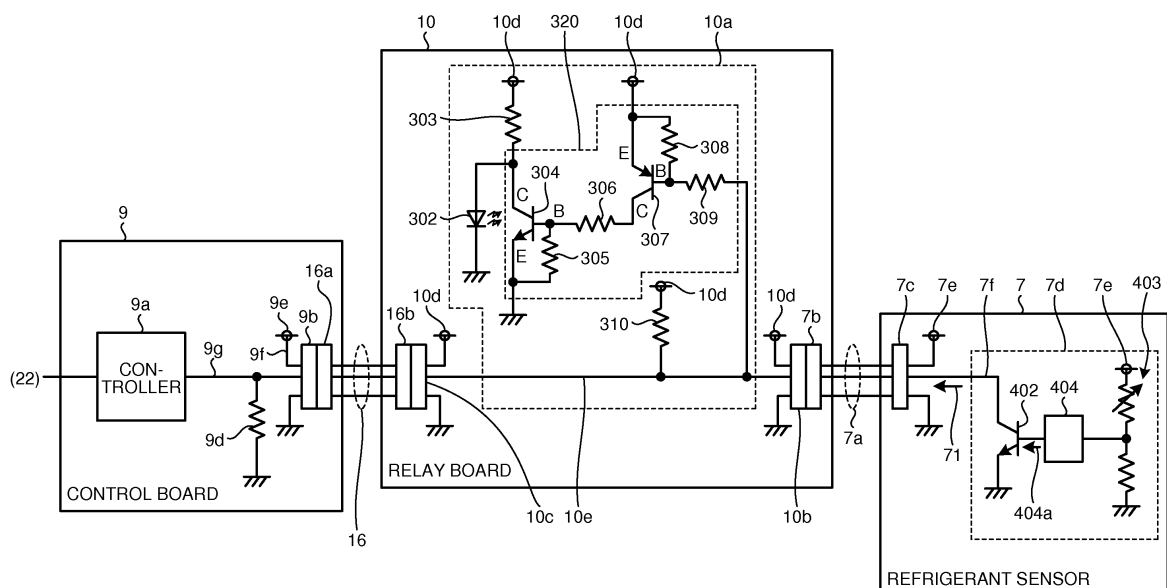
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(54) **AIR CONDITIONER**

(57) An air conditioner includes: a floor-standing indoor unit; a control board (9) that controls the floor-standing indoor unit; a refrigerant sensor (7) that is installed in the floor-standing indoor unit and outputs a detection signal (71) with a duty ratio varied in accordance with the concentration of a refrigerant detected; and an LED (302)

as a luminous unit that is installed in the floor-standing indoor unit and changes between a first illuminated state indicating that a signal transmission path transmitting the detection signal (71) to the control board (9) is disconnected, and a second illuminated state indicating that the signal transmission path is not disconnected.

FIG.4



Description

Field

[0001] The present invention relates to an air conditioner including a floor-standing indoor unit and a refrigerant sensor that detects a leakage of a refrigerant leaked from the floor-standing indoor unit.

Background

[0002] Fluorocarbon refrigerants have stable physical properties and are easy to handle, but have a high global warming potential and an adverse effect on the global environment. For this reason, hydrocarbon refrigerants such as propane or propylene which are natural refrigerants with a low global warming potential are attracting attention as a substitute for the fluorocarbon refrigerants. However, the hydrocarbon refrigerants are flammable so that, when applied to an air conditioner, the refrigerant leaking from the air conditioner can reach a flammable concentration. It is thus desired that the air conditioner detects the leakage of the refrigerant at an early stage and take some measures to prevent the leaked refrigerant from reaching the flammable concentration.

[0003] A floor-standing indoor unit disclosed in Patent Literature 1 includes: a control board that integrally controls devices such as a blower fan, a fan motor, and a compressor; and a remote controller on which a user performs driving operation of an air conditioner, monitors an operating state as well as details of a problem of the air conditioner. A refrigerant sensor is connected to the control board via wiring including a signal line. The refrigerant sensor is installed at the bottom of the machine room in the floor-standing indoor unit disclosed in Patent Literature 1. The refrigerant sensor is installed at the bottom of the machine room to be able to effectively measure the concentration of the leaking refrigerant because the specific gravity of the hydrocarbon refrigerant is higher than the specific gravity of the air. The refrigerant sensor detects the refrigerant leaked from components of a refrigeration cycle such as a heat exchanger and a union joint, and when the concentration of the refrigerant reaches a predetermined value or higher, the floor-standing indoor unit operates the blower fan to diffuse the refrigerant and thus prevent an increase in the concentration of the refrigerant up to the flammable concentration.

[0004] The floor-standing indoor unit disclosed in Patent Literature 1 has a function of displaying the details of a problem on the remote controller in order to notify the user of the details of various problems occurring in the air conditioner. The details of problems include refrigerant leakage information indicating leakage of the refrigerant, communication problem information indicating the occurrence of a problem in communication between the indoor unit and an outdoor unit, and disconnection problem information indicating the occurrence of disconnection of the signal line transmitting a refrigerant

detection signal output from the refrigerant sensor.

Citation List

5 Patent Literature

[0005] Patent Literature 1: Japanese Patent Application Laid-open No. 2015-94566

10 Summary

Technical Problem

[0006] The conventional floor-standing indoor unit typified by the one disclosed in Patent Literature 1 is configured to display the refrigerant leakage information that is given higher priority than the information such as the communication problem and the disconnection problem on the remote controller. This is to notify the user of the refrigerant leakage before the concentration of the refrigerant increases up to the flammable concentration and thus urge the user to ventilate the room in which the air conditioner is installed or operate the air conditioner by a user's operation and forcibly diffuse the refrigerant. Accordingly, when the signal line is disconnected after the refrigerant leakage is detected; the remote controller does not display the disconnection problem but displays only the refrigerant leakage information. A service technician therefore takes measures against only the refrigerant leakage of the floor-standing indoor unit displaying only the refrigerant leakage information, thereby realizing the disconnection problem after the measures are completed and needing to take measures against the disconnection problem anew.

[0007] The present invention has been made in view of the above, and an object of the present invention is to provide an air conditioner that can improve workability of measures against a disconnection problem without impairing measures against leakage of a flammable refrigerant.

Solution to Problem

[0008] To solve the above problems and achieve the object an air conditioner according to the present invention includes: a floor-standing indoor unit; a control board installed in the floor-standing indoor unit to control the floor-standing indoor unit; a refrigerant sensor installed in the floor-standing indoor unit to output a detection signal with a duty ratio varied in accordance with concentration of a detected refrigerant; and a luminous unit installed in the floor-standing indoor unit to change between a first illuminated state indicating that a signal transmission path transmitting the detection signal to the control board is disconnected, and a second illuminated state indicating that the signal transmission path is not disconnected.

Advantageous Effects of Invention

[0009] The air conditioner according to the present invention has the effect of being able to improve the workability of the measures against the disconnection problem without impairing the measures against leakage of the flammable refrigerant.

Brief Description of Drawings

[0010]

FIG. 1 is an external view of an air conditioner according to an embodiment of the present invention. FIG. 2 is an internal view of a floor-standing indoor unit illustrated in FIG. 1.

FIG. 3 is a diagram illustrating connection among a remote controller, a control board, a relay board, and a refrigerant sensor included in the air conditioner according to the embodiment of the present invention.

FIG. 4 is a diagram illustrating a detailed configuration of each of the control board, the relay board, and the refrigerant sensor illustrated in FIG. 3.

FIG. 5 is a diagram illustrating an example of a pulse width modulated signal output from a controller provided in the refrigerant sensor illustrated in FIG. 4.

Description of Embodiments

[0011] An air conditioner according to an embodiment of the present invention will now be described in detail with reference to the drawings. Note that the present invention is not limited to the embodiment.

Embodiment.

[0012] FIG. 1 is an external view of an air conditioner according to an embodiment of the present invention. An air conditioner 100 includes: an outdoor unit 1; a floor-standing indoor unit 2 connected to the outdoor unit 1; and a pipe 3 connecting the outdoor unit 1 and the floor-standing indoor unit 2 to each other and allowing passage of a refrigerant. The air conditioner 100 according to the present embodiment uses a flammable hydrocarbon refrigerant.

[0013] The floor-standing indoor unit 2 includes: a housing 20; a front panel 21 installed on the front of the housing 20; and a remote controller 22. The remote controller 22 may be hereinafter simply referred to as a "remote control 22". The housing 20 is a hollow box body with a front opening formed on the front of the housing 20. The front panel 21 is detachably mounted in the front opening of the housing 20. The front panel 21 is provided with an air inlet 21a formed on a lower area of the front panel 21 and an air outlet 21b formed on an upper area of the front panel 21. Moreover, the remote control 22 is installed between the air inlet 21a and the air outlet 21b

on the front panel 21.

[0014] The remote control 22 is a user interface for a user to perform a driving operation of the air conditioner 100, and to monitor an operating state as well as details of a problem of the air conditioner 100. For example, the driving operation includes: operation for starting the operation of the air conditioner 100; operation for stopping the operation of the air conditioner 100; and operation for switching an operating mode. For example, the details of problems include: refrigerant leakage information indicating leakage of the refrigerant from a part making up a refrigeration cycle of the air conditioner 100; communication problem information indicating the occurrence of a problem in communication between the floor-standing indoor unit 2 and the outdoor unit 1; and disconnection problem information indicating the occurrence of disconnection of a signal line to be described later.

[0015] The remote control 22 includes a display 22a that displays the operating state and the details of a problem. The air conditioner 100 displays the refrigerant leakage information having a higher priority than information such as the communication problem information and the disconnection problem information on the display 22a of the remote control 22. As described above, this is because to notify the user of refrigerant leakage before the concentration of the refrigerant reaches the flammable concentration and thus to urge the user to ventilate a room in which the air conditioner is installed or operate the air conditioner by a user's operation and forcibly diffuse the refrigerant. Moreover, when the signal line to be described later is disconnected while the refrigerant leakage information is displayed, the air conditioner 100 does not display the disconnection problem information but displays only the refrigerant leakage information on the display 22a of the remote control 22. Thus, when the refrigerant leakage information is displayed, a service technician takes measures against only the refrigerant leakage and realizes the disconnection problem after taking the measures against the refrigerant leakage, thereby needing to take measures against the disconnection problem anew.

[0016] In order to solve such a problem, the air conditioner 100 according to the present embodiment includes a luminous unit that changes between a first illuminated state indicating disconnection of the signal line that transmits a detection signal output from the refrigerant sensor to a control board, and a second illuminated state indicating no disconnection of the signal line. The air conditioner 100 is thus configured such that the service technician can check the presence or absence of a disconnection problem by a change in the illuminated state of the luminous unit. An example of the configuration will be specifically described below.

[0017] FIG. 2 is an internal view of the floor-standing indoor unit illustrated in FIG. 1. The housing 20 of the floor-standing indoor unit 2 illustrated in FIG. 2 includes a lower space 200 forming an air intake portion and an upper space 201 positioned above the lower space 200

and forming a heat exchange portion. The lower space 200 and the upper space 201 are partitioned by a partition 4. The partition 4 is a plate-shaped and installed at the center of the housing 20 in the vertical direction. An air passage opening 4a serving as an air passage between the lower space 200 and the upper space 201 is formed in the partition 4.

[0018] The lower space 200 is provided on the rear of the air inlet 21a illustrated in FIG. 1, and is exposed to the front when the air inlet 21a is removed from the front panel 21. The upper space 201 is provided on the rear of the air outlet 21b illustrated in FIG. 1, and is exposed to the front when the air outlet 21b is removed from the front panel 21.

[0019] An indoor blower fan 5 is installed in the lower space 200 to generate an air flow from the air inlet 21a toward the air outlet 21b illustrated in FIG. 1. The indoor blower fan 5 is a multiblade fan including an impeller 5c connected to an output shaft 5b of a motor 5a and having a plurality of blades arranged at regular intervals in the circumferential direction. The indoor blower fan 5 is covered with a spiral fan casing 6. The fan casing 6 is installed at a position facing the air inlet 21a illustrated in FIG. 1. The fan casing 6 is installed below the partition 4 so that the interior of the fan casing 6 is a part of the lower space 200.

[0020] Also installed in the lower space 200 are a refrigerant sensor 7 that detects leakage of the refrigerant and an electrical component box 8 having a rectangular parallelepiped shape. The electrical component box 8 is installed above the indoor blower fan 5, and a control board 9 and a relay board 10, which control the floor-standing indoor unit 2, are installed inside the electrical component box 8. The control board 9 has a drive control function that integrally controls controlled devices included in the air conditioner 100 and a problem display function that displays details of problems occurring in the air conditioner 100 on the display 22a of the remote control 22 illustrated in FIG. 1. The controlled devices are various devices (not illustrated) such as a fan motor, a louver, a compressor, and a propeller fan mounted in the floor-standing indoor unit 2 and the outdoor unit 1. The details of problems displayed by the problem display function include, for example, the refrigerant leakage information indicating leakage of the refrigerant, the communication problem information indicating the occurrence of a problem in communication between the floor-standing indoor unit 2 and the outdoor unit 1, and the disconnection problem information indicating disconnection of wiring 7a.

[0021] The refrigerant sensor 7 includes the wiring 7a that is connected to the relay board 10 to transmit a detection signal 71 output from the refrigerant sensor 7 to the control board 9. The refrigerant sensor 7 is installed below the indoor blower fan 5 and detects the concentration of the refrigerant in the air around the refrigerant sensor 7. The refrigerant sensor 7 outputs the detection signal 71 with a duty ratio varied in accordance with the concentration of the refrigerant detected. Details of the

configuration of the refrigerant sensor 7 will be described later.

[0022] The upper space 201 is located on the downstream of the lower space 200 in the air flow generated by the indoor blower fan 5. An indoor heat exchanger 11 is disposed in the upper space 201. The indoor heat exchanger 11 is connected to one end of an indoor pipe 11a through which the refrigerant flows, and a joint 12a is installed at another end of the indoor pipe 11a. The indoor pipe 11a passes through the partition 4, and the joint 12a is placed in the lower space 200. A joint 12b is installed at one end of the pipe 3 which is an extension pipe. Connecting the joint 12b to the joint 12a allows the pipe 3 to be connected to the indoor pipe 11a.

[0023] Possible portions of leakage of the refrigerant in the floor-standing indoor unit 2 configured as above are a brazed portion 13 between the indoor heat exchanger 11 and the indoor pipe 11a and a connection 14 between the joint 12a and the joint 12b. The refrigerant used in the air conditioner 100 according to the present embodiment is a flammable refrigerant with the specific gravity higher than the specific gravity of air. Thus, the concentration of the refrigerant in the lower space 200 increases when the refrigerant leaks from at least one of the brazed portion 13 and the connection 14. The refrigerant sensor 7 is installed at the bottom of the lower space 200 to be able to accurately measure the concentration of the refrigerant accumulated on the bottom of the lower space 200.

[0024] The detection signal 71 output from the refrigerant sensor 7 is received by the control board 9 via the wiring 7a and the relay board 10. When determining that the concentration of the refrigerant leaking has reached a predetermined value or higher on the basis of the detection signal 71 output from the refrigerant sensor 7, the control board 9 drives the indoor blower fan 5 to diffuse the refrigerant and prevent an increase in the concentration of the refrigerant up to the flammable concentration. The configuration of each of the refrigerant sensor 7, the control board 9, and the relay board 10 will be described in detail below.

[0025] FIG. 3 is a diagram illustrating the connection among the remote control, the control board, the relay board, and the refrigerant sensor included in the air conditioner according to the embodiment of the present invention. FIG. 4 is a diagram illustrating a detailed configuration of each of the control board, the relay board, and the refrigerant sensor illustrated in FIG. 3.

[0026] As illustrated in FIG. 3, the wiring 22b is connected to the remote control 22, and a connector 22c is provided at the wiring 22b. The control board 9 includes a controller 9a, a connection terminal 9b, and a connection terminal 9c. The controller 9a includes the drive control function and the problem display function described above. Connecting the connection terminal 9c to the connector 22c of the remote control 22 allows the controller 9a to be connected to the remote control 22.

[0027] The relay board 10 includes an illumination con-

troller 10a, a connection terminal 10b, and a connection terminal 10c. The connection terminals 10b and 10c are each connected to the illumination controller 10a. The control board 9 and the relay board 10 are connected by wiring 16. Specifically, a connector 16a provided on one end side of the wiring 16 is connected to the connection terminal 9b of the control board 9. A connector 16b provided on another end side of the wiring 16 is connected to the connection terminal 10c of the relay board 10.

[0028] The refrigerant sensor 7 includes a refrigerant detection circuit 7d. Details of the refrigerant detection circuit 7d will be described later. The refrigerant sensor 7 is connected to the relay board 10 by the wiring 7a. Specifically, a connector 7b provided on one end of the wiring 7a is connected to the connection terminal 10b of the relay board 10. A connector 7c provided on another end of the wiring 7a is connected to the refrigerant sensor 7.

[0029] The control board 9 illustrated in FIG. 4 includes: the controller 9a; the connection terminal 9b; a resistor 9d as a pull-down resistor for stabilizing the potential of the signal line; a power supply 9e; a power line 9f for supplying power of the power supply 9e to the refrigerant sensor 7; and a signal line 9g for transmitting the detection signal 71 output from the refrigerant sensor 7 to the controller 9a.

[0030] The relay board 10 illustrated in FIG. 4 includes the illumination controller 10a, the connection terminal 10b, the connection terminal 10c, and a power supply 10d. The power supply 10d is at the same potential as the power supply 9e. The illumination controller 10a includes: a light emitting diode (LED) 302 as the luminous unit; a resistor 303 for adjusting the value of electric current flowing through the LED 302; a resistor 310 as a pull-down resistor for stabilizing the potential of the signal line; and a buffer circuit 320 for transmitting a signal to the LED 302 without affecting the potentials of the signal lines 7f, 9g, and 10e. The luminous unit provided in the illumination controller 10a is not limited to the LED 302 but may be a photoelectric element such as a laser or a lamp instead of the LED 302.

[0031] The buffer circuit 320 includes: an NPN transistor 304; a resistor 305 with one end connected to the base of the transistor 304 and another end connected to the emitter of the transistor 304; a PNP transistor 307; and a resistor 306 with one end connected to the base of the transistor 304 and another end connected to the collector of the transistor 307. The buffer circuit 320 further includes: a resistor 308 with one end connected to the power supply 10d and the emitter of the transistor 307 and another end connected to the base of the transistor 307; and a resistor 309 with one end connected to the base of the transistor 307 and another end connected to the signal line 10e. Note that instead of the buffer circuit 320, an operational amplifier or a common base circuit using one transistor may be used in the illumination controller 10a.

[0032] The refrigerant sensor 7 includes: the refriger-

ant detection circuit 7d; the connector 7c; a power supply 7e being the same potential as the power supply 9e and the power supply 10d; and the signal line 7f for transmitting the detection signal 71 output from the refrigerant detection circuit 7d to the controller 9a. The refrigerant detection circuit 7d includes: a transistor 402 for changing potentials of the signal lines 7f, 9g, and 10e; a sensor element 403 for detecting the refrigerant; and a controller 404 for controlling on-off timing of the transistor 402 in accordance with the concentration of the refrigerant detected by the sensor element 403. The power supply 7e needed for the operation of the transistor 402 and the refrigerant detection circuit 7d is supplied from the power supply 9e of the control board 9. Note that the transistor 402 is used in the refrigerant detection circuit 7d, however, an operational amplifier or a switch element such as a relay may be used instead of the transistor 402.

[0033] FIG. 5 is a diagram illustrating an example of a pulse width modulated signal output from the controller provided in the refrigerant sensor illustrated in FIG. 4. FIG. 5 (1) illustrates a pulse width modulated signal 404a output from the controller 404 when the concentration of the refrigerant detected by the sensor element 403 is less than a predetermined value. In FIG. 5 (1), a duty ratio which is a ratio of ON time T_{on} to one period T of the pulse width modulated signal 404a is 30%. FIG. 5 (2) illustrates the pulse width modulated signal 404a output from the controller 404 when the concentration of the refrigerant detected by the sensor element 403 is higher than or equal to the predetermined value. The duty ratio is 70% in FIG. 5 (2). The controller 404 thus generates the pulse width modulated signal 404a with the duty ratio that is increased as the concentration of the refrigerant detected by the sensor element 403 increases.

[0034] Note that an example of the sensor element 403 is a thermistor whose electric resistance value changes with the use of the cooling action by the refrigerant. Specifically, the higher the concentration of the refrigerant, the lower the electric resistance value of the thermistor so that the electric current value input from the power supply 7e to the controller 404 increases. The controller 404 changes the duty ratio of the pulse width modulated signal 404a as illustrated in FIG. 5 on the basis of the magnitude of the electric current value.

[0035] The refrigerant sensor 7 is thus configured such that the power supply 7e necessary for the operation of the transistor 402 and the refrigerant detection circuit 7d is supplied from the control board 9, and that the duty ratio of the pulse width modulated signal 404a is changed in accordance with the concentration of the refrigerant detected by the sensor element 403. As a result, the transistor 402 is controlled and the duty ratio of the detection signal 71 is changed. Accordingly, the potentials applied to the signal lines 7f, 9g, and 10e connected to the collector of the transistor 402 are changed.

[0036] When the transistor 402 is on, the voltage output from the power supply 9e is divided by the resistors 308, 309, and 9d and the on-resistance of the transistor 402.

Such divided voltage is applied to the controller 9a of the control board 9. When the transistor 402 is off, the voltage output from the power supply 9e is divided by the resistors 308, 309, 310, and 9d. Such divided voltage is applied to the controller 9a of the control board 9. Here, the resistance value of the resistor 9d needs to be high enough to be able to clearly distinguish the voltage applied to the controller 9a between when the transistor 402 is turned on and when turned off. The controller 9a measures the duty ratio of the detection signal 71 to be able to determine whether the concentration of the refrigerant is higher than or equal to the predetermined value or lower than the predetermined value.

[0037] When the transistor 402 of the refrigerant sensor 7 is off, the resistance value of the resistor 9d of the control board 9 is large enough so that the transistor 307 of the relay board 10 is turned off and the transistor 304 of the relay board 10 is pulled down by the resistor 305 and turned off. As a result, an electric current flows through the LED 302 via the resistor 303 to cause the LED 302 of the relay board 10 to be luminous and be in the illuminated state.

[0038] On the other hand, when the transistor 402 of the refrigerant sensor 7 is on, the base electric current determined by the resistor 309 flows to turn on the transistor 307 of the relay board 10. With the transistor 307 turned on, the base electric current determined by the resistor 306 is supplied to the transistor 304 of the relay board 10 so that the transistor 304 is turned on. As a result, the collector-emitter voltage of the transistor 304 becomes sufficiently lower than the forward voltage of the LED 302 of the relay board 10, whereby the LED 302 is turned off.

[0039] According to the above process, the detection signal 71 transmitted from the refrigerant sensor 7 is converted into a luminous signal by the LED 302 of the relay board 10.

[0040] Here, a case where the control board 9 and the relay board 10 are disconnected will be described. When the connector 16a is removed from the connection terminal 9b or the connector 16b is removed from the connection terminal 10c, the power of the power supply 9e is not supplied to the relay board 10 and to the refrigerant sensor 7 so that the LED 302 of the relay board 10 is turned off.

[0041] Next, a case where the relay board 10 and the refrigerant sensor 7 are disconnected will be described. When the connector 7b is removed from the connection terminal 10b or the connector 7c is removed from the refrigerant sensor 7, the transistor 402 of the refrigerant sensor 7 is turned off so that the LED 302 of the relay board 10 is turned on.

[0042] The LED 302 blinks regardless of whether or not the refrigerant sensor 7 detects the refrigerant when the signal line 7f, the wiring 7a, the signal line 10e, the wiring 16, and the signal line 9g which are signal transmission paths of the refrigerant sensor 7 are not disconnected. On the other hand, the LED 302 is turned on or

off when the signal transmission path of the refrigerant sensor 7 is disconnected. A service technician can therefore determine any of the signal transmission paths of the refrigerant sensor 7 is disconnected by confirming that the LED 302 is turned on or off.

[0043] The controller 9a determines that the refrigerant is not leaking when receiving the detection signal 71 with the low duty ratio as illustrated in FIG. 5 (1), thereby not displaying the refrigerant leakage information on the remote control 22. On the other hand, the controller 9a determines that the refrigerant is leaking when receiving the detection signal 71 with the high duty ratio as illustrated in FIG. 5 (2), thereby displaying the refrigerant leakage information that is given higher priority than the information such as the communication problem and the disconnection problem on the remote control 22.

[0044] The remote control 22 displays only the refrigerant leakage information even when the signal transmission path of the refrigerant sensor 7 is disconnected after the refrigerant leakage information is displayed on the remote control 22. According to the air conditioner 100 of the present embodiment, the LED 302 blinks at regular intervals when the signal transmission path of the refrigerant sensor 7 is not disconnected, and the LED 302 is turned on or off when the signal transmission path of the refrigerant sensor 7 is disconnected. The illuminated state of the LED 302 thus changes among the three types depending on the presence or absence of disconnection, so that the service technician can immediately confirm the disconnection problem, not displayed on the remote control 22, by checking the illuminated state of the LED 302. Therefore, the air conditioner 100 according to the present embodiment it is possible to take measures against the refrigerant leakage and the disconnection problem simultaneously and improve workability.

[0045] The refrigerant leakage information remains displayed even when the concentration of the refrigerant drops below the predetermined value after the refrigerant leakage information is displayed on the remote control 22. According to the air conditioner 100 of the present embodiment, the service technician who takes measures against the refrigerant leakage can perceive the disconnection problem by checking the illuminated state of the LED 302 even while the refrigerant leakage information remains displayed.

[0046] Note that although the present embodiment has described the example of using the relay board 10 provided with the illumination controller 10a, the illumination controller 10a may be provided on the control board 9. By providing the illumination controller 10a on the control board 9, the service technician can perceive the disconnection problem even when the relay board 10 cannot be installed due to the limited space for installing equipment in the electrical component box 8. When the illumination controller 10a is provided on the control board 9, the connector 7b of the refrigerant sensor 7 is connected to the connection terminal 9b of the control board 9.

[0047] On the other hand, in the case of using the relay

board 10 provided with the illumination controller 10a, the wiring 16 is connected to the control board 9, and the wiring 7a of the refrigerant sensor 7 is connected to the relay board 10. As a result, the disconnection problem can be perceived without modifying the existing control board 9.

[0048] Moreover, the illumination controller 10a provided on the relay board 10 turns off the LED 302 when the wiring 16 being the signal transmission path between the control board 9 and the relay board 10 is disconnected, or turns on the LED 302 when the wiring 7a being the signal transmission path between the relay board 10 and the refrigerant sensor 7 is disconnected. As a result, the service technician can roughly grasp the site of disconnection and save time associated with taking measures against the disconnection problem.

[0049] Moreover, the air conditioner 100 according to the present embodiment includes the illumination controller 10a that turns on or off the luminous unit in the first illuminated state indicating that the signal transmission path of the refrigerant sensor 7 is disconnected, and blinks the luminous unit in the second illuminated state indicating that the signal transmission path of the refrigerant sensor 7 is not disconnected, whereby the service technician can easily know whether or not the signal transmission path of the refrigerant sensor 7 is disconnected.

[0050] Note that the present embodiment has described the configuration example in which the connector is connected to the connection terminal to establish the electrical connection between the control board 9 and the relay board 10 and between the relay board 10 and the refrigerant sensor 7. Alternatively, the wirings 7a, 16, and 22b may be directly connected to the connection terminals without using the connector, or may be soldered to wiring patterns (not illustrated) on the control board 9 and the relay board 10. Moreover, although the present embodiment has described the example in which the LED 302 is provided on the control board 9 or the relay board 10, the LED 302 may be installed at any site outside the electrical component box 8 illustrated in FIG. 1. In the case where the LED 302 is provided on the control board 9 or the relay board 10, wiring (not illustrated) for connecting the LED 302 to the illumination controller 10a can be shortened or omitted as compared with the case where the LED 302 is installed at any site outside the electrical component box 8, so that the configuration of the control board 9 or the relay board 10 is simplified and that the yield as well as reliability are improved. In the case where the LED 302 is provided outside the electrical component box 8, the visibility of the LED 302 is improved as compared with the case where the LED is installed on the control board 9 or the relay board 10, whereby the workability is improved in taking measures against the disconnection problem.

[0051] The configuration illustrated in the above embodiment merely illustrates an example of the content of the present invention, and can thus be combined with

another known technique or partially omitted and/or modified without departing from the scope of the present invention.

5 Reference Signs List

[0052] 1 outdoor unit; 2 floor-standing indoor unit; 3 pipe; 4 partition; 4a air passage opening; 5 indoor blower fan; 5a motor; 5b output shaft; 5c impeller; 6 fan casing; 7 refrigerant sensor; 7a, 16, 22b wiring; 7b, 7c, 16a, 16b, 22c connector; 7d refrigerant detection circuit; 8 electrical component box; 9 control board; 9a controller; 9b, 9c, 10b, 10c connection terminal; 9f power line; 10 relay board; 10a illumination controller; 11 indoor heat exchanger; 11a indoor pipe; 12a, 12b joint; 13 brazed portion; 14 connection; 7f, 9g, 10e signal line; 20 housing; 21 front panel; 21a air inlet; 21b air outlet; 22 remote controller; 22a display; 71 detection signal; 100 air conditioner; 200 lower space; 201 upper space; 9d, 303, 305, 306, 308, 309, 310 resistor; 7e, 9e, 10d power supply; 302 LED; 304, 307, 402 transistor; 320 buffer circuit; 403 sensor element; 404 controller; 404a pulse width modulated signal.

25 Claims

1. An air conditioner comprising:

a floor-standing indoor unit;
a control board installed in the floor-standing indoor unit to control the floor-standing indoor unit;
a refrigerant sensor installed in the floor-standing indoor unit to output a detection signal with a duty ratio varied in accordance with concentration of a detected refrigerant; and
a luminous unit installed in the floor-standing indoor unit to change between a first illuminated state indicating that a signal transmission path transmitting the detection signal to the control board is disconnected, and a second illuminated state indicating that the signal transmission path is not disconnected.

2. The air conditioner according to claim 1, further comprising an illumination controller to turn on or off the luminous unit in the first illuminated state and blink the luminous unit in the second illuminated state.

3. The air conditioner according to claim 2, further comprising a relay board disposed between the control board and the refrigerant sensor, wherein the illumination controller is installed on the relay board to turn off the luminous unit when the signal transmission path between the control board and the relay board is disconnected, and turn on the luminous unit when the signal transmission path between the relay board and the refrigerant sensor is disconnected.

nected.

4. The air conditioner according to claim 3, wherein the luminous unit is installed on the control board or the relay board.

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FIG.1

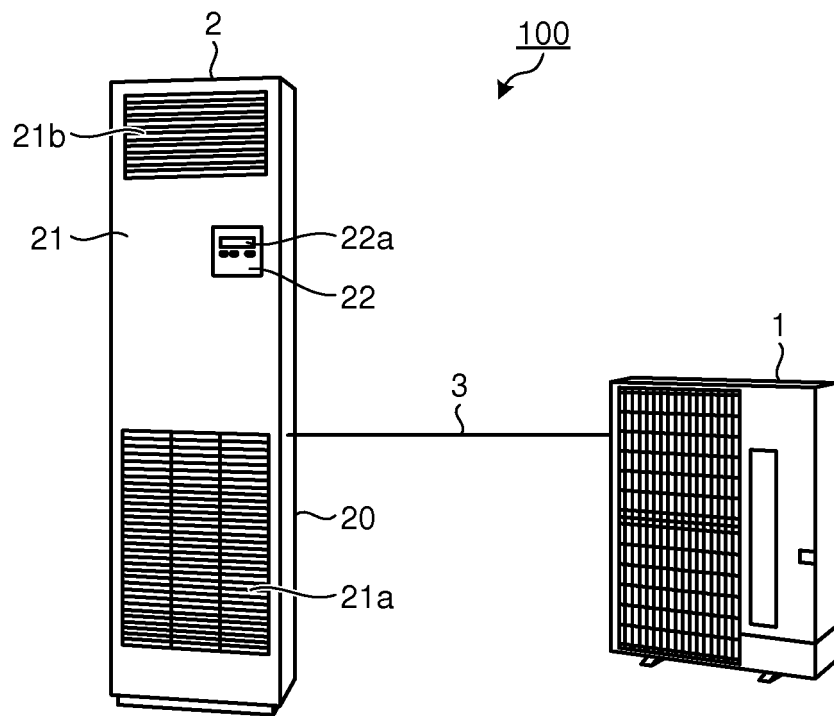


FIG.2

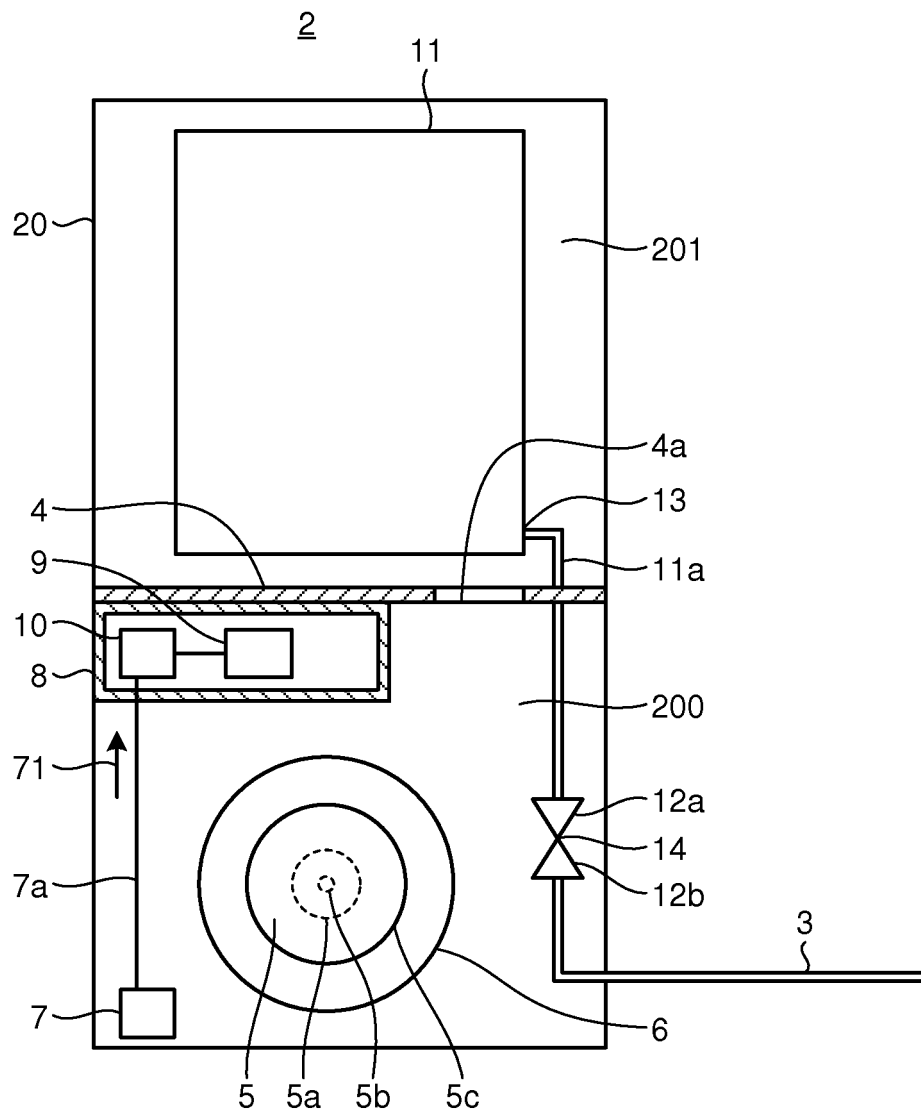


FIG.3

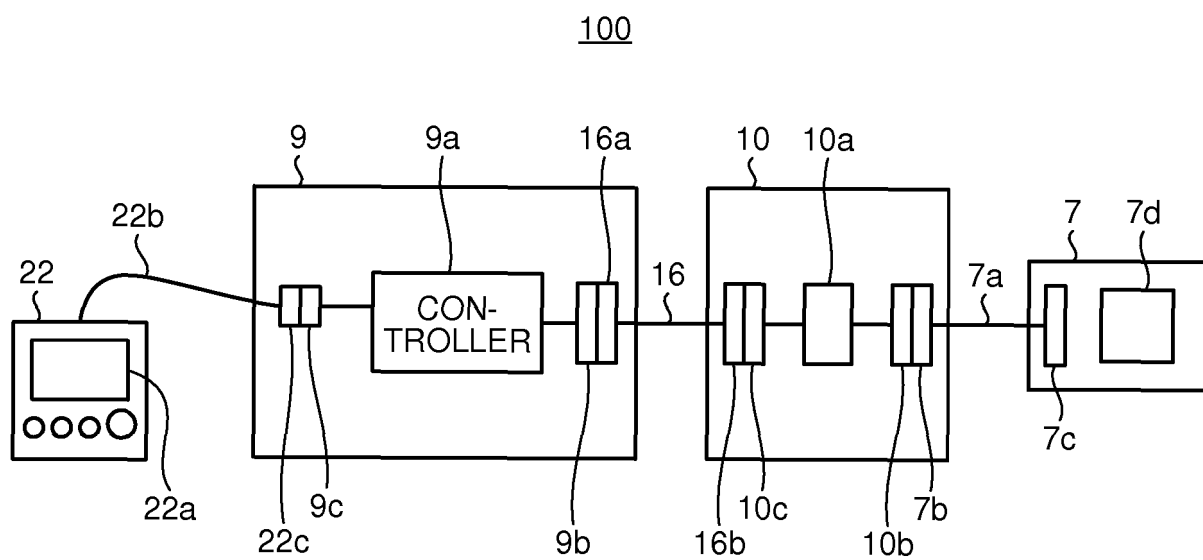


FIG.4

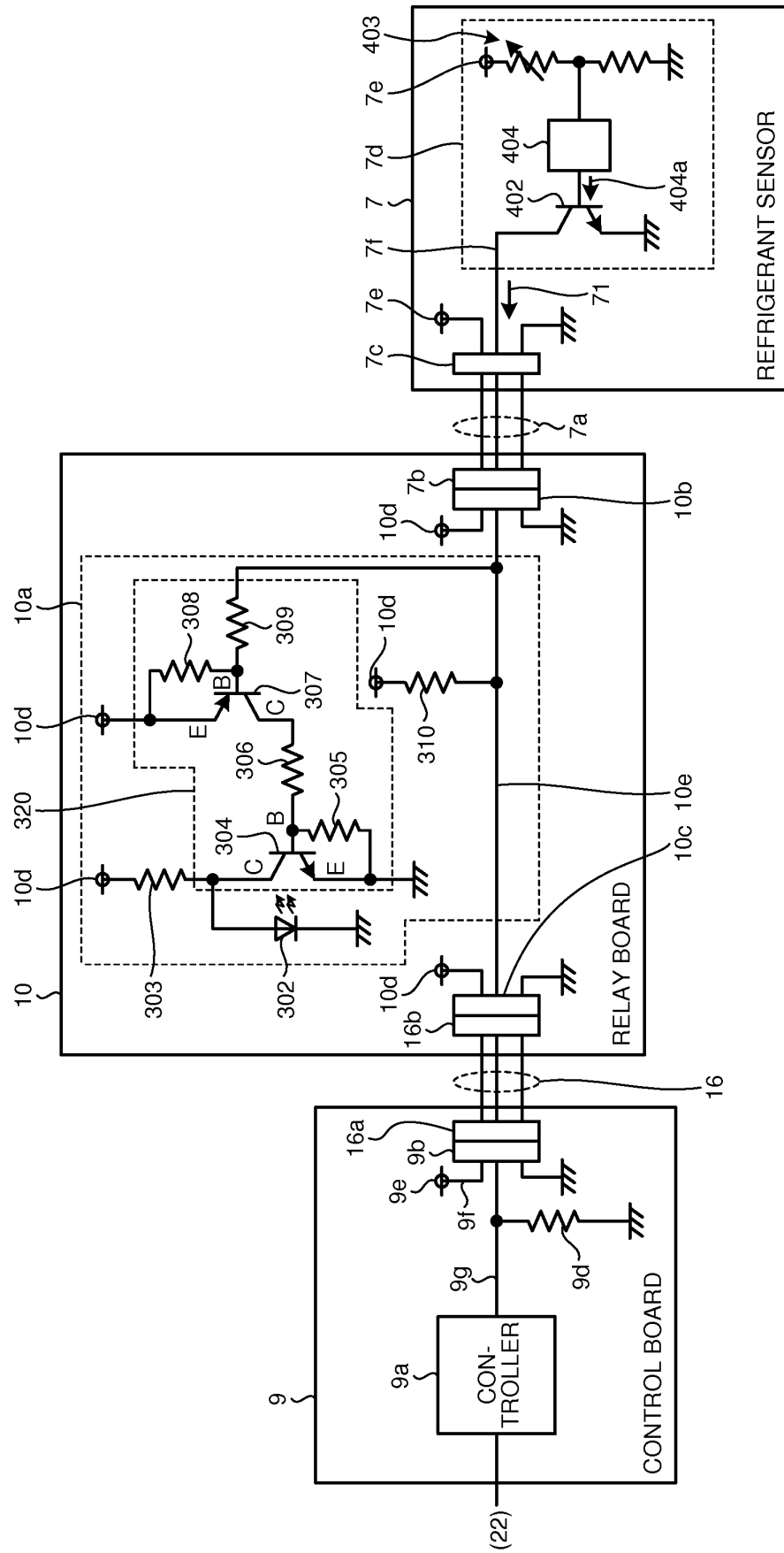
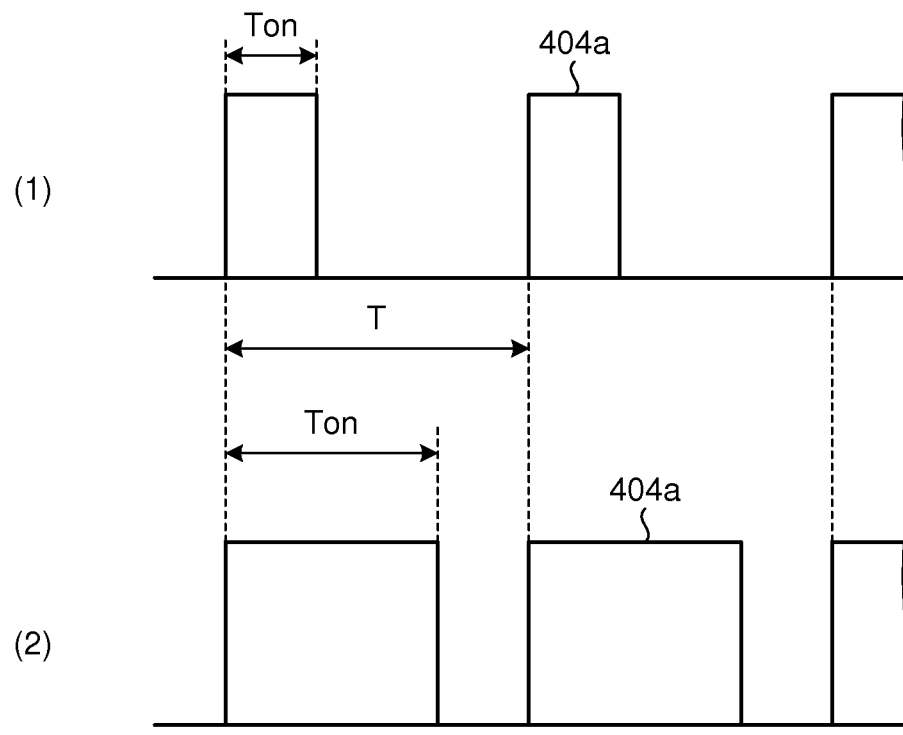


FIG.5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/064362

A. CLASSIFICATION OF SUBJECT MATTER

F24F11/02(2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24F11/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
 Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2012-193884 A (Fuji Koki Corp.), 11 October 2012 (11.10.2012), paragraphs [0001], [0018] to [0036]; fig. 1 (Family: none)	1, 2 3, 4
Y	JP 11-64427 A (Matsushita Electric Works, Ltd.), 05 March 1999 (05.03.1999), paragraphs [0017] to [0033]; fig. 1 to 4 (Family: none)	1, 2
Y	JP 2015-94566 A (Daikin Industries, Ltd.), 18 May 2015 (18.05.2015), paragraphs [0019] to [0064]; fig. 1 to 11 & WO 2015/072270 A	1, 2

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search
06 June 2016 (06.06.16)Date of mailing of the international search report
14 June 2016 (14.06.16)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/064362

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2009-69934 A (Fujitsu Ltd.), 02 April 2009 (02.04.2009), paragraph [0132] (Family: none)	2
Y	JP 2014-82085 A (Tokyo Technology Labo Co., Ltd.), 08 May 2014 (08.05.2014), paragraph [0019] (Family: none)	2

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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