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(54) **Air conditioner and shelter**

(57) An air conditioner (5) housed in a shelter (1) has a cooling mode and other operation modes, and includes an operation mode selecting means selecting the cooling mode in response to the start of the commercial electric

power, and an operation starting means for starting the operation in the cooling mode selected by the operation mode selecting means.

EP 1 707 891 A1

Description

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] This invention relates to an air conditioner and a shelter, and more particularly relates to an air conditioner which operates in a cooling mode, a heating mode, a blowing mode or a suspension mode, and a shelter provided with such an air conditioner.

[0002] A number of communication devices are installed in a base station (called the "shelter") of a mobile communication system such as a cellular telephone system or a radio communication system. Temperature in the shelter is raised by heat generated by communication devices. This adversely affects the reliable operation of the communication devices. For instance, Japanese Patent Laid-Open Publication No. Hei 11-316058 discloses an air conditioner which is installed in a shelter and cools the interior of the shelter and communication devices therein.

[0003] A great majority of shelters are unattended, so that the communication devices and an air conditioner are operated by the commercial electric power. In case of blackouts, the communication devices are operated by a backup electric power source, i.e., a battery charged by the commercial electric power, and can keep on operating. However, such a backup electric power source has a small capacity, and supplies the electric power to the communication devices on a priority bases, so that no backup electric power will be supplied to the air conditioner.

[0004] Further, Japanese Patent Laid-Open Publication No. 2004-324898 describes a multiple-chamber-type air conditioner, for example. With the air conditioner, operation information prior to the blackouts is stored, an automatic or manual operation mode is checked on the basis of the stored information when the electric power comes back on. The air conditioner which was in the manual mode restarts the operation in the manual mode in response to the resumption of the electric power. The air conditioner which was in the automatic mode restarts the operation in the automatic mode. Further, if the air conditioner is in the suspension mode, it will be maintained in the suspension mode even when the electric power is resumed.

[0005] However, the related art seems to suffer from the following problems. For instance, it is assumed that communication devices in a shelter are inspected, maintained and repaired in the winter. Workers may operate the air conditioner in the heating mode. If a power failure occurs in such a case, the workers may finish the maintenance work in the heating mode, and leave the air conditioner in the heating mode. When the electric power is resumed in the foregoing state, the air conditioner will restart its operation in the heating mode, which raises the temperature in the shelter, does not cool the commu-

nication devices, and promotes heating of the communication devices.

[0006] Further, when the communication devices are maintained in an early spring or an early fall, workers may operate the air conditioner in the blowing mode. If the electric power is suspended in such a case, and the electric power is then resumed, the air conditioner will restart its operation in the blowing mode. This will raise the temperature in the shelter, and will not cool the communication devices. Still further, if the workers finish their maintenance work with the air conditioner suspended, and do not return the air conditioner to the cooling mode, the air conditioner will remain in the suspension mode, which will heat the communication devices, and will not cool them.

[0007] Still further, when the commercial electric power is resumed, the backup electric power from the battery will be stopped. The battery will be put into the charging mode. At the same time, the communication devices and the air conditioner will be operated by the commercial electric power. When the battery is switched from the discharging mode over to the charging mode in response the resumption of the commercial electric power, loud noises may be generated in the communication devices or the battery. If the air conditioner resumes its operation in this state, electronics devices thereof will malfunction due to noises, and the air conditioner may re-operate in a mode other than the cooling mode.

BRIEF SUMMARY OF THE INVENTION

[0008] The present invention has been contemplated in order to overcome the problems of the related art, and is aimed at providing an air conditioner which reliably resumes its operation in a cooling mode after the commercial power comes back on, and a shelter which includes the foregoing air conditioner.

[0009] In accordance with a first aspect of the invention, there is provided an air conditioner which includes an operation mode selecting means which selects an operation mode out of a cooling mode and other operation modes whenever the electric power is supplied, the cooling mode being selected regardless of a previous operation mode at the time of the suspension of the electric power; and an operation starting means starting an operation in the cooling mode selected by the operation mode selecting means.

[0010] According to a second aspect of the invention, there is provided a shelter which includes an electronic device; a backup power source providing backup electric power to the electronic device; an air conditioner having a cooling mode in which the electronic device is cooled, and other operation modes, and including an operation mode selecting means which selects the cooling mode in response to the supply of the electric power, the cooling mode being selected regardless of an operation mode at the time of the suspension of the electric power; and an operation starting means for starting an operation in

the cooling mode selected by the operation mode selecting means.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0011] In all Figures identical parts and steps have identical reference numbers.

Fig. 1 schematically shows the configuration of an air conditioner and a shelter according to a first example in one embodiment of the invention;

Fig. 2 is a block diagram of the air conditioner shown in Fig. 1;

Fig. 3 is a flow chart of a control procedure of the air conditioner of the first example;

Fig. 4 is a flow chart of a control procedure of the air conditioner of a second example; and

Fig. 5 is a flow chart of a control procedure of the air conditioner of a third example.

DETAILED DESCRIPTION OF THE INVENTION

[0012] The invention will be described with reference to examples of one embodiment shown in the drawings. It is assumed that an air conditioner is installed in a shelter for a mobile communication system.

(First Example of Embodiment)

[0013] Referring to Fig. 1, a shelter 1 houses an electronic device 2 as a communication unit. The electronic device 2 is connected to a commercial power source 3 and operates on the electric power therefrom. A battery 4 is also housed in the shelter 1, and supplies backup electric power to the electronic device 2 when no electric power is available from the commercial power source 3 in an emergency. Further, an air conditioner 5 is housed in the shelter 1 in order to suppress a temperature rise in the shelter 1 in response to the operation of the electronic device 5. The air conditioner 5 is constituted by an indoor unit 51, an outdoor unit 52, and a remote control 53 specifying the operation, interruption and temperature.

[0014] In the first example, the electronic device 2 includes a receiver and a transmitter, each of which receives and transmits radio waves from and to a mobile communication system for cellular phones, portable wireless applications or the like.

[0015] The commercial power source 3 receives the electric power from an electric power company. The electric power is a single phase AC, for example.

[0016] The battery 4 supplies the backup electric power to the electronic device 2 when no electric power arrives from the commercial power source 3, which enables the electronic device 2 to keep on operating.

[0017] The indoor unit 51 of the air conditioner 5 is installed in the shelter 1. In this example, the air condi-

tioner 5 operates in a cooling mode, a blowing mode, a drying mode, and a heating mode. The air conditioner 5 basically operates on the electric power from the commercial power source 3, and functions in the cooling mode in order to cool the electronic device 2. Further, the air conditioner 5 introduces cool air, winds, or hot air into the shelter 1 via an outlet in accordance with the operation mode specified by the remote control 53, and controls the temperature and circulates the air in the shelter 1.

[0018] The outdoor unit 52 is installed outside the shelter 1, and is connected to the indoor unit 51 via a cooling medium pipe, wirings, or the like. Further, the outdoor unit 52 houses a compressor and so on.

[0019] As described above, the air conditioner 5 is used in order to cool the electronic device 2, and is usually operated in the cooling mode. Sometimes, the air conditioner 5 is operated in an operation mode other than the cooling mode depending upon a season when the electronic device 2 is maintained by workers. Referring to Fig. 2, the remote control 53 is constituted by an operation panel 530, and a liquid crystal display 531 which shows a selected operation mode, a room temperature, time and so on which are specified on the operation panel 530.

[0020] As shown in Fig. 2, the air conditioner 5 includes a DC power source circuit 10, a micro control unit (called the "MCU") 11, a temperature sensor 12, a nonvolatile memory means 13, a blower 14 and a heat exchanger (not shown). The DC power source circuit 10 is connected to the commercial power source 3, and converts the single phase AC to a DC. The MCU 11 is connected to the DC power source circuit 10. The temperature sensor 12 is connected to MCU 11, and measures a temperature in the shelter 1. The nonvolatile memory means 13, blower 14 and heat exchanger are connected to the MCU 11. The outdoor unit 52 and the remote control 53 are connected to the MCU 11, and receive data by wire or radio communications. In the first example, the MCU 11 controls the operations of the blower 14, the outdoor unit 52 and so on based on temperature data of the shelter 1 received from the temperature sensor 12, and based on data on the operation mode, temperature and so on specified by the remote control 53.

[0021] The nonvolatile memory means 13 retains the stored operation information even if the commercial power source 3 fails to supply the electric power, and is preferably an electrically erasable and programmable read only memory means (EEPROM) in this example.

[0022] In this example, the nonvolatile memory means 13 stores detailed information on the operation modes, e.g., "the cooling mode", "the heating mode", and "the blowing mode"; "the set temperature"; "air volume"; "a louver direction"; and so on. At the time of shipment, the foregoing information is stored as default information, and will be updated in the nonvolatile memory means 13 by operating the remote control 53 when the air conditioner 5 is put into practical use.

[0023] The operation of the air conditioner 5 will be

described with reference to Fig. 3, in which the overall operation of the air conditioner 5 is depicted mainly on the operation of the MCU 11.

[0024] First of all, it is checked in step ST1 whether the air conditioner 5 is turned on and is receiving the electric power from the commercial power source 3. This means the activation of the MCU 11. If no electric power arrives from the commercial power source 3 (NO), the MCU 11 is not activated, and remains inactive until the electric power comes from the commercial power source 3.

[0025] On the contrary, when the electric power arrives from the commercial power source 3 (YES) in step ST1, the air conditioner 5 gains access to the nonvolatile memory means 13 in response to a command stored in a ROM (Read Only Memory) 11a of the MCU 11, and selects the cooling mode data out of the operation mode information in the nonvolatile memory means 13 (step ST2). The cooling mode data are read by the MCU 11 (step ST3). On the basis of the read data, the MCU 11 controls the operation of the blower 14, the outdoor unit 52 and so on, which enables the air conditioner 5 to start the cooling mode (step ST4). Concurrently, the MCU 11 provides the operation mode information to the remote control 53. The remote control 53 indicates the received data on the display 531 (step ST5).

[0026] In other words, the air conditioner 5 always operates in the cooling mode regardless of its previous operation mode even if the commercial power source 3 suspends the electric power and then resumes to supply the electric power. The MCU 11 in this example functions both as an operation mode selecting means and an operation starting means.

[0027] Once activated in the cooling mode, the air conditioner 5 checks using the remote control 53 whether or not an operation mode is changed or the operation mode information is updated (step ST6). If the operation mode is changed or if the operation mode information is updated (YES), the air conditioner 5 will be operated in accordance with the selected operation mode data or the updated operation mode information (step ST7). The foregoing information is rewritten and stored in the nonvolatile memory means 13 (step ST8). On the contrary, if there is no change in the operation mode or the operation mode information remains unchanged (NO), the air conditioner 5 keeps on operating in the cooling mode.

[0028] In summary, whenever the electric power is supplied from the commercial power source 3, the air conditioner 5 always selects the cooling mode, so that the interior of the shelter 1 is cooled. This enables the electronic device 2 to operate in a cool atmosphere. Further, when the suspended electric power is resumed, the air conditioner 5 is operated in accordance with the operation mode information stored in the nonvolatile memory means 13. This is because the stored operation mode information is considered to be optimum for the operation of the air conditioner 5. Various settings of the temperatures, directions of the wind, an amount of air and so on

are optimized depending upon a shelter structure, arrangement of the electronic device and so on in the shelter. Therefore, the previous setting information is preferable to the default values.

(Second Example)

[0029] In a second example, an operation procedure of the air conditioner 5 somewhat differs from the operation procedure referred to in the first example. The steps identical to those of the first example have the identical reference numbers, and will be briefly described or will not be described.

[0030] Referring to Fig. 4, it is checked whether or not the air conditioner 5 is turned on and receives the electric power from the commercial power source 3 (step ST1). Then, a timer T (not shown) is activated in order to measure a specific time period, and a flag F is reset to 0 (step ST11). The timer T may be built in the MCU 11 or may be externally provided, and is required to measure the lapse of the specific time period.

[0031] The specific time period denotes the time from the resumption of the commercial electric power after the blackout till the time when noises caused by the suspension of the backup power source (battery) and the charging of the backup power source are subdued. The specific time period is empirically based and determined. In short, the specific time period denotes the time between the resumption of the commercial electric power and the reliable selection of the cooling mode without being affected by noises. Although the specific time period is adjustable as desired, it is usually approximately several seconds. In the second example, the specified time period is 10 seconds for safety sake. The longer the specific time period, the more effectively noises can be subdued. However, this means that the communication device is slow to be cooled. Therefore, the specific time period is determined to be longer within the subduing time of noises, but should be short as possible.

[0032] The flag F is always starts from 0 without fail whenever the suspended commercial electric power source is resumed.

[0033] Following the resumption of the commercial electric power, the air conditioner 5 starts its operation in the cooling mode (steps ST2 to ST4). The current operation mode is indicated on the display 531 of the remote control 53 (step ST5). It is checked whether or not the flag F is 0 (step ST12). The flag F is used as identifying data for forcibly re-selecting the cooling mode after the lapse of the specific time period (10 seconds, for example) following the resumption of the commercial electric power. In other words, the flag F is used to forcibly and reliably let the air conditioner 5 operate in the cooling mode even if the air conditioner 5 selects a false operation mode (the heating mode, for instance) due to noises caused by the switchover of the backup electric power over to the commercial electric power.

[0034] When the flag F is 0 (YES), it is checked whether

or not the specific time period of 10 seconds has lapsed (step ST13). If the specific time period has not run out (NO), the procedure in step ST13 is repeated until the lapse of the specific time period. If the lapse of the specific time period is confirmed (YES) in step ST13, the flag F is updated to 1 (step ST14). Thereafter, the procedure is returned to step ST2 where the cooling mode data stored in the nonvolatile memory means 13 is selected. The air conditioner 5 will select the cooling mode, and operate in the cooling mode.

[0035] It is checked again whether or not the flag F is 0 (step ST12). In this state, the specific time period has passed since the supply of the commercial electric power, which means that the flag F has been updated to 1 (NO). Therefore, the air conditioner 5 keeps on operating in the cooling mode. The procedure advances to step ST6 and succeeding steps similarly to the procedure shown in Fig. 3.

[0036] In the second example, the air conditioner 5 and the shelter 1 operate in the cooling mode without fail once the commercial electric power is supplied from the commercial power source 3, as in the first example of the embodiment. This is effective in enabling the electronic device 2 to be reliably operated in the cooled shelter 1. Further, the cooling mode is forcibly selected after the lapse of the specific time period following the supply of the commercial electric power. Therefore, the air conditioner 5 can be prevented from selecting a false operation mode due to noises generated even when the backup electric power is switched over to the resumed commercial electric power.

(Third Example)

[0037] A third example relates to an operation procedure of the air conditioner 5, which somewhat differs from the procedure in the second example.

[0038] Specifically, the procedure shown in Fig. 5 differs from the procedure of the second example, i.e., from the start of the commercial electric power to the operation of the air conditioner 5 in the cooling mode. In the third example, whenever the commercial power source 3 is turned on, the cooling mode operation is started after the specific time period in which noises caused by the switch-over of the electric power source are subdued.

[0039] It is checked whether or not the air conditioner 5 starts receiving the commercial electric power (step ST1). The timer T begins measuring the time, and the flag F is reset to 0 (step ST11). In this state, the air conditioner 5 does not select any operating mode, and remains inactive. Then, it is checked whether or not the flag F is 0 (step ST12). Whether or not the flag F remains 0 for the specific time period (e.g., 10 seconds) is checked in step ST13. The flag F is updated to 1 after the lapse of the specific time period (step ST14). The procedure returns to step ST2 in order to select the cooling mode data stored in the nonvolatile memory means 13. Thereafter, the procedures in steps ST2 to ST8 are executed

to enable the air conditioner 5 to operate in the cooling mode, as in the first example.

[0040] As described above, the air conditioner 5 in the shelter 1 remain inactive for the specific time period after the supply of the commercial electric power, and then always selects the cooling mode. Therefore, it is possible to prevent the air conditioner 5 from selecting a false operation mode due to noises caused by the suspension of the backup electric power immediately after the start of the commercial electric power.

(Other Examples)

[0041] Although the invention has been described with reference to some examples of the embodiment thereof, it will be understood by those skilled in the art that various modifications are possible without departing from the spirit of the present invention.

[0042] The present invention is described to be applied to the unattended shelter housing mobile communication devices. Alternatively, the invention is applicable to attended or unattended shelters (or rooms) which houses broadcasting systems in a broadcasting station.

[0043] Further, the invention is applicable to an air conditioner in which indoor and outdoor units have an integrated structure.

[0044] As described above, the invention provides the air conditioner and the shelter which can reliably cool the electronic device without being affected by the interruption of the electric power.

[0045] Further, the invention provides the air conditioner and the shelter in which the air conditioner can reliably cool the electronic device without being affected by noises caused by the resumption of the electric power.

Claims

1. An air conditioner comprising:

an operation mode selecting means which selects an operation mode out of a cooling mode and other operation modes whenever the electric power is supplied, the cooling mode being selected regardless of a previous operation mode at the time of the suspension of the electric power; and

an operation starting means for starting an operation in the cooling mode selected by the operation mode selecting means.

2. The air conditioner of claim 1, wherein the operation mode selecting means selects the cooling mode after the lapse of a specific time period when the electric power is supplied.

3. The air conditioner of claim 1 or 2, further comprising a nonvolatile memory means which stores informa-

tion concerning the cooling mode operation when the cooling mode operation is completed, wherein the operation mode selecting means selects data of the cooling mode from the nonvolatile memory means.

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4. A shelter comprising:

an electronic device;
a backup power source providing backup electric power to the electronic device; and
an air conditioner having a cooling mode in which the interior of the shelter is cooled, and other operation modes, and including an operation mode selecting means which selects the cooling mode in response to the supply of the electric power, the cooling mode being selected regardless of an operation mode at the time of the suspension of the electric power; and an operation starting means for starting the operation in the cooling mode selected by the operation mode selecting means.

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5. The shelter of claim 4, wherein the operation starting means starts the cooling mode after the lapse of a specific timer period whenever the electric power is supplied.

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6. The shelter of claim 4, wherein the electronic device is a mobile radio communication device.

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7. The shelter of claim 4, wherein the electronic device is a broadcasting communication device.

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FIG. 1

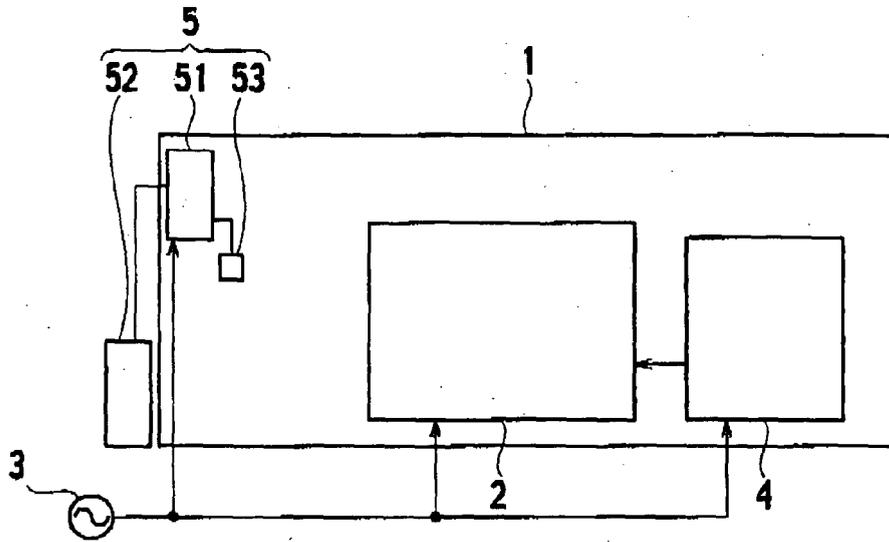


FIG. 2

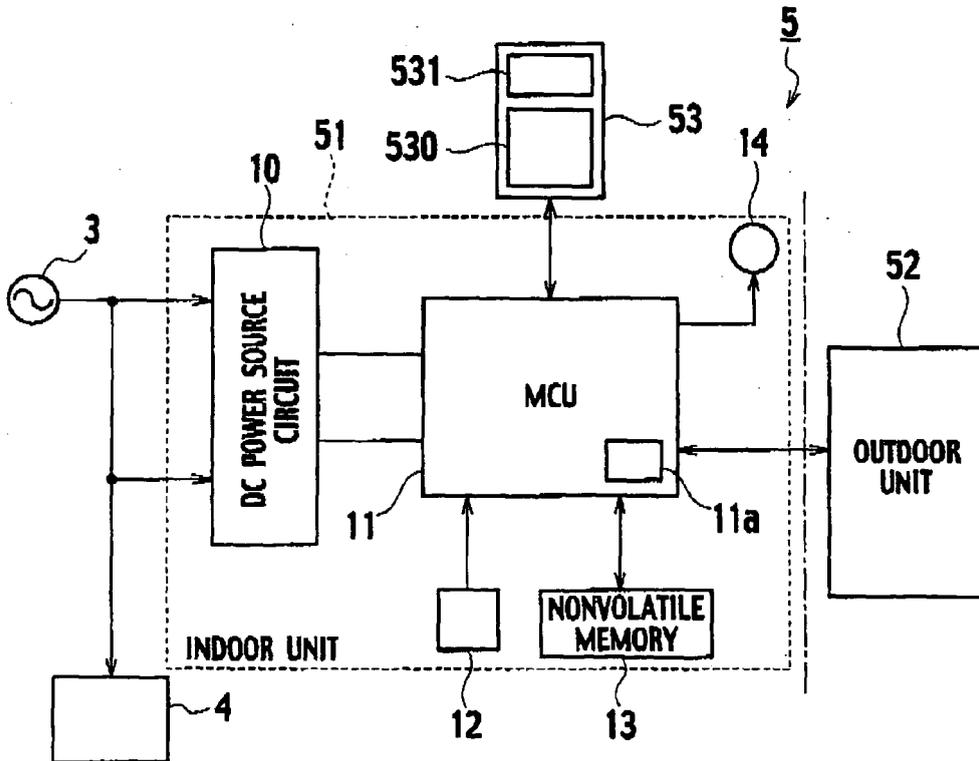


FIG. 3

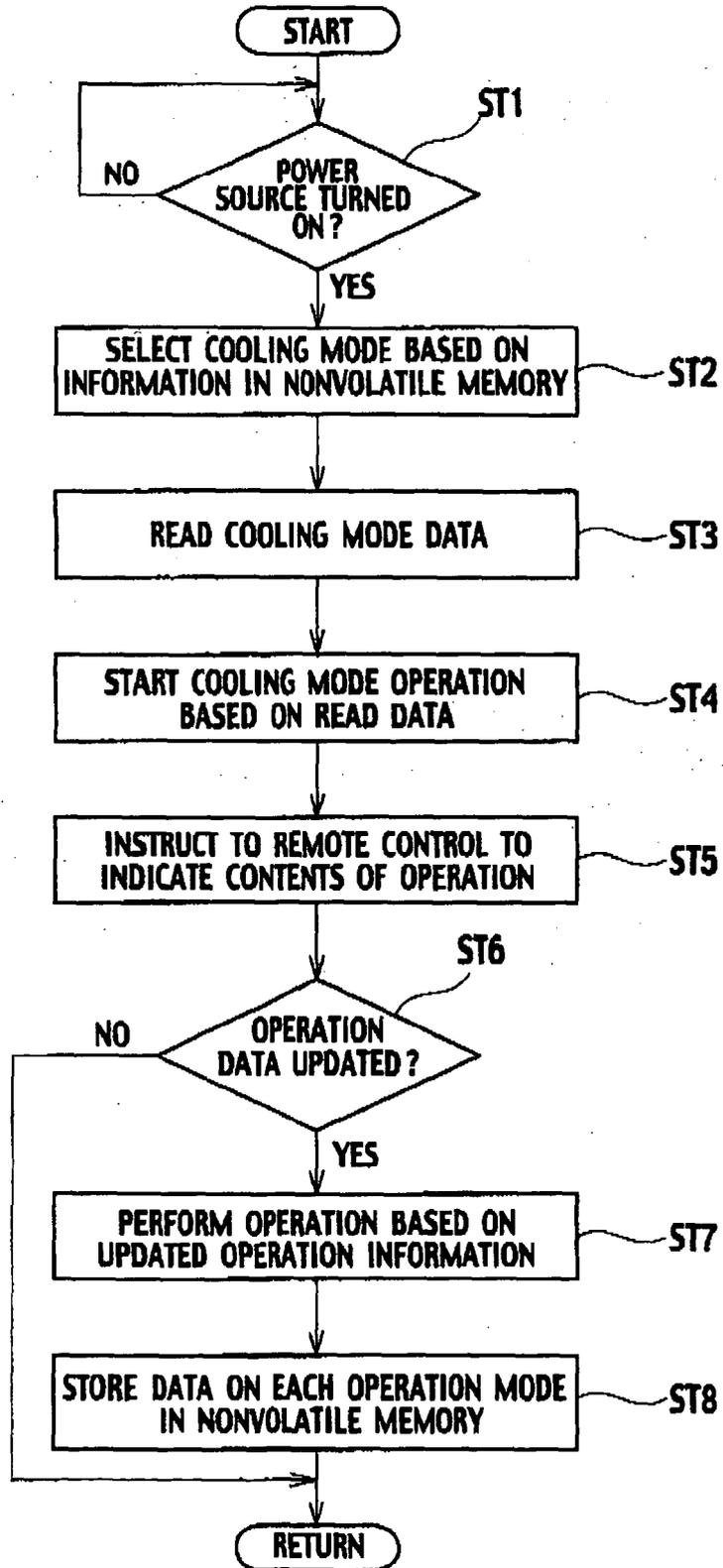


FIG. 4

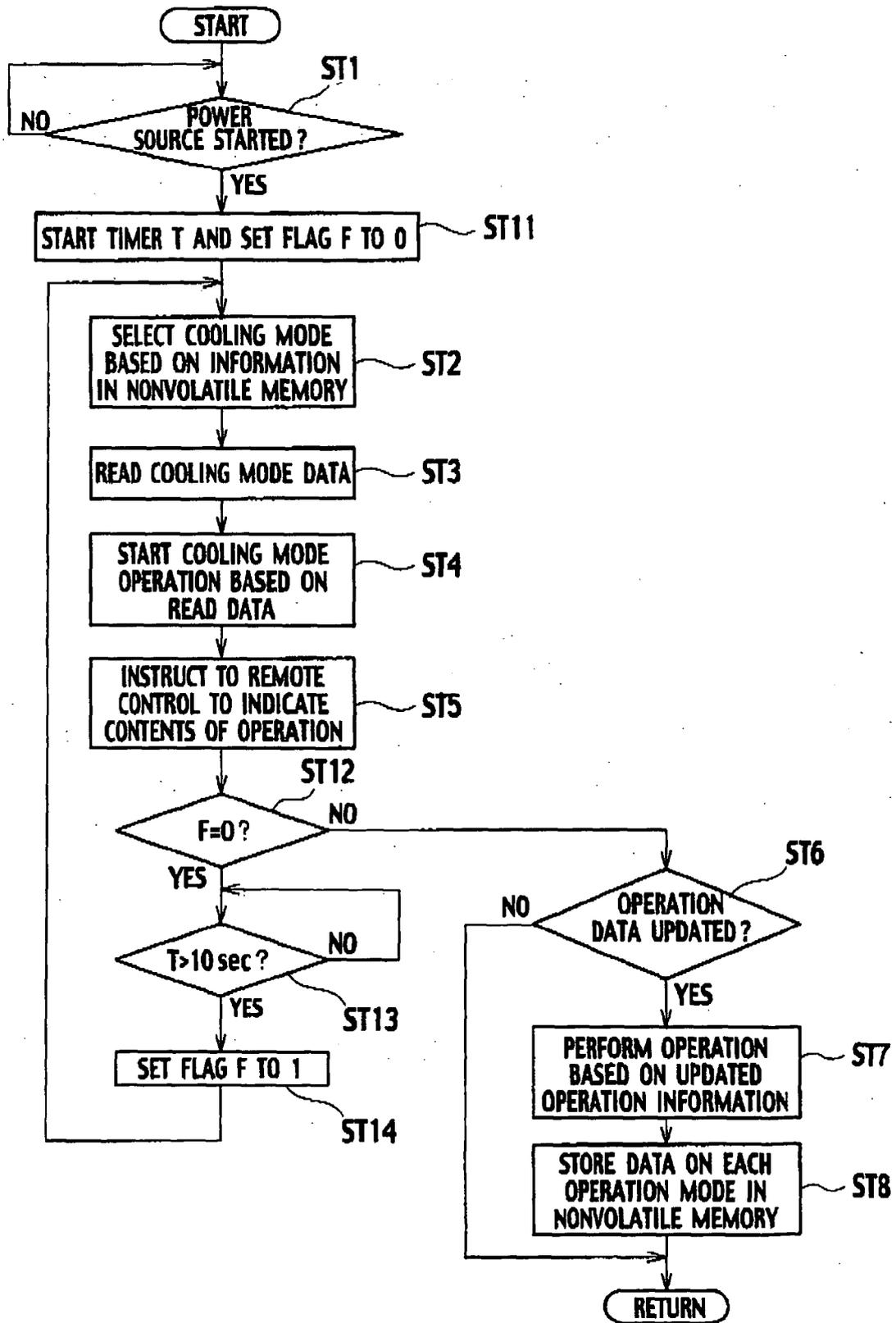
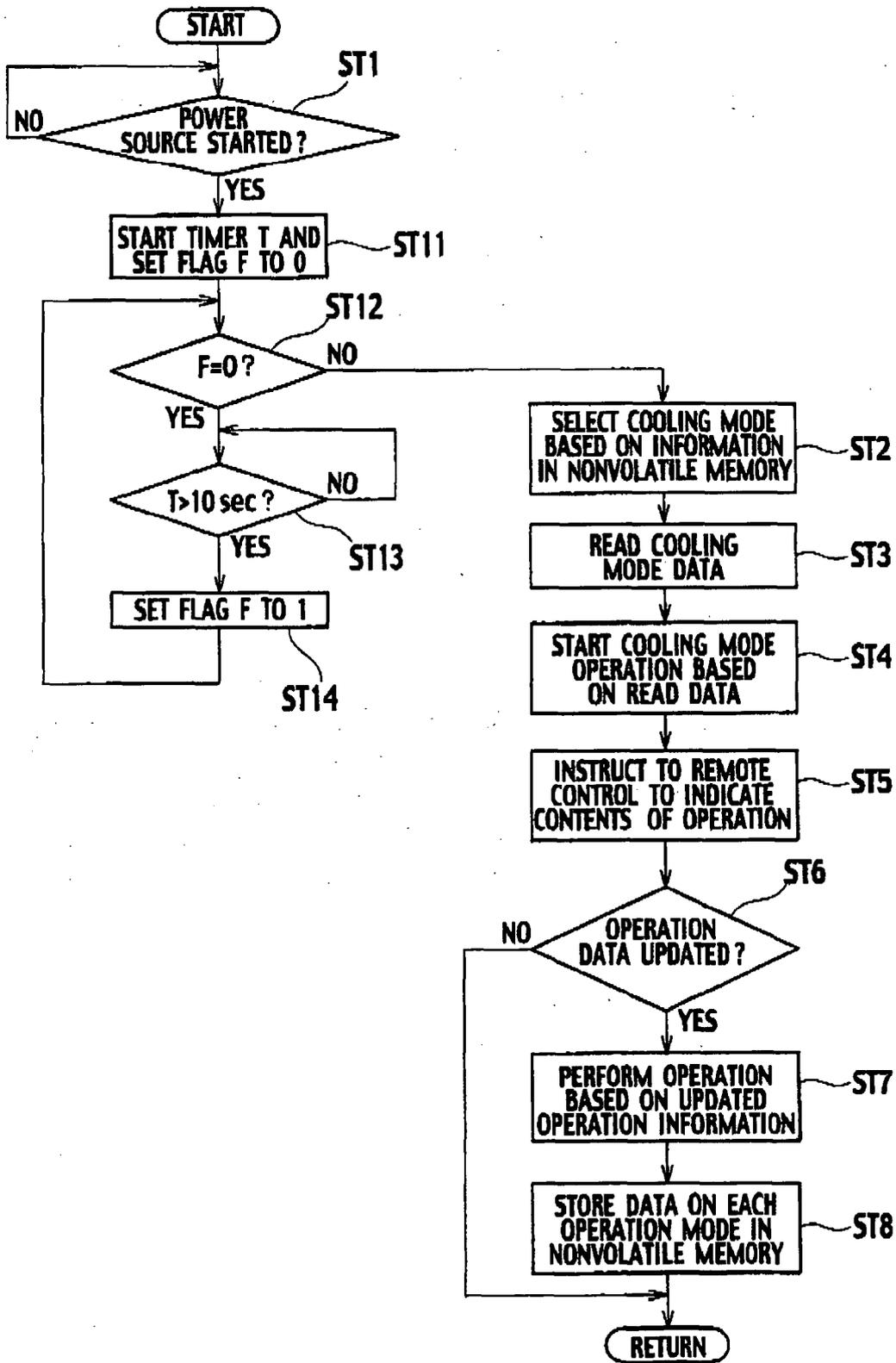


FIG. 5





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**ANNEX TO THE EUROPEAN SEARCH REPORT
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