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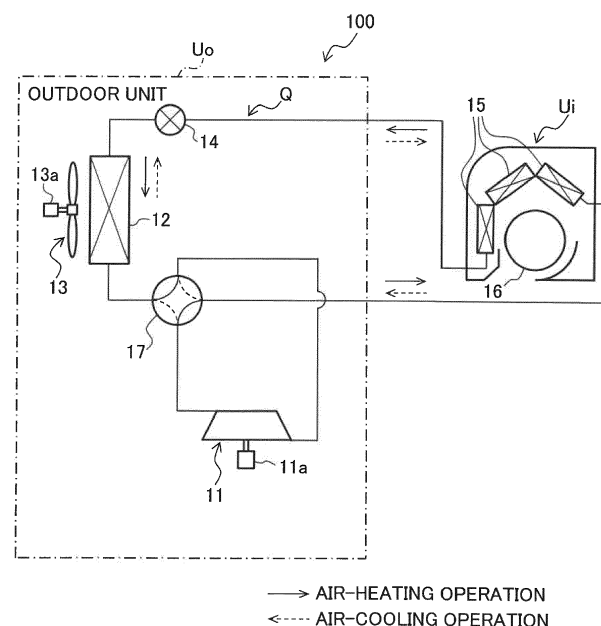
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(54) **AIR-CONDITIONER**

(57) An air-conditioner including: a switching section configured to switch a setting by manual operation; and a control section configured to report an abnormality by a reporting means in a case where a refrigerant detection

sensor is not electrically connected to the control section in a state in which the setting of the switching section has been switched to a setting that the refrigerant detection sensor is installed.

FIG. 1



Description

reference example of the present invention.

BACKGROUND**DETAILED DESCRIPTION**

1. Technical Field

[0001] One aspect of the present invention relates to an air-conditioner.

2. Related Art

[0002] For example, a technique described in JP-A-2019-60556 has been known as the technique of sensing refrigerant leakage from a refrigerant circuit. That is, JP-A-2019-60556 describes a heat source device including at least one refrigerant sensor arranged in an indoor space in which each heat source unit is installed.

SUMMARY

[0003] An air-conditioner including: a switching section configured to switch a setting by manual operation; and a control section configured to report an abnormality by a reporting means in a case where a refrigerant detection sensor is not electrically connected to the control section in a state in which the setting of the switching section has been switched to a setting that the refrigerant detection sensor is installed.

BRIEF DESCRIPTION OF THE DRAWINGS**[0004]**

Fig. 1 is a configuration diagram of an air-conditioner according to an embodiment of the present invention;

Fig. 2 is a functional block diagram of the air-conditioner according to the embodiment of the present invention;

Fig. 3 is a perspective view of an indoor unit in a state in which a front panel and an electrical component box are detached, the indoor unit being included in the air-conditioner according to the embodiment of the present invention;

Fig. 4 is a partially-enlarged view of a region K of Fig. 3 in the indoor unit of the air-conditioner according to the embodiment of the present invention;

Fig. 5 is a view relating to the air-conditioner according to the embodiment of the present invention and provided for describing a component-mounting-side surface of an indoor control board exposed after a lid of the electrical component box has been detached;

Fig. 6 is a flowchart of processing executed by a control section of the air-conditioner according to the embodiment of the present invention; and

Fig. 7 is a flowchart of processing executed by a control section of an air-conditioner according to a

[0005] In the following detailed description, for purpose of explanation, numerous specific details are set forth in order to provide a thorough understanding of the disclosed embodiments. It will be apparent, however, that one or more embodiments may be practiced without these specific details. In other instances, well-known structures and devices are schematically shown in order to simplify the drawing.

[0006] A refrigerant detection sensor (the refrigerant sensor) is not limited to one installed in a single uniform way regardless of the amount and/or type of refrigerant sealed in the refrigerant circuit. As described above, in some cases, the refrigerant detection sensor is an optional component installed as necessary. In this case, a worker installs the refrigerant detection sensor upon installation of an air-conditioner. For this reason, there is a probability that failure to attach the refrigerant detection sensor and erroneous connection of the refrigerant detection sensor by the worker are caused.

[0007] Note that in a case where the refrigerant detection sensor (the refrigerant sensor) is the optional component in the technique described in JP-A-2019-60556, it is difficult to correctly sense, e.g., failure to attach the refrigerant detection sensor only based on the presence or absence of connection of the refrigerant detection sensor. For example, in a case where it is not necessary to install the refrigerant detection sensor, the absence of the refrigerant detection sensor is not actually included in, e.g., failure to attach the refrigerant detection sensor. For this reason, an air-conditioner configured to properly report an abnormality regarding, e.g., installation of the refrigerant detection sensor even in a case where the refrigerant detection sensor is the optional component has been demanded.

[0008] For this reason, one object of the present invention is to provide an air-conditioner configured to properly report an abnormality regarding, e.g., installation of a refrigerant detection sensor.

[0009] To solve the above-mentioned problem, an air-conditioner according to an aspect of the present invention includes: a switching section configured to switch a setting by manual operation; and a control section configured to report an abnormality by a reporting means in a case where a refrigerant detection sensor is not electrically connected to the control section in a state in which the setting of the switching section has been switched to a setting that the refrigerant detection sensor is installed.

[0010] Further, an air-conditioner according to another aspect of the present invention includes: a switching section configured to switch a setting by manual operation; and a control section configured to report an abnormality by a reporting means in a case where a refrigerant detection sensor is electrically connected to the control section in a state in which the setting of the switching section

has been switched to a setting that the refrigerant detection sensor is not installed.

[0011] According to the above-described aspect of the present invention, the air-conditioner configured to properly report the abnormality regarding, e.g., installation of the refrigerant detection sensor can be provided.

<<Embodiment>>

<Configuration of Air-Conditioner>

[0012] Fig. 1 is a configuration diagram of an air-conditioner 100 according to an embodiment.

[0013] Note that solid arrows in Fig. 1 indicate the flow of refrigerant in air-heating operation.

[0014] On the other hand, dashed arrows in Fig. 1 indicate the flow of refrigerant in air-cooling operation.

[0015] The air-conditioner 100 is equipment configured to perform air-conditioning operation such as the air-heating operation or the air-cooling operation. As illustrated in Fig. 1, the air-conditioner 100 includes a compressor 11, an outdoor heat exchanger 12, an outdoor fan 13, and an expansion valve 14. Moreover, the air-conditioner 100 includes, in addition to the above-described configurations, an indoor heat exchanger 15, an indoor fan 16, and a four-way valve 17.

[0016] The compressor 11 is equipment configured to compress low-temperature low-pressure gas refrigerant to discharge high-temperature high-pressure gas refrigerant. As illustrated in Fig. 1, the compressor 11 includes a compressor motor 11a as a drive source.

[0017] The outdoor heat exchanger 12 is a heat exchanger configured to exchange heat between refrigerant flowing in a heat transfer pipe (not shown) of the heat exchanger and external air sent from the outdoor fan 13.

[0018] The outdoor fan 13 is a fan configured to send the external air into the outdoor heat exchanger 12. The outdoor fan 13 includes an outdoor fan motor 13a as a drive source, and is arranged in the vicinity of the outdoor heat exchanger 12.

[0019] The expansion valve 14 is a valve configured to depressurize refrigerant condensed by a "condenser" (one of the outdoor heat exchanger 12 or the indoor heat exchanger 15). Note that the refrigerant depressurized by the expansion valve 14 is guided to an "evaporator" (the other one of the outdoor heat exchanger 12 or the indoor heat exchanger 15).

[0020] The indoor heat exchanger 15 is a heat exchanger configured to exchange heat between refrigerant flowing in a heat transfer pipe g (see Fig. 3) of the heat exchanger and indoor air (air in an air-conditioning target space) sent from the indoor fan 16.

[0021] The indoor fan 16 is a fan configured to send the indoor air into the indoor heat exchanger 15. The indoor fan 16 has an indoor fan motor 16a (see Fig. 2) as a drive source, and is arranged in the vicinity of the indoor heat exchanger 15.

[0022] The four-way valve 17 is a valve for switching

a refrigerant flow path according to an operation mode of the air-conditioner 100. For example, in the air-cooling operation (see the dashed arrows in Fig. 1), in a refrigerant circuit Q, refrigerant sequentially circulates through the compressor 11, the outdoor heat exchanger 12 (the condenser), the expansion valve 14, and the indoor heat exchanger 15 (the evaporator).

[0023] On the other hand, in the air-heating operation (see the solid arrows in Fig. 1), in the refrigerant circuit Q, refrigerant sequentially circulates through the compressor 11, the indoor heat exchanger 15 (the condenser), the expansion valve 14, and the outdoor heat exchanger 12 (the evaporator).

[0024] That is, in the refrigerant circuit Q in which refrigerant sequentially circulates through the compressor 11, the "condenser," the expansion valve 14, and the "evaporator," one of the "condenser" or the "evaporator" as described above is the outdoor heat exchanger 12, and the other one of the "condenser" or the "evaporator" is the indoor heat exchanger 15.

[0025] Note that in an example illustrated in Fig. 1, the compressor 11, the outdoor heat exchanger 12, the outdoor fan 13, the expansion valve 14, and the four-way valve 17 are installed in an outdoor unit Uo. On the other hand, the indoor heat exchanger 15 and the indoor fan 16 are installed in an indoor unit Ui.

[0026] Fig. 2 is a functional block diagram of the air-conditioner 100.

[0027] In addition to each of the above-described configurations, the indoor unit Ui illustrated in Fig. 2 includes a remote controller transmission/reception section 21, an indoor temperature sensor 22, a refrigerant detection sensor 23, a DIP switch 24 (a switching section), a light emitting diode 25 (LED: reporting means). Further, the indoor unit Ui includes an indoor control circuit 31, the indoor fan motor 16a, a right-left wind deflector motor 26a, and an upper-lower wind deflector motor 27a.

[0028] The remote controller transmission/reception section 21 is configured to exchange predetermined information with a remote controller 40 via, e.g., infrared communication.

[0029] The indoor temperature sensor 22 is a sensor configured to detect a temperature in a room (the air-conditioning target space), and is arranged on an air suction side of the indoor unit Ui.

[0030] The refrigerant detection sensor 23 is a sensor configured to sense refrigerant leakage from the refrigerant circuit Q (see Fig. 1), and is installed at a predetermined spot in the indoor unit Ui. The refrigerant detection sensor 23 is an optional component, and is installed as necessary based on the amount and/or type of refrigerant sealed in the refrigerant circuit Q.

[0031] For example, in a case where the refrigerant sealed in the refrigerant circuit Q is flammable, the refrigerant detection sensor 23 is installed in many cases. On the other hand, in a case where the refrigerant sealed in the refrigerant circuit Q is inflammable, the refrigerant detection sensor 23 is not installed in some cases. Thus,

in the present embodiment, the refrigerant detection sensor 23 is installed in the indoor unit Ui as illustrated in Fig. 2, but the refrigerant detection sensor 23 is not an essential configuration and is not installed in the indoor unit Ui in some cases.

[0032] The DIP switch 24 illustrated in Fig. 2 is a switch configured to switch a setting by manual operation according to whether or not the refrigerant detection sensor 23 is installed. The DIP switch 24 is mounted on an indoor control board P (see Fig. 5). When the refrigerant detection sensor 23 is installed upon installation of the air-conditioner 100, a worker switches the setting of the DIP switch 24 by a worker's hand or a tool (e.g., a driver). Note that details of processing regarding the DIP switch 24 will be described later.

[0033] Signals from the remote controller transmission/reception section 21, the indoor temperature sensor 22, the refrigerant detection sensor 23, and the DIP switch 24 illustrated in Fig. 2 are output to the indoor control circuit 31.

[0034] The indoor control circuit 31 includes electronic circuits (all circuits are not shown) such as a central processing unit (CPU), a read only memory (ROM), a random access memory (RAM), and various interfaces. Moreover, in the indoor control circuit 31, the CPU reads a program stored in the ROM and loads the program into the RAM, thereby executing various types of processing.

[0035] As illustrated in Fig. 2, the indoor control circuit 31 includes a storage section 31a and an indoor control section 31b.

[0036] In addition to a predetermined program, the storage section 31a stores data from the remote controller transmission/reception section 21, the indoor temperature sensor 22, the refrigerant detection sensor 23, and the DIP switch 24.

[0037] Based on the data stored in the storage section 31a, the indoor control section 31b controls the LED 25 described subsequently, the indoor fan motor 16a, the right-left wind deflector motor 26a, and the upper-lower wind deflector motor 27a.

[0038] The LED 25 is configured to report an abnormality regarding connection of the refrigerant detection sensor 23, and for example, is installed on an upper surface of a housing of the indoor unit Ui. Note that a case where the indoor control section 31b flashes the LED 25 will be described later.

[0039] As described above, the indoor fan motor 16a is the drive source of the indoor fan 16 (see Fig. 1). The right-left wind deflector motor 26a is a drive source for turning a right-left wind deflector (not shown) in a right-left direction. The upper-lower wind deflector motor 27a is a drive source for turning upper-lower wind deflectors 271, 272 (see Figs. 3 and 4) in an upper-lower direction. Note that the right-left wind deflector motor 26a and the like may be omitted as necessary.

[0040] In addition to each configuration described with reference to Fig. 1, the outdoor unit Uo includes an outdoor temperature sensor 28 and an outdoor control circuit

32.

[0041] The outdoor temperature sensor 28 is a sensor configured to detect an outdoor temperature, and is installed at a predetermined spot in the outdoor unit Uo (see Fig. 1). Note that although not shown in Fig. 3, multiple sensors configured to detect, e.g., a suction temperature and a discharge temperature of the compressor 11 (see Fig. 1) are also installed in the outdoor unit Uo in addition to the outdoor temperature sensor 28. A detection value of each sensor including the outdoor temperature sensor 28 is output to the outdoor control circuit 32.

[0042] The outdoor control circuit 32 includes electronic circuits (all circuits are not shown) such as a CPU, a ROM, a RAM, and various interfaces. The outdoor control circuit 32 is connected to the indoor control circuit 31 via a communication line. As illustrated in Fig. 2, the outdoor control circuit 32 includes a storage section 32a and an outdoor control section 32b.

[0043] In addition to a predetermined program, the storage section 32a stores, e.g., data received from the indoor control circuit 31. Based on the data stored in the storage section 32a, the outdoor control section 32b controls, e.g., the compressor motor 11a, the outdoor fan motor 13a, the expansion valve 14, and the four-way valve 17. Hereinafter, the indoor control circuit 31 and the outdoor control circuit 32 will be collectively referred to as a "control section 30."

[0044] Fig. 3 is a perspective view of the indoor unit Ui in a state in which a front panel and an electrical component box are detached.

[0045] Note that in the indoor unit Ui illustrated in Fig. 3, the indoor unit Ui is partially disassembled and the refrigerant detection sensor 23 is moved laterally from an actual installation spot. Moreover, a floor indoor unit Ui for domestic use is illustrated as one example in Fig. 3. The present embodiment is also applicable to other types of air-conditioners 100.

[0046] In addition to the indoor heat exchanger 15 (also see Fig. 1) and the indoor fan 16 (also see Fig. 1) as described above, the indoor unit Ui includes a drain pan 18, a housing base 19, a stand 29, and the indoor control board P (a control board).

[0047] The indoor heat exchanger 15 includes multiple fins f and the multiple heat transfer pipes g penetrating these fins f.

[0048] The indoor fan 16 is, for example, a cylindrical cross-flow fan, and is arranged in the vicinity of the indoor heat exchanger 15.

[0049] The drain pan 18 is a pan configured to receive condensed water from the indoor heat exchanger 15, and is arranged below the indoor heat exchanger 15.

[0050] The housing base 19 is a housing in which, e.g., the indoor heat exchanger 15 and the indoor fan 16 are installed.

[0051] The stand 29 is a table for installing the indoor unit Ui on the floor. Note that the stand 29 may be omitted and the indoor unit Ui may be installed on a wall in the

room.

[0052] The indoor control board P is a printed-circuit board on which the indoor control circuit 31 (i.e., a circuit component of the control section 30; see Fig. 2) is mounted and the DIP switch 24 (see Fig. 5) is also mounted. Note that in Fig. 3, the indoor control board P is in an exposed state. The indoor control board P is actually housed in the electrical component box B (see Fig. 5).

[0053] As described above, the refrigerant detection sensor 23 illustrated in Fig. 3 is the sensor configured to sense refrigerant leakage, and is provided in the vicinity of the drain pan 18. More specifically, the refrigerant detection sensor 23 is provided on one side of the drain pan 18 in a width direction (the right-left direction) of the indoor unit Ui, the drain pan 18 extending elongated in the width direction. Moreover, it is configured such that the refrigerant detection sensor 23 is housed in the front panel (not shown) and the housing base 19 of the indoor unit Ui. With this configuration, contact of a user's hand with the refrigerant detection sensor 23 can be reduced.

[0054] By drive of the indoor fan 16, air taken into the indoor unit Ui exchanges heat with refrigerant flowing in the heat transfer pipe g of the indoor heat exchanger 15. The heat-exchanged air is guided in a predetermined direction by the right-left wind deflector (not shown) and the upper-lower wind deflectors 271, 272 (see Figs. 3 and 4), and is blown into the room.

[0055] Fig. 4 is a partially-enlarged view of a region K of Fig. 3.

[0056] The refrigerant detection sensor 23 includes a sensor board (not shown) on which a sensor element (not shown) is mounted, and a sensor case 23a configured to house the sensor board. The above-described sensor element is an element having sensitivity to a refrigerant concentration. An element such as a semiconductor element, an infrared element, a contact combustion element, or an electrochemical element can be used as such a sensor element.

[0057] Multiple holes ha for taking refrigerant having leaked from the refrigerant circuit Q (see Fig. 1) are provided at the sensor case 23a. In a case where the concentration of refrigerant taken through the multiple holes ha is equal to or higher than a predetermined value, a predetermined signal indicating refrigerant leakage is output from the refrigerant detection sensor 23 to the indoor control circuit 31 (see Fig. 2).

[0058] Fig. 5 is a view for describing a component-mounting-side surface of the indoor control board P exposed after a lid of the electrical component box B has been detached.

[0059] Note that Fig. 5 illustrates, in a simplified manner, electronic components mounted on the indoor control board P. As illustrated in Fig. 5, the electronic components mounted on the indoor control board P include the DIP switch 24 (also see Fig. 2) and a connector N. As described above, the DIP switch 24 is the switch configured to switch the setting by manual operation according to whether or not the refrigerant detection sensor 23

is installed. The DIP switch 24 is mounted on the indoor control board P. As described above, the DIP switch 24 and the connector N are mounted on the indoor control board P housed in the electrical component box B. Thus, e.g., erroneous switching of the DIP switch 24 by a user can be reduced.

[0060] Note that in the case of installing the refrigerant detection sensor 23, the worker detaches the lid (not shown) of the electrical component box B to expose the indoor control board P. Further, the worker switches the setting of the DIP switch 24 to such a setting (referred to as a "sensor present setting") that the refrigerant detection sensor 23 is installed. On the other hand, in the case of not installing the refrigerant detection sensor 23, the worker switches the setting of the DIP switch 24 to such a setting (referred to as a "sensor absent setting") that the refrigerant detection sensor 23 is not installed.

[0061] Note that even in a case where the setting of the DIP switch 24 is actually left unchanged without switching upon power supply, it will be, for the sake of convenience in description, described that the setting of the DIP switch 24 has been "switched" to such a state.

[0062] The connector N illustrated in Fig. 5 is configured to electrically connect the refrigerant detection sensor 23 and the indoor control board P, and is mounted on the indoor control board P. Moreover, the worker inserts a predetermined connector (not shown) provided at a tip end of a wire of the refrigerant detection sensor 23 into the partner connector N mounted on the indoor control board P. Further, an opening hp through which the wire of the refrigerant detection sensor 23 is drawn is provided at the electrical component box B housed in the indoor unit Ui (see Fig. 3).

[0063] Next, the processing of the control section 30 regarding attachment of the refrigerant detection sensor 23 will be described with reference to Fig. 6.

<Processing of Control Section>

[0064] Fig. 6 is a flowchart of the processing executed by the control section 30 of the air-conditioner 100 (see Figs. 2 and 5, as necessary).

[0065] Note that in an example described below, when the refrigerant detection sensor 23 is installed, the worker electrically connects, in advance of a series of processing illustrated in Fig. 6, the wire of the refrigerant detection sensor 23 to the connector N on the indoor control board P (see Fig. 5) and switches the setting of the DIP switch 24 to the "sensor present setting." Such a process is, upon installation of the air-conditioner 100, performed before power supply. Right after power supply, a series of processing illustrated in Fig. 6 is executed.

[0066] Of connection of the refrigerant detection sensor 23 and switching of the setting of the DIP switch 24, connection of the refrigerant detection sensor 23 may be first performed by the worker before power supply, or switching of the setting of the DIP switch 24 may be first performed before power supply. This is because even

when either of connection or switching is performed first, the same result is obtained if a state upon power supply is the same between connection and switching.

[0067] At a step S101, the control section 30 determines whether or not the setting of the DIP switch 24 has been switched to the setting that the refrigerant detection sensor 23 is installed. That is, the control section 30 determines whether or not the signal input from the DIP switch 24 to the control section 30 itself is a signal indicating the "sensor present setting." Note that based on the amount and/or type of refrigerant sealed in the refrigerant circuit Q (see Fig. 1), the worker oneself knows whether or not the refrigerant detection sensor 23 as the optional component needs to be installed.

[0068] At the step S101, in a case where the setting of the DIP switch 24 has been switched to the setting that the refrigerant detection sensor 23 is installed (S101: Yes), the processing of the control section 30 proceeds to a step S102.

[0069] At the step S102, the control section 30 determines whether or not the refrigerant detection sensor 23 is electrically connected to the indoor control board P (see Fig. 5). For example, in a case where the control section 30 receives a response signal from the refrigerant detection sensor 23 after having sent a predetermined signal to the refrigerant detection sensor 23, the control section 30 determines that the refrigerant detection sensor 23 is electrically connected to the indoor control board P.

[0070] At the step S102, in a case where the refrigerant detection sensor 23 is electrically connected to the indoor control board P (i.e., the control section 30 itself) (S102: Yes), the processing of the control section 30 proceeds to a step S103.

[0071] At the step S103, the control section 30 determines, e.g., connection of the refrigerant detection sensor 23 as normal. As described above, in a case where the refrigerant detection sensor 23 is electrically connected to the indoor control board P (S102: Yes) in a state in which (the setting of) the DIP switch 24 has been switched to the setting that the refrigerant detection sensor 23 is installed (S101: Yes), the control section 30 does not report the abnormality regarding, e.g., connection of the refrigerant detection sensor 23. This is because the refrigerant detection sensor 23 is correctly connected to the indoor control board P (see Fig. 5) via the connector N.

[0072] On the other hand, at the step S102, in a case where the refrigerant detection sensor 23 is not electrically connected to the indoor control board P (S102: No), the processing of the control section 30 proceeds to a step S104.

[0073] At the step S104, the control section 30 determines, e.g., connection of the refrigerant detection sensor 23 as abnormal. That is, the control section 30 determines that the refrigerant detection sensor 23 is not correctly connected to the indoor control board P (see Fig. 5) via the connector N.

[0074] Suppose that in a state in which the setting of the DIP switch 24 has been switched to the "sensor present setting" (S101: Yes), the worker supplies power with the refrigerant detection sensor 23 being left unconnected. In this case, the step S102 is "No," and determination as abnormal is made at the step S104.

[0075] Moreover, even when the worker thinks that the refrigerant detection sensor 23 has been connected, the refrigerant detection sensor 23 is, in some cases, not securely connected to the indoor control board P via the connector N (see Fig. 5). In this case, the step S102 is "No," and determination as abnormal is made at the step S104.

[0076] Further, other types of sensors different from the intended refrigerant detection sensor 23 are connected to the indoor control board P in some cases. In this case, predetermined communication failure is caused. Thus, the step S102 is "No," and determination as abnormal is made at the step S104.

[0077] Next, at a step S105, the control section 30 reports the abnormality. That is, the control section 30 flashes the LED 25 (see Fig. 2) to report the abnormality in, e.g., connection of the refrigerant detection sensor 23. As described above, in a case where the refrigerant detection sensor 23 is not electrically connected to the indoor control board P (S102: No) in a state in which the setting of the DIP switch 24 has been switched to the setting that the refrigerant detection sensor 23 is installed (S101: Yes), the control section 30 reports the abnormality by the LED 25 (S105). Thus, the worker can recognize that the refrigerant detection sensor 23 is not correctly connected. Consequently, failure to attach the refrigerant detection sensor 23 and erroneous connection of the refrigerant detection sensor 23 can be reduced. In the case of reporting such an abnormality, the worker turns off power once, and supplies power again after re-connection of the refrigerant detection sensor 23.

[0078] At the step S101, in a case where the setting of the DIP switch 24 is not switched to the setting that the refrigerant detection sensor 23 is installed (S101: No), the processing of the control section 30 proceeds to a step S106. In other words, in a case where a signal indicating the "sensor absent setting" is input from the DIP switch 24 to the control section 30, the step S101 is "No," and the processing of the control section 30 proceeds to the step S106. For example, in a case where the refrigerant sealed in the refrigerant circuit Q (see Fig. 1) is inflammable and a case where the refrigerant amount is relatively small, it is not necessary to install the refrigerant detection sensor 23 as the optional component in many cases.

[0079] At the step S106, the control section 30 determines whether or not the refrigerant detection sensor 23 is electrically connected to the indoor control board P. In a case where the refrigerant detection sensor 23 is electrically connected to the indoor control board P (S106: Yes), the processing of the control section 30 proceeds to a step S107.

[0080] At the step S107, the control section 30 determines, e.g., connection of the refrigerant detection sensor 23 as abnormal. This is because the state of the DIP switch 24 switched to the "sensor absent setting" and the state of the refrigerant detection sensor 23 actually connected to the indoor control board P do not match each other.

[0081] For example, in some cases, the worker correctly connects the refrigerant detection sensor 23, but supplies power with the worker failing to switch the setting of the DIP switch 24 to the "sensor present setting." In this case, determination as abnormal is made at the step S107. In the case of reporting such an abnormality, the worker turns off power once, and supplies power again after the setting of the DIP switch 24 has been switched to the "sensor present setting."

[0082] Next, at a step S108, the control section 30 reports the abnormality. That is, the control section 30 flashes the LED 25 to report the abnormality in, e.g., connection of the refrigerant detection sensor 23. As described above, in a case where the refrigerant detection sensor 23 is electrically connected to the indoor control board P (S106: Yes) in a state in which the setting of the DIP switch 24 has been switched to the setting that the refrigerant detection sensor 23 is not installed (S101: No), the control section 30 reports the abnormality by the LED 25 (S108). Thus, the worker can recognize that the state of the DIP switch 24 and connection of the refrigerant detection sensor 23 do not match each other.

[0083] At the step S106, in a case where the refrigerant detection sensor 23 is not electrically connected to the indoor control board P (S106: No), the processing of the control section 30 proceeds to a step S109.

[0084] At the step S109, the control section 30 determines, e.g., connection of the refrigerant detection sensor 23 as normal. This is because the refrigerant detection sensor 23 is not actually connected to the indoor control board P in a case where it is not necessary to install the refrigerant detection sensor 23. As described above, in a case where the refrigerant detection sensor 23 is not electrically connected to the indoor control board P (S106: No) in a state in which the setting of the DIP switch 24 has been switched to the setting that the refrigerant detection sensor 23 is not installed (S101: No), the control section 30 does not report the abnormality regarding, e.g., connection of the refrigerant detection sensor 23.

[0085] After the processing of the step S103, S105, S108, or S109, the control section 30 ends a series of processing regarding, e.g., connection of the refrigerant detection sensor 23 (END).

<Advantageous Effects>

[0086] According to the present embodiment, the worker switches the DIP switch 24 according to whether or not the refrigerant detection sensor 23 is installed. Moreover, the control section 30 performs the determi-

nation processing (S101 of Fig. 6) regarding the state of the DIP switch 24 and the determination processing (S102, S106) regarding connection of the refrigerant detection sensor 23. Thus, even in a case where the refrigerant detection sensor 23 is the optional component, the abnormality regarding, e.g., installation of the refrigerant detection sensor 23 can be properly reported to the worker. Consequently, failure to attach the refrigerant detection sensor 23 and erroneous connection of the refrigerant detection sensor 23 can be reduced.

[0087] Moreover, upon power supply, the presence or absence of the abnormality regarding, e.g., connection of the refrigerant detection sensor 23 is determined by the control section 30. Thus, right after power supply after installation of the refrigerant detection sensor 23, the presence or absence of the abnormality regarding, e.g., connection of the refrigerant detection sensor 23 can be properly reported to the worker.

[0088] Further, the connector N (see Fig. 5) to be connected to the refrigerant detection sensor 23 is mounted on the indoor control board P, and the DIP switch 24 (see Fig. 5) is also mounted on the indoor control board P. Thus, e.g., user's erroneous switching of the DIP switch 24 can be reduced.

<<Reference Example>>

[0089] Differences of a reference example from the above-described embodiment are that the DIP switch 24 is omitted from the configuration of the above-described embodiment (see Fig. 2) and determination on whether or not the refrigerant detection sensor 23 needs to be connected to the indoor control board P is made by the control section 30 based on the amount and type of refrigerant in the refrigerant circuit Q. Note that other points of the reference example are similar to those of the embodiment. Thus, the differences of the reference example from the embodiment will be hereinafter described, and description of overlapping contents will be omitted.

[0090] Fig. 7 is a flowchart of processing executed by a control section 30 of an air-conditioner 100 according to the reference example.

[0091] Note that a series of processing illustrated in Fig. 7 is, for example, performed right after power supply after installation of the air-conditioner 100.

[0092] At a step S201, the control section 30 determines whether or not the amount of refrigerant sealed in a refrigerant circuit Q is equal to or greater than a predetermined amount. The above-described "predetermined amount" is a threshold as a criterion for determining whether or not a refrigerant detection sensor 23 needs to be connected, and is set in advance.

[0093] Moreover, the amount of refrigerant sealed in the refrigerant circuit Q is, for example, determined by the control section 30 based on information regarding the models of an outdoor unit U_o (see Fig. 2) and an indoor unit U_i (see Fig. 2) and the number of indoor units U_i to be connected. Note that the information regarding

the model of the indoor unit Ui is stored in advance in a storage section 31a of an indoor control circuit 31 (see Fig. 2). Moreover, the information regarding the model of the outdoor unit Uo is stored in advance in a storage section 32a of an outdoor control circuit 32 (see Fig. 2). Further, the number of indoor units Ui to be connected is identified based on exchange between the indoor control circuit 31 and the outdoor control circuit 32 via a communication line.

[0094] At the step S201 of Fig. 7, in a case where the amount of refrigerant sealed in the refrigerant circuit Q is equal to or greater than the predetermined amount (S201: Yes), the processing of the control section 30 proceeds to a step S203. Note that the step S203 will be described later.

[0095] On the other hand, at the step S201, in a case where the amount of refrigerant sealed in the refrigerant circuit Q is less than the predetermined amount (S201: No), the processing of the control section 30 proceeds to a step S202.

[0096] At the step S202, the control section 30 determines whether or not the refrigerant sealed in the refrigerant circuit Q is flammable. Note that the "flammable" refrigerant includes so-called "slightly-flammable" refrigerant. Moreover, by worker's operation via predetermined input means (e.g., the remote controller 40 of Fig. 2 and the not-shown switch), a signal indicating the type of refrigerant sealed in the refrigerant circuit Q is input to the control section 30. Further, information indicating which type of refrigerant falls into the category of the flammable refrigerant is stored in advance in the storage sections 31a, 32a (see Fig. 2). Thus, based on input of the signal indicating the type of refrigerant, the control section 30 can determine whether or not such refrigerant is flammable.

[0097] At the step S202, in a case where the refrigerant sealed in the refrigerant circuit Q is flammable (S202: Yes), the processing of the control section 30 proceeds to the step S203. In this case, the refrigerant detection sensor 23 is preferably installed so that refrigerant leakage can be sensed.

[0098] At the step S203, the control section 30 determines whether or not the refrigerant detection sensor 23 is electrically connected to an indoor control board P (see Fig. 5). In a case where the refrigerant detection sensor 23 is electrically connected to the indoor control board P (S203: Yes), the processing of the control section 30 proceeds to a step S204.

[0099] At the step S204, the control section 30 determines, e.g., connection of the refrigerant detection sensor 23 as normal. This is because the refrigerant detection sensor 23 which needs to be installed in the indoor unit Ui is correctly connected to the indoor control board P.

[0100] On the other hand, at the step S203, in a case where the refrigerant detection sensor 23 is not electrically connected to the indoor control board P (S203: No), the processing of the control section 30 proceeds to a

step S205.

[0101] At the step S205, the control section 30 determines, e.g., connection of the refrigerant detection sensor 23 as abnormal. This is because the refrigerant detection sensor 23 which needs to be installed in the indoor unit Ui is not correctly connected to the indoor control board P.

[0102] Next, at a step S206, the control section 30 flashes an LED 25 (see Fig. 2) to report the abnormality in, e.g., connection of the refrigerant detection sensor 23. As described above, in a case where the amount of refrigerant sealed in the refrigerant circuit Q is equal to or greater than the predetermined amount (S201: Yes) or a case where the refrigerant sealed in the refrigerant circuit Q is flammable (S202: Yes), when the refrigerant detection sensor 23 is not electrically connected to the control section 30 itself, the control section 30 reports such an abnormality by the LED 25. Thus, a worker can recognize that the refrigerant detection sensor 23 is not correctly connected. Consequently, failure to attach the refrigerant detection sensor 23 and erroneous connection of the refrigerant detection sensor 23 can be reduced.

[0103] At the step S202, in a case where the refrigerant sealed in the refrigerant circuit Q is inflammable (S202: No), the processing of the control section 30 proceeds to a step S207.

[0104] At the step S207, the control section 30 determines, e.g., connection of the refrigerant detection sensor 23 as normal. This is because the refrigerant detection sensor 23 which does not need to be installed in the indoor unit Ui is not actually connected to the indoor unit Ui.

[0105] After the processing of the step S204, S206, or S207, the control section 30 ends a series of processing regarding connection of the refrigerant detection sensor 23 (END).

<Advantageous Effects>

[0106] According to the reference example, the control section 30 performs the determination processing (S201, S202 of Fig. 6) regarding the amount and type (flammable/inflammable) of refrigerant and the determination processing (S203) regarding connection of the refrigerant detection sensor 23. Thus, even in a case where the refrigerant detection sensor 23 is an optional component, the abnormality regarding, e.g., installation of the refrigerant detection sensor 23 can be properly reported to the worker. Consequently, failure to attach the refrigerant detection sensor 23 and erroneous connection of the refrigerant detection sensor 23 can be reduced.

[0107] Moreover, according to the reference example, it is not necessary to provide, in the indoor unit Ui, a DIP switch 24 (see Fig. 5) indicating the presence or absence of installation of the refrigerant detection sensor 23. Thus, a cost for manufacturing the indoor unit Ui can be reduced as compared to the embodiment.

[0108] Further, it is not necessary for the worker to op-

erate the DIP switch 24 (see Fig. 5) as in the embodiment. Thus, a burden on the worker can be further reduced as compared to the embodiment.

<<Variations>>

[0109] The air-conditioner 100 and the like according to one aspect of the present invention have been described above in the embodiment and the like. However, the present invention is not limited to such description. The above-described embodiment and the like can be changed variously.

[0110] For example, the embodiment and the like have described the configuration in which the DIP switch 24 (see Fig. 5) is mounted on the indoor control board P. However, a mounting location of the DIP switch 24 is not limited to such a location. That is, the DIP switch 24 may be provided at other predetermined spots in the indoor unit Ui.

[0111] Moreover, the control section 30 is preferably configured to inhibit the air-conditioning operation while the abnormality regarding, e.g., connection of the refrigerant detection sensor 23 is continuing in a case where such an abnormal state is reported by the LED 25 (the reporting means). With this configuration, even in a case where the worker does not recognize the abnormality only by flashing of the LED 25, the air-conditioning operation is further inhibited, and therefore, the worker easily recognizes the above-described abnormality.

[0112] Further, the control section 30 maybe configured to determine the presence or absence of the abnormality regarding, e.g., connection of the refrigerant detection sensor 23 only once right after power supply and not to perform such determination again until subsequent power-off. In addition, the control section 30 may be configured to inhibit the air-conditioning operation while the state of the abnormality regarding, e.g., connection of the refrigerant detection sensor 23 is continuing. With this configuration, the start of the air-conditioning operation in a state in which the refrigerant detection sensor 23 is not correctly connected can be reduced. Moreover, even in a case where the user erroneously switches the DIP switch 24 during the air-conditioning operation, the probability of interrupting the air-conditioning operation is low, and therefore, a user's feeling of discomfort can be reduced.

[0113] Further, in the processing described in the embodiment and the like, in a case where the control section 30 receives, from the refrigerant detection sensor 23, a response to the predetermined signal transmitted to the refrigerant detection sensor 23, the control section 30 determines that the refrigerant detection sensor 23 is connected to the indoor control board P. However, the method for determining that the refrigerant detection sensor 23 is connected to the indoor control board P is not limited to such a method. For example, it may be configured such that in a case where the control section 30 receives, from the refrigerant detection sensor 23, infor-

mation indicating that current has flowed in the refrigerant detection sensor 23, the control section 30 determines that the refrigerant detection sensor 23 is electrically connected to the indoor control board P. In such processing, advantageous effects similar to those of the embodiment and the like are provided.

[0114] In addition, the embodiment has described the case where the "switching section" configured to switch the setting by manual operation according to whether or not the refrigerant detection sensor 23 configured to sense refrigerant leakage is installed is the DIP switch 24 (see Fig. 2). However, the switching section is not limited to the DIP switch 24. For example, the remote controller 40 (see Fig. 2) may be used as the above-described "switching section" instead of the DIP switch 24. Moreover, in the case of installing the refrigerant detection sensor 23, the predetermined signal may be, by worker's operation, transmitted from the remote controller 40 to the indoor unit Ui. On the other hand, in the case of not installing the refrigerant detection sensor 23, another signal may be transmitted from the remote controller 40 to the indoor unit Ui.

[0115] Further, in the embodiment, report of the abnormality at the step S105 of Fig. 6 and report of the abnormality at the step S108 are not specifically distinguished from each other. The LED 25 may be flashed (or turned on) in a predetermined pattern to distinguish these types of report. With this configuration, the worker easily grasps the contents of the abnormality in a case where the abnormality regarding, e.g., connection of the refrigerant detection sensor 23 has been caused.

[0116] In addition, in the configurations described in the embodiment and the like, the LED 25 (see Fig. 2) is provided on an upper surface of the indoor unit Ui. However, an installation spot of the LED 25 is not limited to such a spot. For example, the LED 25 may be mounted on the indoor control board P (see Fig. 5), or may be provided at other predetermined spots. Moreover, the abnormality regarding, e.g., connection of the refrigerant detection sensor 23 may be, instead of the LED 25 (or in addition to the LED 25), reported by voice from the indoor unit Ui and/or an indication on the remote controller 40.

[0117] Further, the embodiment and the like have described the case where the worker switches the DIP switch 24 as necessary before power supply. Instead, the worker may switch the DIP switch 24 after power supply.

[0118] In addition, the embodiment and the like have described the case where the control section 30 makes determination regarding the abnormality in, e.g., connection of the refrigerant detection sensor 23. However, the sensor targeted for abnormality determination is not limited to the refrigerant detection sensor 23. That is, the embodiment and the like are applicable to various types of sensors other than the refrigerant detection sensor 23.

[0119] Moreover, the embodiment and the like have described the air-conditioner 100 including the floor in-

door unit Ui for domestic use. The embodiment and the like are applicable to various types of air-conditioners such as a wall-mounted room air-conditioner, a package air-conditioner, a building multi-air-conditioner, and an integrated air-conditioner. Further, the embodiment and the like are also applicable to various electrical products in addition to the air-conditioner 100.

[0120] In addition, the embodiment and the like have been described in detail for the sake of easy description of the present invention. The present invention is not limited to one including all configurations described in the embodiment and the like. Moreover, some of the configurations of the embodiment and the like can be omitted or replaced with other configurations. In addition, other configurations can be added to the configurations of the embodiment and the like.

[0121] Moreover, the above-described embodiment and the like have described the mechanisms and the configurations considered necessary for description. All mechanisms and configurations for a product are not necessarily described.

[0122] The foregoing detailed description has been presented for the purposes of illustration and description. Many modifications and variations are possible in light of the above teaching. It is not intended to be exhaustive or to limit the subject matter described herein to the precise form disclosed. Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims appended hereto.

Claims

1. An air-conditioner (100) comprising:

a switching section (24) configured to switch a setting by manual operation; and
a control section (30) configured to report an abnormality by a reporting means (25) in a case where a refrigerant detection sensor (23) is not electrically connected to the control section in a state in which the setting of the switching section has been switched to a setting that the refrigerant detection sensor is installed.

2. An air-conditioner (100) comprising:

a switching section (24) configured to switch a setting by manual operation; and
a control section (30) configured to report an abnormality by a reporting means (25) in a case where a refrigerant detection sensor (23) is electrically connected to the control section in a state

in which the setting of the switching section has been switched to a setting that the refrigerant detection sensor is not installed.

3. The air-conditioner according to claim 1 or 2, wherein in the case where the refrigerant detection sensor is electrically connected to the control section in the state in which the switching section has been switched to the setting that the refrigerant detection sensor is installed, the control section does not report the abnormality.

4. The air-conditioner according to claim 1 or 2, wherein in the case where the refrigerant detection sensor is not electrically connected to the control section in the state in which the switching section has been switched to the setting that the refrigerant detection sensor is not installed, the control section does not report the abnormality.

5. The air-conditioner according to claim 1 or 2, wherein in a case where the abnormality has been reported by the reporting means, the control section inhibits air-conditioning operation while a state of the abnormality is continuing.

6. The air-conditioner according to claim 1 or 2, wherein the control section determines a presence or absence of the abnormality upon power supply.

7. The air-conditioner according to claim 1 or 2, wherein the switching section is a DIP switch.

8. The air-conditioner according to claim 7, further comprising:

an electrical component box (B) configured to house a control board (P),
wherein not only a circuit component of the control section but also the DIP switch are mounted on the control board.

9. The air-conditioner according to claim 1 or 2, wherein in a case where the control section receives, from the refrigerant detection sensor, information indicating that current has flowed in the refrigerant detection sensor, the control section determines that the refrigerant detection sensor is electrically connected to the control section.

FIG. 1

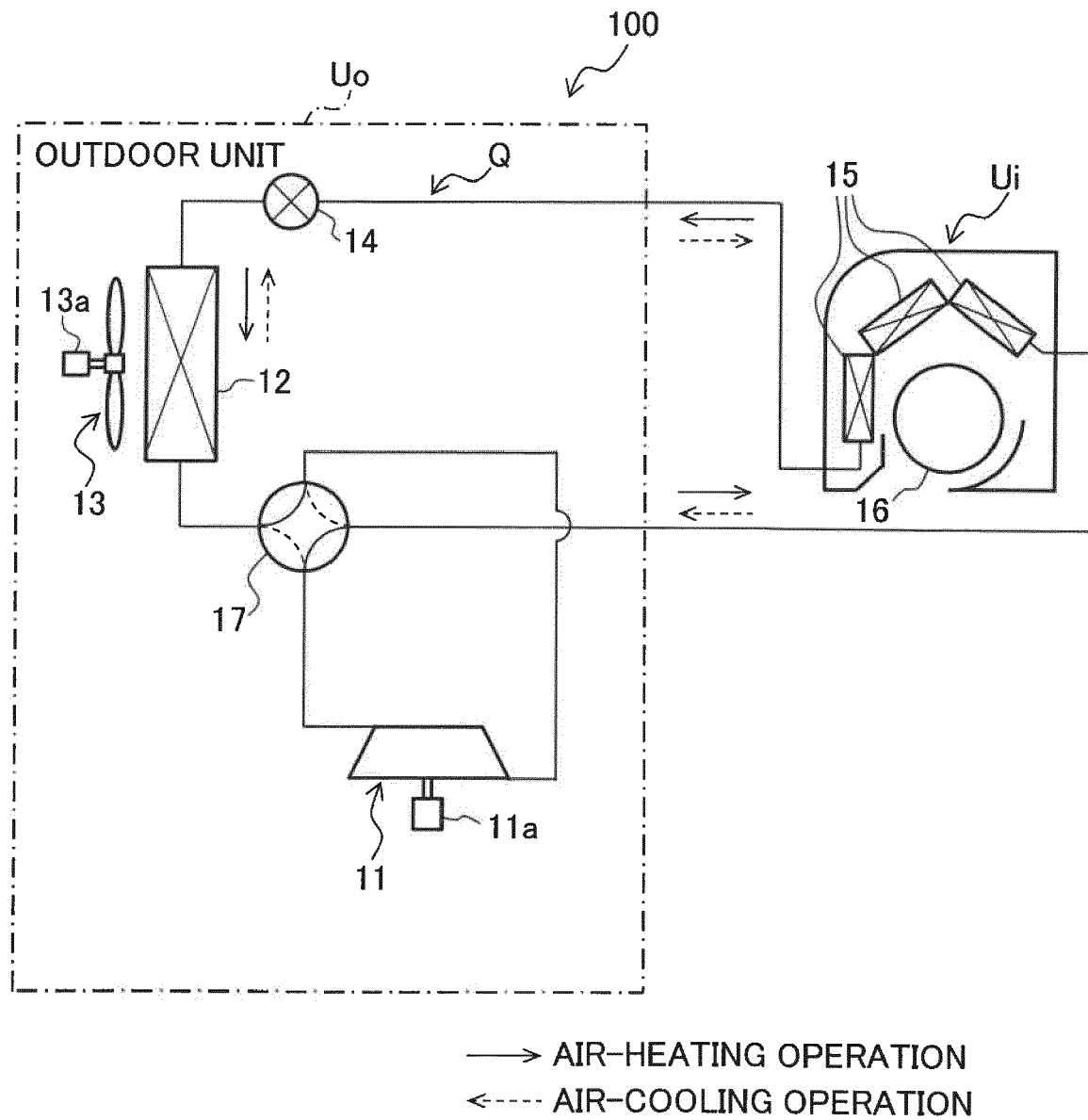


FIG. 2

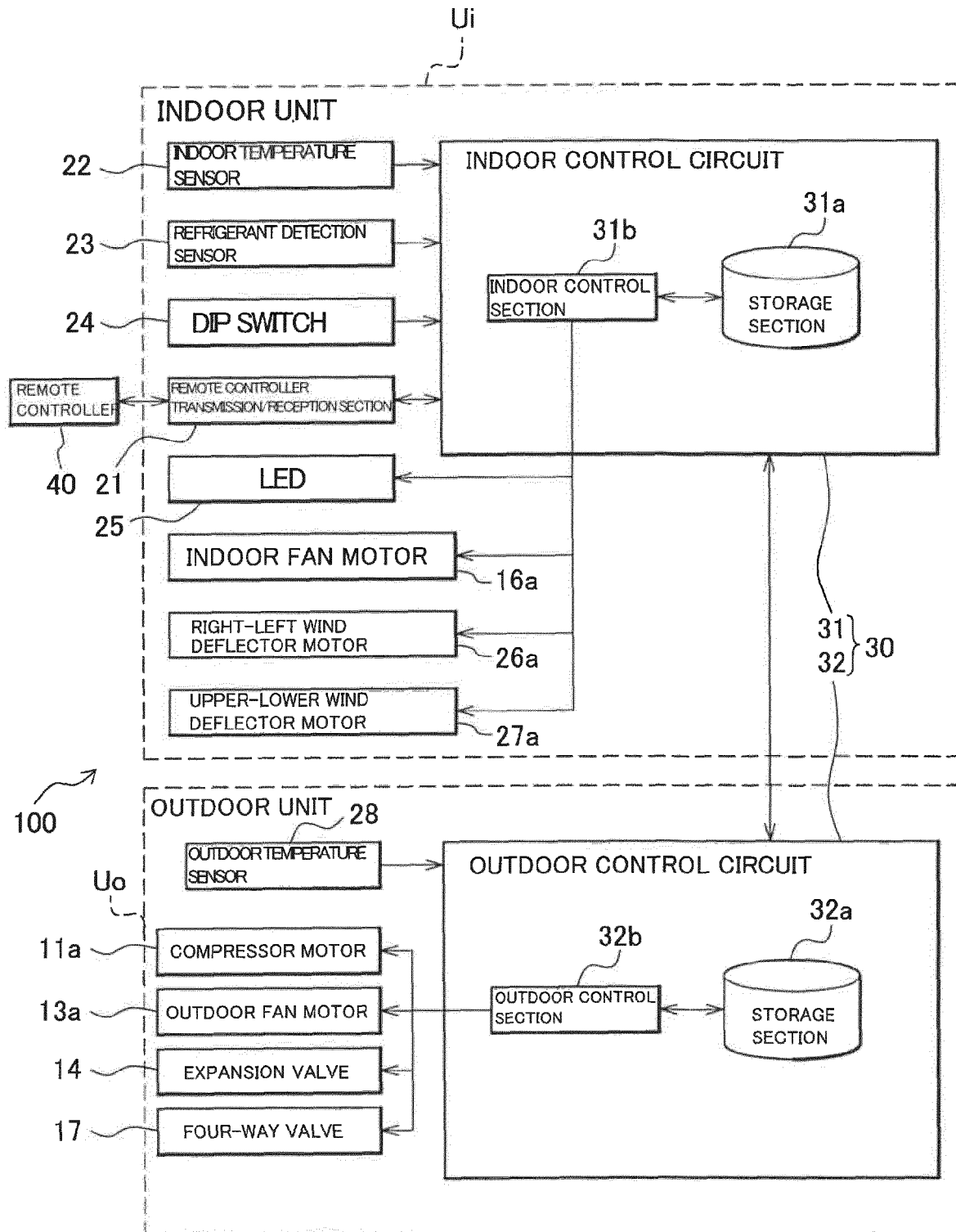


FIG. 3

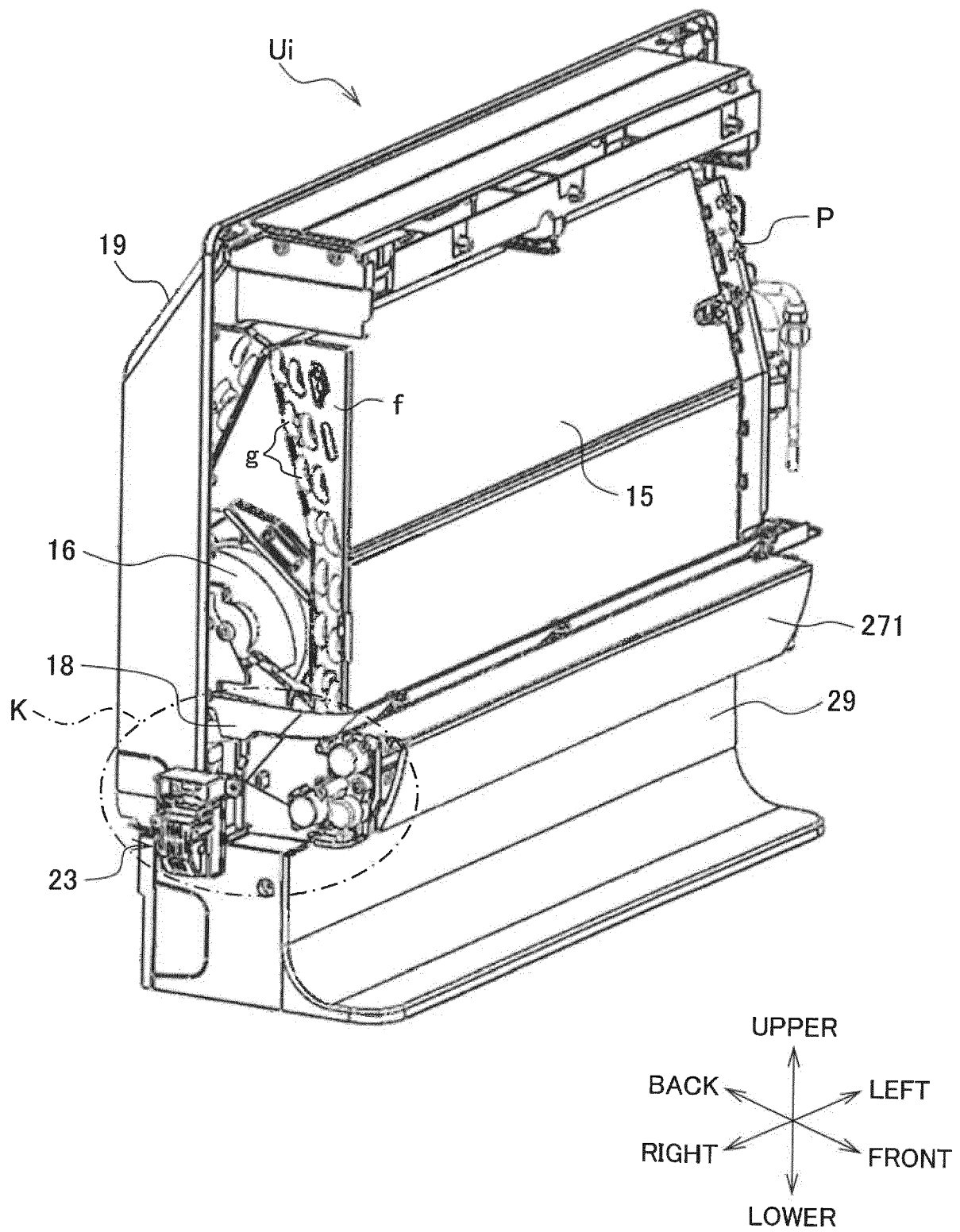


FIG. 4

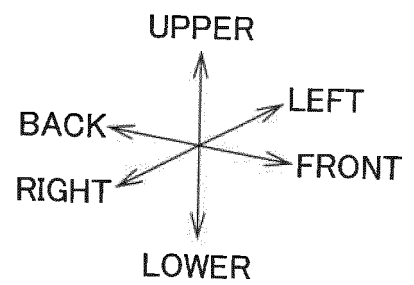
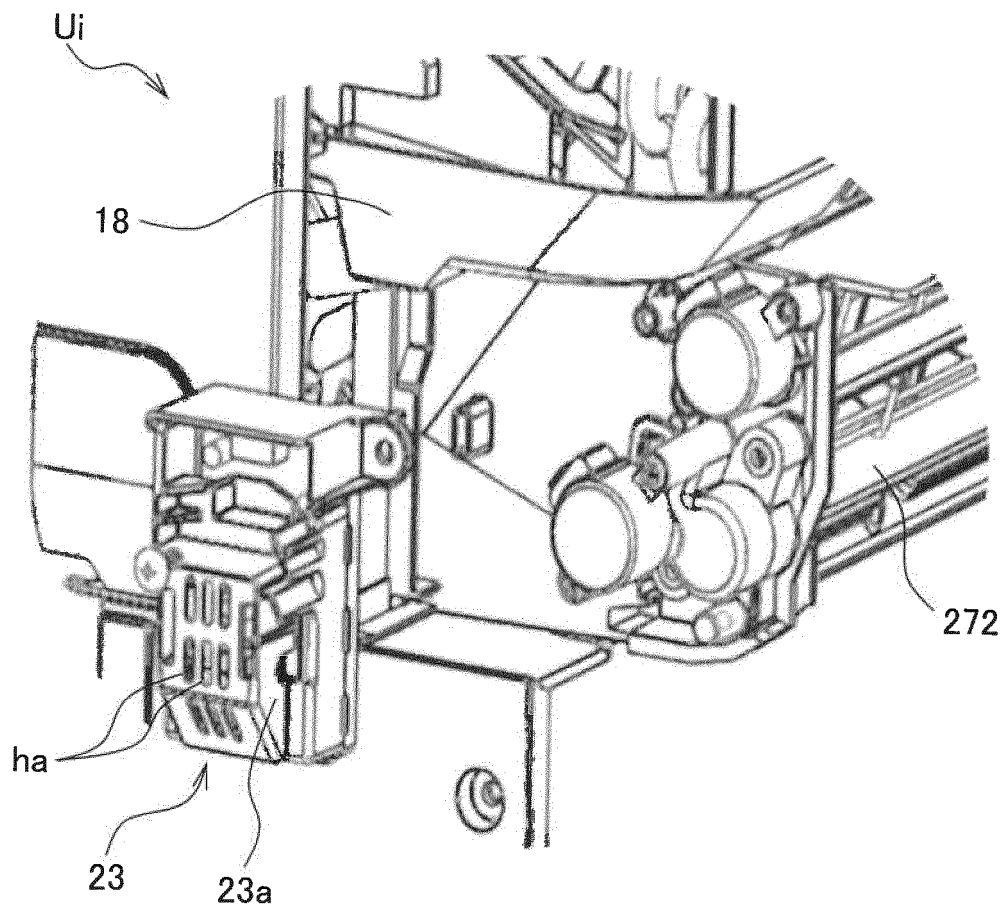


FIG. 5

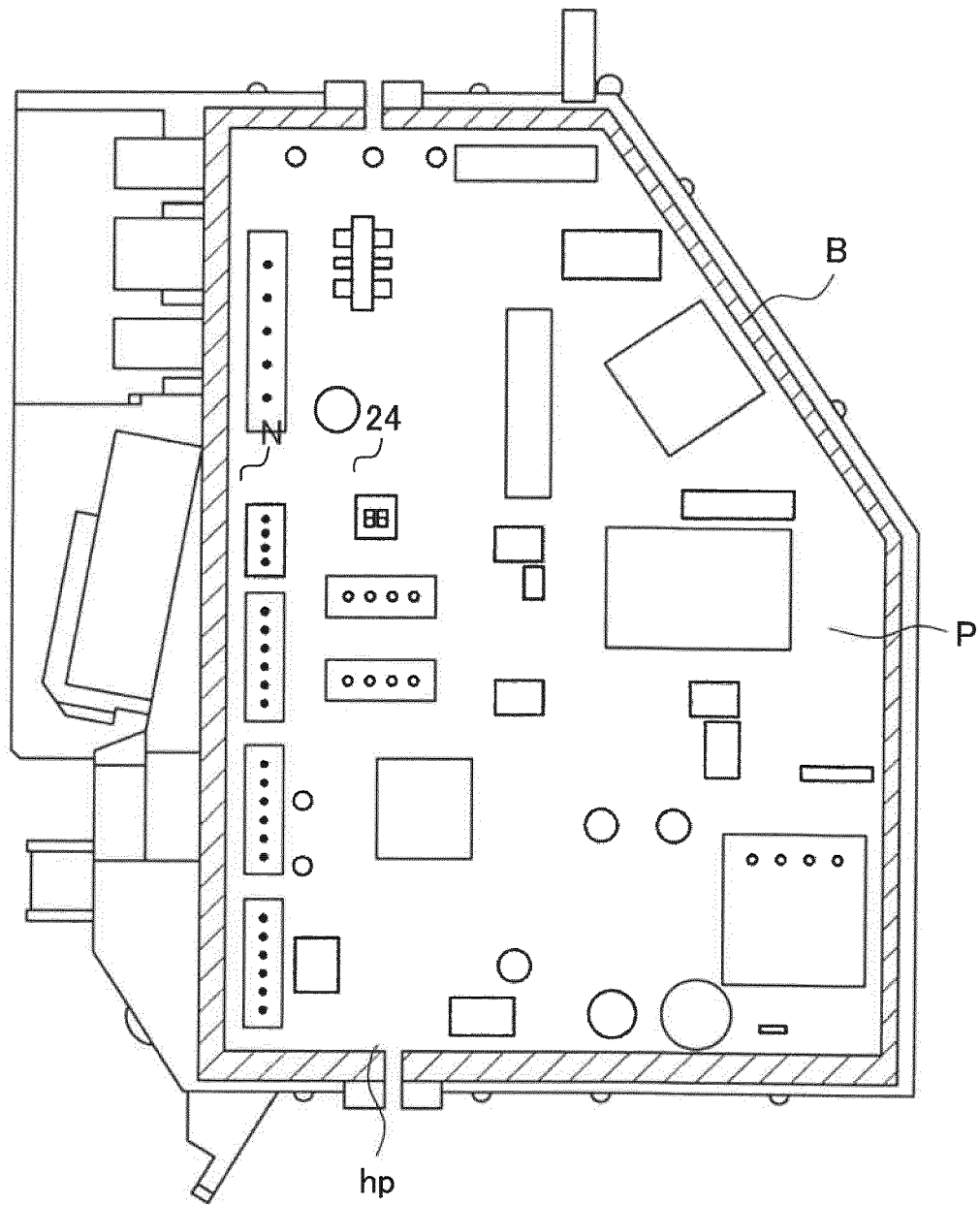


FIG. 6

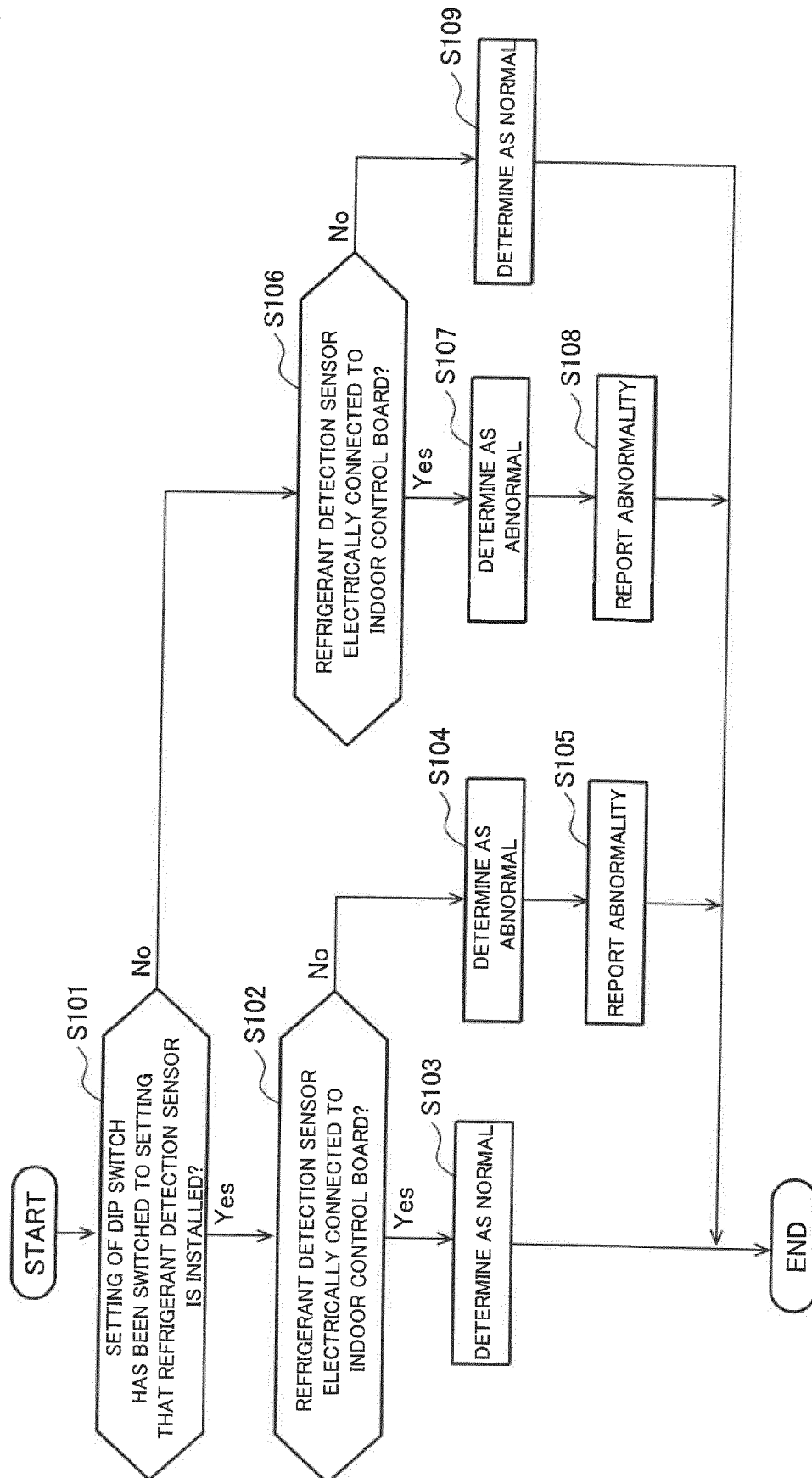
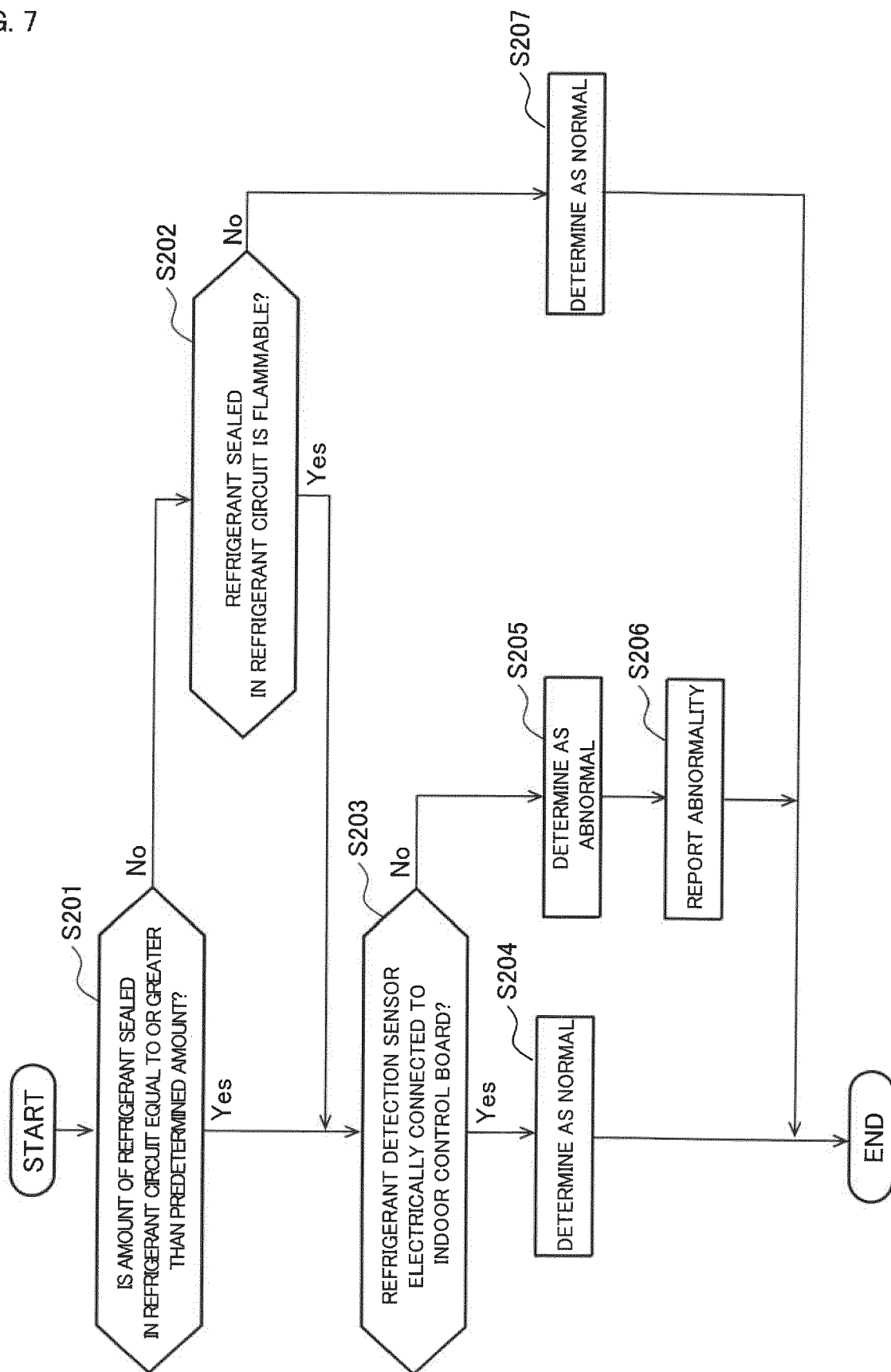


FIG. 7



REFERENCES CITED IN THE DESCRIPTION

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