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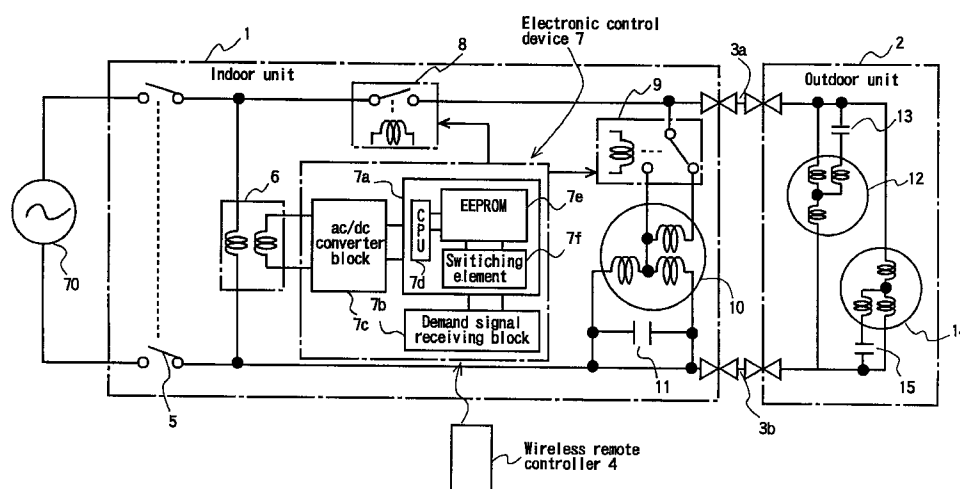
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(54) **Split type air conditioner and method of controlling it**

(57) A split type air conditioner having a wireless remote controller (4) for issuing a demand signal, and an electronic control device (7) for controlling an indoor unit (1) and an outdoor unit (2) basing on the demand

signal, wherein the electronic control device has an EEPROM (7e) for storing the demand signal.

FIG. 1



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Description

FIELD OF THE INVENTION AND RELATED ART STATEMENT

1. FIELD OF THE INVENTION

This invention relates to an improvement in a split type air conditioner and a method of controlling it.

2. DESCRIPTION OF THE RELATED ART STATEMENT

Recently, an air conditioner is widely used in homes. Most of the air conditioner in Japan is a split type air conditioner having an indoor unit and an outdoor unit, because this type one is much quiet in the indoor space. In recent models of the split type air conditioners, it is general that operating conditions are set and adjusted by a wireless remote controller.

Some conventional split type air conditioner was driven without storing the operating conditions. Therefore, in such case there was a problem that the conventional split type air conditioner can not automatically restart after a stopping, for instance, due to a power failure in an electric power source and/or an electric power line during operation.

Apart from the above-mentioned conventional example, a first and a second conventional split type air conditioner were proposed in order to solve the problem.

The first conventional split type air conditioner will be explained with reference to FIG. 3.

FIG. 3 is a circuit diagram showing a first conventional split type air conditioner.

As shown in FIG. 3, the first conventional split type air conditioner comprises an indoor unit 51, an outdoor unit 52, and connecting cables 53a, 53b for electrically connecting the indoor unit 51 and the outdoor unit 52. Furthermore, the first conventional split type air conditioner has a wireless remote controller 54 for issuing a demand signal. When an operator such as a user switches ON/OFF states of the first conventional split type air conditioner and/or operating conditions including a setting value of temperature of indoor air and a setting value of air volume, the demand signal is transmitted from the wireless remote controller 54 in accordance with demand of the operator.

The indoor unit 51 has a main switch 55 connected between an electric power source 70 and a transformer 56, a charging circuit 57 connected to the transformer 56, and a storage battery 58 to be charged by the charging circuit 57. Furthermore, the indoor unit 51 includes an electronic control device 59 for controlling a main relay 60 and a relay 61, an indoor fan motor 62 for driving an indoor fan (not shown), and a capacitor 63 for the indoor fan motor 62. The transformer 56 reduces an alternating current voltage from the electric power source 70. The charging circuit 57 has an ac/dc con-

verter block 57a for converting an alternating current supplied from the transformer 56 into a direct current, and a direct current charging block 57b for charging the direct current to the storage battery 58. The storage battery 58 serves as a backup power source for the electronic control device 59. The electronic control device 59 is driven by the direct current supplied from the storage battery 58. The electronic control device 59 has a control block 59a for issuing switching signals to the main relay 60 and the relay 61, and a demand signal receiving block 59b for receiving the demand signal issued from the wireless remote controller 54. The control block 59a has a CPU and a RAM, which are mounted on a printed board. The electronic control device 59 switches the main relay 60 and the relay 61 in accordance with the demand signal stored in the RAM of the control block 59a. When the main relay 60 is turned off, the outdoor unit 52 and the indoor fan motor 62 are disconnected from the electric power source 70. By the switching operation of the relay 61, the electric power to be supplied to the indoor fan motor 62 is controlled, so that the rotation speed of the indoor fan motor 62 is changed.

The outdoor unit 52 has an outdoor fan motor 64, such as an induction motor, for driving an outdoor fan (not shown), a capacitor 65 for the outdoor fan motor 64, a compressor 66 for compressing a refrigerant, and a capacitor 67 for the compressor 66.

Explanation is made on the operation of the first conventional split type air conditioner of FIG. 3.

When the main switch 55 is turned on, the direct current is supplied to the electronic control device 59 from the storage battery 58, and thereby, the electronic control device 59 starts control operation and waits for the demand signal. Hereafter, when the operator issues a demand signal of a starting operation to the electronic control device 59 by the wireless remote controller 54, the main relay 60 is controlled by the electronic control device 59. Thereby, the electric power is supplied to the indoor fan motor 62 from the electric power source 70, and the indoor fan motor 62 is rotated. By the rotation of the indoor fan motor 62, the indoor air passes through an indoor heat exchanger (not shown), starting circulation of the indoor air. Furthermore, the electric power is supplied from the electric power source 70 to the outdoor unit 52 through the connecting cables 53a, 53b, and thereby, the outdoor fan motor 64 and the compressor 66 are rotated. By the rotation of the outdoor fan motor 64, outdoor air is supplied to an outdoor heat exchanger (not shown).

In the case that the operator changes the temperature of the indoor air and/or the air volume, the wireless remote controller 54 issues the demand signal in accordance with the setting value of the temperature and/or the setting value of the air volume to the circuit of the electronic control device 59. Subsequently, the electronic control device 59 controls the main relay 60 and the relay 61 in accordance with the demand signal, so that the temperature of the indoor air and/or the air vol-

ume are controlled.

In the first conventional split type air conditioner, the electronic control device 59 is backed up by the storage battery 58. Therefore, even if a stoppage of the electric power supplied from the electric power source 70 is occurred during the operation, the demand signal stored in the RAM of the electronic control device 59 is held by the electric power supplied from the storage battery 58. Thereby, when the electric power supplied from the electric power source 70 is restored, the first conventional split type air conditioner can automatically restart using the demand signal stored in the RAM of the electronic control device 59.

However, in the first conventional split type air conditioner, the storage battery 58 uses as the backup power source for the electronic control device 59 in the indoor unit 51. Therefore, there is a problem that the charging circuit 57 for the storage battery 58 is required to dispose in the indoor unit 51. Thereby, it is impossible to attain small size of the indoor unit 51.

In the charging circuit 57, it is necessary to prevent the storage battery 58 from overcharging. Thereby, the charging circuit 57 has a complex construction, and cost of the charging circuit 57 must be inevitably high.

Furthermore, in the case that the stoppage of the electric power supplied from the electric power source 70 is continued for a long time, there is a fear that the demand signal stored in the RAM is lost caused by decay of the electric power supplied from the storage battery 58. Therefore, in order to hold the demand signal stored in the RAM for the long time, it is necessary that the storage battery having large capacity is equipped with the indoor unit 51. As a result, there are problems that size of the indoor unit 51 becomes larger, and cost of the indoor unit 51 is increased.

The second conventional split type air conditioner will be elucidated with reference to FIG. 4.

FIG. 4 is a circuit diagram showing a second conventional split type air conditioner.

This second conventional split type air conditioner is fundamentally the same as the first conventional split type air conditioner except for an electronic control device having an ac/dc converter block and the operation of the wireless remote controller 54. Therefore, corresponding parts and components to the first conventional split type air conditioner are shown by the same numerals and marks, and the description thereon made in the first conventional split type air conditioner similarly apply. In the following description, differences of this second conventional split type air conditioner from the first conventional split type air conditioner are mainly explained.

As shown in FIG. 4, an electronic control device 59' is connected to the transformer 56. The electronic control device 59' has a control block 59'a for issuing switching signals to the main relay 60 and the relay 61, and a demand signal receiving block 59'b for receiving the demand signal issued from the wireless remote controller 54. Furthermore, the electronic control device 59'

includes an ac/dc converter block 59'c for converting an alternating current supplied from the transformer 56 into a direct current. The control block 59'a has a CPU and a RAM, which are mounted on a printed board. The control block 59'a and the demand signal receiving block 59'b are driven by the direct current supplied from the ac/dc converter block 59'c.

Furthermore, in the second conventional split type air conditioner, the wireless remote controller 54 issues the demand signal to the electronic control device 59' at a predetermined interval during operation. That is, the operating conditions are repeatedly given to the control block 59'a through the demand signal receiving block 59'b unless the OFF state is input to the control block 59'a.

Explanation is made on the operation of the second conventional split type air conditioner.

In the second conventional split type air conditioner, the wireless remote controller 54 issues the demand signal to the electronic control device 59' at the predetermined interval even if a stop of the electric power supplied from the electric power source 70 happens during the operation. Therefore, when the electric power supplied from the electric power source 70 is restored, the second conventional split type air conditioner can automatically restart with use of the latest demand signal issued from the wireless remote controller 54.

However, in the second conventional split type air conditioner, there is a problem that life of a battery equipped in the wireless remote controller 54 is shortened. The reason why is that the demand signal is transmitted from the wireless remote controller 54 to the electronic control device 59' in no relation to occurrence of the stoppage of the electric power supplied from the electric power source 70.

Furthermore, it is necessary that the wireless remote controller 54 is disposed in a zone where the demand signal receiving block 59'b can receive the demand signal issued from the wireless controller 54. Moreover, in the case that an obstructive object is existed between the wireless remote controller 54 and the demand signal receiving block 59'b, there is a problem that the demand signal receiving block 59'b can not receive the demand signal. Thereby, it is impossible to make the second conventional split type air conditioner automatically restart when the electric power supplied from the electric power source 70 is restored.

OBJECT AND SUMMARY OF THE INVENTION

The object of the present invention is to provide an air conditioner that can solve the aforementioned problems.

In order to achieve the above-mentioned object, an air conditioner in accordance with the present invention comprises:

a wireless remote controller for issuing a demand signal,

an outdoor unit having at least an outdoor fan motor and a compressor,
 an indoor unit having at least an electronic control device and an indoor fan motor, and the indoor unit connected to the outdoor unit, and
 the electronic control device including at least an EEPROM for storing the demand signal and a CPU for controlling the outdoor unit and the indoor unit in accordance with the demand signal.

In the split type air conditioner of the present invention, the EEPROM is disposed in the electronic control device of the indoor unit, and memorizes a demand signal issued from the wireless remote controller. Thereby, when the electric power is restored after stoppage of the electric power, the split type air conditioner can automatically restart with use of the demand signal stored in the EEPROM. Furthermore, since the EEPROM holds the demand signal during the stoppage of the electric power, it is possible to attain small size of the indoor unit than including in the indoor unit of a split type air conditioner a charging circuit and a storage battery for holding the demand signal. Moreover, it is possible to dispensing with the issuing of demand signal at a predetermined interval repeatedly from the wireless remote controller.

While the novel features of the invention are set forth particularly in the appended claims, the invention, both as to organization and content, will be better understood and appreciated, along with other objects and features thereof, from the following detailed description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a circuit diagram showing a split type air conditioner of the present invention.

FIG. 2 is a flowchart diagram showing a method of controlling the split type air conditioner of FIG. 1.

FIG. 3 is a circuit diagram showing a first conventional split type air conditioner.

FIG. 4 is a circuit diagram showing a second conventional split type air conditioner.

DESCRIPTION OF THE EMBODIMENT

Hereafter, a preferred embodiment is described with reference to the accompanying drawings.

FIG. 1 is a circuit diagram showing a split type air conditioner of the present invention.

As shown in FIG. 1, a split type air conditioner comprises an indoor unit 1, an outdoor unit 2, and connecting cables 3a, 3b for electrically connecting the indoor unit 1 and the outdoor unit 2. Furthermore, the split type air conditioner has a wireless remote controller 4 for issuing a demand signal. When an operator such as a user changes ON/OFF states of the split type air conditioner and/or operating conditions including a setting value of temperature of indoor air and a setting value of

air volume, the demand signal is transmitted from the wireless remote controller 4 in accordance with demand of the operator. The demand signal is formed by an infrared radiation and the like.

The indoor unit 1 has a main switch 5 which is connected to and opens and closes the circuit of an electric power source 70, a transformer 6 connected through the main switch 5 across both ends of the electric power source 70, an electric control device 7 for controlling the indoor unit 1 and the outdoor unit 2 by being fed by the transformer 6, and a main relay 8 to be controlled by the electric control device 7. Furthermore, the indoor unit 1 includes an indoor fan motor 10 for driving an indoor fan (not shown), a change-over relay 9 to be controlled by the electric control device 7 and for changing over the connection of windings of the indoor fan motor 10, and a capacitor 11 connected to windings of the fan motor 10 for leading phase of current given to the indoor fan motor 10.

The main switch 5 is manually operated by the operator. When the main switch 5 is turned on, an alternating current is supplied from the electric power source 70 to the transformer 6. The transformer 6 transforms an alternating current voltage of the electric power source 70 into a lower voltage alternating current and supplies to the electronic control device 7.

The electronic control device 7 has a control block 7a for controlling the main relay 8 and the relay 9, and a demand signal receiving block 7b for receiving the demand signal issued from the wireless remote controller 4. Furthermore, the electronic control device 7 includes an ac/dc converter block 7c for converting an alternating current supplied from the transformer 6 into a direct current. The ac/dc converter block 7c is formed by a known diode-bridge circuit. The control block 7a has a CPU 7d, an EEPROM (Electrically Erasable Programmable Read-Only Memory) 7e for storing the demand signal issued from the demand signal receiving block 7b, and a switching element 7f for the EEPROM 7e. The CPU 7d, the EEPROM 7e, and the switching element 7f are mounted on a printed board.

The CPU 7d issues switching instruction signals to the main relay 8 and the relay 9 in accordance with the demand signal stored in the EEPROM 7e when the switching element 7f is turned on. The CPU 7d issues the switching signals to the main relay 8 and the relay 9 in accordance with the demand signal issued from the demand signal receiving block 7b when the switching element 7f is turned off. When the main relay 8 is turned on by the switching signal issued from the CPU 7d, an alternating current is supplied from the electric power source 70 to the outdoor unit 2 and the indoor fan motor 10. By the switching operation of the relay 9 in accordance with the switching signal issued from the CPU 7d, the electric power to be supplied to the indoor fan motor 10 is controlled, so that the rotation speed of the indoor fan motor 10 is changed. The indoor fan motor 10 is configured by an induction motor.

The EEPROM 7e rewrites and stores the demand

signal issued from the demand signal receiving block 7b when the switching element 7f is turned on. The demand signal stored in the EEPROM 7e is not changed when the switching element 7g is turned off. The EEPROM 7e holds the demand signal even if the electric power supplied from the electric power source 70 stops during operation. Thereby, when the failure of electric power supply from the electric power source 70 is restored, the split type air conditioner can automatically restart with use of the demand signal stored in the EEPROM 7e.

Furthermore, when the electric power supplied from the electric power source 70 is restored from a failure, the CPU 7d performs a delay control using a random time. Concretely, the CPU 7d delays reading the demand signal stored in the EEPROM 7e for not only a predetermined time (for example, 2 --- 3 minutes) but also a random time in a range between several seconds and several decadal seconds. The predetermined time is preliminary set to the CPU 7d, and the random time is generated and decided in the CPU 7d. Thereby, starting operation of the split type air conditioner is delayed from the restoration of the electric power. Accordingly, the below-mentioned compressor 14 can be started without misstarting caused by differences between suction pressure and delivery pressure. Furthermore, even if a plurality of the same split type air conditioners are connected to the same electric power source 70, each of the plurality of the same split type air conditioners can automatically restart at a different time after restoration of the electric power. Thereby, it is possible to prevent occurrence of undesirable reduction of voltage supplied from the electric power source 70.

On the contrary, in the conventional split type air conditioner, it is known that the CPU delays reading the demand signal stored in the RAM for only the above-mentioned predetermined time. Accordingly, when a plurality of the same conventional split type air conditioners connected to the same electric power source automatically restart after restoration of the electric power, voltage supplied from the same electric power source is reduced largely. As a result, in the conventional split type air conditioner, there is fear that the compressor can not start by an insufficient supply of the electric power.

Furthermore, when the electric power supplied from the electric power source 70 is restored, the CPU 7d reads the demand signal stored in the EEPROM 7e except data of a timer function. In other words, even if the demand signal stored in the EEPROM 7e includes data instructing time-controlling operation, the CPU 7d cancels the data after stoppage of the electric power from the electric power source 70. Thereby, when the electric power supplied from the electric power source 70 is restored, it is possible to prevent a time lag caused by occurrence of the stoppage of the electric power.

The switching element 7f is controlled by the demand signal issued from the wireless remote controller 4. By the switching operation of the switching ele-

ment 7f, it is possible to easily change the manner whether automatic starter used with the demand signal stored in the EEPROM 7e after restoration of the electric power should be made or not.

The outdoor unit 2 has an outdoor fan motor 12 which is connected across the connecting cables 3a, 3b for driving an outdoor fan (not shown), a phase adjustment capacitor 13 for the outdoor fan motor 12, a compressor 14 connected across the connecting cables 3a, 3b for compressing a refrigerant, and a phase adjustment capacitor 15 for the compressor 14. The outdoor fan motor 12 and the compressor 14 are configured by an induction motor. The capacitor 13 and the capacitor 15 are used for leading phases of currents given to the outdoor fan motor 12 and the compressor 14, respectively.

A method of controlling the split type air conditioner will be elucidated with reference to FIG. 2.

FIG. 2 is a flowchart diagram showing a method of controlling the split type air conditioner of FIG. 1.

In step S21, the CPU 7d checks whether the switching element 7f is turned on. In the case that the switching element 7f is turned on, the CPU 7d reads initial values stored in the EEPROM 7e as shown in step S22. The initial values are input to the EEPROM 7e in a factory of the split type air conditioner, and include instruction of OFF state. Therefore, the split type air conditioner is stopped as shown in step S23. The initial values further include predetermined setting values of air volume and temperature of indoor air.

As shown in step S24, the CPU 7d checks whether the demand signal is input to the demand signal receiving block 7b from the wireless remote controller 4. This demand signal includes instruction of a starting operation. In the case that the demand signal is not input to the demand signal receiving block 7b, the split type air conditioner is stopped as shown in the step S23. In the case that the demand signal is input to the demand signal receiving block 7b, the demand signal is stored in the EEPROM 7e as shown in step S25.

Subsequently, the CPU 7d issues the switching signals to the main relay 8 and the relay 9 in accordance with the demand signal, and thereby, the split type air conditioner is operated as shown in step S26. That is, the electric power is supplied to the indoor fan motor 10 from the electric power source 70 through the main relay 8 and the relay 9, and the indoor fan motor 10 is rotated. By the rotation of the indoor fan motor 10, the indoor air passes through an indoor heat exchanger (not shown), and makes circulation of the indoor air. Furthermore, the electric power is supplied from the electric power source 70 to the outdoor unit 2 through the main relay 8 and the connecting cables 3a, 3b, and thereby, the outdoor fan motor 12 and the compressor 14 are rotated. By the rotation of the outdoor fan motor 12, outdoor air is supplied to an outdoor heat exchanger (not shown).

As shown in step S27, the CPU 7d checks whether the demand signal is changed. That is, the CPU 7d

checks whether the operator changes the operating conditions by the wireless remote controller 4. In the case that the demand signal is changed, the demand signal is stored in the EEPROM 7e as shown in the step S25. The electronic control device 7 controls the indoor unit 1 and the outdoor unit 2 in accordance with the changed demand signal.

In the case that the demand signal is not changed, the CPU 7d detects whether the electric power is supplied from the electric power source 70 as shown in step S28. In the case that the electric power is supplied from the electric power source 70, the split type air conditioner is operated as shown in the step S26. In the case that the electric power is not supplied from the electric power source 70, the CPU 7d judges that the stoppage of the electric power takes place. Thereby, the split type air conditioner is stopped as shown in step S29.

Hereafter, when the CPU 7d detects that the electric power is supplied from the electric power source 70 as shown in step S30, the CPU 7d delays reading the demand signal stored in the EEPROM 7e for the predetermined time as shown in step S31.

Furthermore, as shown in step S32, the CPU 7d generates and decides the random time. The CPU 7d further delays reading the demand signal stored in the EEPROM 7e for the random time as shown in step S33.

Subsequently, the CPU 7d reads the demand signal stored in the EEPROM 7e as shown in step S34. In the step S34, even if the demand signal stored in the EEPROM 7e includes data instructing time-controlling operation, the CPU 7d cancels the data. Subsequently, as shown in the step S26, the split type air conditioner is operated.

Returning to the step S21. In the case that the switching element 7f is turned off, the split type air conditioner is stopped as shown in step S35.

As shown in step S36, the CPU 7d checks whether the demand signal is input to the demand signal receiving block 7b from the wireless remote controller 4. This demand signal includes instruction of a starting operation. In the case that the demand signal is not input to the demand signal receiving block 7b, the split type air conditioner is stopped as shown in the step S35.

In the case that the demand signal is input to the demand signal receiving block 7b, the CPU 7d issues the switching signals to the main relay 8 and the relay 9 in accordance with the demand signal issued from the wireless remote controller 4, and thereby, the split type air conditioner is operated as shown in step S37.

As shown in step S38, the CPU 7d checks whether the demand signal is changed. That is, the CPU 7d detects whether the operator changes the operating conditions by the wireless remote controller 4. In the case that the demand signal is changed, the CPU 7d changes the switching signals to the main relay 8 and the relay 9 in accordance with the demand signal issued from the wireless remote controller 4, and thereby, the split type air conditioner is operated as shown in step S37. Thereby, the electronic control device 7 controls

the indoor unit 1 and the outdoor unit 2 in accordance with the changed demand signal.

In the case that the demand signal is not changed, the CPU 7d checks whether the electric power is supplied from the electric power source 70 as shown in step S39. In the case that the electric power is supplied from the electric power source 70, the split type air conditioner is operated as shown in the step S37. In the case that the electric power is not supplied from the electric power source 70, the CPU 7d judges that the stoppage of the electric power takes place. Thereby, the split type air conditioner is stopped as shown in step S40.

Hereafter, when the CPU 7d detects that the electric power is supplied from the electric power source 70 as shown in step S41, the CPU 7d checks whether the demand signal is input to the demand signal receiving block 7b from the wireless remote controller 4 as shown in step S42. In the case that the demand signal is not input to the demand signal receiving block 7b, the split type air conditioner is stopped as shown in the step S40. In the case that the demand signal is input to the demand signal receiving block 7b, the CPU 7d issues the switching signals to the main relay 8 and the relay 9 in accordance with the demand signal from the wireless remote controller 4, thereby, operating the split type air conditioner as shown in the step S37.

Although the present invention has been described in terms of the presently preferred embodiments, it is to be understood that such disclosure is not to be interpreted as limiting. Various alterations and modifications will no doubt become apparent to those skilled in the art to which the present invention pertains, after having read the above disclosure. Accordingly, it is intended that the appended claims be interpreted as covering all alterations and modifications as fall within the true spirit and scope of the invention.

Claims

1. A split type air conditioner comprising:

a wireless remote controller (4) for issuing a demand signal,
an outdoor unit (2) having at least an outdoor fan motor (12) and a compressor (14),
an indoor unit (1) having at least an electronic control device (7) and an indoor fan motor (10),
and said indoor unit connected to said outdoor unit, and

said electronic control device including at least an EEPROM (7e) for storing said demand signal and a CPU (7d) for controlling said outdoor unit and said indoor unit in accordance with said demand signal.
(FIG. 1 --- FIG. 2)

2. A split type air conditioner in accordance with claim 1, wherein

said CPU reads the demand signal stored in said EEPROM except for data of a time switch function when an electric power supply is restored after a stoppage of said electric power supply.
(FIG. 1 --- FIG. 2)

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3. A split type air conditioner in accordance with claim 1, wherein

when an electric power supply is restored after a stoppage of said electric power supply, said CPU generates and decides a random time, and said CPU delays reading said demand signal stored in said EEPROM for a predetermined time and said random time.

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(FIG. 1 --- FIG. 2)

4. A split type air conditioner in accordance with claim 1, wherein

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said electronic control device has a switching element (7f) for said EEPROM.
(FIG. 1)

5. A method of controlling a split type air conditioner, said method comprising the steps of:

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storing a demand signal issued from a wireless remote controller (4) in an EEPROM (7e) of an electronic control device (7) disposed in an indoor unit (1),
reading said demand signal stored in said EEPROM when an electric power supply is restored after a stoppage of said electric power supply, and
controlling said indoor unit and an outdoor unit (2) in accordance with said demand signal stored in said EEPROM.

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(FIG. 2)

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6. A method of controlling a split type air conditioner in accordance with claim 5, wherein

said step of reading is performed except data of a timer function in said demand signal.
(FIG. 2)

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7. A method of controlling a split type air conditioner in accordance with claim 5, wherein

said step of reading is performed after delaying for a predetermined time and a random time.
(FIG. 2)

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FIG. 1

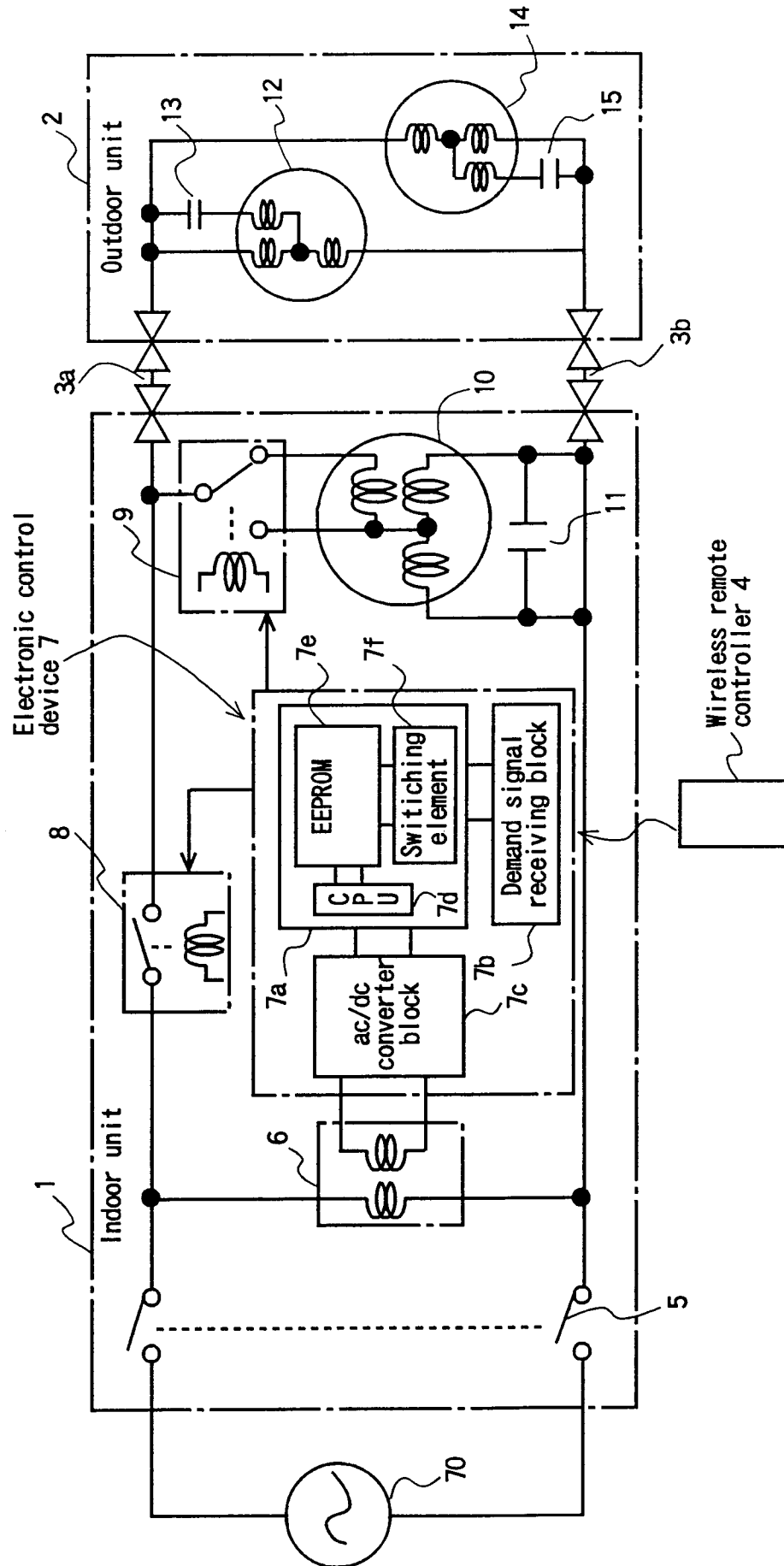


FIG. 2

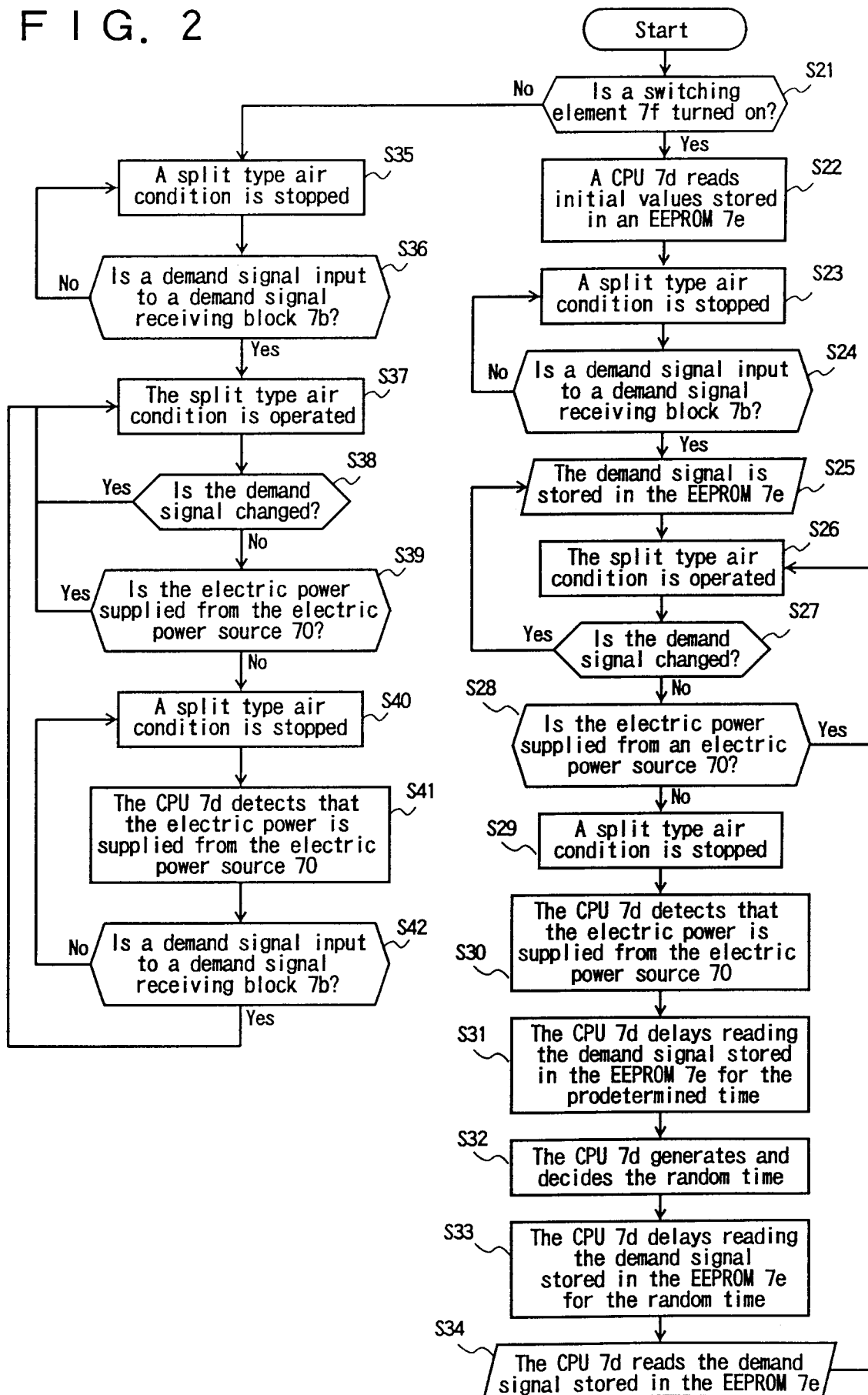


FIG. 3 (Prior Art)

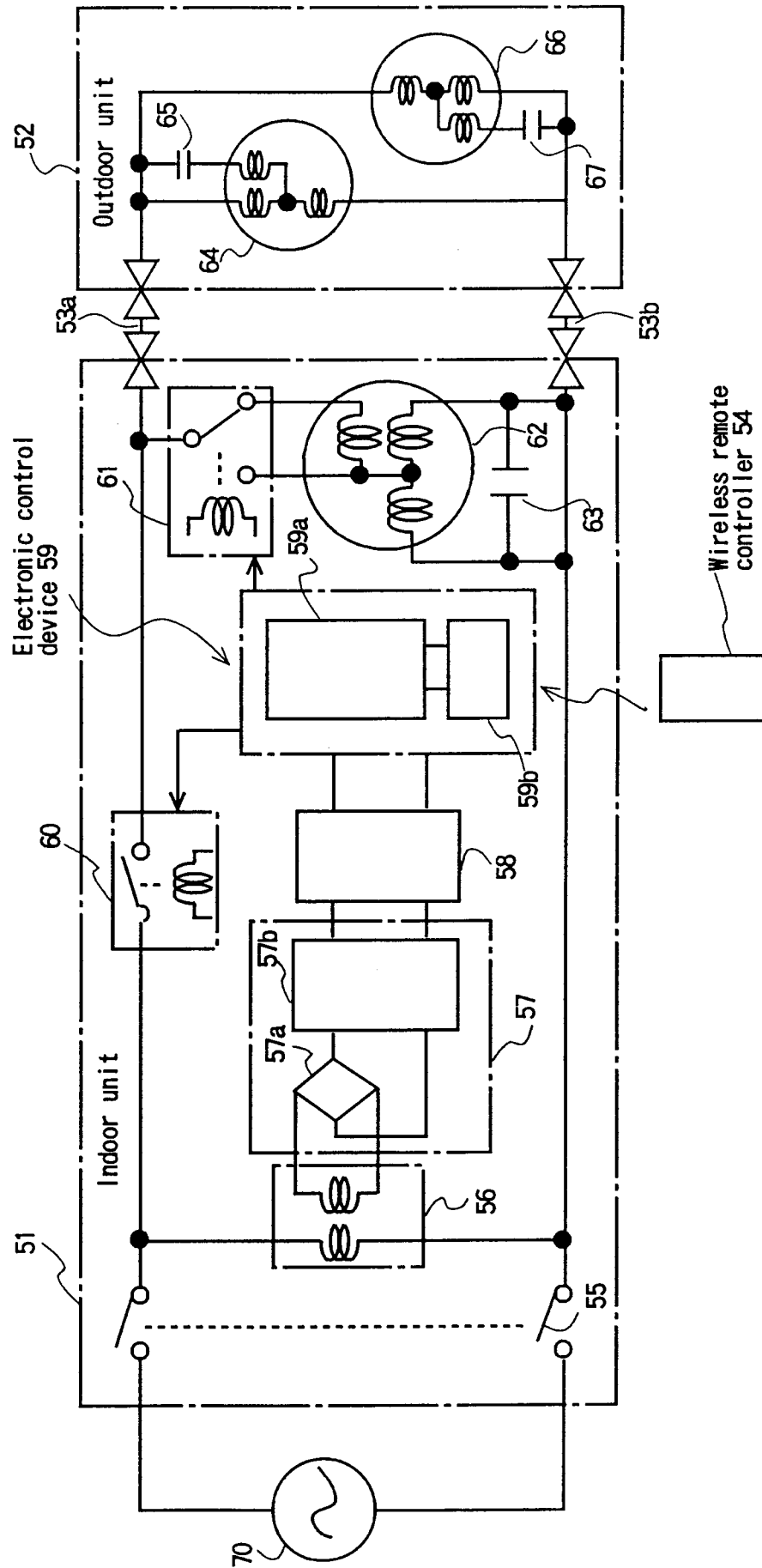


FIG. 4 (Prior Art)

