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(54) Air conditioner

(57) An air conditioner (1) having a function of automatically restarting a predetermined air conditioning operation in a case where a power supply from a power source (21) to the air conditioner (1) is interrupted and then the power supply from the power (21) source thereto is recovered, with

an auto-re-start setting means for switchably setting whether or not the automatic restart operation is performed;
executing means having refrigerating cycle elements annularly connected with each other;
memory means (30) for memorizing a content of the air conditioning operation;
judgement means for judging whether or not the interruption of the power supply and the recovery thereof occur during the air conditioning operation;
control means (20) for reading out the operation content data from the memory means and for controlling the executing means;
indicating means (40) for distinguishably indicating whether or not the automatic restart operation is performed, said indicating means having an indicating lamp (40B) having a predetermined colour which is lit only when the automatic restart operation is performed and an operation indicating lamp (40A) having a predetermined colour which is lit while the executing means executes the air conditioning operation, said colour of the operation indicating lamp (40A) being different from the colour of the indicating lamp (40B).

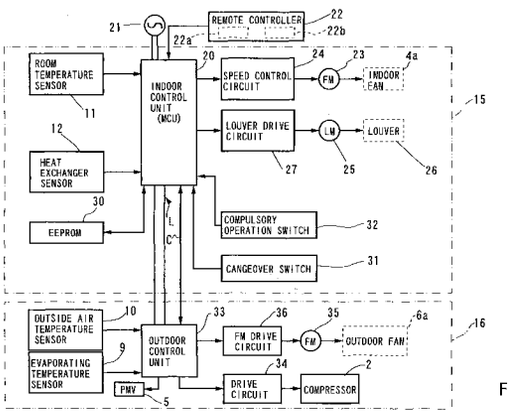

FIG. 2

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an air conditioner which has an auto-re-start control function for storing the content of present air conditioning operation of the air conditioner as data to a memory such as a non-volatile EEPROM or the like and for automatically restarting, when a power supply to the air conditioner is interrupted and then is recovered thereto, an air conditioning operation on the basis of the data stored in the memory.

Description of the Prior Art

[0002] Air conditioners such as room air conditioners and the like circulate a refrigerant in a refrigerating cycle thereby cooling or/and heating room by a condensing action and an evaporating action of the refrigerant. These air conditioners are now one of the necessities in homes and buildings.

[0003] As an example of the air conditioners, there is an air conditioner which carries out an auto-re-start control for executing air conditioning of high reliability and high operability. The auto-re-start control is a control system constructed such that the present operating state of the air conditioner is stored to a non-volatile memory (for example, an EEPROM or the similar memories) and if the air conditioning operation of the air conditioner is stopped by occurring a power failure, that is, an interruption of power supply to the air conditioner and the power supply thereto is recovered after a period of time passing, the air conditioning operation thereof is automatically restarted by reading out the operating state stored in the memory. The air conditioner in which the auto-re-start control system is built permits restarting the air conditioning operation without manually setting data corresponding to the content of the air conditioning operation again after the power supply is recovered.

[0004] Conventional air conditioners are divided into two types; one of the types has been provided with components relating to the above auto-re-start control system (a memory, a program and the like which are needed for carrying out the auto-re-start control) since the air conditioners are produced so as to execute the auto-re start control at all times; and the other type is constructed such that the air conditioners do not carry out the auto-re-start control at all times.

[0005] That is, the conventional air conditioners are fixed to any one of the types in which the auto-re-start control is executed and the types in which the auto-re-start control is not executed.

[0006] Further, although a timer operation is frequently used in air conditioners for cooling and heating a room, no specific control system is determined as to the auto-re-start control when a timer is set.

[0007] Although it is doubtless that the above auto-re-start control system is effective from the view point of operability, since it is not a control system for increasing the comfortableness of users, the necessity of the auto-re-start control is different depending upon users.

[0008] Namely, since a power failure (an interruption of power supply to the air conditioner) often occurs in power-short areas such as certain regions of a foreign countries, an air conditioner is often stopped by the interruption of power supply thereto. Thus, a user in the power-short areas must restart an air conditioning operation by operating, for example, a remote controller each time when the interruption thereof occurs, by which an excessive burden is imposed on the user. From the above background, many users require the auto-re-start control in the power-short areas.

[0009] On the other hand, in the countries where electric power is sufficiently supplied such as Japan and the like, since an interruption of power supply to the air conditioner scarcely occurs and there is a less opportunity of using the auto-re-start control, many users do not particularly need the auto-re-start control. Further, when the air conditioner which carries out the auto-re-start control is disconnected from a wall outlet in off-seasons (in the spring and the autumn) and it is connected thereto in the seasons of the summer and the winter to use the air conditioner, there is a possibility that the air conditioner automatically starts an air conditioning operation contrary to the intention of the users. Thus, there is a case that it is better not to use the auto-re-start control.

[0010] That is, when it cannot be selected and is fixed whether the auto-re-start control is executed or not as in the conventional air conditioners, there is a problem that the requests of all the users cannot be satisfied.

[0011] Since it is anticipated that the necessity of execution of the auto-re-start control changes depending upon the environment surrounding users, it is preferable that whether the auto-re-start control is executed or not can be selected by the users.

[0012] In addition, the air conditioner in which the conventional auto-re-start control system is installed includes no specifically determined control system when the timer is set. Therefore, when an interruption of power supply to the air conditioner occurs while the timer is set and the power supply thereto is recovered after a period of time passing, the air conditioner is restarted on the basis of an operation mode prior to the occurrence of the interruption of power supply in the conventional auto-re-start control. This means that the air conditioner is restarted after the interruption thereof is recovered regardless of the set content of the timer in any case of that the timer is set to a timer entering mode (an operation of the air conditioner is stopped at present and the operation is started at a predetermined time in the future "x minutes past y") and that the timer is set to a timer cutting mode (the air conditioner is operated until a pre-

determined time in the future "x minutes past y" and stopped at the time). Therefore, there is a possibility that the air conditioner is started at the time'at which the user wants to stop the operation of the air conditioner regardless of that the timer is set.

SUMMARY OF THE INVENTION

[0013] The present invention is directed to overcome the foregoing problems.

[0014] Accordingly, it is an object of the present invention to provide an air conditioner in which whether auto-re-start control is executed or not can be selected by a user thereby improving the flexibility of the air conditioner in relation to various different power supply environments.

[0015] Another object of the present invention is to specifically determine how the auto-re-start control is executed when a timer is set thereby improving the flexibility of the air conditioner in relation to the timer operation under various different power supply environments.

[0016] Another object of the present invention is to visibly indicate whether auto-re-start control is executed or not whereby a user can easily and instantly know the whether or not the auto-re-start control is executed.

[0017] To achieve the such objects, according to one aspect of the present invention, there is provided an air conditioner having a function capable of automatically restarting a predetermined air conditioning operation in a case where a power supply from a power source to the air conditioner is interrupted and then the power supply from the power source thereto is recovered, the air conditioner being characterized by an auto-re-start setting means for switchably setting whether or not the automatically restart operation is performed.

[0018] As a preferable embodiment of this aspect, there is provided the air conditioner further comprising executing means having refrigerating cycle elements annularly connected with each other for circulating a refrigerant so as to execute an air conditioning operation, memory means for memorizing a content of the air conditioning operation as an operation content data, judgment means for judging whether or not the interruption of the power supply and the recovery thereof occur during the air conditioning operation, and control means for reading out the operation content data from the memory means and for controlling the executing means so as to automatically restart an air conditioning operation according to the readout operation content data only in a case where the performance of the automatically restart operation is set by the auto-re-start setting means and where the interruption of the power supply and the recovery thereof occur during the air conditioning operation by the judgment of the judgment means.

[0019] In preferred embodiment of this aspect, there is provided the air conditioner further comprising setting means operatively connected to the executing means for setting an operation content data thereto, said executing means executing the air conditioning operation according to the operation content data set by the setting means.

[0020] In preferred embodiment of this aspect, wherein said auto-re-start setting means is provided with a changeover switch adapted to be manually switchable so as to determine whether or not the automatically restart operation is performed according to a switched state of the changeover switch.

[0021] This aspect of the present invention has an arrangement that the memory means has a non-volatile memory capable of writing data to the non-volatile memory and erasing data stored therein and is adapted to write an operation content of the air conditioning operation to the non-volatile memory as the operation content data, said air conditioning operation being executed prior to the interruption of power supply by the executing means.

[0022] In preferred embodiment of this aspect, there is provided an air conditioner further comprising executing means having refrigerating cycle elements annularly connected with each other for circulating a refrigerant so as to execute an air conditioning operation, timer setting means for setting a timer (timer cutting mode) in that the executing means executes a preset air conditioning operation until a predetermined time and stops the preset air conditioning operation when the predetermined time is reached, judgment means for judging whether or not the interruption of the power supply and the recovery thereof occur while the timer is set by the timer setting means and control means for controlling the executing means, when the interruption of the power supply and the recovery thereof occur while the timer is set by the judgment of the judgment means, so as to prohibit the automatically restart operation whether or not the automatically restart operation is performed by the auto-re-start setting means.

[0023] In preferred embodiment of this aspect, there is provided an air conditioner further comprising executing means having refrigerating cycle elements annularly connected with each other for circulating a refrigerant so as to execute an air conditioning operation, timer setting means for setting a timer (timer entering mode) in that the executing means executes a preset air conditioning operation from a predetermined time in a future, first judgment means whether or not the predetermined time is reached, second judgment means for judging whether or not the interruption of the power supply and the recovery thereof occur in a case where the predetermined time is not reached by the judgment of the first judgment means, and control means for controlling the executing means, when the interruption of the power supply and the recovery thereof occur by the judgment of the second judgment means, so as to prohibit the automatically restart operation whether or not the automatically restart operation is performed by the auto-re-start setting means.

[0024] This aspect of the present invention has an arrangement characterized by further comprising memory means for memorizing a content of the preset air conditioning operation as an operation content data, said preset air conditioning operation being executed by the executing means in a case where the predetermined time is reached by the judgment of the first judgment means, third judgment means for judging whether or not the interruption of the power supply and the recovery thereof occur during the preset air conditioning operation and control means for reading out the operation content data from the memory means and for controlling the executing means so as to automatically restart an air conditioning operation according to the readout operation content data only in a case where the performance of the automatically restart operation is set by the auto-re-start setting means and where the interruption of the power supply and the recovery thereof occur during the preset air conditioning operation by the judgment of the third judgment means.

[0025] This aspect of the present invention has an arrangement characterized by further comprising executing means having two groups of refrigerating cycle elements annularly connected with each other for circulating a refrigerant so as to execute an air conditioning operation, one group of said refrigerating cycle elements being provided in an indoor unit disposed in a room having an indoor heat exchanger capable of evaporating and condensing the refrigerant and an indoor fan operatively connected to the indoor heat exchanger so as to supply conditioned air produced by the evaporation and condensation of the refrigerant into the room and another group of said refrigerant cycle being provided in outdoor unit disposed out of the room, means for setting a quiet sleeping operation data including at least a predetermined temperature of the room and a predetermined amount of the supplying air so as to prevent an excessive cooling and heating of the room thereby providing a user therein with a quiet and comfortable sleeping, said executing unit executing the air conditioning operation according to the quiet sleeping operation data, means for judging whether or not the performance of the automatically restart operation is set by the auto-re-start setting means when the interruption of the power supply and the recovery thereof occur while the executing means executes the quiet sleeping operation, and control means for controlling the executing means so as to automatically restart the quiet air conditioning operation according to the quiet sleeping operation data only when the judging means is judged such that the performance of the automatically restart operation is set.

[0026] For achieving such objects, according to another aspect of the present invention, there is provided a method of controlling an air conditioner for automatically restarting a predetermined air conditioning operation in a case where a power supply to the air conditioner is interrupted and then the power supply thereto is recovered, the method characterized by comprising the steps of setting whether or not the automatically restart operation is performed and performing the automatically restart operation only when the performance of the automatically restart operation is set by the setting step.

[0027] According to the present invention, since whether or not the automatically restart operation is performed can be set by manually operating the auto-re-start setting means (for example, the changeover switch), the user can easily select whether or not the automatically restart operation is performed depending upon a power supply environment and the like under which the air conditioner is used and the use thereof.

[0028] Further, according to the present invention, when the power supply from the power source to the air conditioner is interrupted and then recovered during the timer cutting mode and the timer entering mode are set, since the automatically restart operation is not performed whether or not the automatically restart operation is performed by the auto-re-start setting means, the operation of the executing unit of the air conditioner is not started against the intention of the user.

[0029] Incidentally, when the air conditioner is operated by the executing means based on the timer entering mode, the auto-re-start control is executed only when the performance of the automatically restart operation is set by the auto-re-start setting means. As a result, the automatically restart operation is executed only when the executing unit executes the preset air conditioning operation based on the timer entering mode, that is, only when the air conditioning operation is executed based on the intention of the user.

[0030] In addition, according to the present invention, when an interruption of power supply and a recovery thereof occur while the executing unit executes the quiet sleeping operation based on the quiet sleeping operation data, the auto-re-start control is performed only when the judgment means judges that the performance of the automatically restart operation is set by the auto-re-start setting means. As a result, even if an interruption of power supply and a recovery thereof occur during the quiet sleeping operation, the quiet sleeping operation can be executed again according to the performance of the automatically restart operation of the executing means.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] Other objects and aspects of the present invention will become apparent from the following description of embodiments with reference to the accompanying drawings in which:

Fig. 1 is a block diagram showing the refrigerating cycle of an air conditioner according to a first embodiment of the present invention;

Fig. 2 is a control system diagram of the air conditioner as a whole including an indoor unit and an outdoor unit according to the first embodiment;

Fig. 3 is a schematic flowchart showing an example of the operation processings of the air conditioner as a whole in which stress is put on the operation of the indoor control unit of the indoor unit according to the first embodiment;

Fig. 4 is a schematic flowchart showing the example of the operation processings of the air conditioner as a whole in which stress is put on the operation of the indoor control unit of the indoor unit according to the first embodiment;

Fig. 5 is a schematic flowchart showing the example of the operation processings of the air conditioner as a whole in which stress is put on the operation of the indoor control unit of the indoor unit according to the first embodiment;

Fig. 6 is a control system diagram of an air conditioner as a whole including an indoor unit and an outdoor unit according to a second embodiment of the present invention;

Fig. 7 is a portion of a schematic flowchart showing an example of the operation processing of the air conditioner as a whole according to the second embodiment and shows a processing in relation to a indicating unit;

Fig. 8 is a portion of a schematic flowchart showing an example of the operation processing of the air conditioner as a whole according to the second embodiment and shows a processing in relation to the indicating unit;

Fig. 9 is a control system diagram of an air conditioner as a whole including an indoor unit and an outdoor unit according to a modification of the second embodiment;

Fig. 10 is a portion of a schematic flowchart showing an example of the operation processing of the air conditioner as a whole according to the second embodiment and shows a process relating to the indicating unit;

Fig. 11 is a portion of a schematic flowchart showing an example of the operation processing of the air conditioner as a whole according to the second embodiment and shows a process relating to the indicating unit;

Fig. 12 is a portion of a schematic flowchart showing an example of the operation processing of the air conditioner as a whole according to the second embodiment and shows a processing relating to a buzzer;

Fig. 13 is a schematic flowchart showing an example of the timer cutting operation processings of the air conditioner as a whole according to a third embodiment of the present invention;

Fig. 14 is a schematic flowchart showing an example of the timer entering operation processings of the air conditioner as a whole according to the third embodiment;

Fig. 15 is a schematic flowchart showing an example of the quiet sleeping operation processings of the air conditioner according to the third embodiment;

Fig. 16 is a control system diagram of an air conditioner as a whole including an indoor unit and an outdoor unit according to an modification of the present invention; and

Fig. 17 is a portion of a flowchart showing an example of the operation processings of the air conditioner according to the modification and shows the processing relating to the operation of a push button switch according to the modification in Fig.16.

DESCRIPTION OF THE PREFFERED EMBODIMENTS

[0032] Preferred embodiments of the present invention will now be described with reference to the accompanying drawings.

(First Embodiment)

[0033] Fig. 1 is a block diagram showing the construction of the refrigerating cycle of an air conditioner according to the first embodiment.

[0034] As shown in Fig. 1, the air conditioner 1 constitutes a refrigerating cycle for reversibly circulating a refrigerant by sequentially and annularly connecting, through a piping 7, a compressor 2, a four-way valve 3 having a function for switching a refrigerant flow passage, an indoor heat exchanger 4 disposed opposite to an indoor fan 4a, an electronic control valve (PMV) 5, as an example of an expansion valve and an outdoor heat exchanger 6 disposed opposite to an outdoor fan 6a.

[0035] As found from the refrigerating cycle, the air conditioner 1 circulates the refrigerant along the directions of solid lines in Fig. 1 {the compressor 2 → the four-way valve 3 → the outdoor heat exchanger 6, which condenses the refrigerant → the PMV 5 → the indoor heat exchanger 4, which evaporates and cools the refrigerant → the four-way valve 3 → the compressor 2...} by switching the four-way valve 3 (the four-way valve 3 → OFF) when the compressor 2, the indoor fan 4a and the outdoor fan 6a are operated so that the air conditioner 1 operates in a cooling mode so as to supply a coolly conditioned air and further circulates the refrigerant along the directions of broken lines in Fig. 1 {the compressor 2 → the four-way valve 3 → the indoor heat exchanger 4, which condenses and heats the refrigerant → the expansion valve 5 → the outdoor heat exchanger 6, which evaporates the refrigerant → the four-way valve 3 → the compressor 2 → ...} by switching the four-way valve 3 (the four-way valve 3 → ON) so that the air conditioner 1 operates in a heating mode so as to supply a heatedly conditioned air.

[0036] The compressor 2, the four-way valve 3, the PMV 5, the outdoor heat exchanger 6 and the outdoor fan 6a are provided in an outdoor unit disposed out of a

room. The outdoor unit includes an evaporating temperature sensor 9 disposed to the outdoor heat exchanger 6 for detecting the evaporating temperature of the refrigerant in the outdoor heat exchanger 6 and an outside air temperature sensor 10 disposed to the outdoor heat exchanger 6 itself or in the vicinity of the outdoor heat exchanger 6 for detecting the outside temperature. According to the signals and the like detected by the evaporating temperature sensor 9 and the outside air temperature sensor 10, respectively, the outdoor unit is adapted to control the entire outdoor component including the compressor 2 and other elements.

[0037] The indoor heat exchanger 4 and the indoor fan 4a are provided in an indoor unit disposed in the room. The indoor unit includes a room temperature sensor 11 for detecting a room temperature and a heat exchanger temperature sensor 12 disposed to the indoor heat exchanger 4 for detecting the condensing temperature of the refrigerant in the indoor heat exchanger 4. The indoor unit has a performance for controlling the entire indoor component including the indoor heat exchanger 4 and the indoor fan 4a in accordance with the signals and the like detected by the room temperature sensor 11 and the heat exchanger temperature sensor 12, respectively.

[0038] Fig. 2 shows a control system of the air conditioner 1 as a whole including the indoor unit 15 and the outdoor unit 16.

[0039] According to Fig. 2, the indoor unit 15 which is accommodated in a frame formed by an indoor panel includes an indoor control unit (MCU: multi-control unit) 20 having, for example, a microcomputer mounted thereon to control the indoor unit 15 and the outdoor unit 16 as a whole. The indoor control unit 20 is connected to an AC power source 21 which supplies electric power to the air conditioner 1 by turning on a power switch (not shown) provided in the indoor unit 15 or a power switch button disposed at a remote controller described below. Further, the indoor control unit 20 is electrically connected to a remote controller 22 so that the indoor control unit 20 can receive a command signal to the air conditioner 1 supplied from the remote controller 22.

[0040] The remote controller 22 is able to transmit an operation command for operating the air conditioner 1 (the indoor unit 15 and the outdoor unit 16) in a desired operating state and an operation stop command to the indoor controller 20. That is, the remote controller 22 can remotely transmit operation mode selection data such as, for example, the cooling mode, the heating mode, a dehumidifying mode and the like, setting data for setting a desired room temperature, an amount of supply air etc., and so forth to the indoor control unit 20 as an operation command. Further, the remote controller 22 can set a timer to the air conditioner 1 so that operation based on the operation mode selecting data and the setting data is executed thereby from a desired time or until a desired time.

[0041] That is, the remote controller 22 can set the air conditioner 1 (indoor controller 20) to a timer entering mode for starting the air conditioner 1 at a predetermined time in the future "x minutes past y" (or at a time after a predetermined period of time elapses from the present) and to a timer cutting mode for continuing the operation of the air conditioner 1 until a predetermined time in the future "x minutes past y" (or until a predetermined period of time elapses from the present) and stopping the operation at the predetermined time.

[0042] Further, the remote controller 22 can transmit a special operation command to the air conditioner 1 (indoor control unit 20) to operate the air conditioner 1 in a preset operation content. This embodiment includes, as the special operation command, a command (automatic operation command) for automatically executing operation at a preset temperature and a preset amount of supplying air without setting the above operation mode and room temperature and a command (quiet sleeping operation command) for executing a quiet sleeping operation to provide a user with comfortable sleeping by preventing the excessive cooling and heating of a room when the user gets a sleep. The remote controller 22 has an automatic operation command switch 22a for transmitting the automatic operation command to the indoor control unit 20 by operating the automatic operation command switch and has a quiet sleeping operation command switch 22b for transmitting the quiet sleeping operation command thereto by operating the quiet sleeping operation command switch 22b. In the quiet sleeping operation, a cooling or heating operation, which is set in accordance with the environment such as a room temperature and the like when the user sleeps, is continued for a predetermined time to remove the sleepless state of the user, and, as after the predetermined period of time elapses (the user is in sleep), operation is continued for a predetermined time while keeping a predetermined temperature (which is set by being automatically changed so that the temperature is comfortable to the body of the user and the user is not excessively cooled or heated in sleep and the range of change of the temperature is narrow) with the amount of air supplied into the room which is reduced as compared with a usual amount of supply air so as to prevent the excessive cooling or heating of the room.

[0043] On the other hand, the indoor unit 15 includes the room temperature sensor 11 and the heat exchanger temperature sensor 12 mentioned above. The indoor unit 15 also includes a fan motor (FM) 23 for rotating the indoor fan 4a, a speed control circuit 24 capable of variably controlling the rotational speed of the FM 23, a louver motor (LM) 25 for swinging a louver 26 to regulate the direction of wind (cool wind or warm wind) supplied from a blowout port of the indoor unit 15 and a louver drive circuit 27 for driving the LM 25 while controlling the rotational angel thereof. The room temperature sensor 11, the heat exchanger temperature sensor 12, the speed control circuit 24 and the louver drive circuit 27 are connected to the indoor control unit 20, respectively.

[0044] The indoor unit 15 further includes a non-volatile memory (for example, an EEPROM in the embodiment) 30 and a changeover switch 31 for determining whether the auto-re-start control is executed or not. The changeover switch (for example, an ON/OFF switch) 31 is disposed to the indoor panel or the like of the indoor unit 15 and it is predetermined that when the changeover switch 31 is turned ON, for example, it indicates that the auto-re-start control is executed and when the changeover switch 31 is turned OFF, it indicates that the auto-re-start control is not executed.

[0045] The indoor unit 15 includes a compulsory operation switch 32 for compulsorily operating the air conditioner 1 on the basis of the data showing the predetermined operation content regardless of the content transmitted from the remote controller 22. The compulsory operation switch (for example, a slide switch) 32 is also disposed to the indoor panel or the like of the indoor unit 15. In accordance with a slide position of the compulsory operation switch 32 is set, there can be selected various types of operation modes such as, for example, (1) a compulsory automatic operation mode, (2) a compulsory cooling operation mode (in the above compulsory operation modes, an automatic operation or a cooling operation is carried out according to data showing the preset operation content regardless of the operation command transmitted from the remote controller 22) and (3) an ordinary operation mode (operation is carried out on the basis of the operation command transmitted from the remote controller 22) and the like. Usually set is the (3) ordinary operation mode.

[0046] On the other hand, the outdoor unit 16 which is accommodated in a frame formed by an outdoor panel includes an outdoor control unit 33 having a microcomputer mounted thereon, a drive circuit 34 connected with the outdoor control unit 33 for driving the above compressor 2 according to a control thereof, a fan motor (FM) 35 and an FM drive circuit 36 connected with the outdoor control unit 33 for rotating the outdoor fan 6a on the basis of a control thereof. The outdoor unit also includes the expansion valve 5, the evaporating temperature sensor 9 and the outside air temperature sensor 10 mentioned above are connected with the outdoor control unit 33, respectively. An AC power supply line L is connected to the outdoor control unit 33 of the outdoor unit 16 through the indoor controller 20. Further, the outdoor control unit 33 of the outdoor unit 16 is interconnected to the indoor control unit 20 through a line C so that the indoor control unit 20 can transmit and receive control signals relating to the operation of the air conditioner 1 as a whole through the line C.

[0047] The indoor control unit 20 of the indoor unit 15 controls the above respective components (the speed control circuit 24 and the like) of the indoor unit 15 and the above respective components (the drive circuit 34 and the like) of the outdoor unit 16 on the basis of the operation command transmitted from the remote 'controller 22, respectively thereby carrying out air conditioning corresponding to the content of the operation command. Further, when a timer is set, the indoor control unit 20 carries out the operation according to the content set by the timer by controlling the above components of the indoor unit 15 and the above components of the outdoor unit 16, respectively on the basis of the content set by the timer as soon as the time set thereby is reached.

[0048] Furthermore, when the changeover switch 31 is turned ON, the indoor control unit 20 writes the present operation content (the content of the operation command transmitted from the remote controller 22 in the ordinary operation mode) to the EEPROM 30 as data at a necessary timing and, when power supply is interrupted and then recovered, the automatic operation is carried out on the basis of the operation content data written to the EEPROM 30. Further, when the changeover switch 31 is turned OFF, the indoor control unit 20 erases operation content data stored in the EEPROM 30 at a given timing.

[0049] Next, the overall operation of the embodiment will be described using Fig. 3 to Fig. 5 particularly with a stress placed on the control operation executed by the indoor control unit 20 according to the ON/OFF of the changeover switch 31.

[0050] When the air conditioner 1 is energized by the power source 21 by, for example, turning ON the power switch of the air conditioner 1 (the indoor unit 15 and the outdoor unit 16), the microcomputer of the indoor control unit 20 is reset (Fig. 3: step S1). Subsequently, the indoor control unit 20 judges whether the ordinary operation mode is set or not by referring to the slide position of the compulsory operation switch 32 (step S2). When it is judged that the ordinary operation mode is not set but the special operation mode is set as a result of judgment (the result of judgment at step S2: NO, (in Fig. 3 and other figures, NO is abbreviated as "N")), the indoor control unit 20 goes to the processing at step S30 to be described later (Fig. 4). Whereas, when it is judged as the result of judgment that the ordinary operation mode is set (the result of judgment at step S2: YES (in Fig. 3 and other figures, YES is abbreviated as "Y")), the indoor control unit 20 judges whether the changeover switch 31 is turned ON or not (step S3).

[0051] When it is judged that the changeover switch 31 is turned OFF as the result of judgment at step S3, (the result of judgment at step S3: NO), the indoor control unit 20 goes to the processing at step S35 (Fig. 5) to be described below. On the other hand, when it is judged that the changeover switch 31 is turned ON as the result of judgment at step S3, that is, it is judged that the auto-re-start control is executed (the result of judgment at step S3: YES), the microcomputer of the indoor control unit 20 is reset again (step S4) and subsequently the indoor control unit 20 judges whether the EEPROM 30 stores operation content data or not (whether there is data or not) referring to the EEPROM 30 (step S5).

[0052] When it is judged that the data is stored as the result of judgment at step S5 (the result of judgment at

step S5: YES), the indoor control unit 20 judges whether a predetermined period of time (for example, 3 minutes) has elapsed from the energization or not, that is, whether the temperature of the indoor heat exchanger 4 has increased and reached to a heat exchangeable temperature (step S6). When it is judged that the period of time has not passed as the result of judgment at step S6 (the result of judgment at step S6: NO), the indoor control unit 20 repeats the judgment processing at step S6. When it is judged that the period of time has passed as the result of judgment at step S6 (the result of judgment at step S6: YES), the indoor control unit 20 starts an air conditioning operation according to the operation content data stored in the EEPROM 30 by controlling the components of the indoor unit 15 and the components of the outdoor unit 16 through the outdoor control unit 33, respectively (step S7).

[0053] The indoor control unit 20 always judges whether or not a power failure occurs, that is, a power supply from the power source 21 to the air conditioner 1 is interrupted (step S8). When the interruption of power supply from the power source 21 thereto occurs (the result of judgment at step S8: YES) whereby the air conditioner 1 stops the air conditioning operation and the power supply from the power source 21 thereto is recovered thereafter (a result of judgment at step S9: YES), since there arises a state substantially the same as when the air conditioner 1 is energized, the indoor controller 20 returns to the processing at step S1 and repeats the processings at step S1 to step S9. As a result, the auto-re-start control can be executed by which the air conditioner 1 can be restarted after the event of the interruption of power supply therefrom and the recovery thereof.

[0054] On the other hand, when it is judged that the EEPROM 30 does not store the data as the result of judgment at step S5 (the result of judgment at step S5: NO), the indoor control unit 20 is in a control operation waiting state until an operation command is transmitted from the remote controller 22 (step S10). If an interruption of power supply from the power source 21 to the air conditioner 1 occurs in the waiting state (a result of judgment at step S11: YES) and then power supply is recovered thereafter (a result of judgment at step S12: YES), since there arises a state substantially the same as when the air conditioner 1 is energized, the indoor controller 20 returns to the processing at step S1 and repeats the processings at step S1 to step S5.

[0055] When no interruption of power supply from the power source 21 to the air conditioner 1 occurs in the waiting state, (the result of judgment at step S11: NO), the indoor control unit 20 judges whether a present operation mode is the ordinary operation mode or not (step S13). Since the present operation mode is the ordinary operation mode, a result of the judgment is YES and the indoor control unit goes to the processing at step S14.

[0056] On the other hand, the indoor control unit 20 in the operation waiting state judges whether an operation command is transmitted from the remote controller 22 or not (step S14). That is, when the operation command is not transmitted from the remote controller 22 (the result of judgment at step S14: NO), the indoor control unit 20 returns to the processing at step S10 and continues the operation waiting state.

[0057] At the time, the user transmits an operation command including desired operation mode selection data and setting data to the indoor controller 20 by manually operating the remote controller 22. The indoor control unit 20 receives the transmitted operation command (the result of judgment at step S14: YES) and writes the operation content based on the operation command to the EEPROM 30 as data (step S15). Then, the indoor control unit 20 judges whether a predetermined period of time (for example, 3 minutes) has passed from the energization or not, said judgment processing being the same as step S6 (step S16) and when the predetermined period of time has passed, the indoor control unit 20 goes to the processing at step S17.

[0058] The indoor control unit 20 starts the ordinary air conditioning operation according to the content of the operation command from the remote controller 22 by controlling the components (the speed control circuit 24 and the like) of the indoor unit 15 and the components (the compressor drive circuit 34 and the like) of the outdoor unit 16, respectively on the basis of the content of the operation command (step S17).

[0059] In the ordinary operation, the indoor control unit 20 always judges whether a command for changing the set operation content is transmitted from the remote controller 22 or not (step S18). When the setting change command is transmitted (the result of judgment at step S18: YES), the indoor control unit 20 receives the transmitted setting change command and renews (updates) the operation content data stored in the EEPROM 30 to the data based on the operation content which corresponds to the setting change command (obtains data of the renewed operation content) so as to carry out the ordinary air conditioning operation according to the setting change command (step S19).

[0060] In the ordinary operation, the indoor control unit 20 always judges whether or not an interruption of power supply from the power source 21 to the air conditioner 1 occurs (step S20). When an interruption of power supply therefrom occurs (the result of judgment at step S20: YES) whereby the air conditioner 1 stops the air conditioning operation and power supply is recovered thereafter (a result of judgment at step S21: YES), the indoor control unit 20 automatically executes an auto-re-start control operation. That is, the indoor control unit 20 controls the start of the components of the indoor unit 15 and the components of the outdoor unit 16 through the outdoor control unit 33, respectively according to the data of the renewed operation content written to the EEPROM 30 thereby automatically starting the air conditioning operation corresponding to the renewed operation content (step S22) and goes to the

processing at step 26. Whereas, when no interruption of power supply from the power source 21 to the air conditioner 1 occurs (the result of judgment at step S20: NO), the indoor control unit 20 controls the start of the components of the indoor unit 15 and the components of the outdoor unit 16 through the outdoor control unit 33, respectively according to the data of the renewed operation content written to the EEPROM 30 thereby automatically starting the air conditioning operation corresponding to the renewed operation content and goes to the processing at step S26.

[0061] On the other hand, when the judgment at step S18 is NO, that is, when no setting change command is transmitted, the indoor control unit 20 always judges whether or not an interruption of power supply from the power source 21 to the air conditioner occurs in the ordinary air conditioning operation (step S23). When an interruption of power supply therefrom occurs (the result of judgment at step S23: YES) and the power supply is recovered thereafter (a result of judgment at step S24: YES), the indoor control unit 20 controls the start of the components of the indoor unit 15 and the components outdoor unit 16, respectively according to the operation content data written to the EEPROM 30 thereby automatically starting the air conditioning operation corresponding to the operation content data (step S25) and goes to the processing at step S26. Note, when no interruption of power supply from the power source 21 occurs (the result of judgment at step S23: NO), the indoor control unit 20 controls the start of the components of the indoor unit 15 and the components of the outdoor unit 16, respectively according to the operation content data written to the EEPROM 30 thereby automatically starting the air conditioning operation corresponding to the operation content data and goes to the processing at step S26.

[0062] In the ordinary operation by the auto-re-start control according to the data of the renewed operation content data or the operation content data, the indoor control unit 20 always judges whether an operation stop command is transmitted from the remote controller 22 or not (step S26). When it is judged that no stop command is transmitted (the result of judgment at step S26: NO), the indoor control unit 20 returns to the processing at step S18 and continues the ordinary operation.

[0063] On the other hand, when the judgment at step S26 is YES, that is, when it is judged that the operation stop command is transmitted, the indoor control unit 20 erases all the data including the operation content data (or the renewed operation content data) written to the EEPROM 30 (step S27), returns to the processing at step S10 and is put to the waiting state. Then, when an operation command is transmitted again from the remote controller 22 in the processing at step S14 through step S11 to step S13, the indoor control unit 20 executes the above processings at S14 to S27 thereby controlling the operation including the auto-re-start control operation.

[0064] On the other hand, when the result of judgment at step S2 is NO, that is, when the slide position of the compulsory operation switch 32 is set to the special operation mode (the compulsory automatic operation mode or the compulsory cooling operation mode), the indoor control unit 20 judges whether the slide position indicates the compulsory automatic operation mode or not (Fig. 4; step S30). When the result of judgment is YES (the compulsory automatic operation mode is set), the indoor control unit 20 starts the compulsory automatic operation by controlling the start of the components of the indoor unit 15 and the components of the outdoor unit 16, respectively on the basis of the operation content, which is determined in advance, corresponding to the compulsory automatic operation mode (step S31) and goes to step S10 and step S11. Whereas, when the judgment at step S30 is NO (the compulsory cooling operation mode is set), the indoor control unit 20 starts the compulsory cooling operation by controlling the start of the components of the indoor unit 15 and the components of the outdoor unit 16, respectively on the basis of the operation content, which is determined beforehand, according to the compulsory cooling operation mode (step S32) and goes to step S10 and step S11. In the processings at step S11 to step S13, since a present mode is the special operation mode, operation is not controlled according to the operation command from the remote controller 22 at step S14 the following steps (the result of judgment at step S13: NO) and the process goes to the processing at step S1 and repeats the above processings.

[0065] Further, when the result of judgment at step S3 is NO, that is, when it is judged that the changeover switch 31 is turned OFF, the indoor control unit 20 judges that the auto-re-start control operation is not carried out and erases all the contents of the EEPROM 30 (Fig. 5; step S35). Then, the indoor control unit 20 judges whether an operation command is transmitted from the remote controller 22 or not (step S36). When it is not transmitted (the result of judgment at step S36: NO), the indoor control unit 20 repeats the judgment processing at step S36.

[0066] On the other hand, when the operation command is transmitted from the remote controller 22 by the manual operation of the user (the result of judgment at step S36: YES), the indoor control unit 20 receives the transmitted operation command and starts the ordinary air conditioning operation according to the content of the operation command from the remote controller 22 by controlling the start of the components of the indoor unit 15 and the components of the outdoor unit 16, respectively based on the operation command after a predetermined period of time elapses by a processing similar to that of step S6 and step S16 (step S37).

[0067] At that time, the indoor control unit 20 always judges whether or not an interruption of power supply from the power source 21 to the air conditioner 1 occurs in the ordinary air conditioning operation and (step S38).

That is, when no interruption of power supply therefrom occurs (the result of judgment at step S38: NO), the indoor control unit 20 goes to the processing at step S26 and the indoor control unit 20 executes a processing similar to that of steps S26 and S27. Whereas, even if an interruption of power supply therefrom occurs (the result of judgment at step S38: YES) and the power supply is recovered thereafter (a result of judgment at step S39: YES), since the content stored in the EEPROM 30 is erased by the processing at step S35, the indoor control unit 20 does not execute the auto-re-start control operation, that is, it does not execute the operation on the basis of the content stored in the EEPROM 30 and is put to a reset state (step S40), whereby the processing is finished.

[0068] As described above, according to the above construction, when the changeover switch 31 is set to ON/OFF (the former state determines that the auto-re-start control is executed and the latter state determines that the auto-re-start control is not executed) according to the desire of the user, the processing for executing the auto-re-start control (the changeover switch is turned ON, step S4 to step S27) and the processing for not executing the auto-re-start control (the changeover switch is turned OFF, step S35 to step S40) can be selected. That is, since the user can easily select whether the auto-re-start control is executed or not depending upon an environment and the like, the air conditioner responds to the various desires of users, making it possible to improve the degree of satisfaction of the users and the function of the air conditioner in relation to the power supply environment.

(Second Embodiment)

[0069] Fig. 6 shows a control system of an air conditioner 1A as a whole including an indoor unit 15A and an outdoor unit 16A according to a second embodiment.

[0070] In Fig. 6, the indoor unit 15A is provided with an indicating unit 40 having an operation lamp 40A for indicating the operation of the air conditioner 1A and an auto-re-start lamp 40B for indicating the auto-re-start operation of the air conditioner 1A and with a buzzer 41 as a warning signal output unit. AS the operation lamp 40A and the auto-re-start lamp 40B, LED or other similar indicating elements are used. The operation lamp 40A, the auto-re-start lamp 40B and the buzzer 41 are connected to the indoor unit 15A, respectively. Further, the operation lamp 40A and the auto-restart-lamp 40B are disposed to, for example, the indoor panel or the like of the indoor unit 15A and the auto-restart-lamp 40B is lit under the control of the indoor control unit 20 only when the changeover switch 31 is turned ON (that is, only when it judged that the auto-re-start control operation is executed). In addition, the buzzer 41 generates a warning sound under the control of the indoor control unit 20 when the setting of the changeover switch 31 is changed from a previously set state. Note, since the other construction and operation of the second embodiment are the same as those of the first embodiment, the description thereof is omitted.

[0071] Operation relating the indicating unit 40 in the arrangement will be described.

[0072] In the overall operation of the air conditioner 1 shown in Fig. 3 to Fig. 5, after the ordinary air conditioning operation is started by the processing at step S17 when the changeover switch 31 is turned ON (a state that the auto-re-start operation is executed), the indoor control unit 20 lights the operation lamp 40A and the auto-re-start lamp 40B of the indicating unit 40 together (Fig. 7; step S17A) and then executes the processings at step S18 and the following steps. Further, after the ordinary air conditioning operation is started by the processing at step S37 when the changeover switch 31 is turned OFF (a state that the auto-re-start operation is not executed), the indoor control unit 20 lights only the operation lamp 40A of the indicating unit 40 (Fig. 8; step S37A) and then executes the processings at step S38 and the following steps.

[0073] As a result, the user can easily and instantly know whether the auto-re-start is set or not in the ordinary operation from the state of the auto-re-start lamp 40B (depending upon whether it is lit or not), whereby the degree of satisfaction of the users can be more improved.

[0074] Although the construction of this embodiment is provided with the operation lamp 40A and the auto-restart-lamp 40B as the indicating unit 40, the present invention is not limited thereto but operation lamps 40C and 40D such as, for example, two LEDs or the like each of which has a different color may be provided as shown in Fig. 9. That is, as shown in Fig. 10, after the ordinary air conditioning operation is started by the processing at step S17 when the changeover switch 31 is turned ON (the state that the auto-re-start operation is executed), the indoor control unit 20 lights only the operation lamp 40C of the indicating unit 40 (step S17B) and then executes the processings at step S18 and the following steps. Further, as shown in Fig. 11, after the ordinary air conditioning operation is started by the processing at step S37 when the changeover switch 31 is turned OFF (the state that the auto-re-start operation is not executed), the indoor control unit 20 lights only the operation lamp 40D of the indicating unit 40 (step S37B) and then executes the processings at step S38 and the following steps.

[0075] With this lighting control, since the user can easily and instantly know whether the auto-re-start is set or not in the ordinary operation from the colors of the operation lamps, the degree of satisfaction of the users can be more enhanced.

[0076] Next, operation relating to the buzzer 41 will be described.

[0077] In the overall operation of the air conditioner 1A shown in Fig. 3 to Fig. 5, when the user switches (turns ON or OFF) the changeover switch 31 after the

processing at, for example, step S1 (Fig. 12; a result of judgment at step S50: YES, that is, the processing at step S50 is started by an interruption processing when the switch 31 is switched), the indoor control unit 20 judges whether a present setting of the changeover switch 31 (for example, OFF) is the same as the setting thereof before it is switched (for example, ON) (step S51). When the judgment at step S51 is YES, since the setting of the switch 31 is not changed, the indoor control unit 20 executes the processings at step S2 and the following steps. Whereas, when the judgment at step S51 is NO, that is, when the setting of the switch S31 is changed, the indoor control unit 20 controls causes the buzzer 41 to generate a buzzer sound (warning sound) (step S52) and executes the processing at step S2 and the following steps.

[0078] The generation of the sound by the buzzer permits the user to confirm from the buzzer sound whether or not the indoor control unit 20 recognizes the change of setting of the changeover switch 31 caused by the switching operation thereof. As a result, when, for example, the changeover switch 31 fails, the failure of it can be easily found and malfunction resulting from the failure of the switch 31 can be avoided.

[0079] Incidentally, although this construction of the air conditioner 1A uses the LED lamps as the indicating unit 40, any lamps may be used so long as it can be differently indicated when the auto-re-start control can be executed (the changeover switch is turned ON) and when the auto-re-start control cannot be executed (the changeover switch is turned OFF). Further, the type and number of the indicating unit may be arbitrarily set.

[0080] Although the construction of the air conditioner 1A uses the buzzer as the component for outputting the warning sound when the changeover switch 31 is switched, the present invention is not limited thereto but any warning sound output unit may be used so long as it outputs a warming sound.

[0081] Further, the construction thereof is provided with both the indicating unit 40 and the buzzer 41, it may be provided with any one of them.

(Third Embodiment)

[0082] Since an air conditioner 1 according to the third embodiment has substantially the same construction as that of the first embodiment, the described thereof is omitted. The embodiment has a feature in the auto-re-start control when a timer is set and since the other operation thereof is substantially the same as that of the first embodiment, the described thereof is omitted.

[0083] As the auto-re-start control when the timer is set, first, the auto-re-start control when the timer is set to the timer cutting mode will be described.

[0084] The user transmits the command (the timer 'cutting operation command) for stopping the operation of the air conditioner 1 at a predetermined time in the future "x minutes past y" (or at a time after a predetermined period of time passing from the present) to the indoor control unit 20 of the air conditioner 1 by operating a remote controller 22 (Fig. 13; step S60). The indoor control unit 20 starts the operation of the air conditioner (otherwise, continues the operation of the air conditioner when it is in operation at present) according to the operation content according to the transmitted timer cutting operation command (step S61).

[0085] In the timer cutting operation, the indoor control unit 20 always judges whether or not a power failure occurs, that is, a power supply from the power source 21 to the air conditioner 1 is interrupted (step S62). When the interruption of power supply from the power source 21 to the air conditioner 1 occurs (the result of judgment at step S62: YES) and the power supply is recovered thereafter (a result of judgment at step S63: YES), the indoor control unit 20 judges whether a changeover switch 31 is turned ON or not (step S64).

[0086] Then, the indoor control unit 20 does not execute the auto-re-start control operation based on the content stored in an EEPROM 30 regardless of whether the changeover switch 31 is turned ON or OFF (in both the cases that the result of judgment at step S64 is YES and NO) and is put to a reset state (step S65, step S66), by which the processing is finished.

[0087] That is, since the user sets the timer to the timer cut mode to finally stop the operation of the air conditioner 1, even if the auto-re-start control is set when an interruption of power supply from the power source 21 to the air conditioner 1 occurs in the timer cutting operation and power supply therefrom is recovered thereafter, the operation of the air conditioner 1 is compulsorily stopped (reset). Therefore, there can be solved the problem that the air conditioner 1 whose operation is desired to be finally stopped by the timer set to the timer cut mode is restarted and continues its operation by the occurrence of an interruption of power supply and the recovery thereof.

[0088] Next, the auto-re-start control when the timer is set to a timer entering mode will be described.

[0089] The user transmits the command (the timer entering operation command) for starting the air conditioner 1 at a predetermined time in the future "x minutes past y" (or at a time after a predetermined period of time passing from the present) to (the indoor control unit 20 of) the air conditioner 1 by operating the remote controller 22 (Fig. 14; step S70). The indoor control unit 20 sets the execution of operation according to the operation content based on the transmitted timer entering operation command (the timer is set to the timer entering mode) and is put to a waiting state (step S71).

[0090] When the indoor control unit 20 waits in the timer entering mode, it judges whether the present time reaches the time at which the timer entering mode is set or not (step S72). When the result of judgment at step S72 is NO, that is, when the present time does not yet reach the time at which the timer entering mode is set, since the indoor control unit 20 judges whether an inter-

ruption of power supply from the power source 21 to the air conditioner 1 occurs or not (step S73), when the result of judgment at step S73 is NO, that is, an interruption of power supply therefrom does not occur, the indoor control unit 20 returns to the processing at step S71 and is put to a waiting state.

[0091] On the other hand, when an interruption of power supply therefrom occurs (the result of judgment at step S73: YES) and the power supply therefrom is recovered thereafter (a result of judgment at step S74: YES), the indoor control unit 20 puts the air conditioner 1 to a reset state without restarting it regardless of whether the changeover switch 31 is turned ON or OFF (step S75) and finishes the processing.

[0092] When the result of judgment at step S72 is YES, that is, when the set timer entering time is reached, the indoor control unit 20 starts operation according to the operation content based on the transmitted timer entering operation command (step S76). In the timer entering operation, the indoor control unit 20 judges whether the changeover switch 31 is turned ON or not (step S77). When the result of judgment is NO, that is, when the changeover switch 31 is turned OFF (the auto-re-start control is not executed), the indoor control unit 20 goes to the processing at step S73 and does not restart the operation even if an interruption of power supply from the power source 21 to the air conditioner 1 occurs and the power supply therefrom is recovered thereafter and is put to a reset state (note, when no interruption of power supply therefrom occurs, the timer entering operation is continued).

[0093] On the other hand, the result of judgment at step S77 is YES, that is, when the changeover switch 31 is turned ON (the auto-re-start control is executed), since the process escapes from the setting of timer entering mode waiting state, the indoor control unit 20 writes the operation content based on the timer entering operation command to the EEPROM 30 as data (step S78).

[0094] The indoor control unit 20 always judges whether or not an interruption of power supply from the power source 21 to the air conditioner 1 occurs in the timer entering operation (step S79) and when an interruption of power supply therefrom occurs (the result of judgment at step S79: YES) and the power supply is recovered thereafter (a result of judgment at step S80: YES), the indoor control unit 20 automatically starts the air conditioning operation according to the operation content data written to the EEPROM 30 by controlling the components of the indoor unit 15 and the components of the outdoor unit 16, respectively on the basis of the operation content data and finishes the timer operating processing (step S81).

[0095] As described above, according to the timer entering operation of the embodiment, since the user does not want to operate the air conditioner 1 during the time in which the timer is set to the timer entering mode, even if an interruption of power supply and the recovery thereof occur during the time therein, the air conditioner 1 is not restarted and put to a reset state regardless of whether the changeover switch 31 is turned ON or OFF (see step S73 - step S75).

[0096] On the other hand, in a case where an interruption of power supply and the recovery thereof occur after the process escapes from the setting of timer entering mode waiting state and the air conditioner 1 starts its operation in accordance with the content set by the timer entering mode, only when the changeover switch 31 is turned ON (the auto-re-start control is executed), the indoor control unit 20 writes the operation content to the EEPROM 30 and restarts the air conditioner 1 on the basis of the operation content read out from the EEPROM 30 at the time of the recovery of power supply.

[0097] Therefore, the problem that the air conditioner 1 is started at a time different from the time set by the timer according to the recovery of power supply is solved. Further, in a case where, when the process escapes from the setting of entering timer waiting state, it is desired to restart operation of the air conditioner 1 at the time at which the power supply is recovered, the auto-re-start control can be executed by the changeover switch set by the user.

(Fourth Embodiment)

[0098] Since the construction of the air conditioner 1 according to a fourth embodiment is substantially the same as that of the first embodiment, the description thereof is omitted. The embodiment has a feature in the auto-re-start control in the quiet sleeping operation among special operations and since the other operation of the embodiment is substantially the same as that of the first embodiment, the description thereof is omitted.

[0099] According to the embodiment, the remote controller 22 transmits the quiet sleeping operation command to the indoor control unit 20 of the air conditioner 1 in response to operating the quiet sleeping operation switch 22b by the user(Fig. 15; step S90). The indoor control unit 20 starts operation according to the operation content based on the transmitted quiet sleeping operation command and writes the operation content at the initial mode of the quiet sleeping operation to the EEPROM 30 (step S91), said content of the initial mode of the quiet sleeping operation including a temperature set to avoid excessive cooling and excessive heating after a predetermined period of time passing, an amount of supply air smaller than an ordinary amount thereof and the like and a period of time during which the quiet sleeping operation is continued.

[0100] In the quiet sleeping operation, the indoor control unit 20 always judges whether or not a power failure occurs, that is, a power supply from the power source to the air conditioner 1 is interrupted (step S92). When the interruption of power supply from the power source 21 thereto occurs (the result of judgment at step S92: YES) and the power supply is recovered thereafter (a

result of judgment at step S93: YES), the indoor control unit 20 judges whether a changeover switch 31 is turned ON or not (step S94).

[0101] When the judgment at step S94 is NO, that is, when the changeover switch 31 is turned OFF (the auto-re-start control is not executed), the indoor control unit 20 erases the content of the EEPROM 30 and puts the air conditioner 1 to a reset state without restarting it (step S95).

[0102] On the other hand, when the result of judgment at step S94 is YES, that is, when the changeover switch 31 is turned ON (the auto-re-start control is executed), the indoor control unit 20 automatically executes the air conditioning operation according to the operation content data in the initial mode of the quiet sleeping operation written to the EEPROM 30 by controlling the components of an indoor unit 15 and the components of an outdoor unit 16, respectively on the basis of the operation content data in the initial mode of the quiet sleeping operation and finishes the processing (step S96).

[0103] That is, according to the construction of this embodiment, when an interruption of power supply and the recovery thereof occur in the quiet sleeping operation, the air conditioner 1 is restarted based on the operation content data in the initial mode of the quiet sleeping operation written to the EEPROM 30 only when the changeover switch 31 is turned ON (the auto-re-start control is executed). Whereas, when the changeover switch 31 is turned OFF (the auto-re-start control is not executed), the operation of the air conditioner 1 is compulsorily stopped (the air conditioner 1 is put to a reset state). Therefore, in the quiet sleeping operation, whether the auto-re-start control is executed or not can be set by the user. Further, even if an interruption of power supply occurs in the quiet sleeping operation, since the quiet sleeping operation can be executed again from the initial mode of the quiet sleeping operation by the auto-re-start control, a comfortable quiet sleeping operation can be executed.

[0104] In the first to fourth embodiments, although the operation content is written to the EEPROM 30 and the operation is started on the basis of the written operation content data when the auto-re-start control is executed in the occurrence of interruption of power supply and the recovery thereof, the present invention is not limited thereto but it is possible that a operation content is preset as an automatic operation mode (in cooling/heating) and when a power supply is recovered, the operation is always started in the operation content according to the automatic operation mode. With this construction, a volatile memory such as the EEPROM need not be used, whereby a cost can be reduced.

[0105] Further, in the above respective embodiments, although the changeover switch 31 is described as the slide switch, the present invention is not limited thereto but various types of a switch such as, for example, a push button switch may be used.

[0106] When the push button switch is particularly used as a modification of the slide switch, whether the ordinary mode is set or the compulsory operation mode (compulsory automatic mode, compulsory cooling mode) is set can be determined depending upon the length of a period of time during which the push button is pushed (push time).

[0107] Fig. 16 shows the construction of the air conditioner 1B according to a modification when the push button switch is used to select whether the compulsory operation is set or not and whether the auto-re-start control is executed or not.

[0108] According to Fig. 16, the indoor unit 15B is provided with a push button switch 50 having a compulsory operation setting function and a switching function in place of the compulsory operation switch and the changeover switch in Fig. 2. The push button switch 50 is connected to the indoor control unit 20 and the ordinary operation mode or the compulsory selection mode, the execution or non-execution of the auto-re-start control, and the compulsory automatic operation mode or the compulsory cooling operation mode can be selected and set, respectively depending upon the period of time during which the push button switch 50 is pushed (push time). Since the other construction of the modification is substantially the same as that shown in the above respective embodiments, the described thereof is omitted.

[0109] Next, operation of the modification will be described in particular as to the above selection/setting operation of the push button switch 50.

[0110] For example, the user pushes the push button switch 50 for a predetermined period of time after the execution of the processing at step S1 in the overall operation of the air conditioner 1 shown in Fig. 3. The indoor control unit 20 judges whether (A) a command as to the ordinary mode is issued or (B) a command as to the compulsory operation mode is issued depending upon a push time of the push button switch 50 (Fig. 17; step S100). When the indoor control unit 20 judges that the push time indicates (A) the command as to the ordinary mode, the indoor control unit 20 goes to step S101 and further judges whether the push time indicates the execution of the auto-re-start control or not. When the result of judgment at step S101 is YES, that is, when it is judged that the push time indicates the execution of the auto-re-start control, the indoor control unit 20 goes to the processing at step S4 in Fig. 3 and executes an operation processing accompanied by the auto-re-start control.

[0111] On the other hand, when the result of judgment at step S101 is NO, that is, when it is judged that the push time indicates the non-execution of the auto-re-start control, the indoor control unit 20 goes to the processing at step S35 in Fig. 5 and executes an operation processing which is not accompanied by the auto-re-start control.

[0112] When the result of judgment at step S100 is YES, that is, when it is judged that the push time indicates (B) the command as to the compulsory operation,

the indoor control unit 20 further goes to step S102 and judges whether the push time indicates (C) the compulsory automatic operation or (D) the compulsory cooling operation.

[0113] When the judgment at step S102 is YES, that is, when it is judged that the push time indicates (C) the compulsory automatic operation, the indoor controller 20 recognizes to execute the compulsory automatic operation (step S103) and moves to the processing at step S31 in Fig. 4 and executes the control for carrying out the compulsory automatic operation.

[0114] On the other hand, when the result of judgment at step S102 is NO, that is, when it is judged that the push time indicates (D) the compulsory cooling operation, the indoor controller 20 recognizes to execute the compulsory cooling operation (step S104), goes to the processing at step S32 in Fig. 4 and executes the control for carrying out the compulsory cooling operation.

[0115] That is, according to the construction of this modification, all of the selection of ordinary mode/compulsory operation mode, the selection of the execution/non-execution of the auto-re-start control and the selection of the contents (auto/cooling) of the compulsory operation can be set using only the push button switch 50 without using the changeover switch. Therefore, the modification can reduce a cost as compared with the first to fourth embodiments because it does not need the changeover switch.

[0116] Moreover, although the first to fourth embodiments dispose the changeover switch 31 in the indoor unit 15 (the indoor panel or the like), the present invention is not limited thereto but it may be disposed to the remote controller 22 and turned ON/OFF by the operation of the remote controller 22.

[0117] Further, according to the first to fourth embodiments, although the EEPROM 30 is used as the non-volatile memory, the present invention is not limited thereto but any memory may be used so long as it is a non-volatile memory capable of writing and erasing data.

[0118] While the invention has been particularly shown and described with reference to the preferred embodiments thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details can be mode therein without departing from the spirit and scope of the invention.

Claims

1. An air conditioner having a function of automatically restarting a predetermined air conditioning operation in a case where a power supply from a power source to the air conditioner is interrupted and then the power supply from the power source thereto is recovered, **characterized by** comprising:

   an auto-re-start setting means for switchably setting whether or not the automatic restart operation is performed;
   executing means having refrigerating cycle elements annularly connected with each other for circulating a refrigerant so as to execute an air conditioning operation;
   memory means for memorizing a content of the air conditioning operation as an operation content data;
   judgement means for judging whether or not the interruption of the power supply and the recovery thereof occur during the air conditioning operation;
   control means for reading out the operation content data from the memory means and for controlling the executing means so as to automatically restart an air conditioning operation according to the readout operation content data only in a case where the performance of the automatic restart operation is set by the auto-re-start setting means and where the interruption of the power supply and the recovery thereof occur during the air conditioning operation by the judgement of the judgement means;
   indicating means for distinguishably indicating whether or not the automatic restart operation is performed, said indicating means having an indicating lamp having a predetermined colour which is lit only when the automatic restart operation is performed and an operation indicating lamp having a predetermined colour which is lit while the executing means executes the air conditioning operation, said colour of the operation indicating lamp being different from the colour of the indicating lamp.

2. An air conditioner having a function capable of automatically restarting a predetermined air conditioning operation in a case where a power supply from a power source to the air conditioner is interrupted and then the power supply from the power source thereto is recovered, the air conditioner being **characterized by** an auto-re-start setting means for switchably setting whether or not the automatically restart operation is performed.

3. An air conditioner according to claim 2, further comprising:

   executing means having refrigerating cycle elements annularly connected with each other for circulating a refrigerant so as to execute an air conditioning operation;
   memory means for memorizing a content of the air conditioning operation as an operation content data;
   judgment means for judging whether or not the interruption of the power supply and the recov-

ery thereof occur during the air conditioning operation; and

control means for reading out the operation content data from the memory means and for controlling the executing means so as to automatically restart an air conditioning operation according to the readout operation content data only in a case where the performance of the automatically restart operation is set by the auto-re-start setting means and where the interruption of the power supply and the recovery thereof occur during the air conditioning operation by the judgment of the judgment means.

4. An air conditioner according to claim 3, further comprising setting means operatively connected to the executing means for setting an operation content data thereto, said executing means executing the air conditioning operation according to the operation content data set by the setting means.

5. An air conditioner according to claim 4, wherein said refrigerating cycle elements are divided into at least two groups, one of said groups being provided in an indoor unit disposed in a room which has an indoor heat exchanger capable of evaporating and condensing the refrigerant and an indoor fan operatively connected to the indoor heat exchanger so as to supply conditioned air produced by the evaporation and condensation of the refrigerant into the room and another of said groups being provided in an outdoor unit disposed out of the room and wherein said setting means has a remote controller disposed in the room and operatively connected to the executing means for remotely transmitting the operation content data thereto.

6. An air conditioner according to claim 4, wherein said auto-re-start setting means is provided with a changeover switch adapted to be manually switchable so as to determine whether or not the automatically restart operation is performed according to a switched state of the changeover switch.

7. An air conditioner according to claim 4, wherein said auto-re-start setting means includes a push button switch adapted to be manually pushed so as to determine whether or not the automatically restart operation is performed in accordance with a length of a period of time during which the push button switch is pushed.

8. An air conditioner according to claim 7, wherein said push button switch is capable of setting the executing means to execute a predetermined air conditioning operation compulsorily regardless of the operation content data set by the setting means according to the length of the period of time during which the push button switch is pushed.

9. An air conditioner according to claim 4, wherein said memory means has a non-volatile memory capable of writing data to the non-volatile memory and erasing data stored therein and is adapted to write an operation content of the air conditioning operation to the non-volatile memory as the operation content data, said air conditioning operation being executed prior to the interruption of power supply by the executing means.

10. An air conditioner according to claim 2, further comprising:

executing means having refrigerating cycle elements annularly connected with each other for circulating a refrigerant so as to execute an air conditioning operation;

timer setting means for setting a timer in that the executing means executes a preset air conditioning operation until a predetermined time and stops the preset air conditioning operation when the predetermined time is reached;

judgment means for judging whether or not the interruption of the power supply and the recovery thereof occur while the timer is set by the timer setting means; and

control means for controlling the executing means, when the interruption of the power supply and the recovery thereof occur while the timer is set by the judgment of the judgment means, so as to prohibit the automatically restart operation whether or not the automatically restart operation is performed by the auto-re-start setting means.

11. An air conditioner according to claim 2, further comprising:

executing means having refrigerating cycle elements annularly connected with each other for circulating a refrigerant so as to execute an air conditioning operation;

timer setting means for setting a timer in that the executing means executes a preset air conditioning operation from a predetermined time in a future;

first judgment means whether or not the predetermined time is reached;

second judgment means for judging whether or not the interruption of the power supply and the recovery thereof occur in a case where the predetermined time is not reached by the judgment of the first judgment means; and

control means for controlling the executing means, when the interruption of the power supply and the recovery thereof occur by the judg-

ment of the second judgment means, so as to prohibit the automatically restart operation whether or not the automatically restart operation is performed by the auto-re-start setting means.

12. An air conditioner according to claim 11, further comprising:

memory means for memorizing a content of the preset air conditioning operation as an operation content data, said preset air conditioning operation being executed by the executing means in a case where the predetermined time is reached by the judgment of the first judgment means;
third judgment means for judging whether or not the interruption of the power supply and the recovery thereof occur during the preset air conditioning operation; and
control means for reading out the operation content data from the memory means and for controlling the executing means so as to automatically restart an air conditioning operation according to the readout operation content data only in a case where the performance of the automatically restart operation is set by the auto-re-start setting means and where the interruption of the power supply and the recovery thereof occur during the preset air conditioning operation by the judgment of the third judgment means.

13. An air conditioner according to claim 2, further comprising:

executing means having two groups of refrigerating cycle elements annularly connected with each other for circulating a refrigerant so as to execute an air conditioning operation, one group of said refrigerating cycle elements being provided in an indoor unit disposed in a room having an indoor heat exchanger capable of evaporating and condensing the refrigerant and an indoor fan operatively connected to the indoor heat exchanger so as to supply conditioned air produced by the evaporation and condensation of the refrigerant into the room and another group of said refrigerant cycle being provided in outdoor unit disposed out of the room;
means for setting a quiet sleeping operation data including at least a predetermined temperature of the room and a predetermined amount of the supplying air so as to prevent an excessive cooling and heating of the room thereby providing a user therein with a quiet and comfortable sleeping, said executing unit executing the air conditioning operation according to the quiet sleeping operation data;
means for judging whether or not the performance of the automatically restart operation is set by the auto-re-start setting means when the interruption of the power supply and the recovery thereof occur while the executing means executes the quiet sleeping operation; and
control means for controlling the executing means so as to automatically restart the quiet air conditioning operation according to the quiet sleeping operation data only when the judging means is judged such that the performance of the automatically restart operation is set.

14. An air conditioner according to claim 3, further comprising indicating means for distinguishably indicating whether or not the automatically restart operation is performed.

15. An air conditioner according to claim 14, wherein said indicating means has an indicating lamp having a predetermined color which is lit only when the automatically restart operation is performed.

16. An air conditioner according to claim 15, wherein said indicating means has a operation indicating lamp having a predetermined color which is lit while the executing means executes the air conditioning operation, said color of the operation indicating lamp being different from the color of the indicating lamp.

17. An air conditioner according to claim 3, further comprising means for generating a warning sound when whether or not the automatically restart operation is performed is set by switching the auto-re-start setting means, said warning sound notifying the switching operation of the auto-re-start setting means.

18. A method of controlling an air conditioner for automatically restarting a predetermined air conditioning operation in a case where a power supply to the air conditioner is interrupted and then the power supply thereto is recovered, the method **characterized by** comprising the steps of:

setting whether or not the automatically restart operation is performed; and
performing the automatically restart operation only when the performance of the automatically restart operation is set by the setting step.

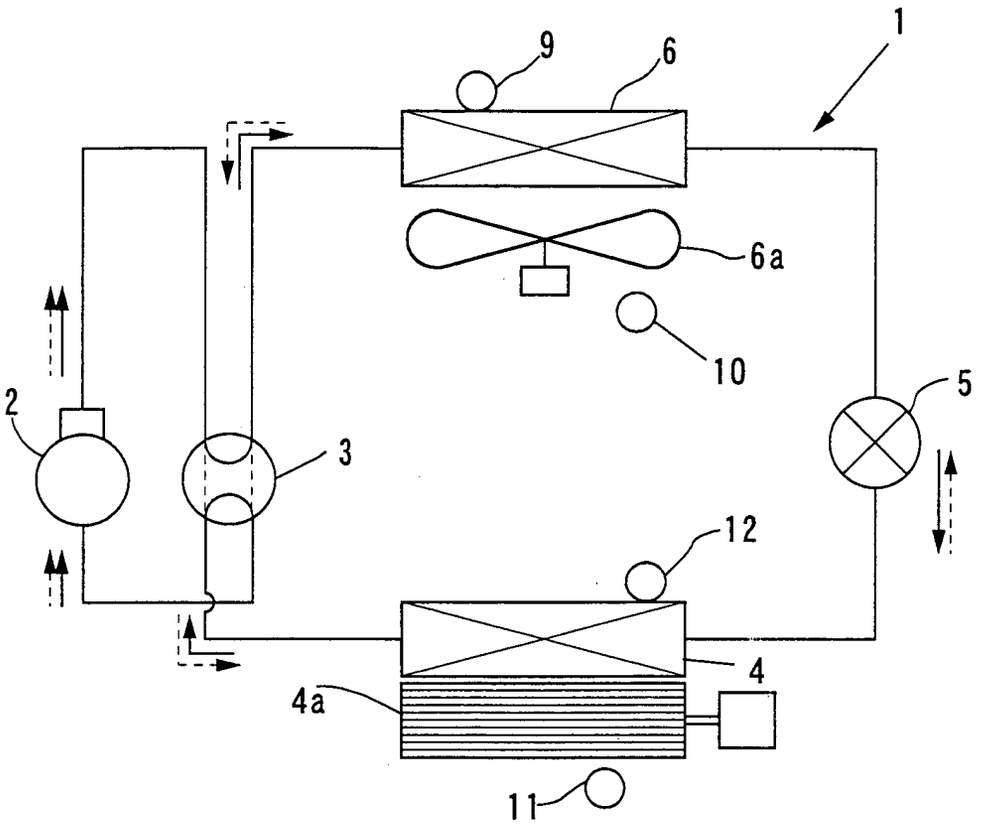

FIG. 1

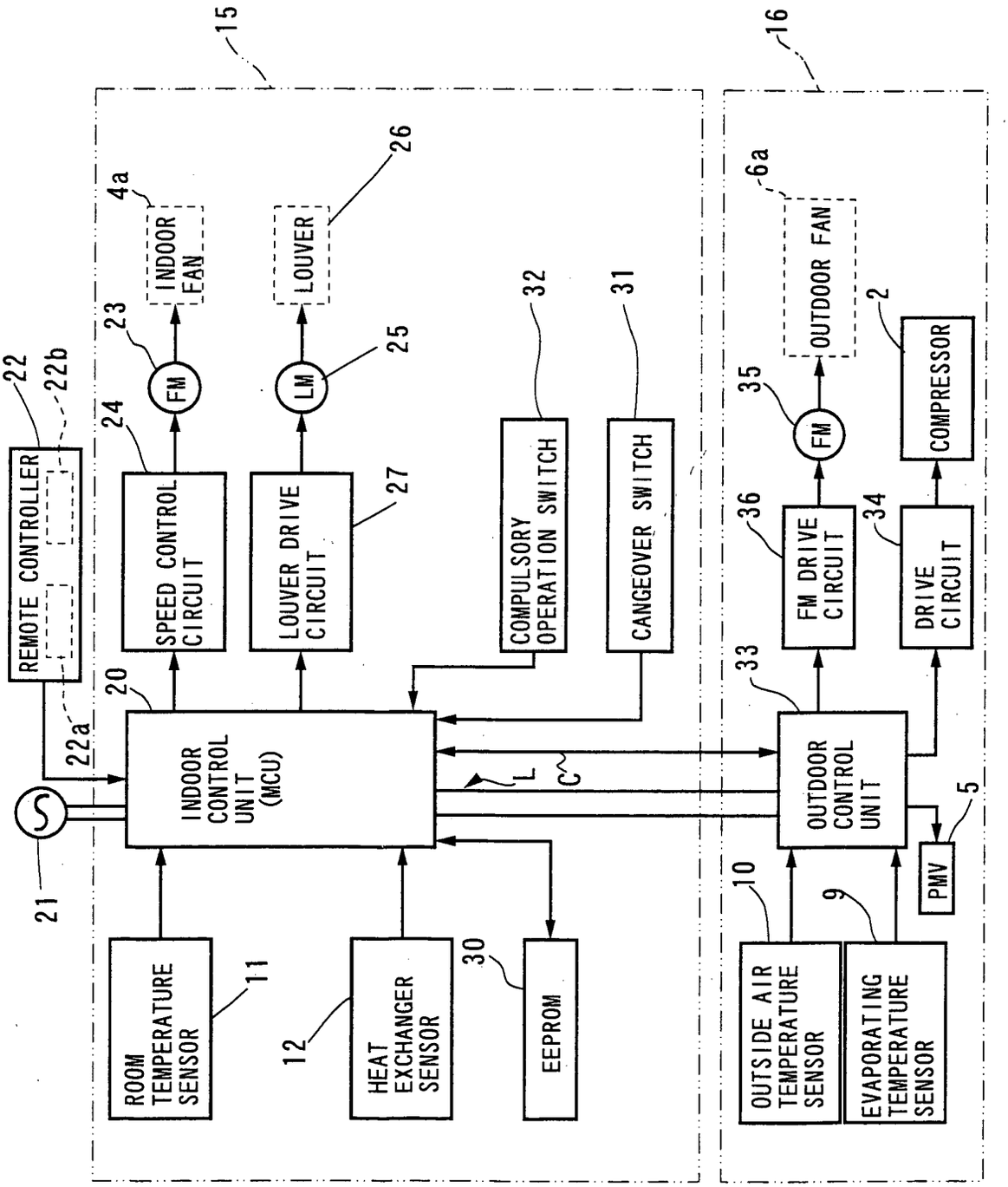
15
16
4a
INDOOR FAN
26
LOUVER
6a
OUTDOOR FAN
22
22b
23
FM
25
LM
32
31
35
2
COMPRESSOR
REMOTE CONTROLLER
24
SPEED CONTROL CIRCUIT
LOUVER DRIVE CIRCUIT
27
COMPULSORY OPERATION SWITCH
CANGEOVER SWITCH
FM
36
FM DRIVE CIRCUIT
34
DRIVE CIRCUIT
20
33
22a
INDOOR CONTROL UNIT (MCU)
L
C
OUTDOOR CONTROL UNIT
5
PMV
21
10
9
ROOM TEMPERATURE SENSOR
11
12
HEAT EXCHANGER SENSOR
30
EEPROM
OUTSIDE AIR TEMPERATURE SENSOR
EVAPORATING TEMPERATURE SENSOR

FIG. 2

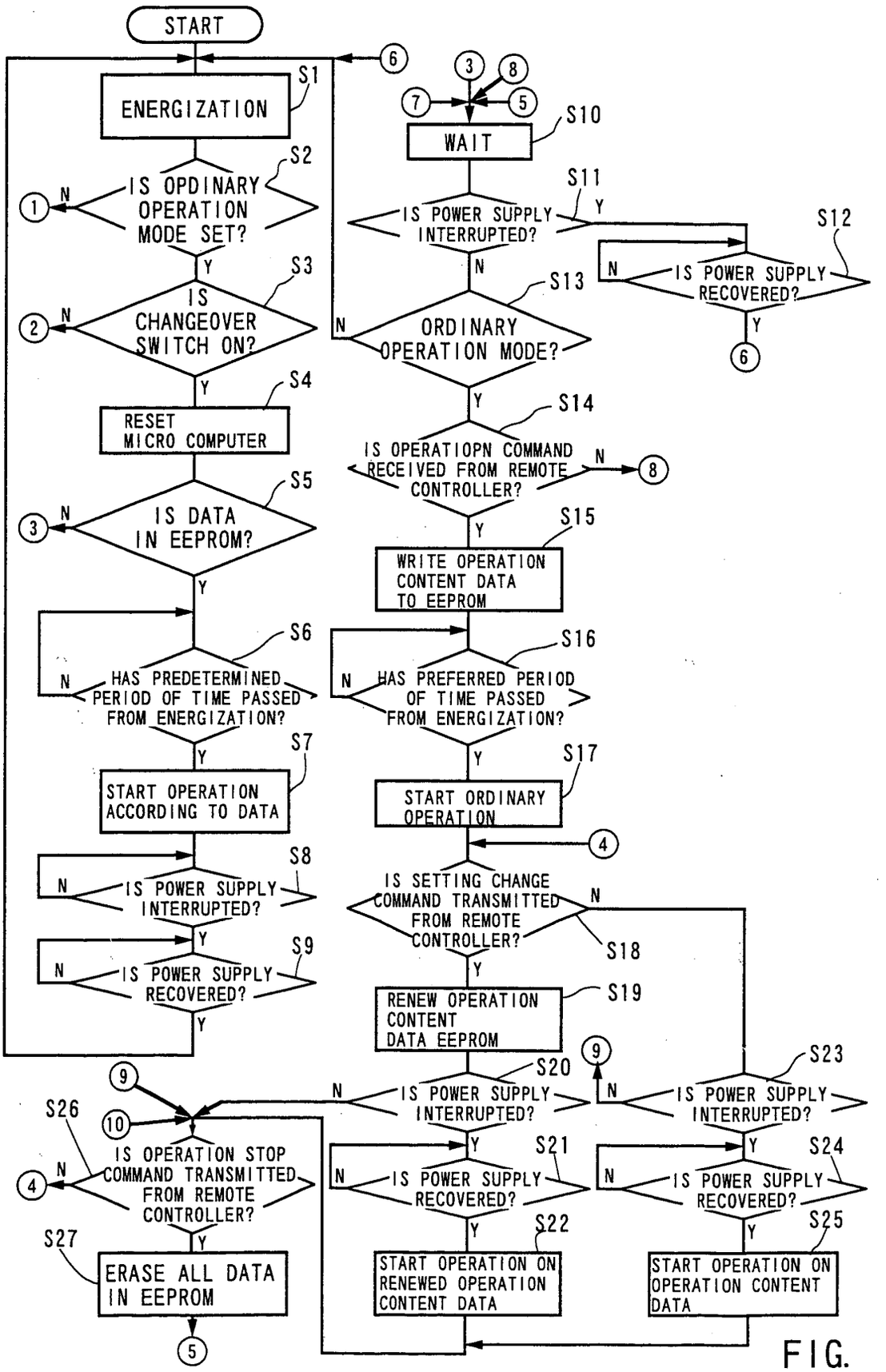
START
ENERGIZATION
S1
IS OPDINARY OPERATION MODE SET?
S2
IS CHANGEOVER SWITCH ON?
S3
RESET MICRO COMPUTER
S4
IS DATA IN EEPROM?
S5
HAS PREDETERMINED PERIOD OF TIME PASSED FROM ENERGIZATION?
S6
START OPERATION ACCORDING TO DATA
S7
IS POWER SUPPLY INTERRUPTED?
S8
IS POWER SUPPLY RECOVERED?
S9
WAIT
S10
IS POWER SUPPLY INTERRUPTED?
S11
IS POWER SUPPLY RECOVERED?
S12
ORDINARY OPERATION MODE?
S13
IS OPERATIOPN COMMAND RECEIVED FROM REMOTE CONTROLLER?
S14
WRITE OPERATION CONTENT DATA TO EEPROM
S15
HAS PREFERRED PERIOD OF TIME PASSED FROM ENERGIZATION?
S16
START ORDINARY OPERATION
S17
IS SETTING CHANGE COMMAND TRANSMITTED FROM REMOTE CONTROLLER?
S18
RENEW OPERATION CONTENT DATA EEPROM
S19
IS POWER SUPPLY INTERRUPTED?
S20
IS POWER SUPPLY RECOVERED?
S21
START OPERATION ON RENEWED OPERATION CONTENT DATA
S22
IS POWER SUPPLY INTERRUPTED?
S23
IS POWER SUPPLY RECOVERED?
S24
START OPERATION ON OPERATION CONTENT DATA
S25
IS OPERATION STOP COMMAND TRANSMITTED FROM REMOTE CONTROLLER?
S26
ERASE ALL DATA IN EEPROM
S27
Y
N

FIG. 3

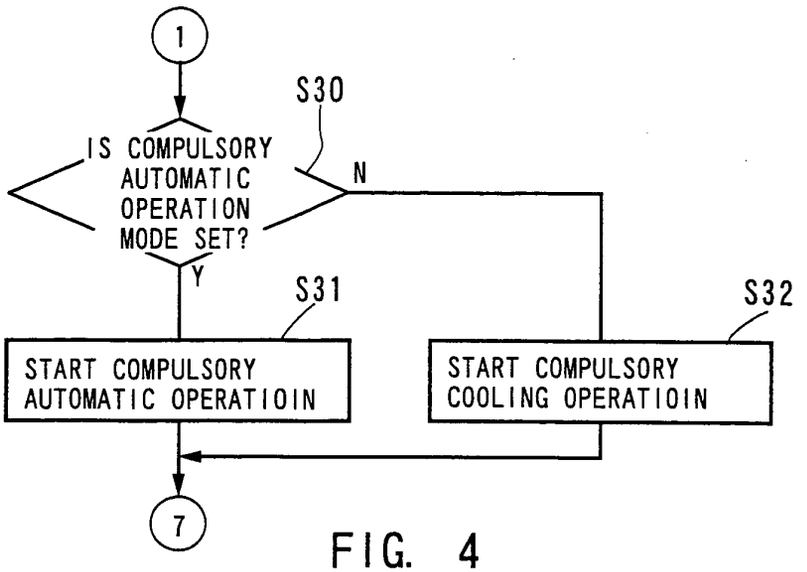
1
S30
IS COMPULSORY AUTOMATIC OPERATION MODE SET?
N
Y
S31
START COMPULSORY AUTOMATIC OPERATIOIN
S32
START COMPULSORY COOLING OPERATIOIN
7

FIG. 4

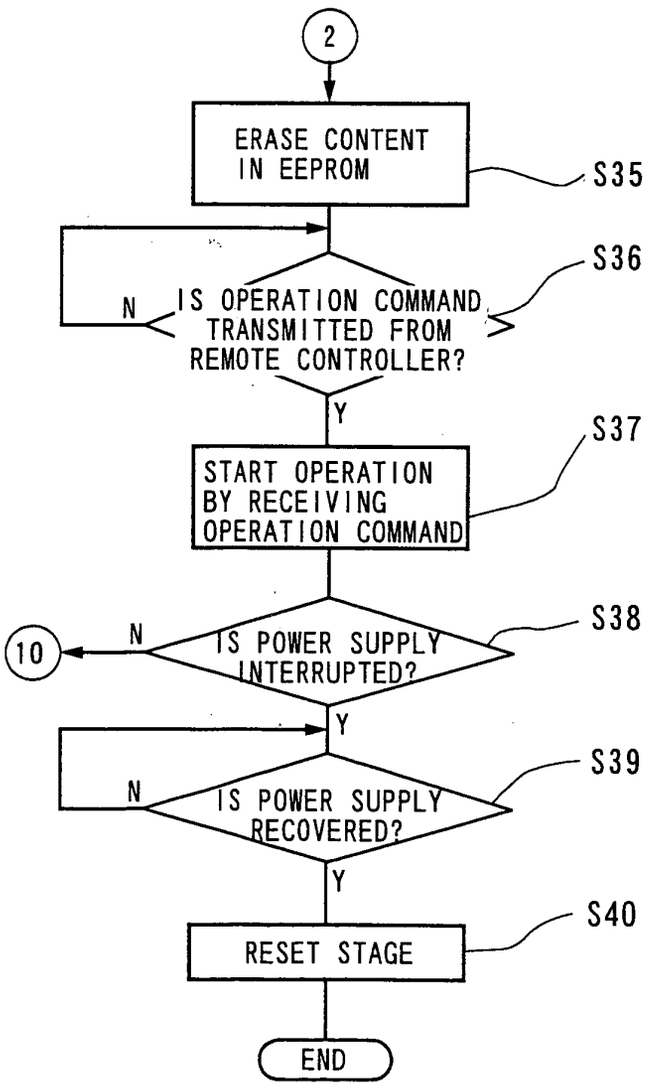
2
ERASE CONTENT IN EEPROM
S35
S36
N
IS OPERATION COMMAND TRANSMITTED FROM REMOTE CONTROLLER?
Y
S37
START OPERATION BY RECEIVING OPERATION COMMAND
S38
10
N
IS POWER SUPPLY INTERRUPTED?
Y
S39
N
IS POWER SUPPLY RECOVERED?
Y
S40
RESET STAGE
END

FIG. 5

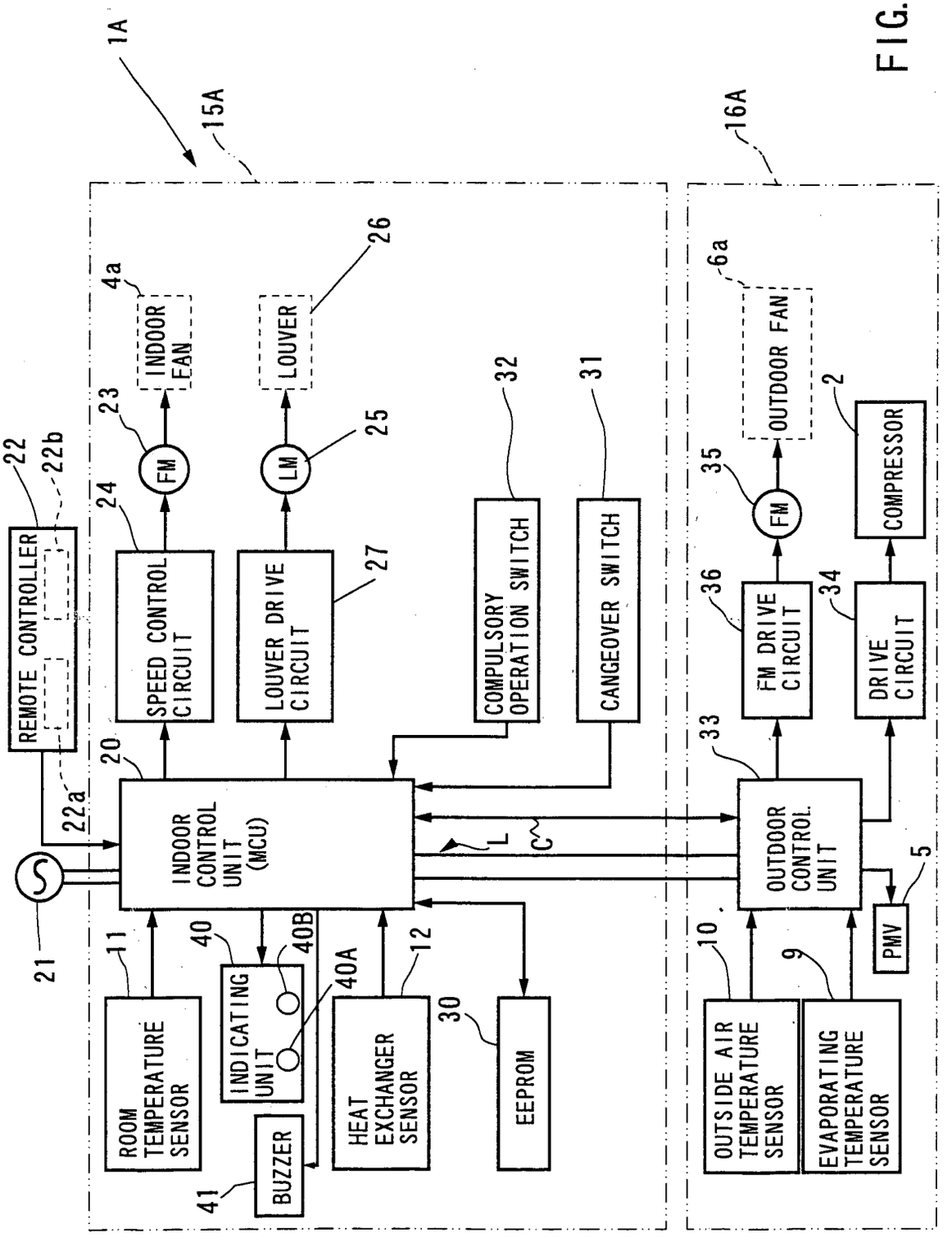
1A
15A
16A
INDOOR FAN
4a
LOUVER
26
OUTDOOR FAN
6a
23
FM
LM
25
35
FM
22
22b
24
SPEED CONTROL CIRCUIT
LOUVER DRIVE CIRCUIT
27
COMPULSORY OPERATION SWITCH
32
CANGEOVER SWITCH
31
36
FM DRIVE CIRCUIT
34
DRIVE CIRCUIT
COMPRESSOR
2
REMOTE CONTROLLER
22a
20
INDOOR CONTROL UNIT (MCU)
L
C
33
OUTDOOR CONTROL UNIT
5
PMV
21
11
ROOM TEMPERATURE SENSOR
40
INDICATING UNIT
40B
40A
12
HEAT EXCHANGER SENSOR
30
EEPROM
10
OUTSIDE AIR TEMPERATURE SENSOR
9
EVAPORATING TEMPERATURE SENSOR
41
BUZZER

FIG. 6

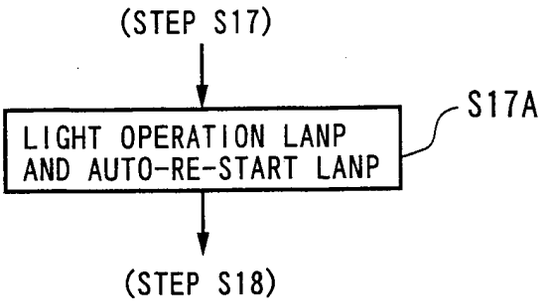
(STEP S17)
LIGHT OPERATION LANP
AND AUTO-RE-START LANP
S17A
(STEP S18)

FIG. 7

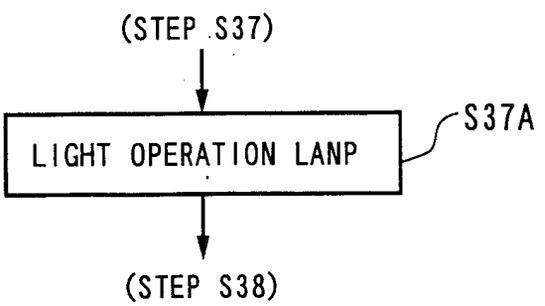
(STEP S37)
LIGHT OPERATION LANP
S37A
(STEP S38)

FIG. 8

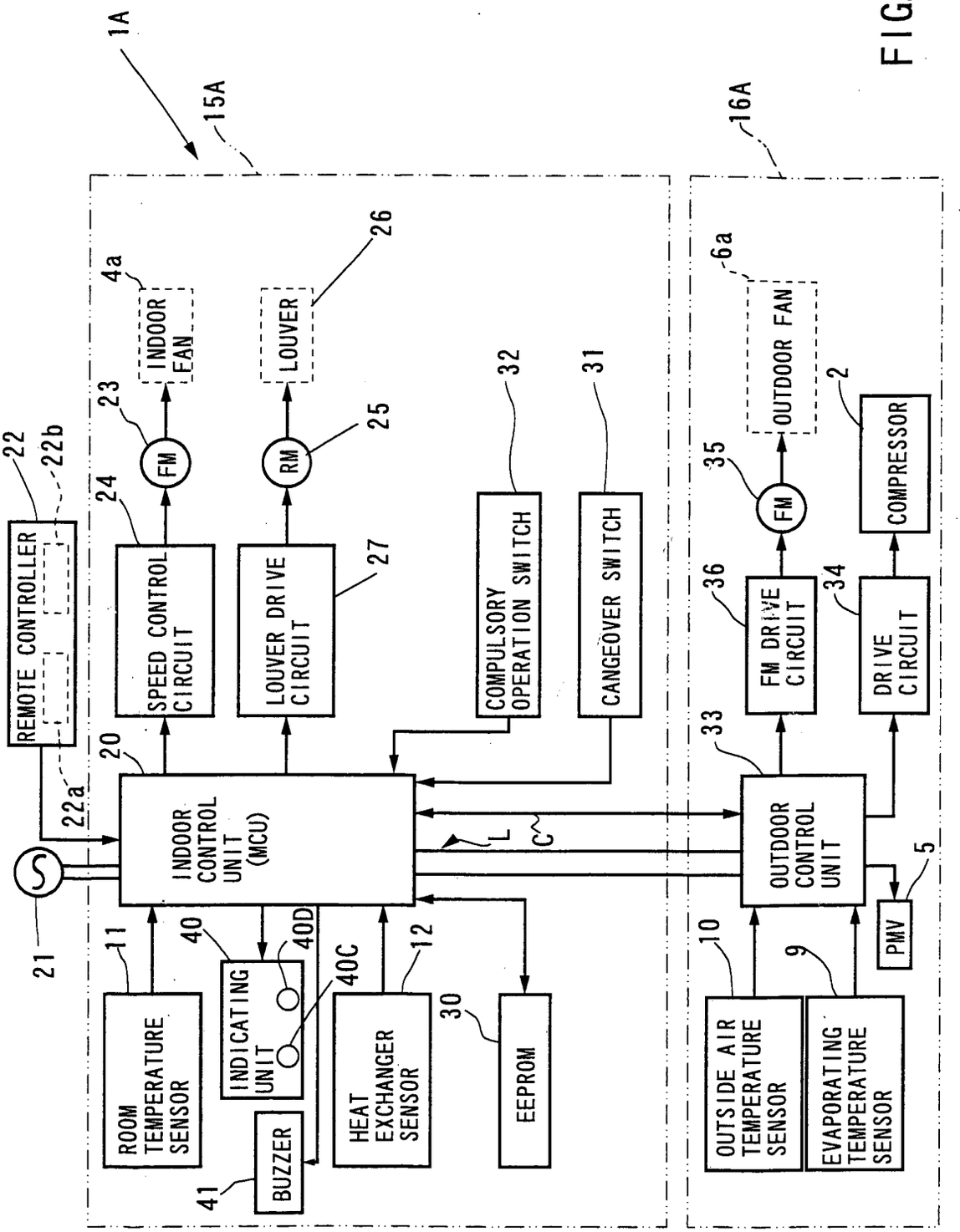
1A
15A
16A
INDOOR FAN
4a
LOUVER
26
23
FM
RM
25
22
22b
REMOTE CONTROLLER
24
SPEED CONTROL CIRCUIT
LOUVER DRIVE CIRCUIT
27
COMPULSORY OPERATION SWITCH
32
CANGEOVER SWITCH
31
6a
OUTDOOR FAN
35
FM
2
COMPRESSOR
36
FM DRIVE CIRCUIT
34
DRIVE CIRCUIT
20
INDOOR CONTROL UNIT (MCU)
22a
21
L
C
33
OUTDOOR CONTROL UNIT
5
PMV
11
40
40D
40C
12
10
9
ROOM TEMPERATURE SENSOR
INDICATING UNIT
HEAT EXCHANGER SENSOR
30
EEPROM
OUTSIDE AIR TEMPERATURE SENSOR
EVAPORATING TEMPERATURE SENSOR
41
BUZZER

FIG. 9

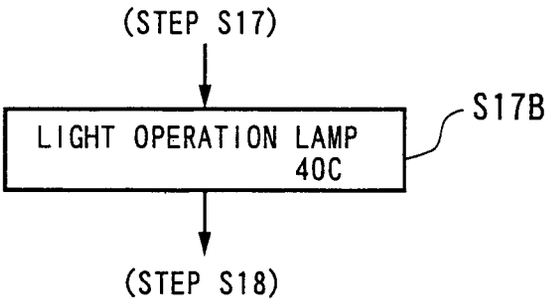
(STEP S17)
LIGHT OPERATION LAMP 40C
S17B
(STEP S18)

FIG. 10

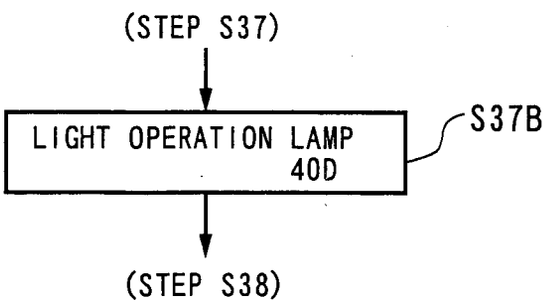
(STEP S37)
LIGHT OPERATION LAMP 40D
S37B
(STEP S38)

FIG. 11

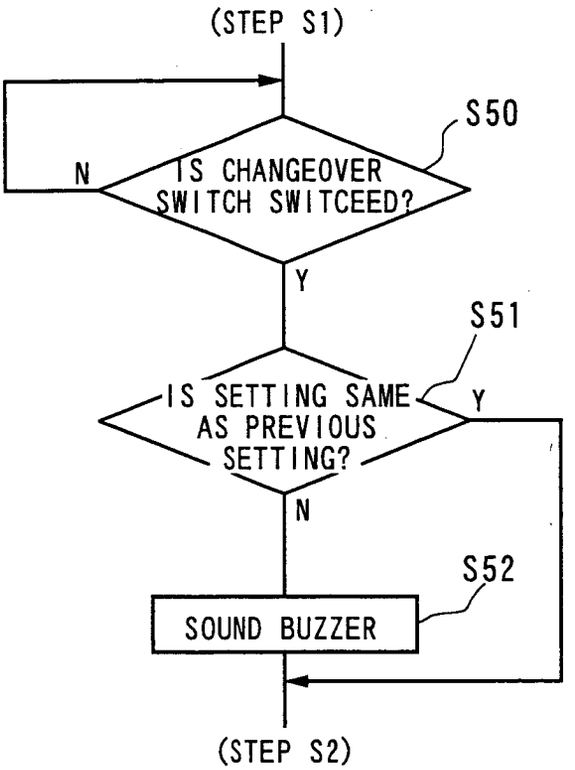
(STEP S1)
S50
IS CHANGEOVER SWITCH SWITCEED?
N
Y
S51
IS SETTING SAME AS PREVIOUS SETTING?
Y
N
S52
SOUND BUZZER
(STEP S2)

FIG. 12

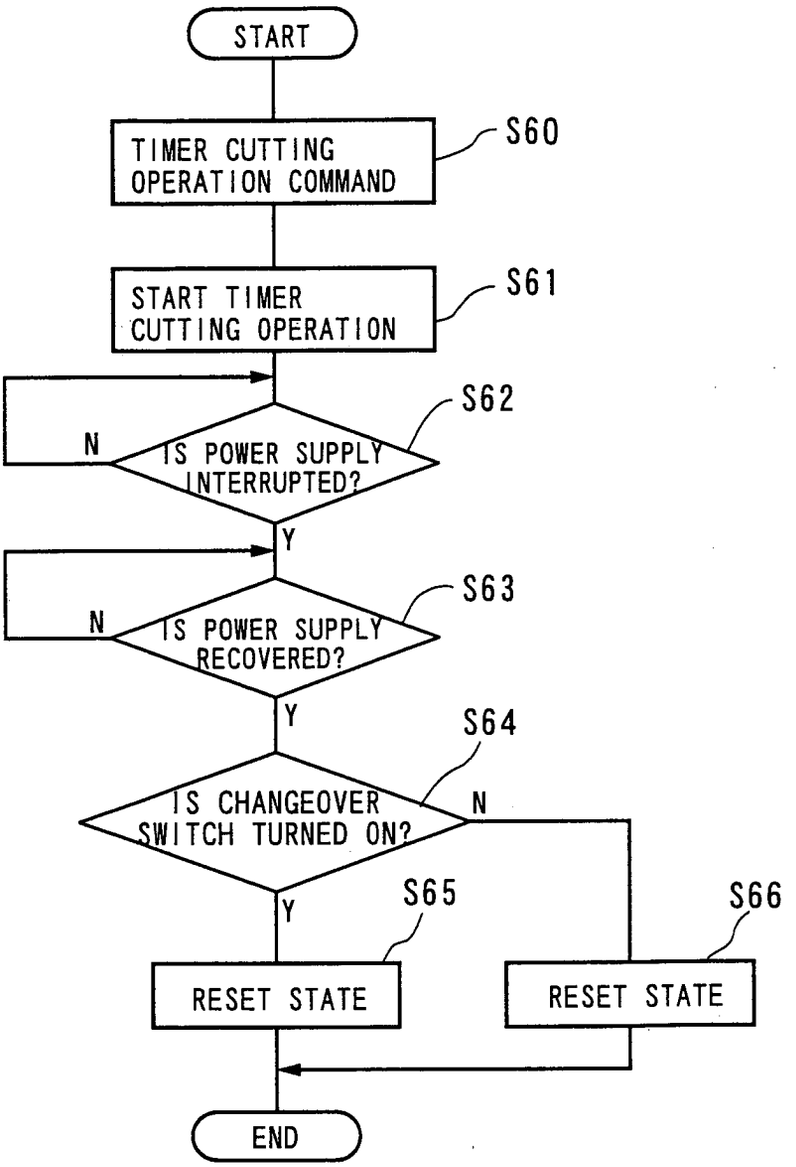
START
TIMER CUTTING OPERATION COMMAND
S60
START TIMER CUTTING OPERATION
S61
S62
IS POWER SUPPLY INTERRUPTED?
N
Y
S63
IS POWER SUPPLY RECOVERED?
N
Y
S64
IS CHANGEOVER SWITCH TURNED ON?
N
Y
S65
RESET STATE
S66
RESET STATE
END

FIG. 13

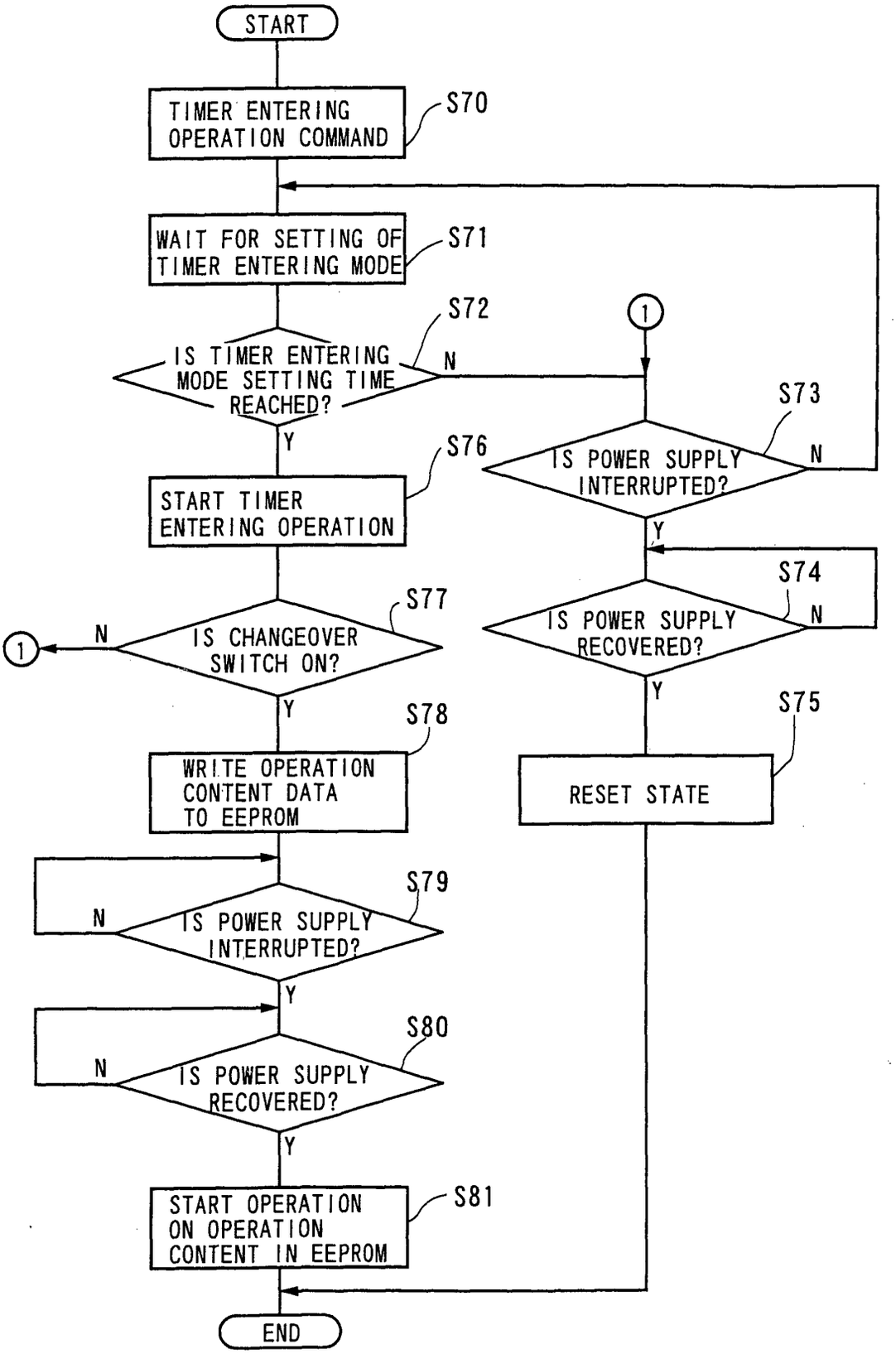
START
TIMER ENTERING OPERATION COMMAND
S70
WAIT FOR SETTING OF TIMER ENTERING MODE
S71
S72
IS TIMER ENTERING MODE SETTING TIME REACHED?
N
Y
1
S73
IS POWER SUPPLY INTERRUPTED?
N
Y
S74
IS POWER SUPPLY RECOVERED?
N
Y
S75
RESET STATE
S76
START TIMER ENTERING OPERATION
S77
IS CHANGEOVER SWITCH ON?
N
1
Y
S78
WRITE OPERATION CONTENT DATA TO EEPROM
S79
IS POWER SUPPLY INTERRUPTED?
N
Y
S80
IS POWER SUPPLY RECOVERED?
N
Y
S81
START OPERATION ON OPERATION CONTENT IN EEPROM
END

FIG. 14

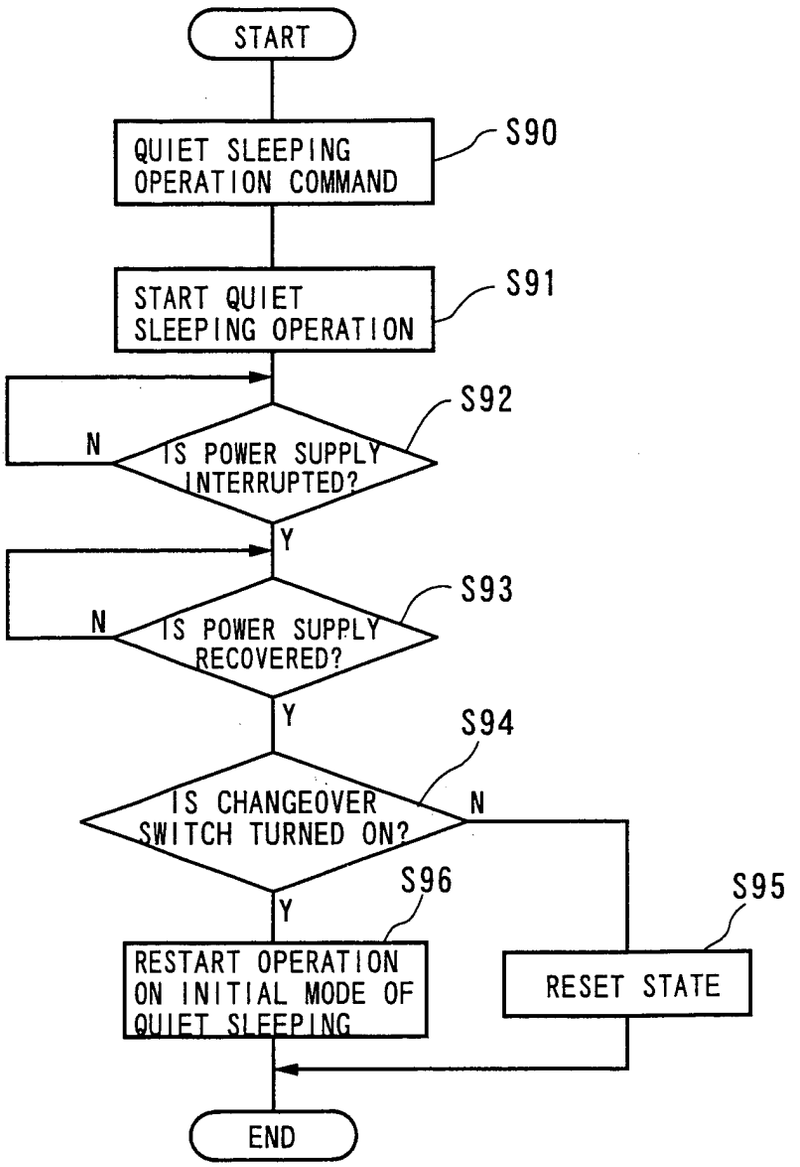
START
QUIET SLEEPING OPERATION COMMAND
S90
START QUIET SLEEPING OPERATION
S91
S92
N
IS POWER SUPPLY INTERRUPTED?
Y
S93
N
IS POWER SUPPLY RECOVERED?
Y
S94
IS CHANGEOVER SWITCH TURNED ON?
N
Y
S96
S95
RESTART OPERATION ON INITIAL MODE OF QUIET SLEEPING
RESET STATE
END

FIG. 15

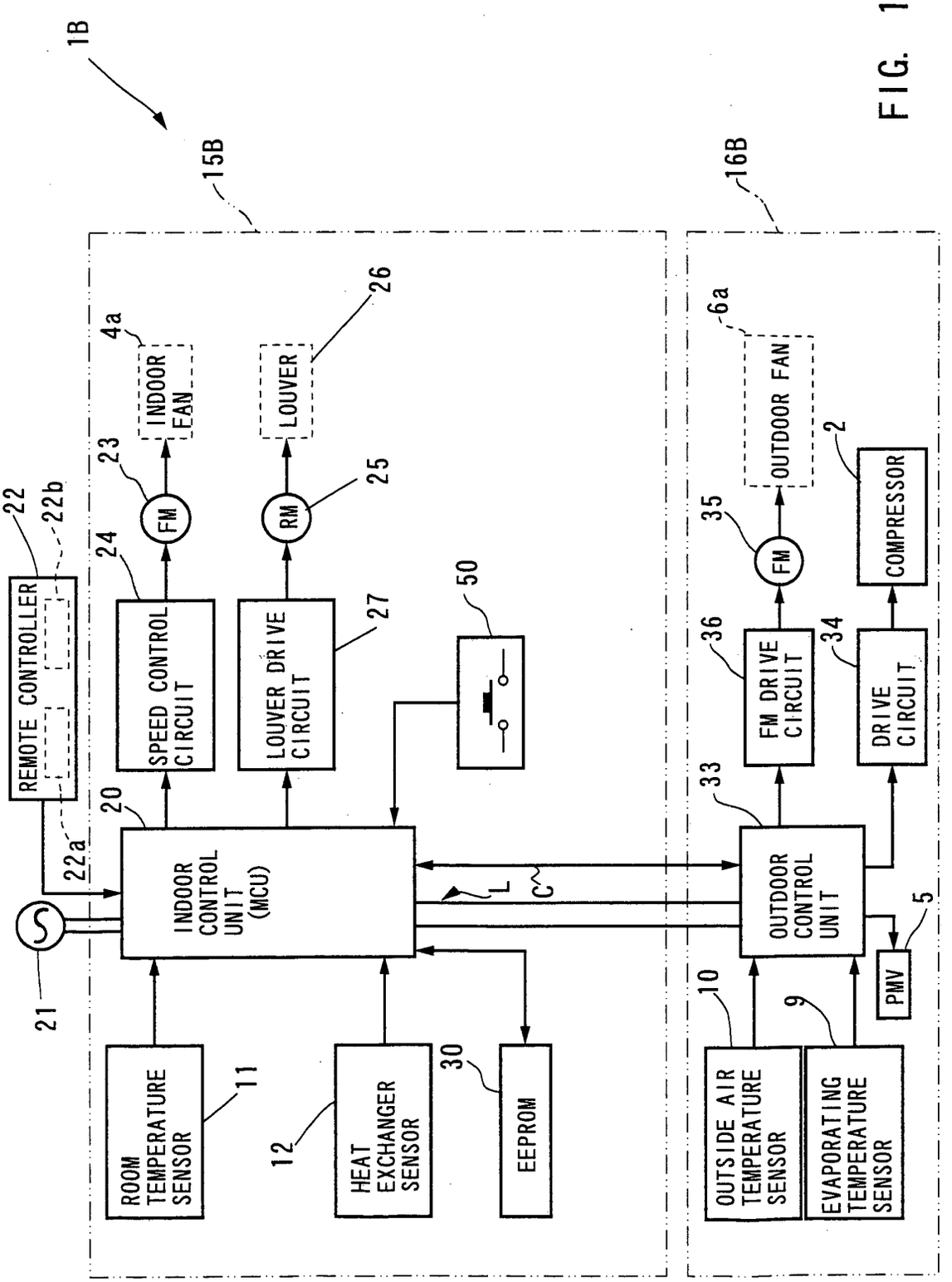
1B
15B
16B
INDOOR CONTROL UNIT (MCU)
OUTDOOR CONTROL UNIT
REMOTE CONTROLLER
SPEED CONTROL CIRCUIT
LOUVER DRIVE CIRCUIT
FM DRIVE CIRCUIT
DRIVE CIRCUIT
INDOOR FAN
LOUVER
OUTDOOR FAN
COMPRESSOR
FM
RM
PMV
ROOM TEMPERATURE SENSOR
HEAT EXCHANGER SENSOR
EEPROM
OUTSIDE AIR TEMPERATURE SENSOR
EVAPORATING TEMPERATURE SENSOR
L
C
20
21
22
22a
22b
23
24
25
26
27
30
33
34
35
36
50
2
4a
5
6a
9
10
11
12

FIG. 16

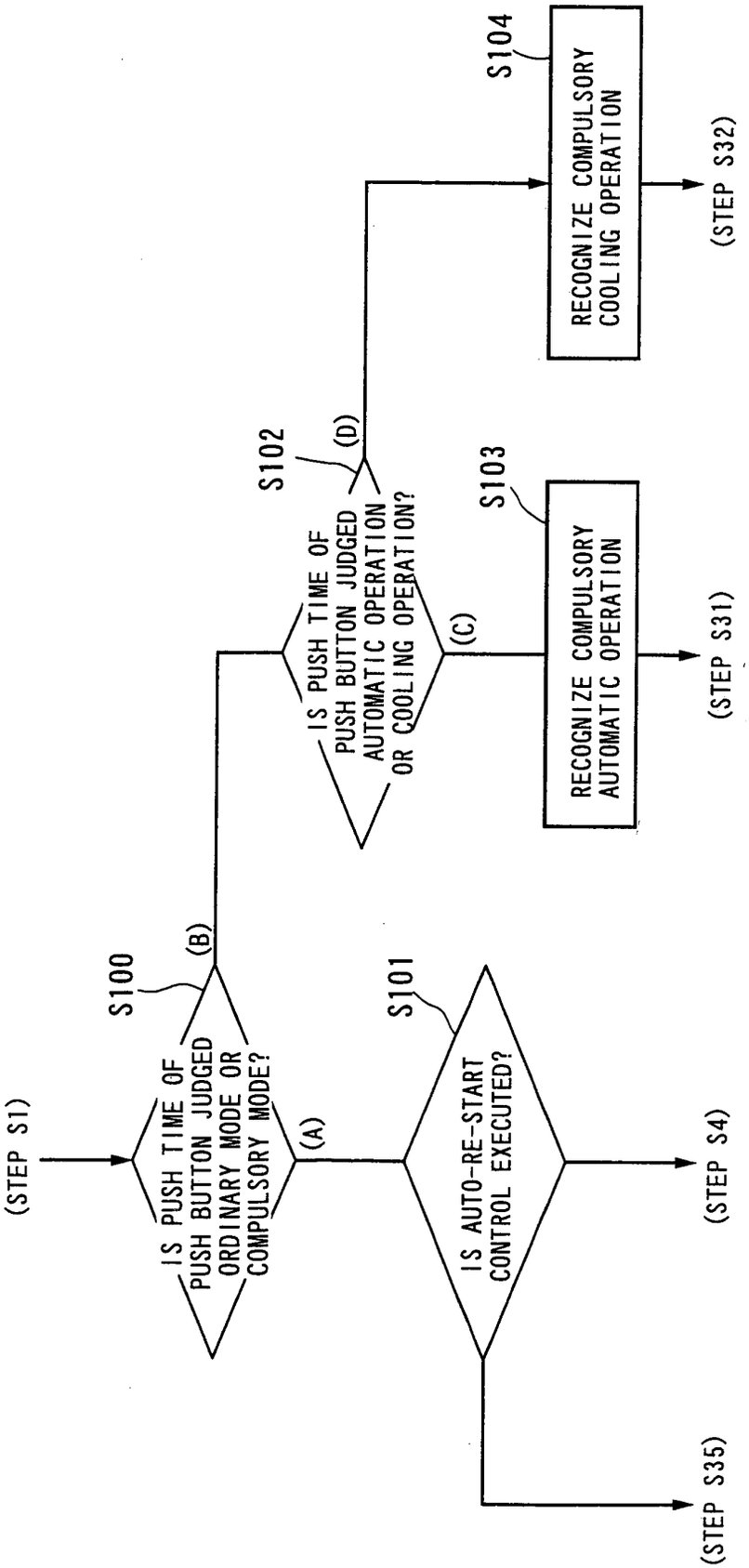
(STEP S1)
S100
IS PUSH TIME OF PUSH BUTTON JUDGED ORDINARY MODE OR COMPULSORY MODE?
(A)
(B)
S101
IS AUTO-RE-START CONTROL EXECUTED?
(STEP S4)
(STEP S35)
S102
IS PUSH TIME OF PUSH BUTTON JUDGED AUTOMATIC OPERATION OR COOLING OPERATION?
(C)
(D)
S103
RECOGNIZE COMPULSORY AUTOMATIC OPERATION
(STEP S31)
S104
RECOGNIZE COMPULSORY COOLING OPERATION
(STEP S32)

FIG. 17