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(54) AIR CONDITIONER

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(57) **ABSTRACT**

The present invention particularly relates to a decrease in a standby power in an outdoor side unit, in an air conditioner comprising an indoor side unit and the outdoor side unit. The air conditioner includes a current detector which detects an alternating current flowing through a power line connecting the indoor side unit to the outdoor side unit, and a switch which performs a circuit communicating operation in a case where a current value detected by this current detector exceeds a predetermined standard value, and the air conditioner has a constitution in which via this switch, an operation of an outdoor side control circuit is started, and with the driving of a motor of the indoor side unit, the outdoor side control circuit is operated.

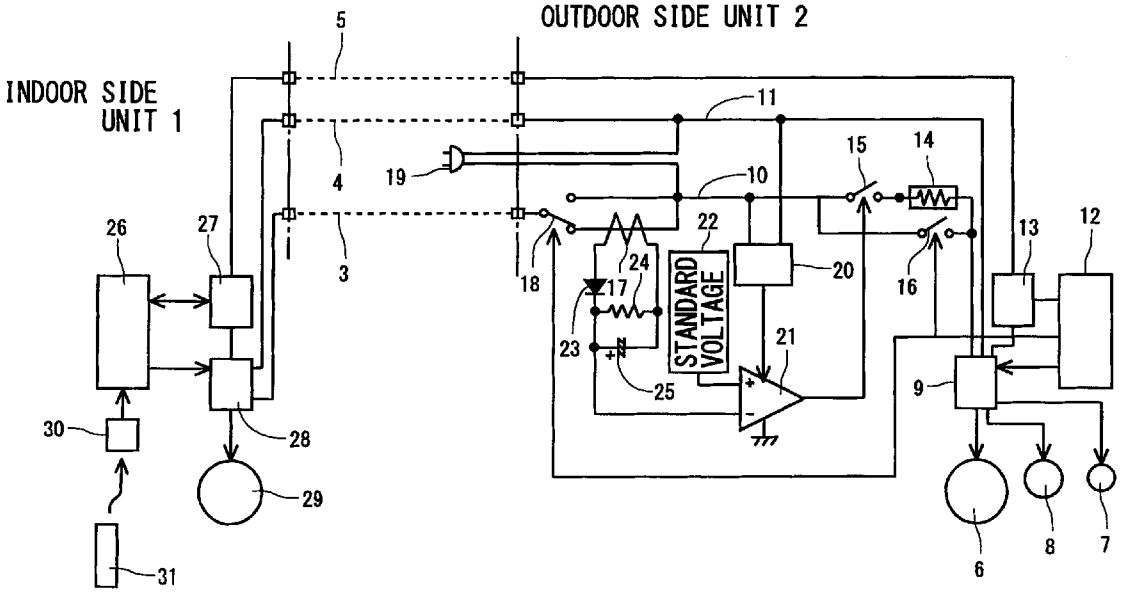
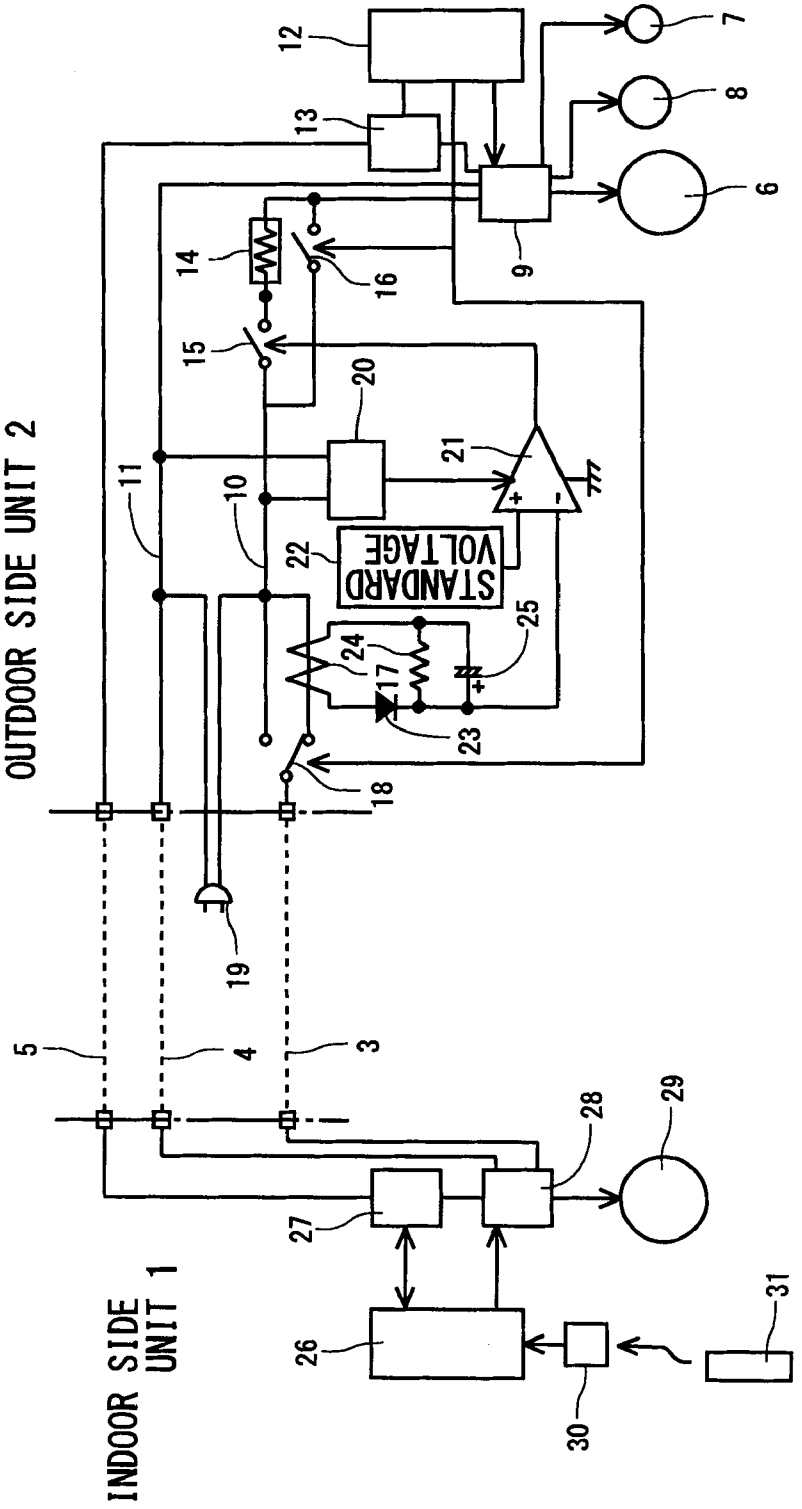


FIG. 1


OUTDOOR SIDE UNIT 2
INDOOR SIDE UNIT 1
STANDARD VOLTAGE
12
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14
15
16
9
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6
20
21
11
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AIR CONDITIONER

TECHNICAL FIELD

[0001] The present invention relates to an air conditioner which comprises an indoor side unit and an outdoor side unit and which is configured to supply a driving power of the indoor side unit from the outdoor side unit via a crossover line between the units.

BACKGROUND ART

[0002] As a conventional air conditioner, a separate type air conditioner is constituted of an indoor side unit and an outdoor side unit, and a commercial alternating-current power is supplied from the indoor side unit to the outdoor side unit via an alternating-current power line between the units, restored to a direct-current power in the outdoor side unit and then supplied to the indoor side unit again.

[0003] This direct-current power is a direct-current power with a high voltage (an output of a main power circuit) in a state where the air conditioner has an air conditioning operation state, and is a direct-current power with a low voltage (an output of an auxiliary power circuit) in a state where the air conditioner does not perform the air conditioning operation (a stop state or a standby state).

[0004] The direct-current power with the high voltage is required for driving a motor for an air blowing fan disposed in the indoor side unit, and the direct-current power with the low voltage is required for driving a control circuit such as a microcomputer, because the motor does not have to be driven in the state where the air conditioning operation is not performed. When the auxiliary power circuit is operated, the main power circuit (an INV drive circuit, to supply a power source for an outdoor fan motor) is stopped, and a standby power in the outdoor side unit is decreased to a degree of a power of the auxiliary power circuit.

[0005] The driving of the main power circuit is started when the control circuit (the microcomputer or the like) of the outdoor side unit receives an air conditioning operation start signal superimposed on a direct-current power line via which the direct-current power is supplied from the outdoor side unit to the indoor side unit (e.g., see Patent Document 1). Moreover, as another conventional air conditioner, a separate type air conditioner is constituted of an indoor side unit and an outdoor side unit, and the indoor side unit is connected to the outdoor side unit via three lines in total including two power lines through which a commercial alternating current flows and a signal line shared by one of these power lines, whereby the commercial alternating current is directly supplied to the power line in the outdoor side unit, and supplied to the indoor side unit successively via the outdoor side unit and the power line.

[0006] When an air conditioning operation is stopped, the supplying of an alternating-current power to a power circuit of the outdoor side unit is blocked by opening a relay contact piece. The alternating-current power remains to be supplied to the indoor side unit.

[0007] When the air conditioning operation is started, a higher voltage is applied from the indoor side unit to a signal line than a voltage for use in usual signal transmission or reception. The outdoor side unit excites a relay of the outdoor side unit by use of this high voltage as a start power, and closes the relay contact piece, to operate the power circuit, thereby changing the outdoor side unit to an operating state (e.g., see Patent Document 2).

PRIOR ART DOCUMENTS

Patent Documents

[0008] Patent Document 1: Japanese Patent No. 3730808

[0009] Patent Document 2: Japanese Patent No. 3019844

SUMMARY OF THE INVENTION

Problems to be solved by the Invention

[0010] However, in a technology disclosed in Patent Document 1, it is necessary to keep a microcomputer of an indoor side unit and a microcomputer of an outdoor side unit in a state where a signal for operation/stop or the like is constantly transmitted or received. That is, it is necessary to constantly keep at least the microcomputer of the outdoor side unit in an operating state, and a standby power for this purpose is constantly required. Moreover, the transmission and reception of the signal requires a signal line and a direct-current power line, and hence at least four lines including an alternating-current power line are required, which causes faulty wiring and trouble of an installation work.

[0011] Moreover, in an air conditioner disclosed in Patent Document 2, a special power circuit is required for applying a higher voltage to a signal line than a voltage for use in usual signal transmission and reception, and at the same time, it is necessary to change specifications of a communication circuit of an indoor side unit and an outdoor side unit to those for this high voltage. Furthermore, even if this high voltage is not excessively high, it is necessary to supply a sufficient current for exciting a relay, and owing to a difference between a low impedance of an excitation coil of the relay and a high impedance of the communication circuit, such a constitution as to cut this relay after the start of the operation of the power circuit is also required.

[0012] The present invention focuses attention on the point that the start of an indoor side unit (the start of an air conditioning operation) is associated with the operation start of a motor for an air blowing fan disposed in the indoor side unit, and the consumption of a current by the operation of this motor is judged so that the start of the air conditioning operation of the indoor side unit can be judged by an outdoor side unit. More specifically, the indoor side unit is connected to the outdoor side unit via two alternating-current power lines and one signal line (shared by one of the alternating-current power lines), and an alternating-current power is supplied to the indoor side unit via the outdoor side unit, whereby even in a case where a control circuit of the outdoor side unit is stopped, when the motor is operated in the indoor side unit, a current increases as much as at least a current for the operation on the alternating-current power line. That is, the current flowing through the alternating-current power line from the outdoor side unit to the indoor side unit increases. This current increase is detected by using a CT, and when a current value detected by this CT exceeds a predetermined value, a relay is energized to start the control circuit of the outdoor

side unit. Therefore, the outdoor side unit may include at least a switching circuit to excite this relay and the CT to detect the current.

Means for Solving the Problems

[0013] To solve the above problem, there is provided an air conditioner having a refrigerating cycle in which at least a refrigerant compressor driven by an electromotive element, a heat source side heat exchanger, a pressure reducing unit and a utilization side heat exchanger are circularly connected via a refrigerant piping line, these constituent elements of the refrigerant cycle being divided and disposed in an indoor side unit and an outdoor side unit, the indoor side unit being provided with a motor which drives an air blowing fan of the utilization side heat exchanger, a power to drive the motor being supplied via the outdoor side unit, wherein the indoor side unit is connected to the outdoor side unit via three lines including a first power line and a second power line through which an alternating current flows and a signal line through which a signal is transmitted by using one of the power lines as a common use line, a commercial alternating-current power is applied to the first power line and the second power line in the outdoor side unit, the outdoor side unit includes a current detector which detects, from this commercial alternating-current power, the alternating current flowing through one of the first power line and the second power line, a switch which performs a circuit communicating operation in a case where a current value detected by this current detector exceeds a predetermined standard value, and an outdoor side control circuit to which the commercial alternating-current power is supplied via this switch to control the driving of the electromotive element, the indoor side unit includes an indoor side control circuit which controls the supplying, to the motor, of the commercial alternating-current power obtained via the first power line and the second power line, and this indoor side control circuit starts the driving of the motor in response to the start of an air conditioning operation, and transmits or receives the signal to or from the outdoor side control circuit of the outdoor side unit via the signal line after driving the motor.

[0014] According to such a constitution, a change of the current consumed by the indoor side unit is detected by the outdoor side unit so that the operation of the outdoor side control circuit of the outdoor side unit can be started.

[0015] In a second aspect of the invention, in addition to the air conditioner according to the first aspect, the predetermined standard value in a case where the switch performs the communicating operation includes at least a current to be consumed by the motor.

[0016] According to such a constitution, when at least the motor is driven, the outdoor side control circuit of the outdoor side unit can be driven.

[0017] In a third aspect of the invention, the air conditioner according to the second aspect additionally includes a normally opened contact piece of a relay constituting a bypass circuit which passes by a circuit after the switch performs the communicating operation of the circuit, and the outdoor side control circuit excites the relay to close the normally opened contact piece.

[0018] According to such a constitution, when the outdoor side control circuit starts the operation, a self holding circuit of power supply is formed.

[0019] In a fourth aspect of the invention, in addition to the air conditioner according to the first to third aspects, at the start of the operation, the operation of the motor disposed in the indoor side unit is started.

[0020] According to such a constitution, in association with the operation start of the indoor side unit, the operation of the motor is also started.

[0021] In a fifth aspect of the invention, in addition to the air conditioner according to the fourth aspect, the outdoor side control circuit includes a microcomputer to which the commercial alternating-current power is supplied to start the operation, and the microcomputer starts a predetermined operation, acquires a signal to judge the start of the air conditioning operation via the signal line to the indoor side control circuit of the indoor side unit, and opens a circuit of the switch in a case where the start of the air conditioning operation cannot be judged.

[0022] According to such a constitution, the outdoor side control circuit of the outdoor side unit starts the operation, and then transmits and receives the signal from and to the indoor side control circuit of the indoor side unit to judge the start of the air conditioning operation, whereby a faulty operation can be suppressed.

[0023] In a sixth aspect of the invention, the air conditioner according to the fourth aspect additionally includes a changeover circuit which disturbs a flow of the alternating current to the current detector after the normally opened contact piece of the relay closes.

[0024] According to such a constitution, after the start of the air conditioning operation of the air conditioner, the current is prevented from flowing through the current detector.

Advantageous Effect of the Invention

[0025] In an air conditioner of the present invention in which an indoor side unit is connected to an indoor side unit via three lines (two power lines and one signal line), a current flowing through a power line is detected to start the operation of an outdoor side control circuit of the outdoor side unit, and hence special signal exchange is not performed, but the operation of the outdoor side control circuit can be associated with the start of an air conditioning operation of the indoor side unit by use of the existing three lines, whereby a standby power in the outdoor side unit can be decreased in a case where the indoor side unit does not perform the air conditioning operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] FIG. **1** is a schematic electric circuit diagram of an air conditioner according to an embodiment of the present invention.

MODE FOR CARRYING OUT THE INVENTION

[0027] Hereinafter, an air conditioner as an embodiment of the present invention will be described in detail with reference to the drawing. FIG. **1** is a schematic electric circuit diagram of an air conditioner constituted of an indoor side unit **1** and an outdoor side unit **2**. The indoor side unit **1** is connected to the outdoor side unit **2** via three lines including power lines **3** and **4** through which an alternating-current power flows and a signal line **5**. Moreover, this air conditioner has a refrigerating cycle in which constituent elements such as a refrigerant compressor driven by an electromotive element **6**, a heat source side heat exchanger (not shown), a

pressure reducing unit (not shown) and a utilization side heat exchanger (not shown) are circularly connected via a refrigerant piping line, the utilization side heat exchanger is disposed in the indoor side unit **1**, and the refrigerant compressor, the heat source side heat exchanger and the pressure reducing unit are disposed in the outdoor side unit. It is to be noted that the constituent elements of the refrigerating cycle divided and disposed in the indoor side unit **1** and the outdoor side unit **2** are connected via the refrigerant piping line between both the units. The outdoor side unit **2** is provided with a four-way changeover valve **7**, and the refrigerant piping line is disposed so that the flow of a refrigerant discharged from the refrigerant compressor can selectively be switched in order of the heat source side heat exchanger, the pressure reducing unit and the utilization side heat exchanger or in order of the utilization side heat exchanger, the pressure reducing unit and the heat source side heat exchanger.

[0028] Reference numeral **8** is a motor which drives an air blowing fan to blow air to the heat source side heat exchanger of the outdoor side unit **2**, and the motor is connected to a power circuit **9** of the outdoor side unit **2**, together with the electromotive element **6** which drives the refrigerant compressor, and the four-way changeover valve **7**, whereby the energization of the motor is controlled.

[0029] The power circuit **9** is connected to power bus lines **10** and **11** in the outdoor side unit **2** connected to the power lines **3** and **4**, and supplies an operating power to a microcomputer **12** (corresponding to an outdoor side control circuit) which controls the operation of the indoor side unit **2**, an outdoor side communication circuit **13** which transmits and receives a signal to and from the indoor side unit **1** via the signal line **5** and the like.

[0030] The four-way changeover valve **7** switches the flow of the refrigerant, when a predetermined direct current is supplied thereto from the power circuit **9**, and the supplying of this direct current is controlled by the power circuit **9** in accordance with the signal from the microcomputer **12**. The motor **8** is an induction motor having two speed adjustment taps for a low speed and a high speed, the power circuit **9** switches the speed adjustment tap to which this alternating current is to be supplied, in accordance with the signal from the microcomputer **12**, and the motor **8** is switched to three speeds including stop, low speed and high speed. When the electromotive element **6** is an induction motor in the same manner as in the motor **8**, the power circuit **9** switches the supply/block of the alternating current in accordance with the signal from the microcomputer **12**, whereby the operation of the refrigerant compressor can be controlled to be ON/OFF. When a frequency and voltage of the alternating-current power to be supplied to the electromotive element **6** are changed by using an inverter technology, the ability of the refrigerant compressor can be varied. Moreover, when a direct-current brushless motor is used in the electromotive element **6**, an energization timing and applied voltage of each stator coil are changed in accordance with a rotary position of a rotor of the motor, whereby the ability of the refrigerant compressor can similarly be varied. The operating ability of the refrigerant compressor can be varied on the basis of an air conditioning load.

[0031] The power bus line **10** extending from the power circuit **9** to the power line **3** is connected to a current limiting PCT element **14**, a normally opened contact piece **15** (a relay contact piece corresponding to a switch), a CT (a current detector) **17**, and a changeover contact piece (a relay contact piece corresponding to a changeover switch) **18** in order from the power circuit **9**. **16** is a normally opened contact piece (a relay contact piece corresponding to a switch) connected in parallel with a series circuit of the PCT element **14** and the normally opened contact piece **15**. The changeover contact piece **18** switches two contacts between a normally opened A-contact side and a normally closed B-contact side, and the CT **17** detects the alternating current flowing through the power bus line **10**, when the changeover contact piece **18** is on the normally closed B-contact side. The opening/closing of the normally opened contact piece **16** and the changeover of the changeover contact piece **18** are controlled from the microcomputer **12**. Therefore, when the microcomputer **12** does not operate, the normally opened contact piece **16** and the changeover contact piece **18** have a shown state.

[0032] Reference numeral **19** is a power plug connected to a commercial alternating-current power source, the alternating current obtained via this power plug is supplied to the power bus lines **10** and **11** in the outdoor side unit **2**, and the power plug is connected to the power bus line **10** between the normally opened contact piece **15** and the changeover contact piece **18**.

[0033] Reference numeral **20** is an auxiliary power circuit connected to positions along the power bus lines **10** and **11** where the alternating current from the power plug **19** is directly obtained. The auxiliary power circuit **20** supplies a driving power to a comparator **21** and a standard current setting unit **22** which supplies a standard voltage to one input of this comparator. The normally opened contact piece **15** is switched by an output of the comparator **21**. To the other input of the comparator **21**, the output of the CT **17** is applied after the output is converted to a voltage corresponding to a current value detected by the CT **17** by a rectifying/smoothening circuit constituted of a rectifying diode **23**, a resistor **24** and a capacitor **25**. It is to be noted that during rectification, the output may be enlarged by using full wave rectification. Therefore, when the voltage corresponding to the current detected by the CT **17** exceeds a voltage corresponding to a set current set by the standard current setting unit, the output of the comparator **21** inverts. When this output inverts, the normally opened contact piece **15** is closed to enable the supplying of the alternating current to the power circuit **9** through the power bus line **10**. It is to be noted that the shown comparator **21** has a constitution in which when an output voltage of the comparator becomes 0-voltage, a relay coil is excited to close the normally opened contact piece **15**, but the comparator **21** may have a constitution in which the output voltage of the comparator becomes a high voltage (from about 5 V to 15 V) to excite the relay coil.

[0034] When the outdoor side unit **2** having such a constitution has a shown stop state, any alternating current is not supplied to the power circuit **9**, the microcomputer **12** is stopped, and the electromotive element **6**, the motor **8** and the four-way changeover valve **7** are not energized. The auxiliary power circuit **20** has the alternating current supplied thereto to operate, so that the comparator **21** operates. When the current detected by the CT **17** exceeds the value set by the standard current setting unit **22**, the output of the comparator **21** inverts to close the normally opened contact piece **15**.

[0035] When the normally opened contact piece **15** closes, the alternating current from the power plug **19** is supplied to the power circuit **9**, and the power circuit **9** supplies the operating power to the microcomputer **12**. The microcomputer **12** ends initialization to start a predetermined operation.

The microcomputer **12** closes the normally opened contact piece **16**, and acquires the supply of the alternating current to the power circuit **9** regardless of the opening/closing of the normally opened contact piece **15**, whereby the operation of the microcomputer **12** is continued.

[0036] It is to be noted that the normally opened contact piece **16** is a contact piece closed by exciting a coil of a relay (not shown), and is energized via a drive circuit of the relay in response to the signal of the microcomputer **12**. The changeover contact piece **18** similarly switches the A-contact side and the B-contact side of the contact piece in response to the signal of the microcomputer **12**. The changeover contact piece **18** switches from the B-contact side to the A-contact side at the same time when the normally opened contact piece **16** closes, and regardless of the current value detected by the CT **17**, the output of the comparator **21** does not invert, and the normally opened contact piece **15** remains to be opened.

[0037] Therefore, the operation of the microcomputer **12** is continued until the microcomputer **12** opens the normally opened contact piece **16**. After closing the normally opened contact piece **16** and switching the changeover contact piece **18**, there is output, to the indoor side unit **1** via the communication circuit **13** and the signal line **5**, a signal to request information indicating whether or not the air conditioner has an air conditioning operation state, i.e., whether or not the air conditioning operation is started by a user who directly operates the indoor side unit **1** or automatically by a timer operation. When the signal transmitted to the microcomputer **12** from the indoor side unit **1** via the signal line **5** includes a signal indicating the air conditioning operation state, the microcomputer keeps the normally opened contact piece **16** in a closed state, and keeps the changeover contact piece **18** switched to the A-contact side to maintain the operation thereof. When the signal transmitted from the outdoor side unit **1** does not include the signal indicating the air conditioning operation state, the microcomputer judges that the above output of the comparator **21** inverts owing to a faulty operation, opens the normally opened contact piece **16**, and returns the changeover contact piece **18** to the B-contact side, whereby the indoor side unit **2** returns to the stop state.

[0038] The indoor side unit **1** includes a microcomputer **26** (corresponding to an indoor side control circuit) which controls the operation of the indoor side unit **1**, an indoor side communication circuit **27** connected to the signal line **5** to transmit and receive a signal to and from the outdoor side unit **2**, an indoor side power circuit **28**, a motor **29** having the controlled supply of a power from the power circuit **28**, to drive an air blowing fan which blows air to the utilization side heat exchanger, a reception circuit **30** which receives a signal (e.g., an infrared signal) transmitted in response to a key operation from a remote controller **31**, demodulates the signal and then outputs the signal to the microcomputer **26** and the like.

[0039] When the remote controller **31** is operated, a switch provided in the indoor side unit **1** is directly operated or operation start time is reached by a timer operation, the microcomputer **26** starts the operation of the motor **29** via the power circuit **8**. In the motor **29**, an induction motor, a brushless motor or the like can be used in the same manner as in the electromotive element or the motor disposed in the outdoor side unit **2**, whereby a rotation number can be controlled. The rotation number of the motor **29** is automatically controlled on the basis of room temperature (a temperature to be controlled) and set temperature (target temperature). Alternatively, the rotation number is controlled to user's desirable rotation number. The minimum rotation number of the motor **29** is set in each of the induction motor and the brushless motor owing to a structure or characteristics thereof, and the operation of the motor **29** is performed with the minimum rotation number or more. Therefore, as long as the motor **29** operates, a power more than a current required for the minimum rotation number is consumed. The current to be consumed by the motor **29** is supplied via the power circuit **28**, the power lines **3** and **4**, the outdoor side unit **2**, the CT **27** and the power plug **19**.

[0040] When the air conditioning operation of the indoor side unit **1** is started and the operation of the motor **29** is started, the driving current of the motor **29** is detected by the CT **17** of the outdoor side unit **2**, the output of the comparator **21** of the outdoor side unit **2** inverts, and the normally opened contact piece **15** closes to start the operation of the microcomputer **12**. It is to be noted that when the air conditioning operation stops, a stop signal is transmitted from the indoor side unit **1** to the microcomputer **12** of the outdoor side unit **2**, and the microcomputer **12** opens the normally opened contact piece **16** to stop the operation.

DESCRIPTION OF REFERENCE NUMERALS

[0041] **1** indoor side unit
[0042] **2** outdoor side unit
[0043] **3**, **4** power line
[0044] **5** signal line
[0045] **6** electromotive element
[0046] **9** power circuit
[0047] **12** microcomputer
[0048] **15** normally opened contact piece
[0049] **17** CT
[0050] **18** changeover contact piece
[0051] **26** microcomputer
[0052] **29** motor

1. An air conditioner having a refrigerating cycle in which at least a refrigerant compressor driven by an electromotive element, a heat source side heat exchanger, a pressure reducing unit and a utilization side heat exchanger are circularly connected via a refrigerant piping line, these constituent elements of the refrigerant cycle being divided and disposed in an indoor side unit and an outdoor side unit, the indoor side unit being provided with a motor which drives an air blowing fan of the utilization side heat exchanger, a power to drive the motor being supplied via the outdoor side unit,

wherein the indoor side unit is connected to the outdoor side unit via three lines comprising a first power line and a second power line through which an alternating current flows and a signal line through which a signal is transmitted by using one of the power lines as a common use line, a commercial alternating-current power is applied to the first power line and the second power line in the outdoor side unit, the outdoor side unit includes a current detector which detects, from this commercial alternating-current power, the alternating current flowing through one of the first power line and the second power line, a switch which performs a circuit communicating operation in a case where a current value detected by this current detector exceeds a predetermined standard value, and an outdoor side control circuit to which the commercial alternating-current power is supplied via this switch to control the driving of the electromotive element, the indoor side unit includes an indoor side

control circuit which controls the supplying, to the motor, of the commercial alternating-current power obtained via the first power line and the second power line, and this indoor side control circuit starts the driving of the motor in response to the start of an air conditioning operation, and transmits and receives the signal to and from the outdoor side control circuit of the outdoor side unit via the signal line after driving the motor.

2. The air conditioner according to claim **1**, wherein when the predetermined standard value in a case where the switch performs the communicating operation includes at least a current to be consumed by the motor.

3. The air conditioner according to claim **2**, further comprising a normally opened contact piece of a relay constituting a bypass circuit which passes by a circuit after the switch performs the communicating operation of the circuit, wherein the outdoor side control circuit excites the relay to close the normally opened contact piece.

4. The air conditioner according to any one of claims **1** to **3**, wherein at the start of the operation, the operation of the motor disposed in the indoor side unit is started.

5. The air conditioner according to claim **4**, wherein the outdoor side control circuit includes a microcomputer to which the commercial alternating-current power is supplied to start the operation, and

the microcomputer starts a predetermined operation, acquires a signal to judge the start of the air conditioning operation via the signal line to the indoor side control circuit of the indoor side unit, and opens a circuit of the switch in a case where the start of the air conditioning operation is not judged.

6. The air conditioner according to claim **4**, further comprising a changeover circuit which disturbs a flow of the alternating current to the current detector after the normally opened contact piece of the relay is closed.

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