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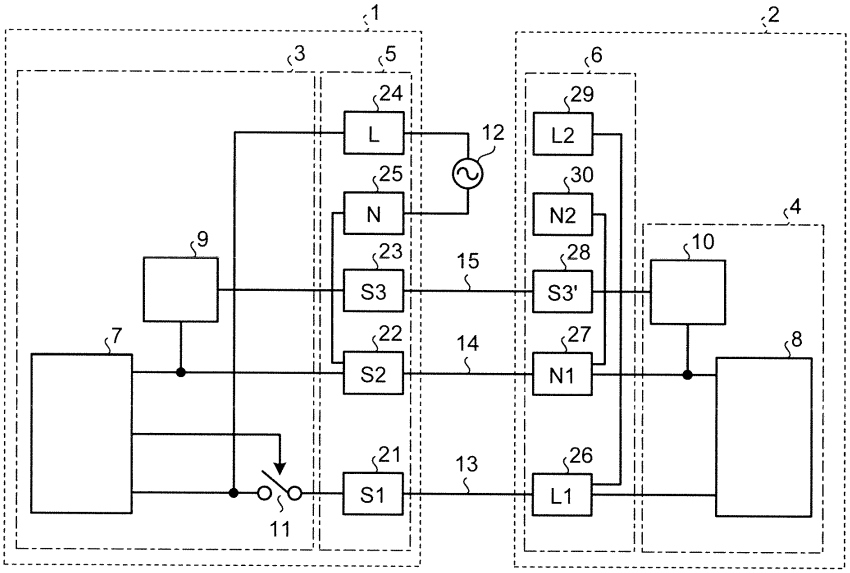
(54) Air conditioner

(57) An indoor unit (1) includes L and N terminals (24, 25), to which a commercial power supply (12) is connected when operating under the indoor-unit power receiving system and to which commercial power supply is input via an outdoor unit (2) when operating under the outdoor-unit power receiving system, and S1 and S2 terminals (21, 22), which supply commercial power supply to the outdoor unit via a relay (11) when operating under the indoor-unit power receiving system, and the outdoor unit includes L1 and N1 terminals (26, 27), to which commercial power supply is input via the indoor unit when operating under the indoor-unit power receiving system and to which the commercial power supply is connected when operating under the outdoor-unit power receiving system, and L2 and N2 terminals (29, 30), which supply commercial power supply to the indoor unit when operating under the outdoor-unit power receiving system.

FIG.1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an air conditioner.

2. Description of the Related Art

[0002] As a conventional air conditioner, for example, an air conditioner is proposed that supplies power supplied to an indoor unit to an outdoor unit via a power line and is provided with a reference frequency extraction circuit and an indoor-unit control unit in the indoor unit, wherein a commercial power supply is connected to an indoor-unit rectifier circuit and the indoor-unit control unit, a power relay and the reference frequency extraction circuit are connected to the power line that supplies power to the outdoor unit, and, in a standby state, the reference frequency extraction circuit enters a de-energized state by having the power relay opened (for example, see Japanese Patent Application Laid-open 2007-225128).

[0003] Conventional air conditioners, representative of which is the air conditioner disclosed in Japanese Patent Application Laid-open 2007-225128, use a system (hereinafter, referred to as an "indoor-unit power receiving system") in which the commercial power supply supplied to an indoor unit is supplied to an outdoor unit via a power line. In order to reduce standby power when the air conditioner is on operational standby, a power relay is connected to the power line and the feeding of power to the outdoor unit is stopped by having the power relay opened when the air conditioner is on operational standby, thereby realizing a reduction in standby power.

[0004] However, with the configuration of the conventional technology described above, when the outdoor unit is changed to an outdoor unit for a system (hereinafter, referred to as an "outdoor-unit power receiving system") in which the commercial power supply is received on the outdoor unit side and then supplied to the indoor unit and the power is intended to be supplied to the indoor unit for the indoor-unit power receiving system via the power line in a similar manner to the indoor-unit power receiving system, the feeding of power to the indoor unit is prevented by the power relay provided in the indoor unit; therefore, the indoor unit cannot be operated. Thus, it is necessary to change to an indoor unit that has a configuration in which a power relay is not provided and the commercial power supply is connected to an indoor-unit-side power-supply control circuit from the outdoor unit via the power line. In this case, the air conditioner can use both the indoor-unit power receiving system and the outdoor-unit power receiving system; however, there is a problem in that even when the air conditioner is used under the indoor-unit power receiving system, the feeding of power to the outdoor unit cannot be stopped when the air conditioner is on operational standby and thus the standby power cannot be reduced.

[0005] The present invention is achieved in view of the above and has an object to provide an air conditioner that can use both the indoor-unit power receiving system and the outdoor-unit power receiving system and can realize a reduction in standby power by stopping the feeding of power to the outdoor unit in the indoor-unit power receiving system.

SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to at least partially solve the problems in the conventional technology.

[0007] According to an aspect of the present invention, an air conditioner that includes an indoor unit and an outdoor unit, and includes a relay on the indoor unit side, the relay being capable of interrupting supply of a commercial power supply from the indoor unit to the outdoor unit, wherein the indoor unit includes a pair of commercial-power-supply input terminals, to which the commercial power supply is connected when operating under an indoor-unit power receiving system, in which the commercial power supply supplied to the indoor unit is supplied to the outdoor unit, and to which the commercial power supply is supplied via the outdoor unit when operating under an outdoor-unit power receiving system, in which the commercial power supply supplied to the outdoor unit is supplied to the indoor unit, and a pair of commercial-power-supply output terminals that supplies the commercial power supply connected to the pair of commercial-power-supply input terminals to the outdoor unit via the relay when operating under the indoor-unit power receiving system.

[0008] The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 is a diagram illustrating an example of wiring of an indoor-unit power receiving system in one example configuration of an air conditioner according to a first embodiment;

FIG. 2 is a diagram illustrating an example of wiring of an outdoor-unit power receiving system in one example configuration of the air conditioner according to the first embodiment;

FIG. 3 is a front view of a cable receptacle of an indoor-unit-side terminal block of the air conditioner according to the first embodiment;

FIG. 4 is a diagram illustrating one example of a con-

trol process flow when an indoor unit starts to receive power in the indoor-unit power receiving system of the air conditioner according to the first embodiment;
FIG. 5 is a diagram illustrating a first example of faulty wiring between an indoor unit and an outdoor unit in the indoor-unit power receiving system of the air conditioner according to the first embodiment;
FIG. 6 is a diagram illustrating a second example of faulty wiring between the indoor unit and the outdoor unit in the indoor-unit power receiving system of the air conditioner according to the first embodiment;
FIG. 7 is a diagram illustrating a third example of faulty wiring between the indoor unit and the outdoor unit in the indoor-unit power receiving system of the air conditioner according to the first embodiment;
FIG. 8 is a diagram illustrating a fourth example of faulty wiring between the indoor unit and the outdoor unit in the indoor-unit power receiving system of the air conditioner according to the first embodiment;
FIG. 9 is a diagram illustrating a fifth example of faulty wiring between the indoor unit and the outdoor unit in the indoor-unit power receiving system of the air conditioner according to the first embodiment;
FIG. 10 is a diagram illustrating one example of a control process flow when the outdoor unit starts to receive power in the outdoor-unit power receiving system of the air conditioner according to the first embodiment;
FIG. 11 is a diagram illustrating a first example of faulty wiring between the indoor unit and the outdoor unit in the outdoor-unit power receiving system of the air conditioner according to the first embodiment;
FIG. 12 is a diagram illustrating a second example of faulty wiring between the indoor unit and the outdoor unit in the outdoor-unit power receiving system of the air conditioner according to the first embodiment;
FIG. 13 is a diagram illustrating a third example of faulty wiring between the indoor unit and the outdoor unit in the outdoor-unit power receiving system of the air conditioner according to the first embodiment;
FIG. 14 is a diagram illustrating a fourth example of faulty wiring between the indoor unit and the outdoor unit in the outdoor-unit power receiving system of the air conditioner according to the first embodiment;
FIG. 15 is a diagram illustrating a fifth example of faulty wiring between the indoor unit and the outdoor unit in the outdoor-unit power receiving system of the air conditioner according to the first embodiment;
FIG. 16 is a diagram illustrating a sixth example of faulty wiring between the indoor unit and the outdoor unit in the outdoor-unit power receiving system of the air conditioner according to the first embodiment;
FIG. 17 is a diagram illustrating one example configuration on an indoor unit side of an air conditioner according to a second embodiment; and
FIG. 18 is a diagram illustrating one example of an indoor-unit-side terminal block of the air conditioner according to the second embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] Exemplary embodiments of an air conditioner according to the present invention will be explained below in detail with reference to the accompanying drawings. The present invention is not limited to the embodiments.

First Embodiment

[0011] FIG. 1 is a diagram illustrating an example of wiring of an indoor-unit power receiving system in one example configuration of an air conditioner according to the first embodiment. FIG. 2 is a diagram illustrating an example of wiring of an outdoor-unit power receiving system in one example configuration of the air conditioner according to the first embodiment. As illustrated in FIG. 1 and FIG. 2, the air conditioner according to the first embodiment includes an indoor unit 1 and an outdoor unit 2.

[0012] The indoor unit 1 includes an indoor-unit-side control board 3 and an indoor-unit-side terminal block 5. The indoor-unit-side control board 3 includes an indoor-unit-side power-supply control circuit 7, an indoor-unit-side communication circuit 9, and a power relay (hereinafter, simply referred to as a "relay") 11. In a case where the air conditioner is operated under the indoor-unit power receiving system, the relay 11 has a function of stopping the supply of a commercial power supply 12 to the outdoor unit 2 when the air conditioner is on operational standby.

[0013] The indoor-unit-side terminal block 5 includes an S1 terminal (first terminal) 21 that is connected to the ungrounded-side power-supply input terminal of the indoor-unit-side power-supply control circuit 7 via the relay 11; an S2 terminal (second terminal) 22 that is connected to the grounded-side power-supply input terminal of the indoor-unit-side power-supply control circuit 7; an S3 terminal (third terminal) 23 that is connected to the grounded-side power-supply input terminal of the indoor-unit-side power-supply control circuit 7 via the indoor-unit-side communication circuit 9; an L terminal (fourth terminal) 24 that is connected to the ungrounded-side power-supply input terminal of the indoor-unit-side power-supply control circuit 7; and an N terminal (fifth terminal) 25 that is connected to the S2 terminal 22.

[0014] When the air conditioner according to the first embodiment is operated under the indoor-unit power receiving system, the L terminal (fourth terminal) 24 and the N terminal (fifth terminal) 25 are connected to the commercial power supply 12. When the air conditioner according to the first embodiment is operated under the outdoor-unit power receiving system, the L terminal (fourth terminal) 24 and the N terminal (fifth terminal) 25 form a pair of commercial-power-supply input terminals to which the commercial power supply 12 is input via the

outdoor unit 2. When the air conditioner according to the first embodiment is operated under the indoor-unit power receiving system, the S1 terminal (first terminal) 21 and the S2 terminal (second terminal) 22 form a pair of commercial-power-supply output terminals that supplies the commercial power supply 12 input to the L terminal (fourth terminal) 24 and the N terminal (fifth terminal) 25 to the outdoor unit 2 via the relay 11.

[0015] The outdoor unit 2 includes an outdoor-unit-side control board 4 and an outdoor-unit-side terminal block 6. The outdoor-unit-side control board 4 includes an outdoor-unit-side power-supply control circuit 8 and an outdoor-unit-side communication circuit 10.

[0016] The outdoor-unit-side terminal block 6 includes an L1 terminal (sixth terminal) 26 that is connected to the ungrounded-side power-supply input terminal of the outdoor-unit-side power-supply control circuit 8; an N1 terminal (seventh terminal) 27 that is connected to the grounded-side power-supply input terminal of the outdoor-unit-side power-supply control circuit 8; an S3' terminal (eighth terminal) 28 that is connected to the grounded-side power-supply input terminal of the outdoor-unit-side power-supply control circuit 8 via the outdoor-unit-side communication circuit 10; an L2 terminal (ninth terminal) 29 that is connected to the L1 terminal 26; and an N2 terminal (tenth terminal) 30 that is connected to the N1 terminal 27.

[0017] When the air conditioner according to the first embodiment is operated under the indoor-unit power receiving system, the commercial power supply 12 is input to the L1 terminal (sixth terminal) 26 and the N1 terminal (seventh terminal) 27 via the indoor unit 1. When the air conditioner according to the first embodiment is operated under the outdoor-unit power receiving system, the L1 terminal (sixth terminal) 26 and the N1 terminal (seventh terminal) 27 form a pair of commercial-power-supply input terminals to which the commercial power supply 12 is connected. When the air conditioner according to the first embodiment is operated under the outdoor-unit power receiving system, the L2 terminal (ninth terminal) 29 and the N2 terminal (tenth terminal) 30 form a pair of commercial-power-supply output terminals that supplies the commercial power supply 12 input to the L1 terminal (sixth terminal) 26 and the N1 terminal (seventh terminal) 27 to the indoor unit 1.

[0018] The example illustrated in FIG. 1 illustrates an example of wiring of the indoor-unit power receiving system as described above. The commercial power supply 12 is connected between the L terminal 24 and the N terminal 25 on the indoor unit 1 side; the S1 terminal 21 on the indoor unit 1 side and the L1 terminal 26 on the outdoor unit 2 side are connected by a power line 13; the S2 terminal 22 on the indoor unit 1 side and the N1 terminal 27 on the outdoor unit 2 side are connected by a power-supply and communication common line 14; and the S3 terminal 23 on the indoor unit 1 side and the S3' terminal 28 on the outdoor unit 2 side are connected by a communication line 15. With such connections, the power supplied between the L terminal 24 and the N terminal 25 of the indoor-unit-side terminal block 5 from the commercial power supply 12 is supplied to the indoor-unit-side power-supply control circuit 7 and the power is also supplied to the outdoor-unit-side power-supply control circuit 8 via the power line 13 and the power-supply and communication common line 14 by the indoor-unit-side power-supply control circuit 7 closing the relay 11. The outdoor-unit-side power-supply control circuit 8 generates power for communication between the indoor unit 1 and the outdoor unit 2 and the power for communication generated by the outdoor-unit-side power-supply control circuit 8 is supplied to the loop (hereinafter, referred to as a "communication loop") formed by the indoor-unit-side communication circuit 9, the outdoor-unit-side communication circuit 10, the power-supply and communication common line 14, and the communication line 15 via the outdoor-unit-side communication circuit 10, whereby communication is established between the indoor-unit-side communication circuit 9 and the outdoor-unit-side communication circuit 10. Therefore, the operation of the air conditioner under the indoor-unit power receiving system is enabled.

[0019] The example illustrated in FIG. 2 illustrates an example of wiring of the outdoor-unit power receiving system as described above. The commercial power supply 12 is connected between the L1 terminal 26 and the N1 terminal 27 on the outdoor unit 2 side; the L terminal 24 on the indoor unit 1 side and the L2 terminal 29 on the outdoor unit 2 side are connected by the power line 13; the N terminal 25 on the indoor unit 1 side and the N2 terminal 30 on the outdoor unit 2 side are connected by the power-supply and communication common line 14; and the S3 terminal 23 on the indoor unit 1 side and the S3' terminal 28 on the outdoor unit 2 side are connected by the communication line 15. With such connections, the power supplied between the L1 terminal 26 and the N1 terminal 27 of the outdoor-unit-side terminal block 6 from the commercial power supply 12 is supplied to the outdoor-unit-side power-supply control circuit 8 and the power is also supplied to the indoor-unit-side power-supply control circuit 7 via the power line 13 and the power-supply and communication common line 14. In a similar manner to the case of the indoor-unit power receiving system, the outdoor-unit-side power-supply control circuit 8 generates power for communication between the indoor unit 1 and the outdoor unit 2 and the power for communication generated by the outdoor-unit-side power-supply control circuit 8 is supplied to the communication loop formed by the indoor-unit-side communication circuit 9, the outdoor-unit-side communication circuit 10, the power-supply and communication common line 14, and the communication line 15 via the outdoor-unit-side communication circuit 10, whereby communication is established between the indoor-unit-side communication circuit 9 and the outdoor-unit-side communication circuit 10. Therefore, the operation of the air conditioner under the indoor-unit power receiving system is enabled.

[0020] FIG. 3 is a front view of a cable receptacle of the indoor-unit-side terminal block of the air conditioner according to the first embodiment. As illustrated in FIG. 3, in the present embodiment, the S1 terminal 21, the S2 terminal 22, the S3 terminal 23, the N terminal 25, and the L terminal 24 are sequentially arranged from the left in the order that they appear in this sentence when viewed from the front side of the cable receptacle of the indoor-unit-side terminal block 5. As the terminals 21 to 25 are arranged in such an order, it is satisfactory that the commercial power supply 12 is connected to the two terminals on the right side when viewed from the front side of the cable receptacle of the indoor-unit-side terminal block 5, and the power line 13, the power-supply and communication common line 14, and the communication line 15 are connected to the three terminals on the left side when viewed from the front side of the cable receptacle of the indoor-unit-side terminal block 5. Furthermore, for example, the terminals 21 to 23 and the terminals 24 and 25 may be arranged spaced apart from each other or may be color-coded on the indoor-unit-side terminal block 5 to clearly distinguish between the terminals 21 to 23 and the terminals 24 and 25. When the terminals 21 to 23 and the terminals 24 and 25 are arranged such that they are explicitly distinguished, the occurrence of faulty wiring can be prevented.

[0021] Next, with reference to FIG. 1 to FIG. 4, an explanation will be made of a control process flow when the indoor unit starts to receive power in the indoor-unit power receiving system of the air conditioner according to the first embodiment. FIG. 4 is a diagram illustrating one example of a control process flow when the indoor unit starts to receive power in the indoor-unit power receiving system of the air conditioner according to the first embodiment.

[0022] As described above, communication between the indoor-unit-side communication circuit 9 and the outdoor-unit-side communication circuit 10 in the indoor-unit power receiving system of the air conditioner according to the first embodiment is established by supplying power for communication generated by the outdoor-unit-side power-supply control circuit 8 to the communication loop formed by the indoor-unit-side communication circuit 9, the outdoor-unit-side communication circuit 10, the power-supply and communication common line 14, and the communication line 15. When AC power starts to be supplied from the commercial power supply 12 to the indoor unit 1 via the L terminal 24 and the N terminal 25 of the indoor-unit-side terminal block 5 (Step ST101), the indoor-unit-side power-supply control circuit 7 closes the relay 11 to start feeding power to the outdoor unit 2 after a predetermined time (for example, three minutes) has elapsed from when the feeding of power to the indoor unit 1 is started (Step ST102).

[0023] When the feeding of power to the outdoor unit 2 is started, the indoor-unit-side power-supply control circuit 7 enters a communication standby state (Step ST103) and the outdoor-unit-side communication circuit 10 starts communication with the indoor-unit-side communication circuit 9. The indoor-unit-side power-supply control circuit 7 determines whether communication between the indoor-unit-side communication circuit 9 and the outdoor-unit-side communication circuit 10 is established before a predetermined time (for example, three seconds) has elapsed after the feeding of power to the outdoor unit 2 is started (Step ST104).

[0024] If communication between the indoor-unit-side communication circuit 9 and the outdoor-unit-side communication circuit 10 is established before the predetermined time (three seconds in this example) has elapsed after the feeding of power to the outdoor unit 2 is started (Yes in Step ST104), the outdoor-unit-side power-supply control circuit 8 starts an operation of the outdoor unit 2 (Step ST105) and the control process flow ends.

[0025] If communication between the indoor-unit-side communication circuit 9 and the outdoor-unit-side communication circuit 10 is not established before the predetermined time (three seconds in this example) has elapsed after the feeding of power to the outdoor unit 2 is started (No in Step ST104), the indoor-unit-side power-supply control circuit 7 determines that a communication error has occurred (Step ST106) and opens the relay 11 to stop feeding power to the outdoor unit 2 (Step ST107), and the control process flow ends.

[0026] Next, with reference to FIG. 1 and FIG. 4 to FIG. 9, an explanation will be made of examples of faulty wiring between the indoor unit 1 and the outdoor unit 2 in the indoor-unit power receiving system of the air conditioner according to the first embodiment.

[0027] FIG. 5 is a diagram illustrating a first example of faulty wiring between the indoor unit and the outdoor unit in the indoor-unit power receiving system of the air conditioner according to the first embodiment. FIG. 6 is a diagram illustrating a second example of faulty wiring between the indoor unit and the outdoor unit in the indoor-unit power receiving system of the air conditioner according to the first embodiment. FIG. 7 is a diagram illustrating a third example of faulty wiring between the indoor unit and the outdoor unit in the indoor-unit power receiving system of the air conditioner according to the first embodiment. FIG. 8 is a diagram illustrating a fourth example of faulty wiring between the indoor unit and the outdoor unit in the indoor-unit power receiving system of the air conditioner according to the first embodiment. FIG. 9 is a diagram illustrating a fifth example of faulty wiring between the indoor unit and the outdoor unit in the indoor-unit power receiving system of the air conditioner according to the first embodiment. As illustrated in FIG. 5 to FIG. 9, there are five faulty wiring patterns between the indoor-unit-side terminal block 5 and the outdoor-unit-side terminal block 6 in the indoor-unit power receiving system of the air conditioner according to the present embodiment.

[0028] In the example illustrated in FIG. 5, although the connection of the grounded-side power-supply input terminal and the ungrounded-side power-supply input

terminal of the outdoor-unit-side power-supply control circuit 8 is reversed, the feeding of power to the outdoor unit 2 is performed in a similar manner to the case of the normal wiring illustrated in FIG. 1. However, because the communication loop between the indoor-unit-side communication circuit 9 and the outdoor-unit-side communication circuit 10 is not formed, communication is not established even if the indoor-unit-side power-supply control circuit 7 closes the relay 11 to start feeding power to the outdoor unit 2 (Step ST102 in FIG. 4) (No in Step ST104 in FIG. 4). Consequently, a communication error occurs (Step ST106 in FIG. 4), and the relay 11 is opened by the indoor-unit-side power-supply control circuit 7 and the feeding of power to the outdoor unit 2 is stopped (Step ST107 in FIG. 4). As described above, in the example of faulty wiring illustrated in FIG. 5, even if a connection technician starts feeding power to the indoor unit 1 when the air conditioner is installed, the operation of the outdoor unit 2 is not started and thus an air-conditioning operation cannot be performed. Therefore, it is possible to cause the connection technician to recognize faulty wiring.

[0029] In any of the examples illustrated in FIG. 6 to FIG. 9, power is not supplied normally from the commercial power supply 12 to the outdoor-unit-side power-supply control circuit 8, which generates power for communication necessary for communication, via the indoor unit 1 and thus communication cannot be started. Therefore, even if the indoor-unit-side power-supply control circuit 7 closes the relay 11 to start feeding power to the outdoor unit 2 (Step ST102 in FIG. 4), communication is not established (No in Step ST104 in FIG. 4). Consequently, a communication error occurs (Step ST106 in FIG. 4), and the relay 11 is opened by the indoor-unit-side power-supply control circuit 7 and the feeding of power to the outdoor unit 2 is stopped. As described above, in the examples of faulty wiring illustrated in FIGS. 6 to 9 also, even if a connection technician starts feeding power to the indoor unit 1 when the air conditioner is installed, the operation of the outdoor unit 2 is not started and thus an air-conditioning operation cannot be performed. Therefore, it is possible to cause the connection technician to recognize faulty wiring.

[0030] As described above, when the air conditioner according to the present embodiment is operated under the indoor-unit power receiving system, an air-conditioning operation is not performed if there is a faulty wiring pattern. Therefore, it is possible to cause a connection technician to recognize faulty wiring.

[0031] Next, with reference to FIG. 2 and FIG. 10, an explanation will be made of a control process flow when the outdoor unit starts to receive power in the outdoor-unit power receiving system of the air conditioner according to the first embodiment. FIG. 10 is a diagram illustrating one example of a control process flow when the outdoor unit starts to receive power in the outdoor-unit power receiving system of the air conditioner according to the first embodiment.

[0032] As described above, in a similar manner to the case of the indoor-unit power receiving system, communication between the indoor-unit-side communication circuit 9 and the outdoor-unit-side communication circuit 10 in the outdoor-unit power receiving system of the air conditioner according to the first embodiment is established by supplying power for communication generated by the outdoor-unit-side power-supply control circuit 8 to the communication loop formed by the indoor-unit-side communication circuit 9, the outdoor-unit-side communication circuit 10, the power-supply and communication common line 14, and the communication line 15. When AC power starts to be supplied from the commercial power supply 12 to the outdoor unit 2 via the L1 terminal 26 and the N1 terminal 27 of the outdoor-unit-side terminal block 6, the feeding of power to the indoor unit 1 is also started at the same time (Step ST201), and the outdoor-unit-side communication circuit 10 starts communication with the indoor-unit-side communication circuit 9 (Step ST202).

[0033] When the feeding of power to the indoor unit 1 is started, the indoor-unit-side power-supply control circuit 7 enters a communication standby state (Step ST203) and determines whether communication between the indoor-unit-side communication circuit 9 and the outdoor-unit-side communication circuit 10 is established before a predetermined time (for example, three seconds) has elapsed after the feeding of power to the indoor unit 1 is started (Step ST204).

[0034] If communication between the indoor-unit-side communication circuit 9 and the outdoor-unit-side communication circuit 10 is established before the predetermined time (three seconds in this example) has elapsed after the feeding of power to the indoor unit 1 is started (Yes in Step ST204), the outdoor-unit-side power-supply control circuit 8 starts an operation of the outdoor unit 2 in response to the operation start request from the indoor-unit-side power-supply control circuit 7 (Step ST205) and the control process flow ends.

[0035] If communication between the indoor-unit-side communication circuit 9 and the outdoor-unit-side communication circuit 10 is not established before the predetermined time (three seconds in this example) has elapsed after the feeding of power to the indoor unit 1 is started (No in Step ST204), the outdoor-unit-side power-supply control circuit 8 determines that a communication error has occurred (Step ST206) and performs a process of refusing the operation start request from the indoor-unit-side power-supply control circuit 7 (Step ST207), and the control process flow ends.

[0036] Next, with reference to FIG. 2 and FIG. 10 to FIG. 16, an explanation will be made of examples of faulty wiring between the indoor unit 1 and the outdoor unit 2 in the outdoor-unit power receiving system of the air conditioner according to the first embodiment.

[0037] FIG. 11 is a diagram illustrating a first example of faulty wiring between the indoor unit and the outdoor unit in the outdoor-unit power receiving system of the air

conditioner according to the first embodiment. FIG. 12 is a diagram illustrating a second example of faulty wiring between the indoor unit and the outdoor unit in the outdoor-unit power receiving system of the air conditioner according to the first embodiment. FIG. 13 is a diagram illustrating a third example of faulty wiring between the indoor unit and the outdoor unit in the outdoor-unit power receiving system of the air conditioner according to the first embodiment. FIG. 14 is a diagram illustrating a fourth example of faulty wiring between the indoor unit and the outdoor unit in the outdoor-unit power receiving system of the air conditioner according to the first embodiment. FIG. 15 is a diagram illustrating a fifth example of faulty wiring between the indoor unit and the outdoor unit in the outdoor-unit power receiving system of the air conditioner according to the first embodiment. FIG. 16 is a diagram illustrating a sixth example of faulty wiring between the indoor unit and the outdoor unit in the outdoor-unit power receiving system of the air conditioner according to the first embodiment. FIG. 11 to FIG. 16 illustrate six typical patterns among a plurality of kinds of faulty wiring patterns between the indoor-unit-side terminal block 5 and the outdoor-unit-side terminal block 6 that can be dealt with on the device side in the outdoor-unit power receiving system of the air conditioner according to the present embodiment. In a faulty wiring pattern in which the commercial power supply 12 becomes short-circuited, such as when the L2 terminal 29 of the outdoor-unit-side terminal block 6 and the S2 terminal 22 of the indoor-unit-side terminal block 5 are erroneously connected together, a breaker for a premises wiring or the like is blown; therefore, an explanation thereof is omitted here.

[0038] In the example illustrated in FIG. 11, although the connection of the grounded-side power-supply input terminal and the ungrounded-side power-supply input terminal of the indoor-unit-side power-supply control circuit 7 is reversed, the feeding of power to the outdoor unit 2 is performed in a similar manner to the case of the normal wiring illustrated in FIG. 2. Moreover, in the example illustrated in FIG. 12, a pair of power feeding terminals for the indoor-unit-side power-supply control circuit 7 is the same as that in the normal wiring illustrated in FIG. 2; therefore, the feeding of power to the outdoor unit 2 is performed normally. However, because the communication loop between the indoor-unit-side communication circuit 9 and the outdoor-unit-side communication circuit 10 is not formed, communication is not established even if communication with respect to the indoor-unit-side communication circuit 9 is started from the outdoor-unit-side communication circuit 10 (Step ST202 in FIG. 10) (No in Step ST204 in FIG. 10). Consequently, a communication error occurs (Step ST206 in FIG. 10) and a process of refusing the operation start request from the indoor-unit-side power-supply control circuit 7 is performed (Step ST207). As described above, in the examples of faulty wiring illustrated in FIG. 11 and FIG. 12, even if a connection technician starts feeding power to the outdoor unit 2 when the air conditioner is installed and the operation start request is issued from the indoor unit 1, the operation of the outdoor unit 2 is not started and thus an air-conditioning operation cannot be performed. Therefore, it is possible to cause the connection technician to recognize faulty wiring.

[0039] In any of the examples illustrated in FIG. 13 to FIG. 16, a voltage lower than the commercial power supply 12 is input to the indoor-unit-side power-supply control circuit 7; therefore, the voltage is not sufficient for controlling the indoor unit 1 and thus the indoor unit 1 does not operate. As described above, in the examples of faulty wiring illustrated in FIGS. 13 to 16, even if a connection technician starts feeding power to the outdoor unit 2 when the air conditioner is installed, the operation of the indoor unit 1 is not started and thus an air-conditioning operation cannot be performed. Therefore, it is possible to cause the connection technician to recognize faulty wiring.

[0040] As above, when the air conditioner according to the present embodiment is operated under the outdoor-unit power receiving system, in a similar manner to the case of operating the air conditioner under the indoor-unit power receiving system, an air-conditioning operation is not performed if there is a faulty wiring pattern. Therefore, it is possible to cause a connection technician to recognize faulty wiring.

[0041] As described above, according to the air conditioner in the first embodiment, the indoor unit includes the L terminal (fourth terminal) and the N terminal (fifth terminal), to which the commercial power supply is connected when operating under the indoor-unit power receiving system and which form a pair of commercial-power-supply input terminals, to which the commercial power supply is input via the outdoor unit, when operating under the outdoor-unit power receiving system, and the S1 terminal (first terminal) and the S2 terminal (second terminal), which form a pair of commercial-power-supply output terminals, which supplies the commercial power supply input to the L terminal (fourth terminal) and the N terminal (fifth terminal) to the outdoor unit via the relay, when operating under the indoor-unit power receiving system, the outdoor unit includes the L1 terminal (sixth terminal) and the N1 terminal (seventh terminal), to which the commercial power supply is input via the indoor unit when operating under the indoor-unit power receiving system and which form a pair of commercial-power-supply input terminals, to which the commercial power supply is input, when operating under the outdoor-unit power receiving system, and the L2 terminal (ninth terminal) and the N2 terminal (tenth terminal), which form a pair of commercial-power-supply output terminals, which supplies the commercial power supply input to the L1 terminal (sixth terminal) and the N1 terminal (seventh terminal) to the indoor unit, when operating under the outdoor-unit power receiving system. Therefore, the air conditioner can use both the indoor-unit power receiving system and the outdoor-unit power receiving system. Moreover, in the indoor-unit power receiving system,

standby power can be reduced by stopping the feeding of power to the outdoor unit by opening the relay.

[0042] Moreover, the indoor-unit-side communication circuit and the outdoor-unit-side communication circuit are included that, when the connection between the outdoor unit and the indoor unit is normal, form a communication loop between the indoor unit and the outdoor unit, and the communication loop is formed by the indoor-unit-side communication circuit, the outdoor-unit-side communication circuit, the power-supply and communication common line, and the communication line, whereby communication is established between the indoor-unit-side communication circuit and the outdoor-unit-side communication circuit, thereby performing an operation under the indoor-unit power receiving system or the outdoor-unit power receiving system. When operating under the indoor-unit power receiving system, if the communication loop is not formed within a predetermined time after the feeding of the commercial power supply to the outdoor unit is started and communication is not established between the indoor-unit-side communication circuit and the outdoor-unit-side communication circuit, the feeding of the commercial power supply to the outdoor unit is stopped by having the relay opened. When operating under the outdoor-unit power receiving system, if the communication loop is not formed within a predetermined time after the feeding of the commercial power supply to the indoor unit is started and communication is not established between the indoor-unit-side communication circuit and the outdoor-unit-side communication circuit, a process of refusing the operation start request from the indoor-unit-side power-supply control circuit is performed. Thus, when faulty wiring occurs between the indoor unit and the outdoor unit, an air-conditioning operation cannot be performed. Therefore, it is possible to cause a connection technician to recognize faulty wiring.

[0043] Moreover, the S1 terminal (first terminal), the S2 terminal (second terminal), the S3 terminal (third terminal), the N terminal (fifth terminal), and the L terminal (fourth terminal) are sequentially arranged from the left in the order that they appear in this sentence when viewed from the front side of the cable receptacle of the indoor-unit-side terminal block. Therefore, it is satisfactory that the commercial power supply is connected to the two terminals on the right side when viewed from the front side of the cable receptacle of the indoor-unit-side terminal block, and the power line, the power-supply and communication common line, and the communication line are connected to the three terminals on the left side when viewed from the front side of the cable receptacle of the indoor-unit-side terminal block. Furthermore, for example, if the terminal group including the S1 terminal (first terminal), the S2 terminal (second terminal), and the S3 terminal (third terminal), and the terminal group including the N terminal (fifth terminal) and the L terminal (fourth terminal) are arranged spaced apart from each other or are color-coded on the indoor-unit-side terminal block to explicitly distinguish between the terminal group including the S1 terminal (first terminal), the S2 terminal (second terminal), and the S3 terminal (third terminal), and the terminal group including the N terminal (fifth terminal) and the L terminal (fourth terminal), the occurrence of faulty wiring can be prevented.

Second Embodiment

[0044] FIG. 17 is a diagram illustrating one example configuration on an indoor unit side of an air conditioner according to the second embodiment and FIG. 18 is a diagram illustrating one example of an indoor-unit-side terminal block of the air conditioner according to the second embodiment. The components that are the same as or similar to those of the first embodiment are denoted by the same reference numerals and a detailed explanation thereof is omitted.

[0045] In the present embodiment, as illustrated in FIG. 17, a thermal fuse 16 is connected in series between the S2 terminal (second terminal) 22 and the grounded-side power-supply input terminal of the indoor-unit-side power-supply control circuit 7 and, as illustrated in FIG. 18, the thermal fuse 16 is arranged such that it is blown due to the heat generated in the indoor-unit-side terminal block 5.

[0046] When the indoor-unit-side terminal block 5 generates abnormal heat due to a poor connection of the power line or the like, the thermal fuse 16 arranged on the indoor-unit-side terminal block 5 is blown due to the heat generated in the indoor-unit-side terminal block 5. Consequently, the power supply loop is cut regardless of which one of the indoor-unit power receiving system and the outdoor-unit power receiving system is used to operate the air conditioner. Therefore, when the indoor-unit-side terminal block 5 generates abnormal heat, the feeding of power from the commercial power supply 12 to the indoor unit 1 can be stopped.

[0047] As described above, according to the air conditioner in the second embodiment, the thermal fuse, which is connected in series between the S2 terminal (second terminal) and the grounded-side power-supply input terminal of the indoor-unit-side power-supply control circuit, is arranged on the indoor-unit-side terminal block; therefore, when the indoor-unit-side terminal block generates abnormal heat due to a poor connection of the power line or the like, the thermal fuse is blown. Therefore, the feeding of the commercial power supply to the indoor unit can be stopped regardless of which one of the indoor-unit power receiving system and the outdoor-unit power receiving system is used to operate the air conditioner.

[0048] In the above embodiments, an explanation is made of a case of a single connection configuration in which one indoor unit is connected to one outdoor unit; however, it is obvious that the same effect can be obtained even with a multiple connection configuration in which a plurality of indoor units are connected to one outdoor unit.

[0049] Moreover, the configurations illustrated in the above embodiments are examples of the configuration of the present invention and it is obvious that the configurations can be combined with other publicly known technologies and the configurations can be changed, for example, by omitting a part thereof without departing from the scope of the present invention.

[0050] According to the present invention, an effect is obtained where both the indoor-unit power receiving system and the outdoor-unit power receiving system are used and, in the indoor-unit power receiving system, a reduction in standby power can be realized by stopping the feeding of power to the outdoor unit.

[0051] Although the invention has been described with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching herein set forth.

Claims

1. An air conditioner that includes an indoor unit (1) and an outdoor unit (2), and includes a relay (11) on the indoor unit side, the relay being capable of interrupting supply of a commercial power supply (12) from the indoor unit to the outdoor unit, wherein
the indoor unit includes
a pair of commercial-power-supply input terminals (24, 25), to which the commercial power supply is connected when operating under an indoor-unit power receiving system, in which the commercial power supply supplied to the indoor unit is supplied to the outdoor unit, and to which the commercial power supply is supplied via the outdoor unit when operating under an outdoor-unit power receiving system, in which the commercial power supply supplied to the outdoor unit is supplied to the indoor unit, and
a pair of commercial-power-supply output terminals (21, 22) that supplies the commercial power supply connected to the pair of commercial-power-supply input terminals to the outdoor unit via the relay when operating under the indoor-unit power receiving system.

2. The air conditioner according to claim 1, wherein
the outdoor unit (2) includes
a pair of commercial-power-supply input terminals (26, 27), to which the commercial power supply supplied from the indoor unit is supplied when operating under the indoor-unit power receiving system and to which the commercial power supply is connected when operating under the outdoor-unit power receiving system, and
a pair of commercial-power-supply output terminals (29, 30) that supplies the commercial power supply connected to the pair of commercial-power-supply input terminals to the indoor unit when operating under the outdoor-unit power receiving system.

3. An air conditioner that includes an indoor unit (1) and an outdoor unit (2), and includes a relay (11) on the indoor unit side, the relay being capable of interrupting supply of a commercial power supply (12) from the indoor unit to the outdoor unit, wherein
the indoor unit includes
a pair of commercial-power-supply input terminals (24, 25), and
a pair of commercial-power-supply output terminals (21, 22) that supplies the commercial power supply to the outdoor unit via the relay,
the outdoor unit includes
a pair of commercial-power-supply input terminals (26, 27), and
a pair of commercial-power-supply output terminals (29, 30) that supplies the commercial power supply to the indoor unit,
the air conditioner uses an indoor-unit power receiving system, in which the commercial power supply supplied to the indoor unit is supplied to the outdoor unit, by connecting the commercial power supply to the pair of commercial-power-supply input terminals on the indoor unit side and connecting the pair of commercial-power-supply output terminals on the indoor unit side and the pair of commercial-power-supply input terminals on the outdoor unit side, and
the air conditioner uses an outdoor-unit power receiving system, in which the commercial power supply supplied to the outdoor unit is supplied to the indoor unit, by connecting the commercial power supply to the pair of commercial-power-supply input terminals on the outdoor unit side and connecting the pair of commercial-power-supply output terminals on the outdoor unit side and the pair of commercial-power-supply input terminals on the indoor unit side.

4. The air conditioner according to claim 2 or 3, wherein
the indoor unit (1) includes
an indoor-unit-side power-supply control circuit (7) that performs power-supply control on the indoor unit side,
an indoor-unit-side communication circuit (9) that forms a communication loop between the indoor unit and the outdoor unit,
a first terminal (21) that is one of the commercial-power-supply output terminals on the indoor unit side and is connected to an ungrounded-side power-supply input terminal of the indoor-unit-side power-supply control circuit via the relay,
a second terminal (22) that is another of the commercial-power-supply output terminals on the indoor unit side and is connected to a grounded-side power-supply input terminal of the indoor-unit-side power-

supply control circuit,
a third terminal (23) that is connected to the grounded-side power-supply input terminal of the indoor-unit-side power-supply control circuit via the indoor-unit-side communication circuit,
a fourth terminal (24) that is one of the commercial-power-supply input terminals on the indoor unit side and is connected to the ungrounded-side power-supply input terminal of the indoor-unit-side power-supply control circuit, and
a fifth terminal (25) that is another of the commercial-power-supply input terminals on the indoor unit side and is connected to the second terminal,
the outdoor unit (2) includes
an outdoor-unit-side power-supply control circuit (8) that performs power-supply control on the outdoor unit side,
an outdoor-unit-side communication circuit (10) that forms a communication loop between the indoor unit and the outdoor unit,
a sixth terminal (26) that is one of the commercial-power-supply input terminals on the outdoor unit side and is connected to an ungrounded-side power-supply input terminal of the outdoor-unit-side power-supply control circuit,
a seventh terminal (27) that is another of the commercial-power-supply input terminals on the outdoor unit side and is connected to a grounded-side power-supply input terminal of the outdoor-unit-side power-supply control circuit,
an eighth terminal (28) that is connected to the grounded-side power-supply input terminal of the outdoor-unit-side power-supply control circuit via the outdoor-unit-side communication circuit,
a ninth terminal (29) that is one of the commercial-power-supply output terminals on the outdoor unit side and is connected to the sixth terminal, and
a tenth terminal (30) that is another of the commercial-power-supply output terminals on the outdoor unit side and is connected to the seventh terminal,
in the indoor-unit power receiving system,
the commercial power supply is connected between the fourth terminal and the fifth terminal,
the first terminal and the sixth terminal are connected by a power line (13),
the second terminal and the seventh terminal are connected by a power-supply and communication common line (14), and
the third terminal and the eighth terminal are connected by a communication line (15), and
in the outdoor-unit power receiving system,
the commercial power supply is connected between the sixth terminal and the seventh terminal,
the fourth terminal and the ninth terminal are connected by the power line,
the fifth terminal and the tenth terminal are connected by the power-supply and communication common line, and
the third terminal and the eighth terminal are connected by the communication line.

5. The air conditioner according to claim 4, wherein an operation under the indoor-unit power receiving system or the outdoor-unit power receiving system is performed by forming the communication loop by the indoor-unit-side communication circuit (9), the outdoor-unit-side communication circuit (10), the power-supply and communication common line (14), and the communication line (15) and establishing communication between the indoor-unit-side communication circuit and the indoor-unit-side communication circuit.

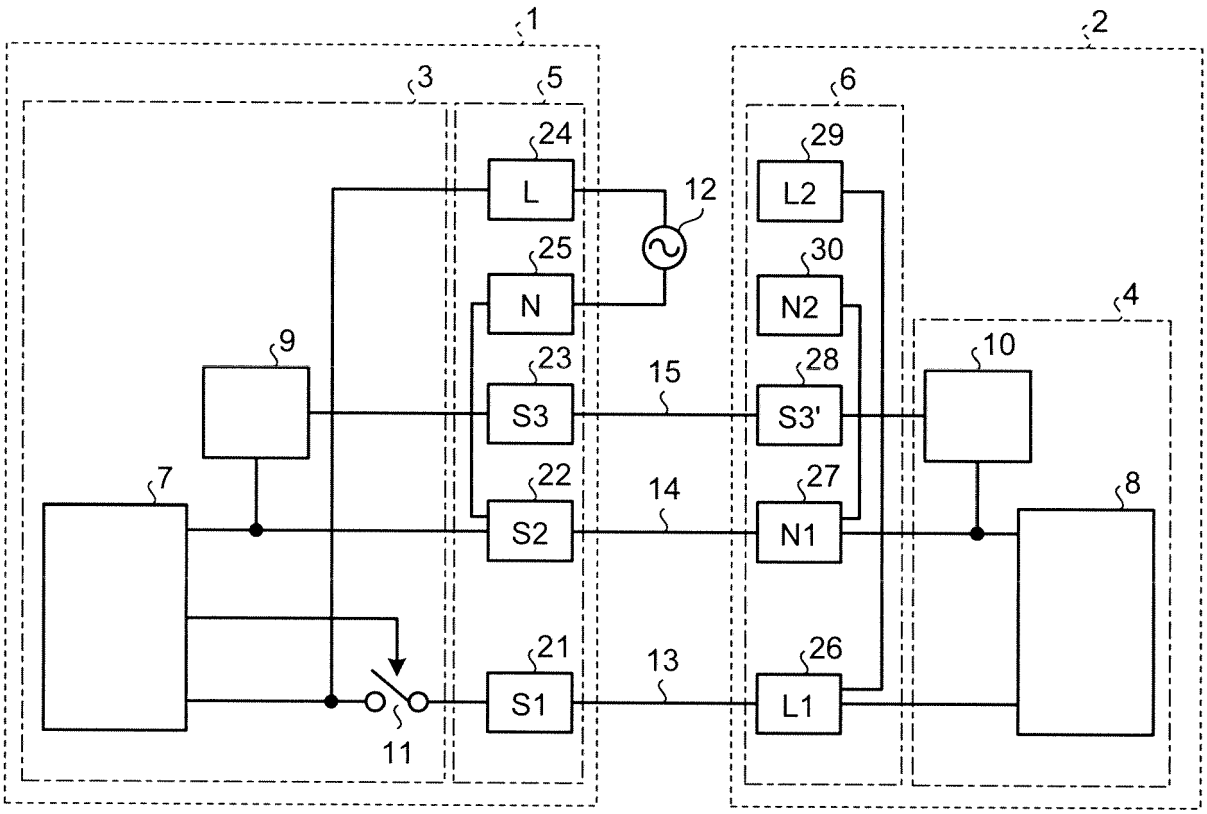
6. The air conditioner according to claim 5, wherein, in the indoor-unit power receiving system, if the communication loop is not formed within a predetermined time after feeding of the commercial power supply to the outdoor unit (2) is started and communication is not established between the indoor-unit-side communication circuit (9) and the outdoor-unit-side communication circuit (10), the indoor-unit-side power-supply control circuit (7) stops feeding the commercial power supply to the outdoor unit by opening the relay (11).

7. The air conditioner according to claim 5, wherein, in the outdoor-unit power receiving system, if the communication loop is not formed within a predetermined time after feeding of the commercial power supply to the indoor unit is started and communication is not established between the indoor-unit-side communication circuit (9) and the outdoor-unit-side communication circuit (10), the outdoor-unit-side power-supply control circuit (8) performs a process of refusing an operation start request from the indoor-unit-side power-supply control circuit (7).

8. The air conditioner according to any one of claims 4 to 7, wherein the first to third terminals (21, 22, 23) and the fourth to fifth terminals (24, 25) are arranged such that they are explicitly distinguished.

9. The air conditioner according to any one of claims 4 to 8, wherein a thermal fuse (16), which is connected in series between the second terminal (22) and the grounded-side power-supply input terminal of the indoor-unit-side power-supply control circuit (7), is arranged on an indoor-unit-side terminal block (5) on which the first to fifth terminals (21, 22, 23, 24, 25) are arranged.

FIG.1


1
2
3
5
6
24
L
29
L2
12
25
N
30
N2
4
9
23
S3
15
28
S3'
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7
22
S2
14
27
N1
8
21
S1
13
26
L1
11

FIG.2

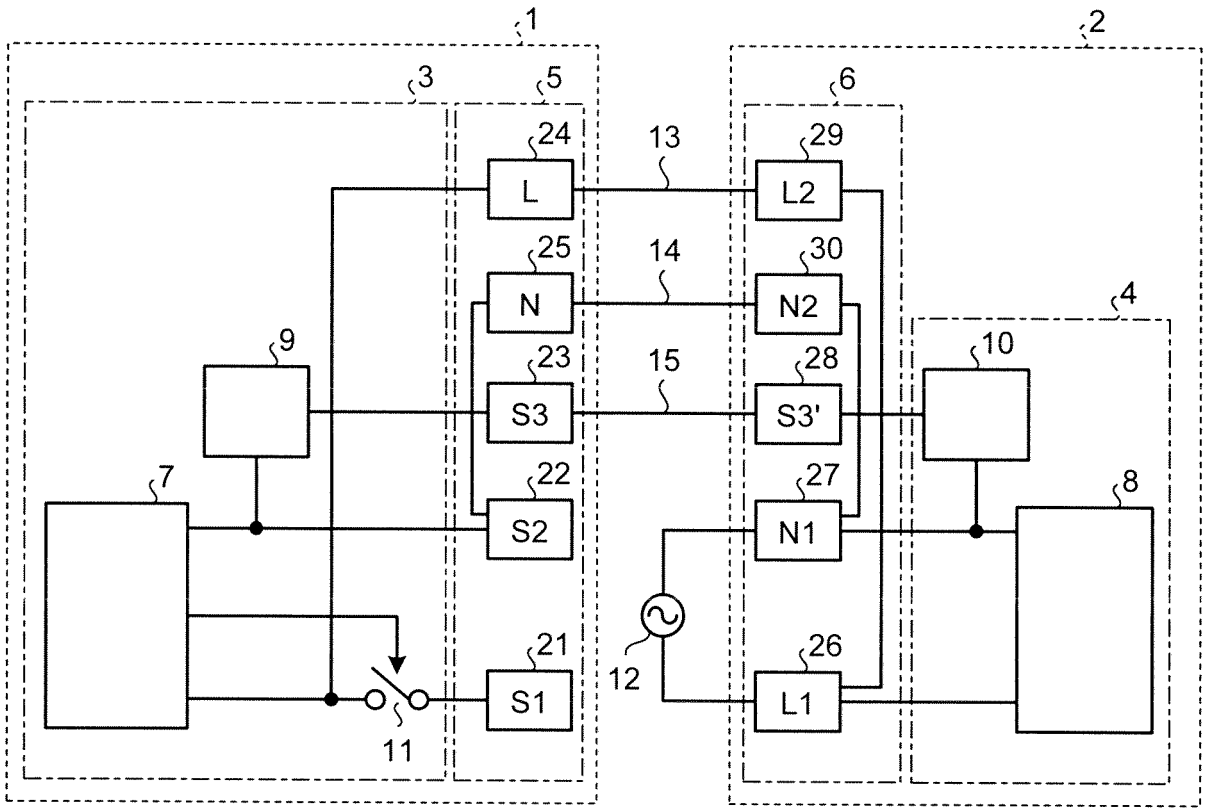

1
2
3
5
6
24
13
29
L
L2
25
14
30
N
N2
4
9
10
23
15
28
S3
S3'
7
22
27
8
S2
N1
12
21
26
S1
L1
11

FIG.3

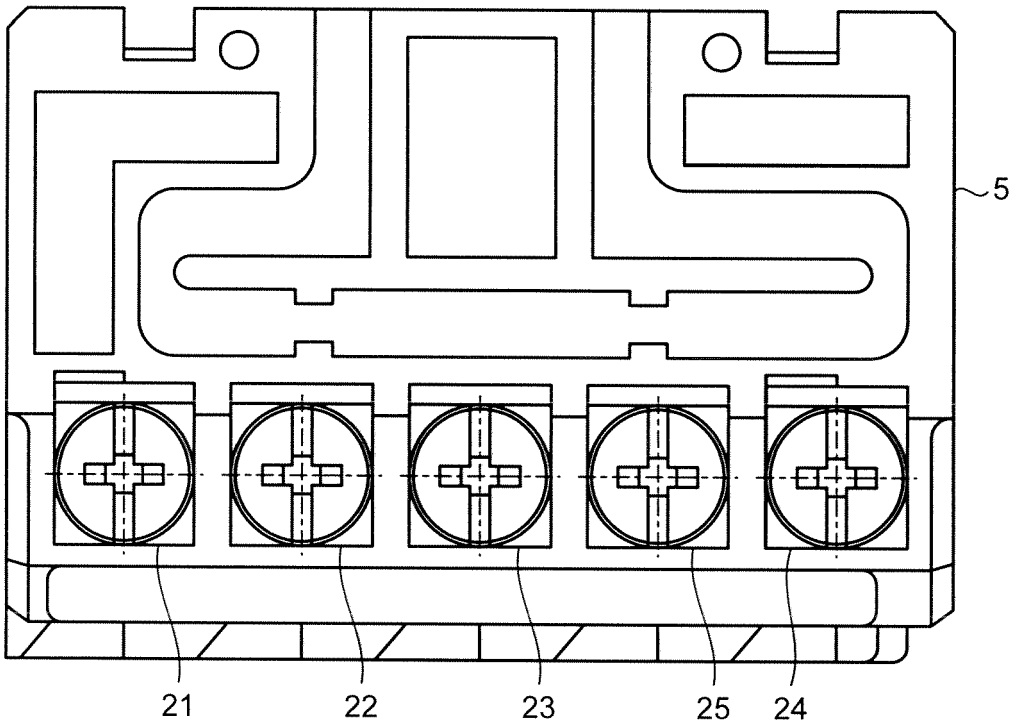


FIG.4

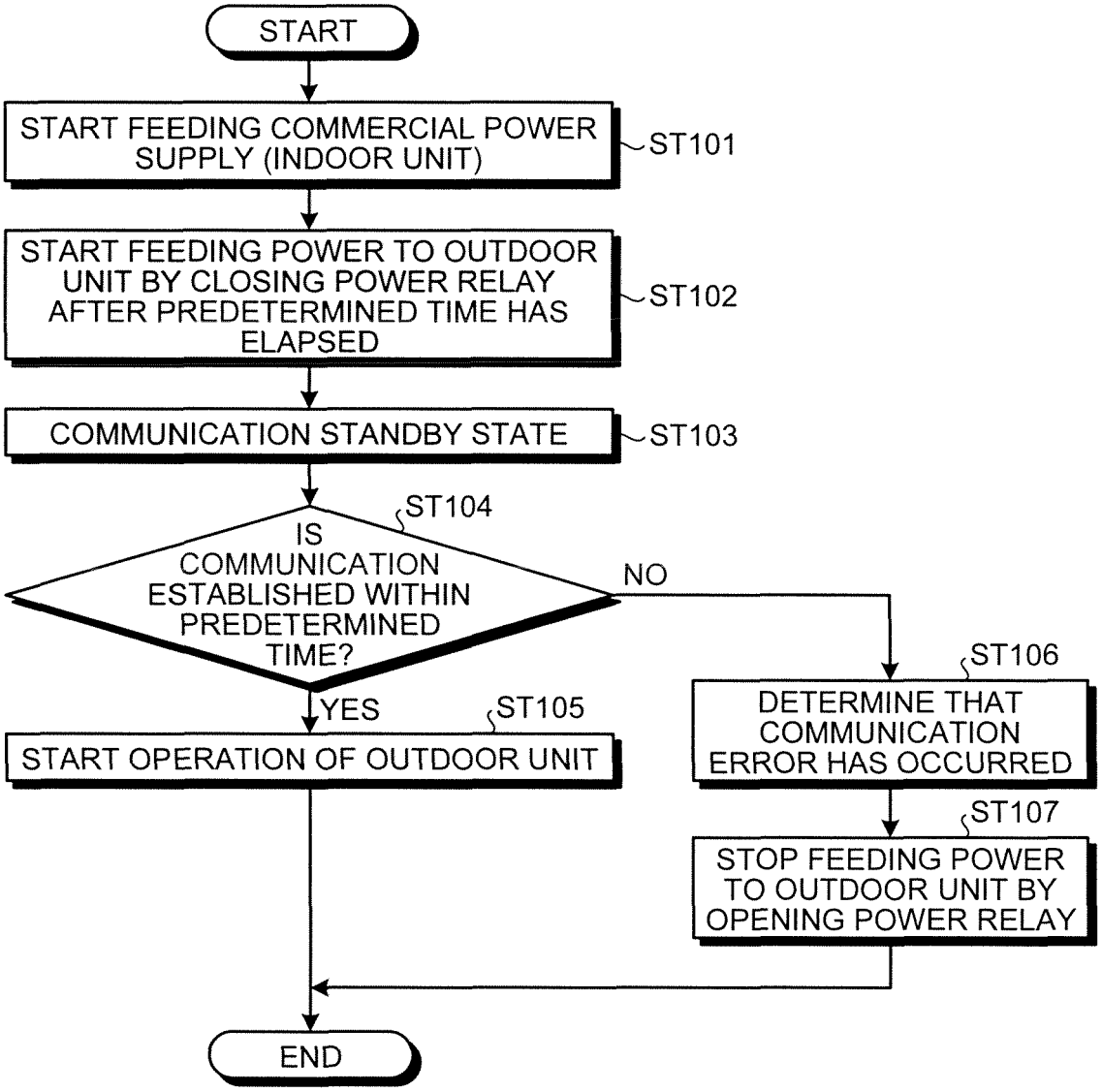
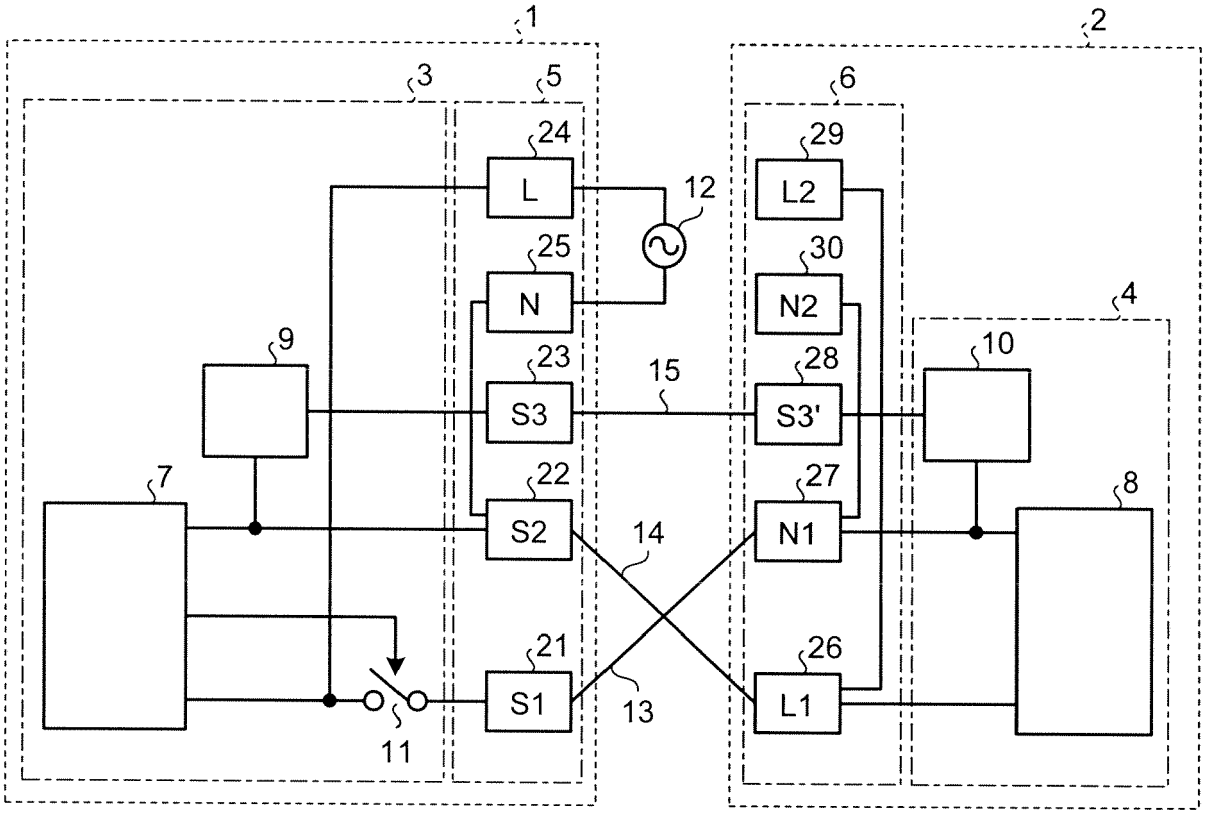

START
START FEEDING COMMERCIAL POWER SUPPLY (INDOOR UNIT)
ST101
START FEEDING POWER TO OUTDOOR UNIT BY CLOSING POWER RELAY AFTER PREDETERMINED TIME HAS ELAPSED
ST102
COMMUNICATION STANDBY STATE
ST103
ST104
IS COMMUNICATION ESTABLISHED WITHIN PREDETERMINED TIME?
NO
YES
ST105
START OPERATION OF OUTDOOR UNIT
ST106
DETERMINE THAT COMMUNICATION ERROR HAS OCCURRED
ST107
STOP FEEDING POWER TO OUTDOOR UNIT BY OPENING POWER RELAY
END

FIG.5


1
2
3
5
6
24
L
29
L2
12
25
N
30
N2
4
9
23
S3
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28
S3'
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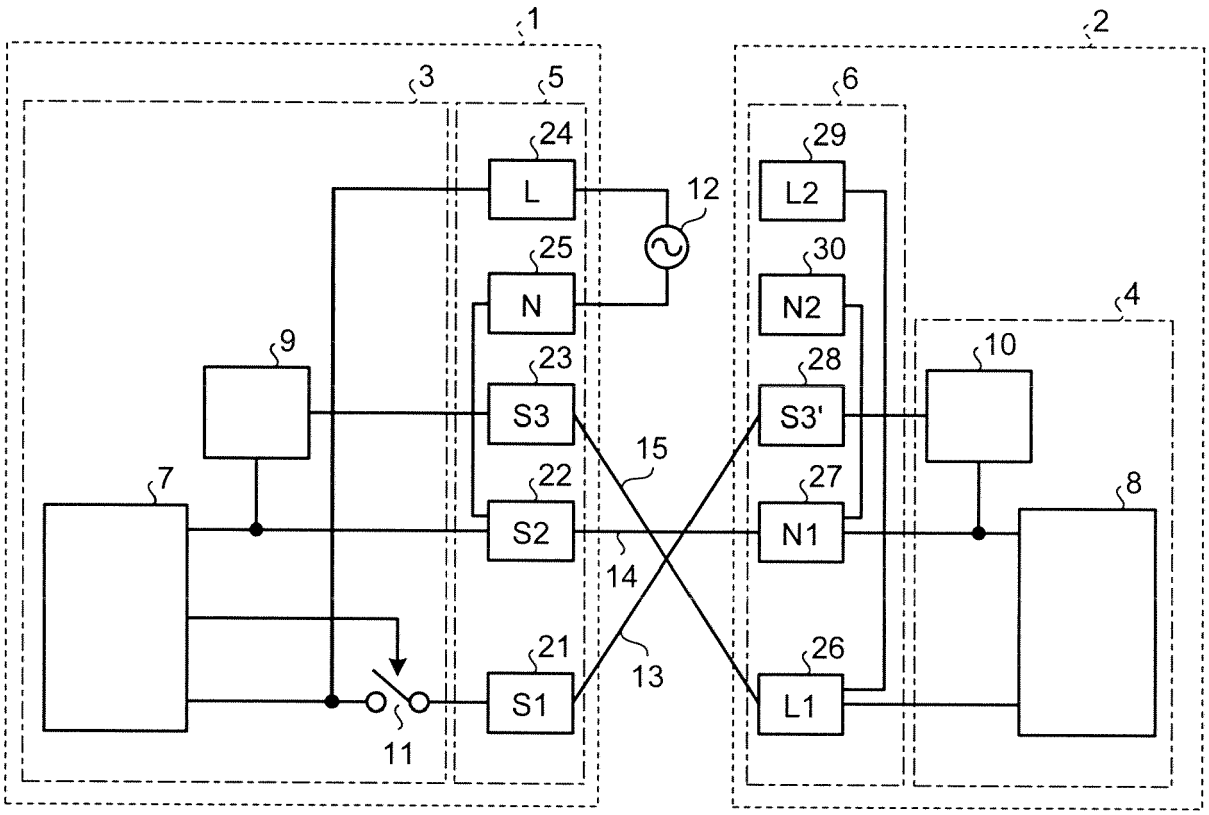
22
S2
14
27
N1
8
21
S1
13
26
L1
11

FIG.6


1
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24
L
29
L2
12
25
N
30
N2
4
9
23
S3
28
S3'
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7
22
S2
27
N1
8
14
21
S1
26
L1
13
11

FIG.7

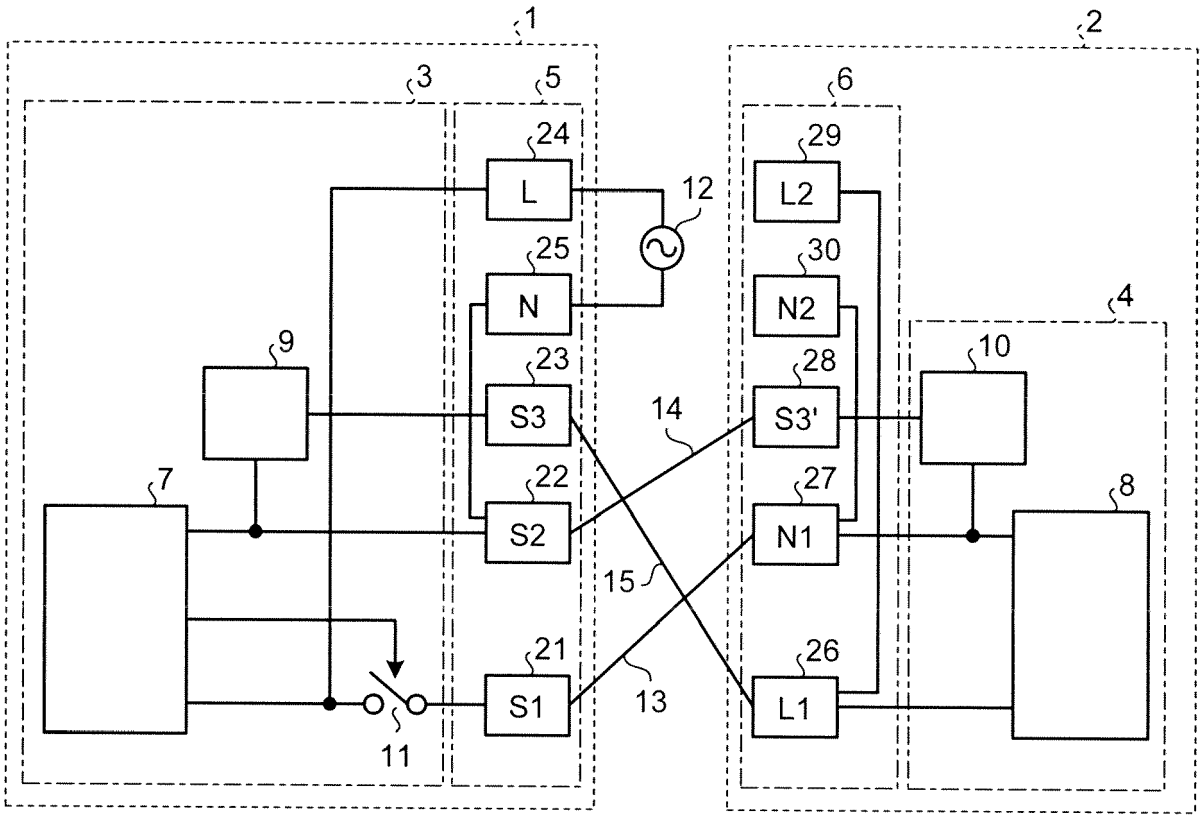
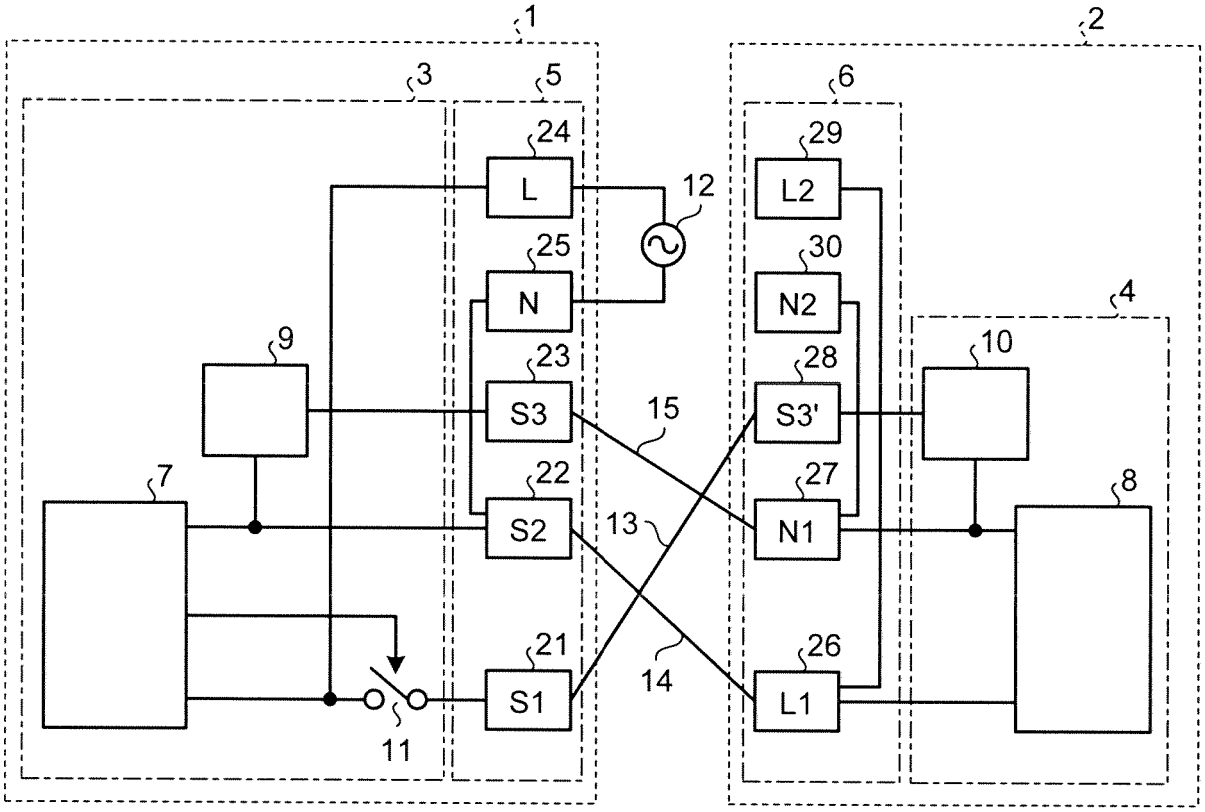

1
2
3
5
6
24
L
29
L2
12
25
N
30
N2
4
9
23
S3
28
S3'
10
14
7
22
S2
27
N1
8
15
21
S1
26
L1
13
11

FIG.8


1
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L
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L2
12
25
N
30
N2
4
9
10
23
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N1
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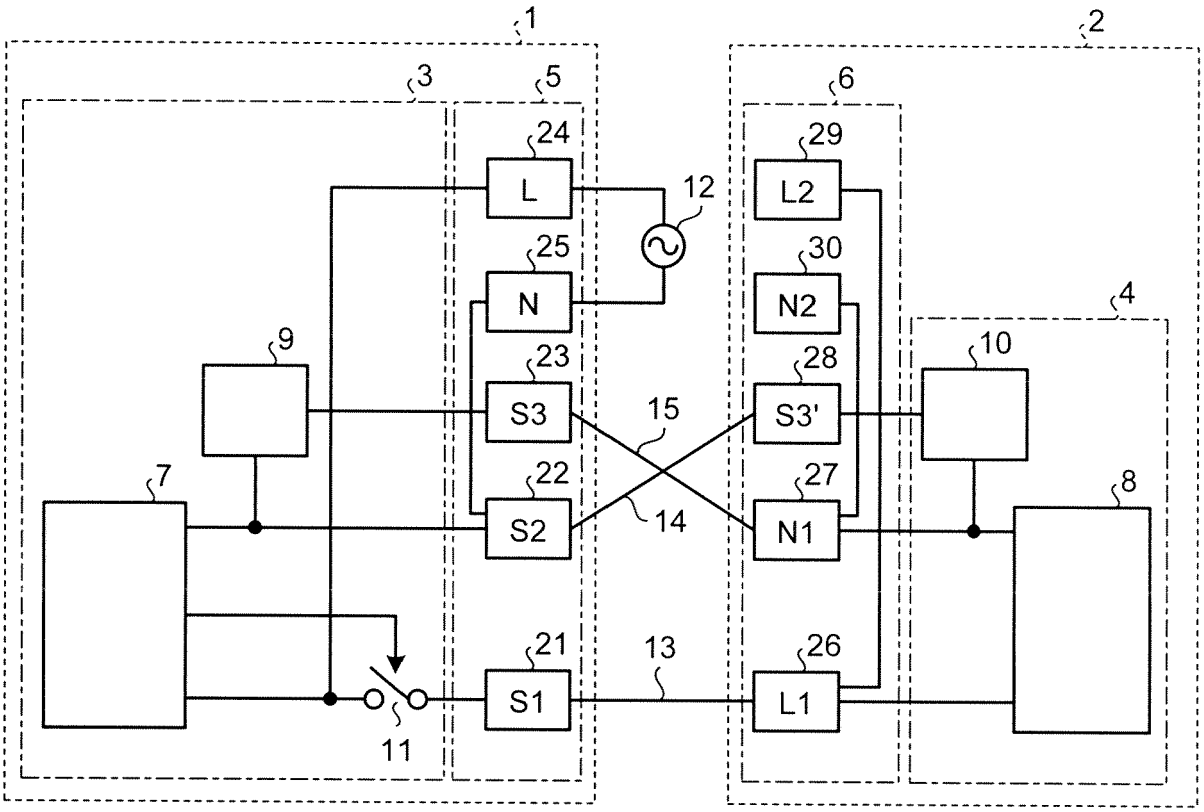
13
21
S1
26
L1
14
11

FIG.9


1
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L
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L2
12
25
N
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N2
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23
S3
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S2
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21
13
26
S1
L1
11

FIG.10

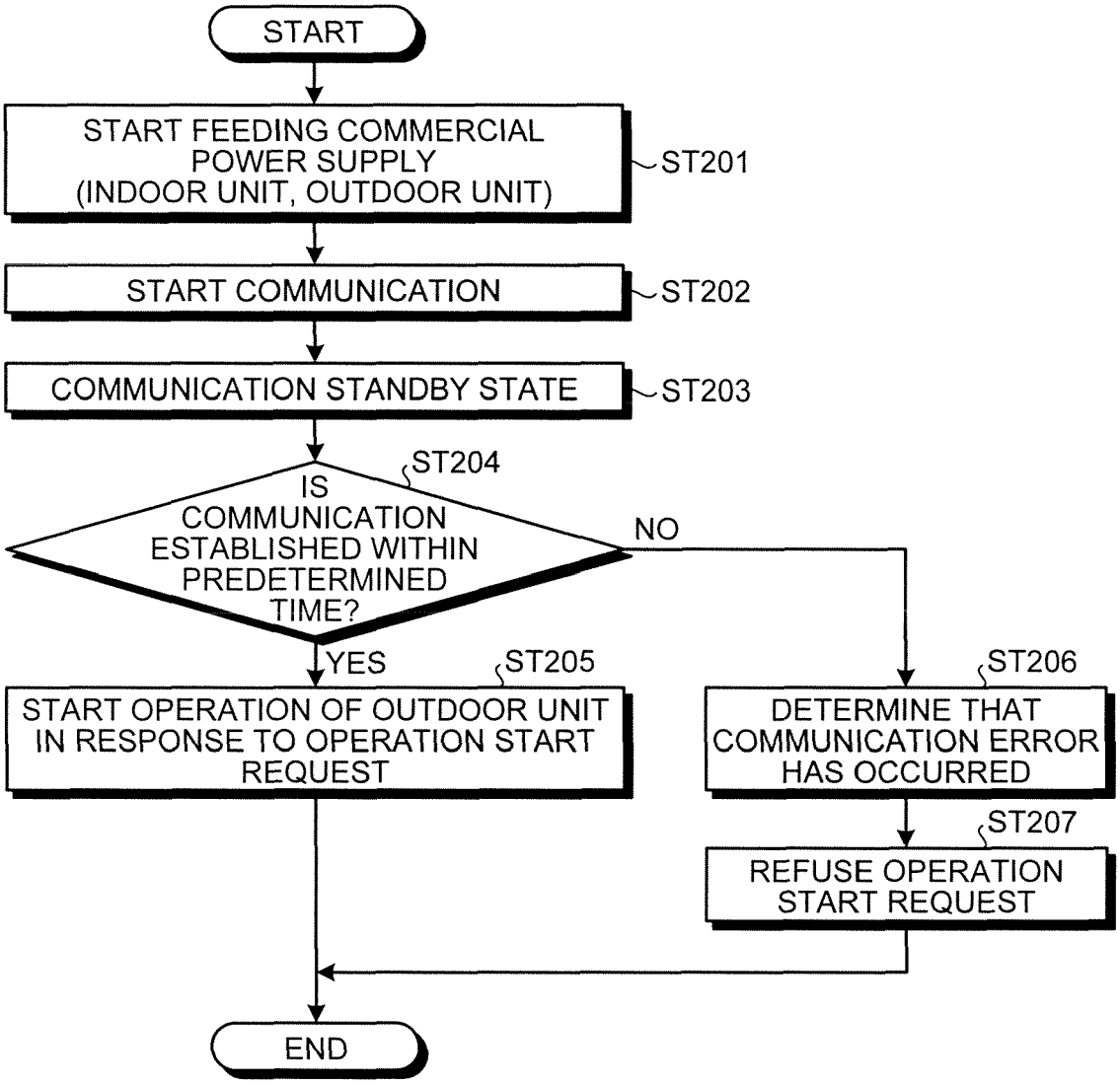
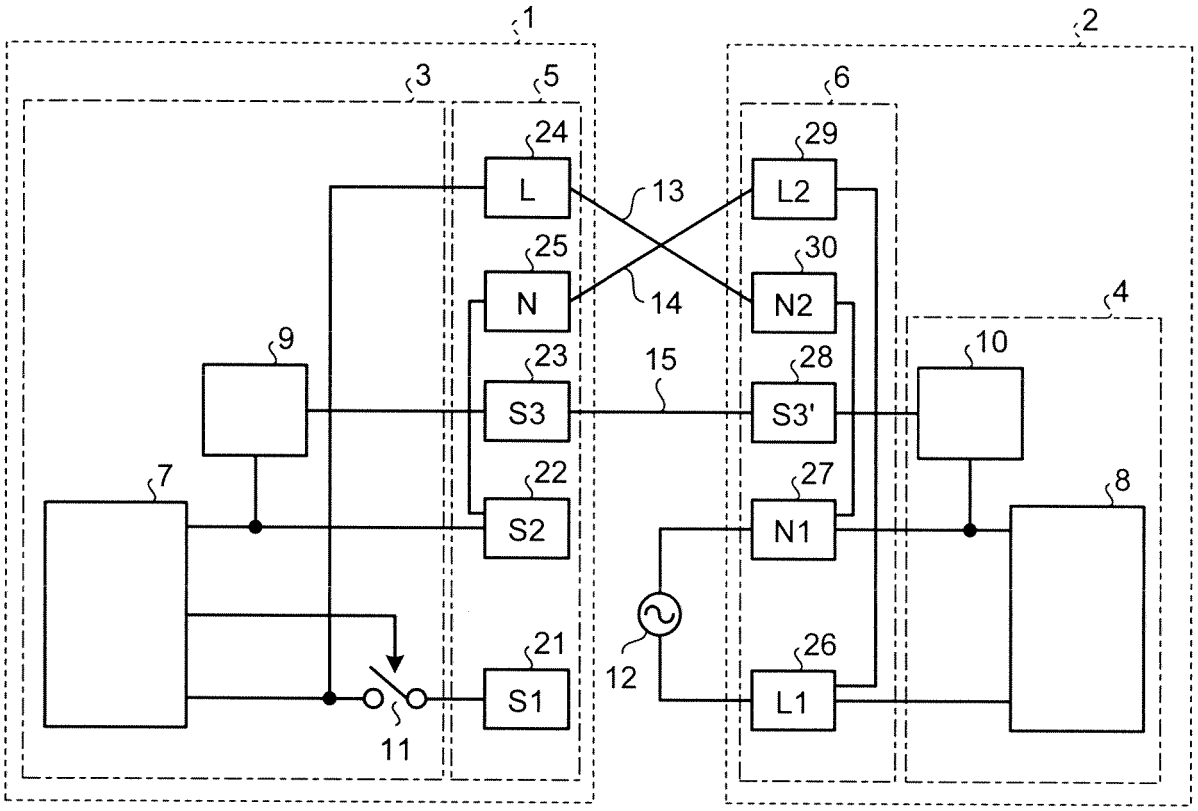

START
START FEEDING COMMERCIAL POWER SUPPLY (INDOOR UNIT, OUTDOOR UNIT)
ST201
START COMMUNICATION
ST202
COMMUNICATION STANDBY STATE
ST203
ST204
IS COMMUNICATION ESTABLISHED WITHIN PREDETERMINED TIME?
NO
YES
ST205
START OPERATION OF OUTDOOR UNIT IN RESPONSE TO OPERATION START REQUEST
ST206
DETERMINE THAT COMMUNICATION ERROR HAS OCCURRED
ST207
REFUSE OPERATION START REQUEST
END

FIG.11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L2
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N
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N2
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4
9
23
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S2
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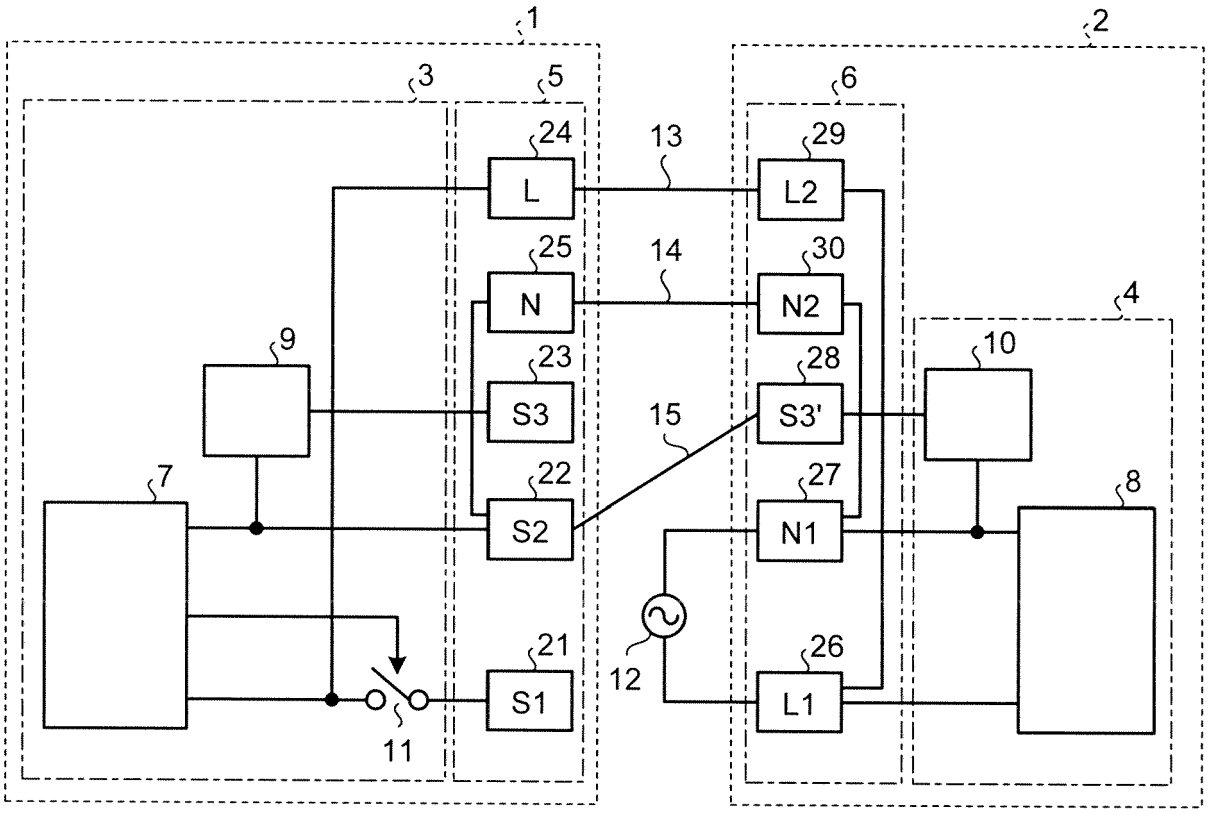
8
21
S1
26
L1
12
11

FIG.12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L2
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14
30
N
N2
4
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N1
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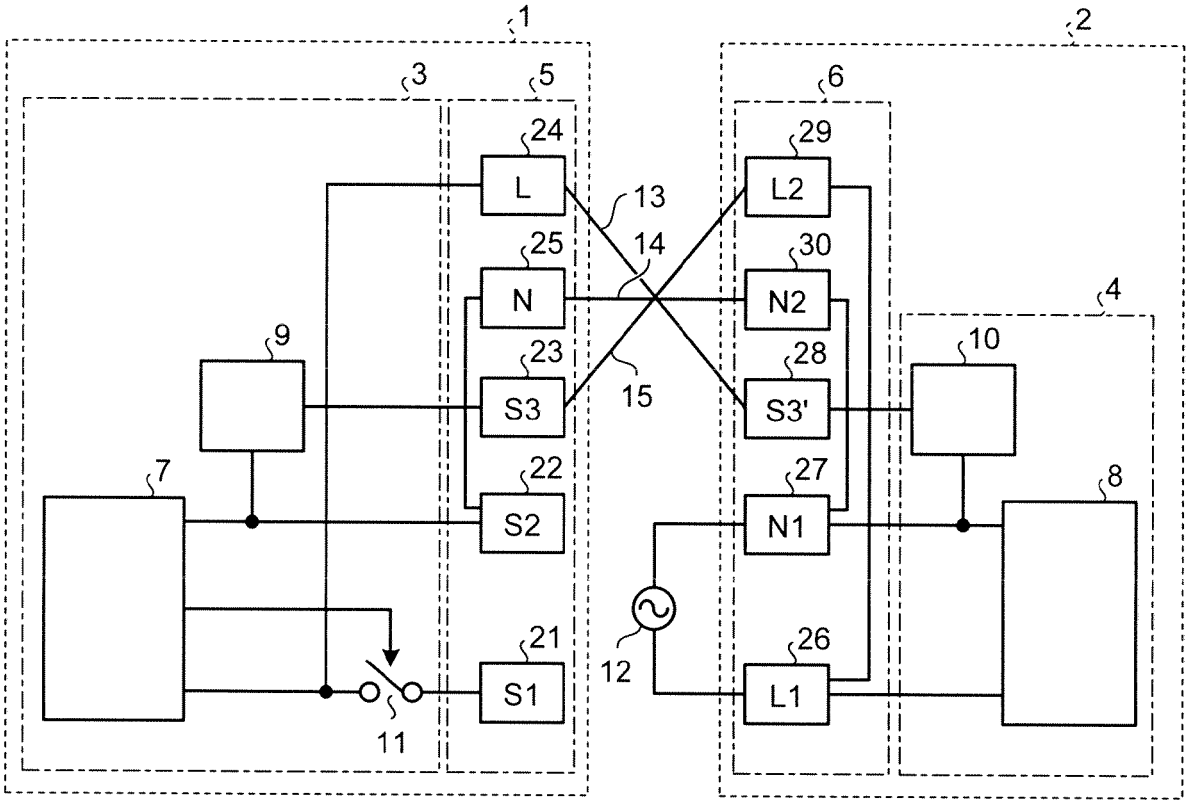
26
S1
L1
11

FIG.13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L2
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N2
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21
S1
12
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L1
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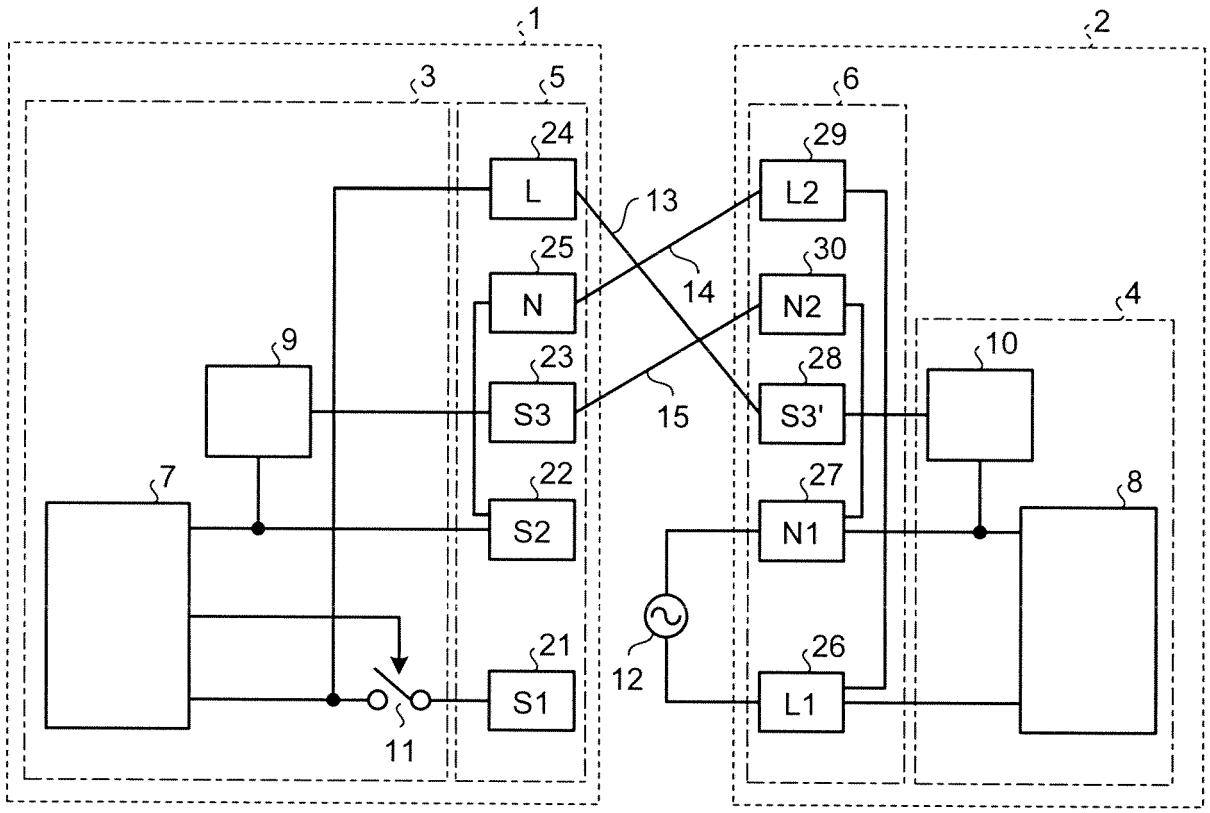
FIG.14


1
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24
L
29
L2
13
25
N
30
N2
14
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9
23
S3
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S3'
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22
S2
27
N1
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12
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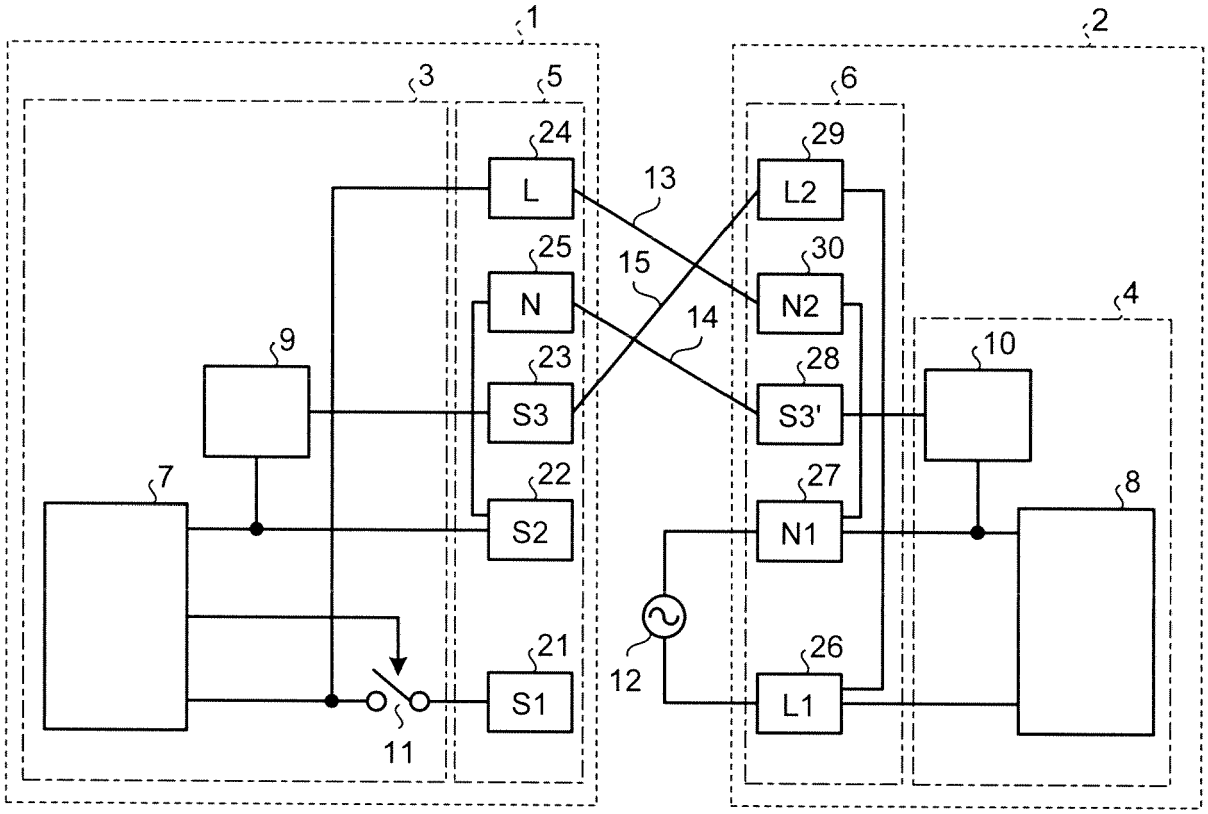
S1
26
L1
11

FIG.15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L
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L2
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N2
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14
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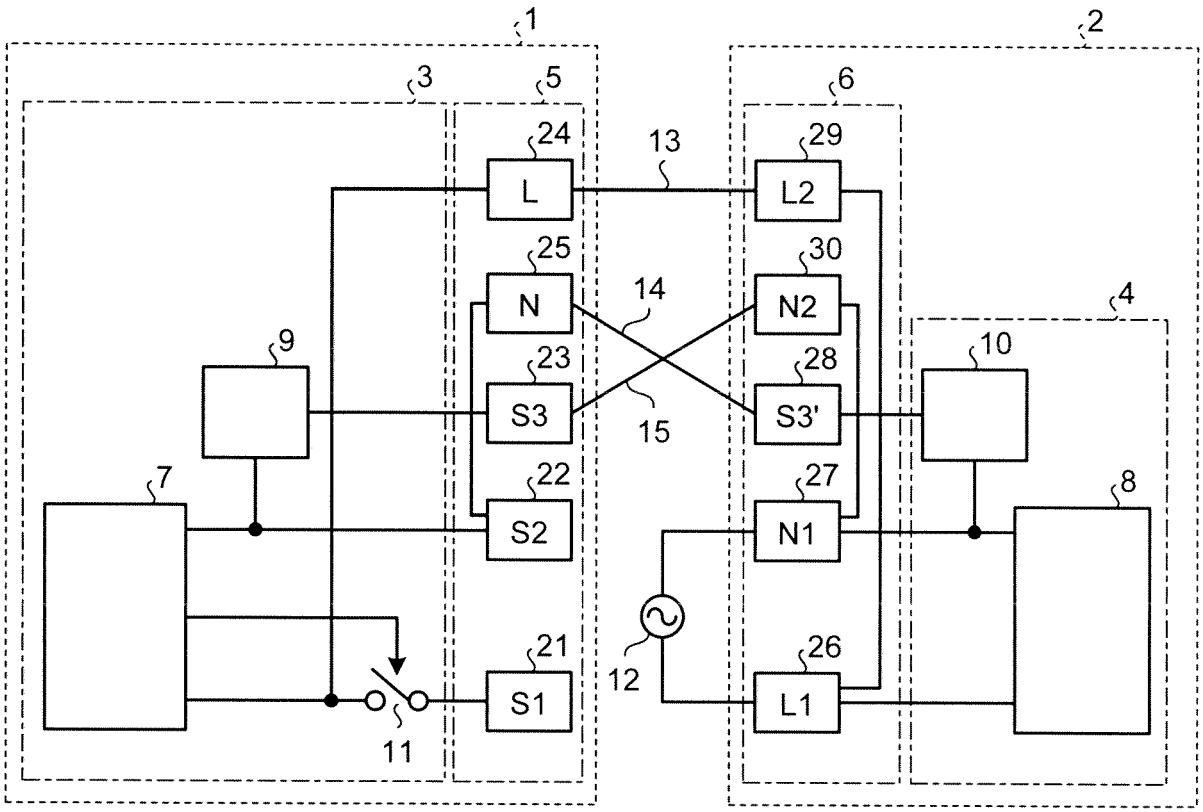
8
21
S1
26
L1
12
11

FIG.16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L
L2
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N2
4
9
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S3
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S3'
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S2
N1
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S1
L1
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FIG.17

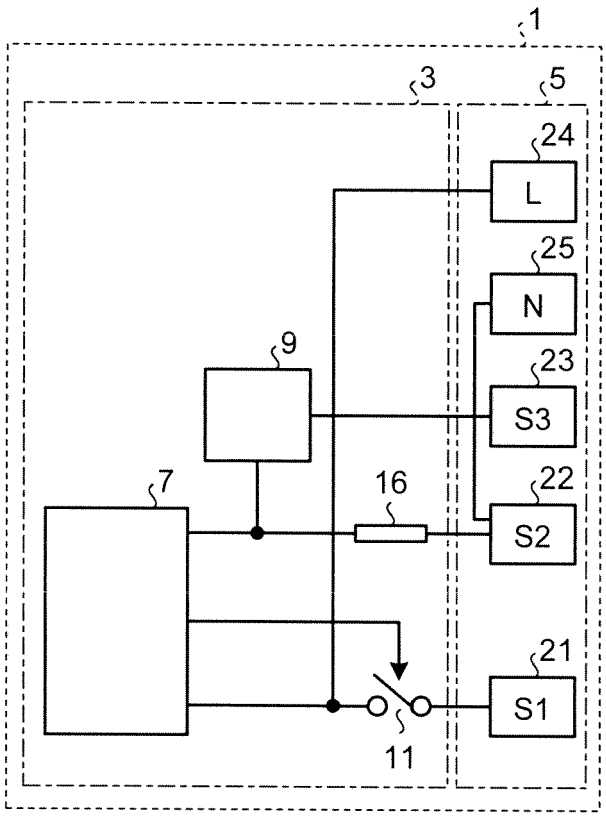
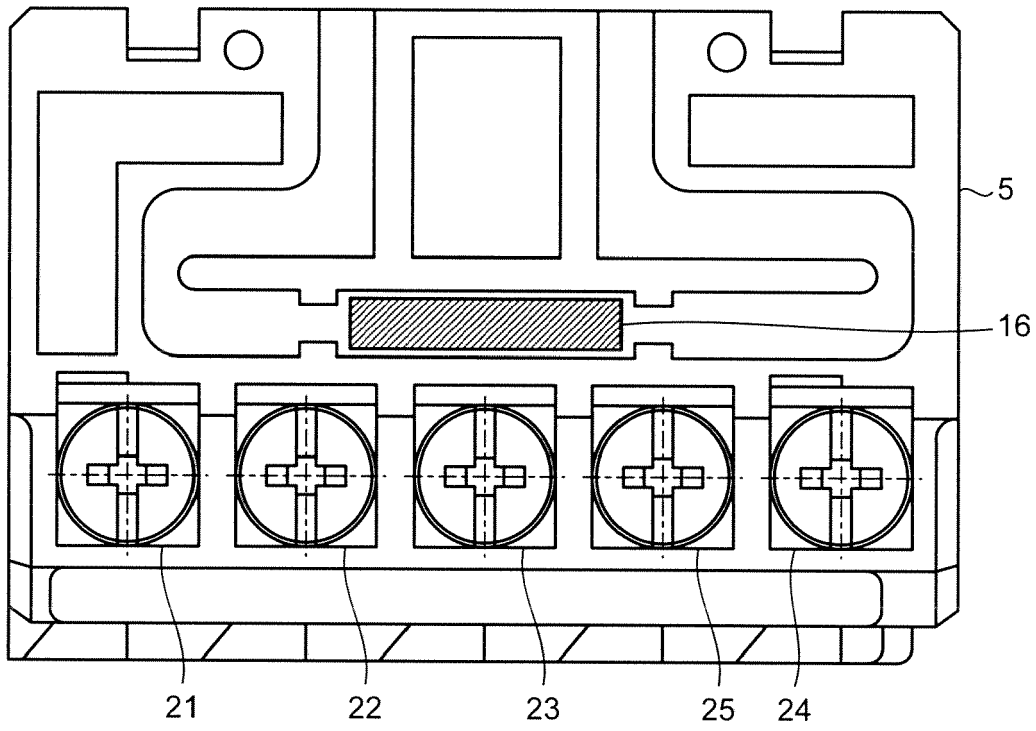


FIG.18



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2007225128 A **[0002] [0003]**