

[Document Name] Specification

[Title of the Invention] Electric circuit board and refrigeration apparatus equipped with the electric circuit board

[Technical Field]

5 To provide an electric circuit board connected to a control board of a refrigerating apparatus via a communication line, and a refrigerating apparatus equipped with the electric circuit board.

[Background of the Invention]

10 Conventionally, in a multi-air conditioner type, the indoor unit with cut off power supply controls the opening degree of the electric expansion valve to a predetermined opening degree by the electric power supplied from the outdoor unit via the transmission line. For example, in the multi-air conditioner type disclosed in Patent Document 1 (Japanese Unexamined Patent Publication No. 2013-40698), the communication line
15 connected to the outdoor unit is used as an emergency power supply line only for a certain period of time, and the opening degree of the electric expansion valve of the indoor unit with cut off power supply is controlled to a predetermined opening degree.

[Summary of the Invention]

20 **[Problems to be Solved by the Invention]**

Therefore, during the time when the power supply cut off of the indoor unit occurs until the inoperable voltage of the controller on the indoor unit side, it is necessary to provide a signal indicating that the power cut off has occurred to the controller on the outdoor unit side. Upon
25 receiving this, the controller on the outdoor unit side is to transmit the signal to the other indoor units during normal operation to suspend communication only for the above-mentioned predetermined time.

As described above, in the indoor unit disclosed in Patent Document 1, when the power cut off occurs in one of the indoor units, the indoor unit
30 in which the power supply cut off does not occur is also affected. Therefore, the problem is that it is not necessary to suspend the communication with the indoor unit during its normal operation for a certain period of time, even if the power supply is cut off from one of the indoor units. This problem remains to be solved.

35 **[Means for Solving Problems]**

The electric circuit board related to the first aspect is an electric circuit board that is electrically connected to a control board of an indoor unit of a refrigerating apparatus connected to a first power source via a communication line. The electric circuit board is further connected to the
40 second power source. The electric circuit board comprises a relay. The relay switches to the second power supply when power is not supplied from the first power supply to the control board.

With this electric circuit board, electric power can be appropriately supplied to the control board of the indoor unit. "The electric circuit board
45 is further connected to the second power source" also includes that the second power source is equipped with the electric circuit board.

The electric circuit board related to the second aspect is the electric circuit board according to the first aspect. The refrigerating apparatus includes an indoor unit, which an outdoor unit electrically connected to the indoor unit. The electric power of the second power source is the electric power supplied from the outdoor unit.

The electric circuit board related to the third aspect is the electric circuit board according to the first aspect or the second aspect, and further includes a switching circuit. The switching circuit is switched between a first state that is electrically connected to the second power supply and a second state that is not electrically connected. The switching circuit is switched to the first state by the relay when power is not supplied from the first power supply to the control board.

The electric circuit board related to the fourth aspect is the electric circuit board according to the third aspect, and further includes a switch. The switch turns on or off the energization of the relay to switch the switching circuit to the first state, when the power is not supplied from the first power supply to the control board.

In this electric circuit board, the switch energizes and de-energizes the relay according to the presence or absence of power supply from the first power source, so that the configuration can be simplified, and the cost can be reduced.

The electric circuit board related to the fifth aspect is the electric circuit board according to the fourth aspect. The switch is turned on to energize the relay while power is being supplied from the first power source. Further, the switch is turned off to cut off the power supply to the relay while the power is not supplied from the first power source.

In this electric circuit board, the configuration with a simple circuit and a small number of parts can be obtained, in which a switch is turned on to energize a relay when power is supplied from a first power source.

The electric circuit board related to the sixth aspect is an electric circuit board according to any one of the third aspect to the fifth aspect. The relay comprises a relay coil and a relay switch. The relay switch switches the switching circuit to the first state when the energization of the relay coil is on or off.

This electric circuit board does not require a logic circuit and a general-purpose mechanical relay including a coil and a switch can be used, it is possible to control the production cost.

The electric circuit board related to the seventh aspect is an electric circuit board according to any one of the first aspect to the sixth aspect. The electric circuit board is separated from the control board.

In this electric circuit board, the electric circuit board can be retrofitted by separating the electric circuit board from the control board. Therefore, it can be located with an indoor unit wherein the electric circuit board is not equipped.

The refrigerating apparatus related to the eighth aspect is a refrigerating apparatus equipped with an electric circuit board according

to any one of the first aspect to the seventh aspect.

a refrigerating apparatus equipped with an electric circuit board relates to the eighth aspect. The refrigeration system includes an outdoor unit and a plurality of indoor units connected to the outdoor unit. When the power from the first power supply is not supplied to the control board of any one of the plurality of indoor units, the power supply is switched from the second power supply by the relay.

[Brief Description of the Drawings]

FIG. 1 is a configuration diagram of an air conditioner which is a refrigerating apparatus equipped with an electric circuit board according to an embodiment of the present disclosure.

FIG. 2 is a diagram of an electric circuit of an air conditioner.

FIG. 3 is a circuit diagram of a polarity correction circuit.

FIG. 4 is a circuit diagram of a switching circuit.

FIG. 5 is a polarity correction circuit diagram showing a transmission path of a positive electrode signal and a negative electrode signal when a positive electrode signal is input to the first input line and a negative electrode signal is input to the second input line.

FIG. 6 is a polarity correction circuit diagram showing transmission paths of a positive electrode signal and a negative electrode signal when a positive electrode signal is input to the second input line and a negative electrode signal is input to the first input line.

FIG. 7 is an explanatory diagram showing a state of a switching circuit when the power supply from the first power supply is not cut off.

FIG. 8 is an explanatory diagram showing a state of a switching circuit when the power supply from the first power supply is cut off.

[Modes for Carrying Out the Invention]

(1) Outline of air conditioner 100

FIG. 1 is a configuration diagram of an air conditioner 100, which is a refrigerating apparatus equipped with an electric circuit board according to an embodiment of the present disclosure. Further, FIG. 2 is a diagram of an electric circuit of the air conditioner 100.

First, in FIG. 1, the air conditioner 100 consists of an indoor unit 1 which is a user side unit and an outdoor unit 2 which is a heat source side unit.

The indoor unit 1 is installed in each room of the tenant, for example, and each indoor unit 1 is connected to the outdoor unit 2 by a refrigerant connecting pipe.

The air conditioner 100, includes a compressor 15, a four-way switching valve 16, an outdoor heat exchanger 17, an outdoor expansion valve 18 as a decompression mechanism, the refrigerant circuit 10 having an indoor expansion valve 20, and an indoor heat exchanger 13 are annularly connected in a ring shape by a refrigerant pipe.

(1-1) Indoor unit 1

The indoor expansion valve 20 and the indoor heat exchanger 13 of the refrigerant circuits 10 are components of the indoor unit 1. In

addition, the indoor unit 1 is equipped with an indoor fan 14. The indoor fan 14 creates a flow of air to the indoor heat exchanger 13.

In FIG. 2, the indoor unit 1 includes an indoor control power supply 25, an indoor communication circuit 35, a polarity correction circuit 37, an indoor microcomputer 45, a switching circuit 75, and a second power supply 102. Both the indoor control power supply 25 and the indoor communication circuit 35 are connected to the indoor microcomputer 45.

The indoor control power supply 25 receives power from the first power supply 101, which is an AC power supply, via the power supply lines 801, 802, generates a control voltage from the first power supply 101, and supplies the control voltage to the indoor microcomputer 45. The first power supply 101 is a commercial power supply of AC220V.

The indoor communication circuit 35 is used when the indoor unit 1 communicates with the outdoor unit 2.

The polarity correction circuit 37 can switch the positive electrode signal is output to the positive electrode output line and the negative electrode signal is output to the negative electrode output line, even if the positive electrode signal line and the negative electrode signal line that transmit the signal from the outdoor unit 2 are connected with the wrong polarity.

The indoor microcomputer 45 controls the opening degree of the indoor expansion valve 20, the operating frequency of the indoor fan 14.

A circuit breaker 71 is interposed between the indoor control power supply 25 and the first power supply 101. For example, when the indoor unit 1 of the air conditioner 100 is installed in each of the plurality of tenants, when the any tenant decided not to use, the breaker 71 cuts off the power supply from the first power supply 101 to the indoor unit 1.

Furthermore, the indoor unit 1 includes a switching circuit 75 to detect if the power supply from the first power supply 101 is cut off, when the power from the first power supply 101 is cut off, and then switching to power supply from the second power supply 102, in which is a different power source from the first power supply 101.

The indoor unit 1 includes a first control board 81 and a first electric circuit board 91 that is different from the first control board 81.

The indoor control power supply 25, the indoor communication circuit 35, and the indoor microcomputer 45 are equipped with the first control board 81. Furthermore, the polarity correction circuit 37, the switching circuit 75, and the second power supply 102 are equipped with the first electric circuit board 91.

(1-2) Outdoor unit 2

The compressor 15, the four-way switching valve 16, the outdoor heat exchanger 17, and the outdoor expansion valve 18 of the refrigerant circuits 10 are components of the outdoor unit 2. In addition, the outdoor unit 2 is equipped with an outdoor fan 19. The outdoor fan 19 creates a flow of air to the outdoor heat exchanger 17.

Furthermore, the outdoor unit 2 includes an outdoor control power

supply 26, an outdoor communication circuit 36, a polarity correction circuit 38, an outdoor microcomputer 46, and a DC power supply circuit 72 as shown in FIG. 2. Both the outdoor control power supply 26 and the outdoor communication circuit 36 are connected to the outdoor microcomputer 46.

The outdoor control power supply 26 receives electric power from the three-phase AC power supply 111 via the power supply lines 811, 812, and 813, generates a control voltage from the power line, and supplies the control voltage to the outdoor microcomputer 46. The AC power supply 111 is a commercial power supply of AC380V and the line 814 is a ground wire.

The outdoor communication circuit 36 is used when the outdoor unit 2 communicates with the indoor unit 1.

The polarity correction circuit 38 can switch the outputs resulting in the positive electrode signal to the positive electrode output line and the negative electrode signal to the negative electrode output line even if the positive electrode signal line and the negative electrode signal line that transmit the signal from the outdoor communication circuit 36 are connected with the wrong polarity.

The outdoor microcomputer 46 controls the operating frequency of the compressor 15, the switching operation of the four-way switching valve 16, the opening degree of the outdoor expansion valve 18, the operating frequency of the outdoor fan 19.

The outdoor unit 2 includes a second control board 82 and a second electric circuit board 92, that is different from the second control board 82.

The outdoor control power supply 26, the outdoor communication circuit 36, and the outdoor microcomputer 46 are equipped with the second control board 82. In addition, the polarity correction circuit 38 and the DC power supply circuit 72 are equipped with the second electric circuit board 92.

(2) First electric circuit board 91

The polarity correction circuit 37 and the switching circuit 75 are equipped with the first electric circuit board 91.

In the present embodiment, the first electric circuit board 91 of the indoor unit 1 is a board separate from the first control board 81, but it can optionally be integrated into one board.

(2-1) Polarity correction circuit 37

FIG. 3 is a circuit diagram of the polarity correction circuit 37. The first terminal N1a of the first connector CN1 is connected to the first input line 11. In addition, the second terminal N1b of the first connector CN1 is connected to the second input line 12. The communication line of the positive electrode signal F1 is connected to the first terminal N1a, and the communication line of the negative electrode signal F2 is connected to the second terminal N2b.

The polarity correction circuit 37 comprises a switching relay 30, a first circuit 41, a second circuit 42, a first voltage divider circuit 51, a

second voltage divider circuit 52, a relay driver circuit 53, and a comparator 55.

The function of the polarity correction circuit 37 is to use a switching relay 30 to connect the first input line 11 and the first output line 21 when the first input line 11 is a positive electrode, and to connect the second input line 12 and the second output line. 22 is connected, and when the first input line 11 is a negative electrode, the first input line 11 and the second output line 22 are connected, and the second input line 12 and the first output line 21 are connected.

The purpose of installing the polarity correction circuit 37 is to ensure that the communication is performed correctly when connecting the indoor unit 1 and the outdoor unit 2 with a communication line, even in case of the service provider may make a mistake in wiring the communication line, and resulting in a wiring error in the communication line but the communication is still performed correctly.

(2-1-1) Switching relay 30

The switching relay 30 comprises a relay coil 31 and a contact switching mechanism 32. The contact switching mechanism 32 can close the first contact C1a and the second contact C2a and at the same time, simultaneously open the third contact C1b and the fourth contact C2b while the relay coil 31 is energized.

Furthermore, the contact switching mechanism 32 can open the first contact C1a and the second contact C2a and at the same time, simultaneously close the third contact C1b and the fourth contact C2b, while the relay coil 31 is not energized.

(2-1-2) First circuit 41

The first circuit 41 connects the first input line 11 with the first output line 21, and connects the second input line 12 with the second output line 22.

The first circuit 41 is provided with the first contact C1a of the switching relay 30 in the middle of the wiring connecting the first input line 11 and the first output line 21. The first input line 11 and the first output line 21 are connected when the first contact C1a is closed, and the connection between the first input line 11 and the first output line 21 are released when the first contact C1a is open.

Furthermore, the first circuit 41 is provided with a second contact C2a of the switching relay 30 in the middle of the wiring connecting the second input line 12 and the second output line 22. The second input line 12 and the second output line 22 are connected when the second contact C2a is closed, and the connection between the second input line 12 and the second output line 22 is released when the second contact C2a is open.

(2-1-3) Second circuit 42

The second circuit 42 connects the first input line 11 with the second output line 22, and connects the second input line 12 with the first output line 21.

The second circuit 42 is provided with a third contact C1b of the

switching relay 30 in the middle of the wiring connecting the first input line 11 with the second output line 22. The first input line 11 and the second output line 22 are connected when the third contact C1b is closed, and the connection between the first input line 11 and the second output line 22 are released when the third contact C1b is open.

Furthermore, the second circuit 42 is provided with a fourth contact C2b of the switching relay 30 in the middle of the wiring connecting the second input line 12 with the first output line 21. The second input line 12 and the first output line 21 are connected when the fourth contact C2b is closed, and the connection between the second input line 12 and the first output line 21 are released when the fourth contact C2b is open.

(2-1-4) First voltage divider circuit 51

The first voltage divider circuit 51 is provided with the first diode D11, the first resistor R11, and the second resistor R12, in which are connected in series from the connection point S11 facing the first input line 11 to the connection point S12 with the second input line 12.

Since the anode of the first diode D11 is connected to the connection point S11 and the cathode is connected to one end of the first resistor R11, therefore, the direction from the connection point S11 to the connection point S12 is the forward direction of the first diode D11.

Accordingly, when the first input line 11 is the positive electrode and the second input line 12 is the negative electrode, as a result the voltage is dropped in accordance with the resistance value ratio of the first resistor R11 and the second resistor R12 in which is located at both ends of the first resistor R11 and the second resistor R12 facing from the connection point S11 toward the connection point S12.

The connection point Q12 between the first resistor R11 and the second resistor R12 are connected to the inverting input terminal of the comparator 55, which will be described later.

(2-1-5) Second voltage divider circuit 52

The second voltage divider circuit 52 provided with the second diode D21, the third resistor R21, and the fourth resistor R22, in which are connected in series from the connection point S21 facing the second input line 12 toward the connection point S22 with the first input line 11.

Since the anode of the second diode D21 is connected to the connection point S21 and the cathode is connected to one end of the third resistor R21, therefore, the direction from the connection point S21 to the connection point S22 is the forward direction of the second diode D21.

Accordingly, when the second input line 12 is the positive electrode and the first input line 11 is the negative electrode, the third resistor R21 is located at both ends of the third resistor R21 and the fourth resistor R22 from the connection point S21 toward the connection point S22. And a voltage drop corresponding to the resistance value ratio of the fourth resistor R22 occurs.

The connection point Q22 between the third resistor R21 and the fourth resistor R22 is connected to the non-inverting input terminal of the

comparator 55 described later.

(2-1-6) Relay driver circuit 53

The relay driver circuit 53 includes a transistor Tra while a predetermined positive voltage is applied to the base of the transistor Tra, a drive voltage E1 is applied to the relay coil 31, in which the collector and emitter of the transistor Tra are electrically connected to each other.

When the drive voltage E1 is applied to the relay coil 31, the relay coil 31 is energized, so that the first contact C1a and the second contact C2a provided in the first circuit 41 are closed, and at the same time, the third contact C1b and the fourth contact C2b provided in the second circuit 42 are open.

When the drive voltage E1 is not applied to the relay coil 31, the relay coil 31 is not energized, so that the first contact C1a and the second contact C2a provided in the first circuit 41 are opened, and at the same time, the third contact C1b and the fourth contact C2b provided in the second circuit 42 are closed.

(2-1-7) Comparator 55

The comparator 55 compares the voltage input to the inverting input terminal (hereinafter referred to as the first voltage V1) with the voltage input to the non-inverting input terminal (hereinafter referred to as the second voltage V2). The predetermined output voltage $V_{out} = E2$ is output from the output terminal when the second voltage $V2 >$ the first voltage V1. On the other hand, the output voltage $V_{out} = 0V$ is output from the output terminal when the second voltage $V2 <$ the first voltage V1.

Accordingly, when a predetermined output voltage $V_{out} = E2$ is output from the output terminal, the second voltage $V2 >$ the first voltage V1, and while it is applied to the base of the transistor Tra, the collector and the emitter emitter are electrically connected to each other. The drive voltage E1 is applied to the relay coil 31. $E1 = E2$ may be used.

In the present embodiment, the connection point Q12 is between the first resistor R11 and the second resistor R12 wherein is connected to the inverting input terminal of the comparator 55, and the inverting input terminal is connected to the ground GND via the fifth resistor R15. Therefore, the first voltage V1 is the potential difference between the connection point Q12 of the first resistor R11 and the second resistor R12 and the ground GND.

Furthermore, since the connection point Q22 is between the third resistor R21 and the fourth resistor R22 wherein is connected to the non-inverting input terminal of the comparator 55, and the non-inverting input terminal is connected to the ground GND via the sixth resistor R26. Therefore, the second voltage V2 is the potential difference between the connection point Q22 of the third resistor R21 and the fourth resistor R22 and the ground GND.

(2-2) Switching circuit 75

FIG. 4 is a circuit diagram of the switching circuit 75. The switching

circuit 75 in FIG. 4 includes an on / off relay 76, a first switching circuit 77a, a second switching circuit 77b, a third switching circuit 77c, a photocoupler 78, and a relay driver circuit 79. The function of the switching circuit 75 is to detect the presence or absence of power supply from the first power supply 101 using the photocoupler 78, and to use the on / off relay 76 to supply electric power to the first control board 81 from the second power source 102 which is another power source when there is no power supply from the first power supply 101.

(2-2-1) On / off relay 76

In the present embodiment, the switching circuit 75 includes the two on / off relays 76. The number of on / off relays 76 can be set arbitrarily. The on / off relay 76 includes a relay coil 76a and a relay switch 76b.

The relay switch 76b can close the first contact S1a and the second contact S2a, and at the same time open the third contact S1b and the fourth contact S2b while the relay coil 76a is energized.

Furthermore, the relay switch 76b can open the first contact S1a and the second contact S2a, and at the same time close the third contact S1b and the fourth contact S2b while the relay coil 76a is not energized.

(2-2-2) First switching circuit 77a

The first switching circuit 77a establishes conduction between the first DC power supply Ea and the first terminal N3a of the third connector CN3 only when the third contact S1b of the on / off relay 76 is closed, and the power is supplied from the first DC power source Ea that connects to the first control board 81.

(2-2-3) Second switching circuit 77b

The second switching circuit 77b establishes conduction between the second DC power supply Eb and the second terminal N3b of the third connector CN3 only when the fourth contact S2b of the on / off relay 76 is closed, and the power is supplied from the second DC power source Eb that connects to the first control board 81.

(2-2-4) Third switching circuit 77c

The third switching circuit 77c establishes conduction between the third DC power supply Ec and the third terminal N3c of the third connector CN3 only when the third contact S1b of the on / off relay 76 is closed, and the power is supplied from the third DC power source Ec that connects to the first control board 81.

(2-2-5) Photocoupler 78

As shown in FIG. 4, the photocoupler 78 is an insulating switch including a photodiode 78a and a phototransistor 78b. The first terminal N5a of the connector CN5 is connected to the anode of the photodiode 78a of the photocoupler 78. In addition, the second terminal N5b of the connector CN5 is connected to the cathode of the photodiode 78a of the photocoupler 78.

The branch wire of the power supply line 801 is connected to the first terminal N5a, and the branch wire of the power supply line 802 is connected to the second terminal N5b.

A rectifier circuit 73 is connected in parallel to both ends of the photodiode 78a. The rectifier circuit 73 rectifies the AC voltage of the first power supply 101 with the diode Da and the smoothing capacitor Ca, and generates a DC voltage suitable for the photodiode 78a to emit light by the voltage dividing resistors Ra and Rb.

(2-2-6) Relay driver circuit 79

As shown in FIG. 4, the relay driver circuit 79 includes a transistor Trb. In the transistor Trb, the voltage of the drive power supply Ed is applied to the relay coil 76a via the collector and the emitter conduct with each other, while a predetermined positive voltage is applied to the base.

While the voltage of the drive power supply Ed is applied to the relay coil 76a, the relay coil 76a is energized, so that the third contact S1b provided in the first switching circuit 77a and the third switching circuit 77c, with the fourth contact S2b provided in the switching second circuit 77b is opened. Therefore, the power of the first DC power supply Ea, the second DC power supply Eb, and the third DC power supply Ec is not supplied to the first control board 81.

On the other hand, when the voltage of the drive power supply Ed is not applied to the relay coil 76a, the relay coil 76a is not energized, so that the third contact S1b provided in the first switching circuit 77a and the third switching circuit 77c, with the fourth contact S2b provided in the switching circuit 77b is closed. Therefore, the power of the first DC power supply Ea, the second DC power supply Eb, and the third DC power supply Ec is supplied to the first control board 81.

(2-2-7) Second power supply 102

As shown in FIG. 2, the second power supply 102 introduces the DC voltage generated by the DC power supply circuit 72 of the outdoor unit 2 via the communication lines L1 and L2, and introduces the voltage required for each of the first DC power supply Ea, the second DC power supply Eb and the third DC power supply Ec of the first control board 81.

When the power is supplied from the first power supply 101 to the first control board 81, the second power supply 102 and the first control board 81 are cut off by the switching circuit 75 and both are connected to the power is supplied from the first power supply 101 when the power is not supplied by the switching circuit 75.

The advantage is that, after the power supply from the first power supply 101 of the indoor unit 1 is cut off, the opening degree of the indoor expansion valve 20 which is an electric expansion valve is to be adjusted based on the operation mode before the power supply is cut off. For example, in the case of cooling operation, the opening degree of the indoor expansion valve is closed, and in the case of heating operation, it is slightly opened. These controls are properly operated by activating the indoor microcomputer 45.

(3) Second electric circuit board 92

As shown in FIG. 2, the polarity correction circuit 38 and the DC power supply circuit 72 are equipped with the second electric circuit board

92.

In the present embodiment, the second electric circuit board 92 of the outdoor unit 2 is a circuit board separate from the second control board 82, but may be integrated into one board.

5 (3-1) Polarity correction circuit 38

The polarity correction circuit 38 can switch the outputs so the positive electrode signal to the positive electrode output line and the negative electrode signal to the negative electrode output line even if the positive electrode signal line and the negative electrode signal line that
10 transmit the signal from the outdoor communication circuit 36 are connected with the wrong polarity

Since the circuit configuration of the polarity correction circuit 38 is the same as the circuit configuration of the polarity correction circuit 37 shown in FIG. 3, description thereof will be omitted the details here.

15 (3-2) DC power supply circuit 72

The DC power supply circuit 72 is a circuit that generates a DC voltage to be supplied to the second power supply 102 equipped with the first electric circuit board 91 of the indoor unit 1.

The DC power supply circuit 72 introduces an AC voltage from one
20 of the power supply lines 811, 812, 813 of the three-phase AC power supply 111, and generates a DC voltage via the filter circuit 72a, the rectifier circuit 72b, and the smoothing capacitor 72c.

As shown in FIG. 2, the DC voltage generated by the DC power supply circuit 72 is transmitted from the outdoor communication circuit
25 36 in a state of being superimposed on the positive electrode signal F1 and the negative electrode signal F2. The positive electrode signal F1 is transmitted to the indoor unit 1 via the communication line L1 and the negative electrode signal F2 is transmitted to the indoor unit 1 via the communication line L2.

30 (4) Operation of polarity correction circuits 37 and 38

The operation of the polarity correction circuits 37 and 38 will be described herein by taking the polarity correction circuit 37 of the indoor unit 1 as an example.

(4-1) When the first input line 11 is a positive electrode and the second
35 input line 12 is a negative electrode

When the signal line which the positive electrode signal F1 is transmitted and the communication line which the negative electrode signal F2 is transmitted, are correctly connected, the positive electrode signal F1 is input to the input line 11 via the communication line L1 and
40 the first terminal N1a of the first connector CN1. In addition, the negative electrode signal F2 is input to the second input line 12 via the communication line L2 and the second terminal N1b of the first connector CN1.

FIG. 5 is a polarity correction circuit diagram showing the
45 transmission paths of the positive electrode signal F1 and the negative electrode signal F2 when the positive electrode signal F1 is input to the

first input line 11 and the negative electrode signal F2 is input to the second input line 12.

In FIG. 5, since a positive voltage is applied to the connection point S11 of the first voltage divider circuit 51, resulting the voltage drop occurs in accordance with the resistance value ratio of the first resistor R11 and the second resistor R12 that are located at both ends of the first resistor R11 and the second resistor R12 from the connection point S11 facing toward the connection point S12.

Furthermore, a positive voltage is also applied to the connection point S22 of the second voltage divider circuit 52, but since the direction is opposite to the forward direction of the second diode D21, resulting in the voltage drop occurs at both ends of each of the fourth resistor R22 and the sixth resistor R26 in accordance with the resistance value ratio of the fourth resistor R22 and the sixth resistor R26, where no voltage drop occurs in the third resistor R21.

In this case, the resistance values of the first resistor R11, the second resistor R12, the third resistor R21, the fourth resistor R22, and the sixth resistor R26 are set for the potential difference (V2) between the connection point Q22 of the second voltage divider circuit 52 and the ground GND becomes larger than the potential difference (V1) between the connection point Q12 of the first voltage divider circuit 51 and the ground GND.

Since V2 ($V2 > V1$) is input to the non-inverting input terminal and V1 is input to the inverting input terminal of the comparator 55, a predetermined output voltage $V_{out} = E2$ is output from the output terminal of the comparator 55.

This output voltage V_{out} is applied to the base of the transistor Tra of the relay driver circuit 53, and the collector and the emitter are established to conduct electricity to the relay coil 31, so that the first contact C1a and the first contact C1a and the second contact C2a in the first circuit 41 are closed, and at the same time, the third contacts C1b and the fourth contact C2b provided in the second circuit 42 are opened.

As a result, when the first input line 11 is a positive electrode, the first input line 11 and the first output line 21 are connected, and the second input line 12 and the second output line 22 are connected.

(4-2) When the first input line 11 is the negative electrode and the second input line 12 is the positive electrode

When the signal line which the positive electrode signal F1 is transmitted and the communication line which the negative electrode signal F2 is transmitted are erroneously connected, for example, this is the case where the positive electrode signal F1 is input to the second input line 12 that is transmitted via the communication line L1 and the second terminal N1b of the first connector CN1. At this moment, the negative electrode signal F2 is input to the first input line 11 via the communication line L2 and the first terminal N1a of the first connector CN1.

FIG. 6 is a polarity correction circuit diagram showing the

transmission paths of the positive electrode signal F1 and the negative electrode signal F2 when the positive electrode signal F1 is input to the second input line 12 and the negative electrode signal F2 is input to the first input line 11.

5 In FIG. 6, since a positive voltage is applied to the connection point S21 of the second voltage divider circuit 52, resulting the voltage drop occurs in accordance with the resistance value ratio of the third resistor R21 and the fourth resistor R22 that are located at both ends of the third resistor R21 and the fourth resistor R22 from the connection point S21
10 facing toward the connection point S22.

Furthermore, a positive voltage is also applied to the connection point S12 of the first voltage divider circuit 51, but since the direction is opposite to the forward direction of the first diode D11, resulting in the voltage drop occurs at both ends of each of the second resistor R12 and the
15 fifth resistor R15 in accordance with the resistance value ratio of the second resistor R12 and the fifth resistor R15, where no voltage drop occurs in the first resistor R11.

In this case, the resistance values of the first resistor R11, the second resistor R12, the third resistor R21, the fourth resistor R22, and the fifth resistor R15 are set for the potential difference (V1) between the
20 connection point Q12 of the first voltage divider circuit 51 and the ground GND becomes larger than the potential difference (V2) between the connection point Q22 of the second voltage divider circuit 52 and the ground GND.

25 Since V_2 ($V_2 < V_1$) is input to the non-inverting input terminal and V_1 is input to the inverting input terminal of the comparator 55 so that the output voltage $V_{out} = 0$ is then output from the output terminal of the comparator 55.

Since this output voltage $V_{out} = 0$ becomes the base voltage of the transistor Tra of the relay driver circuit 53, there is no conduction between the collector and the emitter, and the relay coil 31 is not energized.
30 Therefore, the first contact C1a and the second contact C2a provided in the first circuit 41 are opened, and at the same time, the third contact C1b and the fourth contact C2b provided in the second circuit 42 are closed.

35 As a result, when the first input line 11 is the negative electrode, the first input line 11 and the second output line 22 are connected, and the second input line 12 and the first output line 21 are connected.

As described above, the positive electrode signal F1 is always output from the first output line 21, and the negative electrode signal F2
40 is always output from the second output line 22 by the polarity correction circuit 37.

(5) Operation of switching circuit 75

The function of the switching circuit 75 detects that the power supply from the first power supply 101 is cut off when the power from the
45 first power supply 101 is cut off, and can switch to the power from the second power supply 102 which is the different power source from the first

power supply 101.

Hereinafter, the operation of the switching circuit 75 will be described separately for the case where the power supply from the first power supply 101 is not cut off and the case where the power supply from the first power supply 101 is cut off.

(5-1) When the power supply from the first power supply 101 is not cut off

FIG. 7 is an explanatory diagram showing a state of the switching circuit 75 when the power supply from the first power supply 101 is not cut off. In FIG. 7, the current flows are indicated by arrows.

In FIG. 7, a DC voltage obtained by rectifying the AC voltage of the first power supply 101 is applied to both ends of the photodiode 78a of the photocoupler 78 in the forward direction, and the photodiode 78a emits light when the I_f current flows.

The phototransistor 78b receives the I_{out} current through conduction between the collector and the emitter by the emitted light from the photodiode 78a.

As a result, this generates a potential difference between the emitter and the ground GND by the resistor R_c between the emitter and the ground GND, which is applied as the base voltage of the transistor Trb of the relay driver circuit 79, and the base current I_b flows.

When the base voltage is applied to the transistor Trb, the collector and the emitter conduct with each other, the voltage of the drive power supply E_d is applied to the relay coil 76a, and the I_{con} current is energized to the relay coil 76a.

While the relay coil 76a is energized, the third contact S1b provided in the first switching circuit 77a and the third switching circuit 77c and the fourth contact S2b provided in the second switching circuit 77b are open. Therefore, the power of the first DC power supply E_a , the second DC power supply E_b , and the third DC power supply E_c is not supplied to the first control board 81.

(5-2) When the power supply from the first power supply 101 is cut off

FIG. 8 is an explanatory diagram showing a state of the switching circuit 75 when the power supply from the first power supply 101 is cut off. In FIG. 8, the current flows are indicated by the arrows.

In FIG. 8, since no DC voltage is applied to both ends of the photodiode 78a of the photocoupler 78, so that no light is emitted. Therefore, the phototransistor 78b does not receive the light emission of the photodiode 78a, the collector and the emitter then do not conduct with each other. As a result, there is no potential difference between the emitter and ground GND.

Since the base voltage is not applied to the transistor Trb, the collector and the emitter do not conduct with each other, and the relay coil 76a is not energized.

Since the relay coil 76a is not energized, so that the third contact S1b provided in the first switching circuit 77a and the third switching circuit 77c, with the fourth contact S2b provided in the second switching

circuit 77b are closed, and the first direct current is connected. The power of the power source Ea, the second DC power source Eb, and the third DC power source Ec is supplied to the first control board 81.

(6) Characteristics of invention

5 (6-1)

The first electric circuit board 91 is an electric circuit board electrically connected to the first control board 81 via a communication line. The first control board 81 is a control board of the indoor unit 1 of the air conditioner 100 connected to the first power supply 101. The first
10 electric circuit board 91 is further connected to the second power supply 102. The first electric circuit board 91 includes an on / off relay 76. The on / off relay 76 switches to the second power supply 102 when power is not supplied from the first power supply 101 to the first control board 81. As a result, the first electric circuit board 91 can appropriately supply electric
15 power to the first control board 81 of the indoor unit 1.

"The first electric circuit board 91 is further connected to the second power supply 102" includes that the second power supply 102 is equipped with the first electric circuit board 91.

(6-2)

20 The air conditioner 100 comprises an indoor unit 1 and an outdoor unit 2 that electrically connected to the indoor unit 1. The electric power of the second power source 102 is the electric power supplied from the outdoor unit 2.

(6-3)

25 The first electric circuit board 91 further comprises a switching circuit 75. The switching circuit 75 is switched to either a first state that is electrically connected to the second power supply 102 or a second state that is not electrically connected. When power is not supplied from the first power supply 101 to the first control board 81, the switching circuit
30 75 switches to the first state by the on / off relay 76.

(6-4)

The first electric circuit board 91 further comprises a photocoupler 78 as a switch. The photocoupler 78 turns on or off the energization of the on / off relay 76 to switch the switching circuit 75 to the first state, when
35 power is not supplied from the first power supply 101 to the first control board 81. Since the photocoupler 78 energizes and de-energizes the on / off relay 76 in accordance with the presence or absence of power supply from the first power supply 101, the configuration can be simplified, and the cost can be reduced.

40 (6-5)

The photocoupler 78 is turned on while power is being supplied from the first power supply 101 to energize the on / off relay 76. Moreover, the photocoupler 78 is turned off when power is not supplied from the first power supply 101 to cut off the energization to the on / off relay 76. Since
45 the configuration in which the photocoupler 78 is turned on to energize the relay when power is supplied from the first power supply 101, a circuit

that is simple and has a small number of components can be archived.
(6-6)

In the first electric circuit board 91, the on / off relay 76 included a relay coil 76a and a relay switch 76b. The relay switch 76b switches the switching circuit 75 to the first state when the energization of the relay coil 76a is on or off. Since this electric circuit board can use be used with a general-purpose mechanical relay including a relay coil and a relay switch, it does not require a logic circuit and it is possible to suppress the increase of production cost.

(6-7)

In the first electric circuit board 91, the first electric circuit board 91 can be retrofitted by separating the first electric circuit board 91 from the first control board 81. Therefore, it can be equipped with the indoor unit 1, in which the first electric circuit board 91 is not installed.

(6-8)

The air conditioner 100 equipped with the first electric circuit board 91 comprises an outdoor unit 2 and the pluralities of indoor units 1 connected to the outdoor unit 2. When the power from the first power supply 101 is not supplied to the first control board 81 of any one of the pluralities of indoor units 1, the power supply is switched to be supplied from the second power supply 102 by the on / off relay 76.

Although the embodiments of the present disclosure have been described above, it will be understood that various modifications of the embodiments and details are possible without departing from the spirit and scope of the present disclosure described in the claims.

[Explanation of Code]

1 Indoor unit

2 outdoor unit

75 Switching circuit

76 On / off relay (relay)

76a relay coil

76b relay switch

81 First control board (control board)

91 First electric circuit board (electric circuit board)

100 Air conditioner (refrigerator)

101 First power supply

102 Second power supply

[Prior Art Document]

[Patent Document]

[Patent Document 1] Japanese Unexamined Patent Publication No. 2013-40698

[Document Name] Claims**[Claim 1]**

5 An electric circuit board, which is an electric circuit board that is electrically connected to a control board (81) of an indoor unit of a refrigerating apparatus connected to a first power source via a communication line;

the electric circuit board is further connected to a second power source comprising:

10 a relay (76) that switches to the second power supply when power is not supplied from the first power supply to the control board (81).

[Claim 2]

15 The electric circuit board according to claim 1, wherein the refrigerating apparatus includes the indoor unit, in which an outdoor unit is electrically connected to the indoor unit and

the electric power of the second power source is the electric power supplied from the outdoor unit.

[Claim 3]

20 The electric circuit board according to claim 1 or 2, wherein the electric circuit board further comprises a switching circuit (75) that can be switched between the first state that is electrically connected, and the second state that is not electrically connected to the second power source.

25 When power is not supplied from the first power supply to the control board (81), the switching circuit (75) is switched to the first state by the relay (76).

[Claim 4]

30 The electric circuit board according to claim 3, wherein the electric circuit board further comprises a switch (78); and

the switch (78) turns on or off the energization of the relay (76) to switch the switching circuit (75) to the first state when the power is not supplied from the first power source to the control board (81).

[Claim 5]

35 The electric circuit board according to claim 4, wherein the switch (78) is turned on while the power is being supplied from the first power source to energize the relay (76); and

40 it is turned off to cut off the power supply to the relay (76) while the power is not supplied from the first power supply.

[Claim 6]

45 The electric circuit board according to any one of claims 3 to 5, wherein the relay (76) comprises a relay coil (76a) and a relay switch (76b) and

the relay switch (76) switches the switching circuit (75) to the first

state when the energization of the relay coil (76a) is on or off.

[Claim 7]

5 The electric circuit board according to any one of claims 1 to 6,
wherein the electric circuit board is separated from the control board (81).

[Claim 8]

10 The refrigerating apparatus equipped with the electric circuit
board according to any one of claims 1 to 7.

[Claim 9]

15 A refrigerating apparatus equipped with the electric circuit board
according to claim 8,

 wherein the refrigerating apparatus comprises an outdoor unit
and a plurality of indoor units connected to the outdoor unit and

 when the power from the first power supply is not supplied to the
control board of any one of the indoor units, a relay (76) switches to the
second power supply.

20