(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 811 238 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
07.06.2017 Bulletin 2017/23

(51) Int Cl.:
F24F 11/00 *(2006.01)*

(21) Application number: **06007855.7**

(22) Date of filing: **13.04.2006**

(54) Apparatus and method for controlling sleep mode of airconditioner

Verfahren und Vorrichtung zur Schalfmodusregelung in einer Klimaanlage

Procédé et appareil de commande du mode sommeil pour dispositif de conditionnement d'air

(84) Designated Contracting States:
DE FR GB

(30) Priority: **18.01.2006 KR 20060005524**

(43) Date of publication of application:
25.07.2007 Bulletin 2007/30

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Description

[0001] The present invention relates to an air-conditioner, and more particularly to an apparatus and method for controlling a sleep mode of an air-conditioner to provide a sleeping environment when a user desires to sleep.

[0002] Generally, an air-conditioner has been widely used to reduce or increase a room temperature, and includes a variety of automatic operation modes to implement optimum temperature or humidity according to a room condition or user condition.

[0003] A representative example of the above-mentioned automatic operation modes is a sleep mode (also called a sleeping mode). Since the sleep mode is indicative of an operation mode capable of being selected by a user who desires to sleep, the air-conditioner must sufficiently consider characteristics induced in a sleeping human being who does not move, such that it can perform an optimum air-conditioning operation suitable for the sleeping human being.

[0004] JP 2004 092 918 discloses an air conditioner which raises indoor temperature immediately after a so-called "good-night mode" is started. This temperature increase can cause discomfort to users who dislike sleeping in warm environments.

SUMMARY OF THE INVENTION

[0005] Therefore, it is an aspect of the invention to provide an apparatus and method for controlling a sleep mode of an air-conditioner to provide an optimum air-conditioning operation suitable for individual sleep stages in consideration of temperature characteristics of the sleep stages of a sleeping human being, such that it can provide the sleeping human being with an optimum sleep mode.

[0006] Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

[0007] In accordance with the invention, the above and/or other aspects can be achieved by the provision of an apparatus for controlling a sleep mode of an air-conditioner according to claim 1. Preferably, the controller maintains the room temperature at the first temperature for a predetermined period of time when the room temperature is reduced to the first temperature during the sleep-entrance stage.

[0008] Preferably, the controller maintains the room temperature at the second temperature for a predetermined period of time when the room temperature is increased to the second temperature during the deep-sleep stage.

[0009] Preferably, the controller repeatedly increases or reduces the room temperature in a predetermined temperature range from the setup temperature to the second temperature, when the room temperature is increased to the second temperature during the deep-sleep stage.

[0010] Preferably, the controller maintains the room temperature at the third temperature when the room temperature is increased to the third temperature during the wake-up stage.

[0011] Preferably, the controller terminates the sleep mode if a predetermined sleep mode time elapses on the condition that the room temperature is maintained at the third temperature for a predetermined period of time at the wake-up stage.

[0012] Preferably, the deep-sleep stage includes: a) if the room temperature is increased to the second temperature, maintaining the room temperature at the second temperature during a predetermined period of time; b) repeatedly increasing or reducing the room temperature within a specific temperature range from the setup temperature to the second temperature; and c) if the operation time allocated to the deep-sleep stage is a short time incapable of executing the steps (a) ~ (b), omitting at least one of the step (a), the step (b), and the wake-up stage.

[0013] Preferably, the deep-sleep stage includes: d) if the room temperature is increased to the second temperature, maintaining the room temperature at the second temperature during a predetermined period of time; e) repeatedly increasing or reducing the room temperature within a specific temperature range from the setup temperature to the second temperature; and f) if the operation time allocated to the deep-sleep stage is longer than a specific time capable of executing the steps (d) ~ (e), repeatedly executing at least one of the steps (d) ~ (e).

[0014] Preferably, the air-conditioner further includes a variable capacity compressor, an indoor unit fan for varying a rotation number, and an outlet for varying a discharge direction and a discharge area, and the controller operates the compressor at minimum capacity, operates the indoor unit fan at a minimum rotation number, and controls the outlet to indirectly provide a user with cool air, and increases at least one of a cooling capacity of the compressor, a rotation number of the indoor unit fan, and the cool-air discharge area if the rapid cooling mode is required.

[0015] Preferably, the controller controls the room temperature in 0.5°C units for each 30 minutes during the sleep mode.

[0016] Preferably, the controller controls the room temperature in 1°C units for each 1 hour during the sleep mode.

[0017] In accordance with another aspect of the present invention, there is provided a method for controlling a sleep mode of an air-conditioner according to claim 12. Preferably, the sleep-entrance stage maintains the room temperature at the first temperature for a predetermined period of time when the room temperature is reduced to the first temperature.

[0018] Preferably, the sleep-entrance stage maintains the room temperature at the second temperature for a

predetermined period of time when the room temperature is increased to the second temperature.

[0019] Preferably, the deep-sleep stage repeatedly increases or reduces the room temperature in a predetermined temperature range from the setup temperature to the second temperature, when the room temperature is increased to the second temperature.

[0020] Preferably, the wake-up stage maintains the room temperature at the third temperature when the room temperature is increased to the third temperature.

[0021] Preferably, the control method further comprises: terminating the sleep mode if a predetermined sleep mode time elapses on the condition that the room temperature is maintained at the third temperature for a predetermined period of time at the wake-up stage.

[0022] Preferably, the deep-sleep stage (b) includes: b1) if the room temperature is increased to the second temperature, maintaining the room temperature at the second temperature during a predetermined period of time; b2) repeatedly increasing or reducing the room temperature within a specific temperature range from the setup temperature to the second temperature; and b3) if the operation time allocated to the deep-sleep stage is a short time incapable of executing the steps (a) ~ (b), omitting at least one of the step (a), the step (b), and the wake-up stage.

[0023] Preferably, the deep-sleep stage (b) includes: b4) if the room temperature is increased to the second temperature, maintaining the room temperature at the second temperature during a predetermined period of time; b5) repeatedly increasing or reducing the room temperature within a specific temperature range from the setup temperature to the second temperature; and b6) if the operation time allocated to the deep-sleep stage is longer than a specific time capable of executing the steps (b4) ~ (b5), repeatedly executing at least one of the steps (b4) ~ (b5).

[0024] Preferably, the control method further comprises: operating a compressor at minimum capacity, operating an indoor unit fan at a minimum rotation number, and setting a cool-air discharge direction to an upper direction to indirectly provide a user with cool air; and increasing at least one of cooling capacity of the compressor, a rotation number of the indoor unit fan, and a cool-air discharge area if the rapid cooling mode is required.

[0025] Preferably, the control method further comprises: controlling the room temperature in 0.5°C units for each 30 minutes during the sleep mode.

[0026] Preferably, the control method further comprising: controlling the room temperature in 1°C units for each 1 hour during the sleep mode.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

FIG. 1 is a block diagram illustrating a controller for use in an air-conditioner in accordance with a preferred embodiment of the present invention;

FIG. 2 is a graph illustrating temperature characteristics of a sleep mode for use in an air-conditioner in accordance with a preferred embodiment of the present invention;

FIG. 3 is a flow chart illustrating a method for controlling a sleep mode of an air-conditioner according to temperature characteristics of the sleep mode shown in FIG. 2 in accordance with a preferred embodiment of the present invention;

FIG. 4 is a graph illustrating temperature characteristics of a sleep mode for use in an air-conditioner in accordance with another preferred embodiment of the present invention;

FIG. 5 is a flow chart illustrating a method for controlling a sleep mode of an air-conditioner according to sleep-mode temperature characteristics shown in FIG. 4 in accordance with another preferred embodiment of the present invention;

FIG. 6 is a graph illustrating temperature characteristics of a sleep mode for use in an air-conditioner in accordance with still another preferred embodiment of the present invention;

FIG. 7 is a flow chart illustrating a method for controlling a sleep mode of an air-conditioner according to sleep-mode temperature characteristics shown in FIG. 6 in accordance with still another preferred embodiment of the present invention;

FIG. 8 is a graph illustrating time- and temperature-control characteristics for use in the method for controlling the sleep mode of the air-conditioner according to sleep-mode temperature characteristics shown in FIG. 2 according to the present invention; and

FIG. 9 is a graph illustrating other time- and temperature- control characteristics for use in the method for controlling the sleep mode of the air-conditioner according to sleep-mode temperature characteristics shown in FIG. 2 according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] Reference will now be made in detail to the embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. The embodiments are described below to explain the present invention by referring to the figures.

[0029] FIG. 1 is a block diagram illustrating a controlled for use in an air-conditioner in accordance with a preferred embodiment of the present invention.

[0030] Referring to FIG. 1, a user input unit 104 and a

room temperature sensor 106 are connected to input terminals of the controller 102 for controlling overall operations of the air-conditioner. A compressor 108, an indoor unit fan 110, and a discharge blade 112 are connected to output terminals of the controller 102. A timer is contained in the controller 102.

[0031] The user input unit 104 allows a user to enter a desired operation mode or desired temperature for the air-conditioner, such that the entered operation mode or temperature can be established. The room temperature sensor 106 detects room temperature. It is preferable that the compressor 108 may be designed in the form of a variable capacity compressor according to an inverter control scheme or tandem scheme. It is preferable that the indoor unit fan 110 may be designed to have a variable rotation speed. The discharge blade 112 is installed at an outlet via which cool air is discharged from an indoor unit, such that it variably adjusts a discharge direction or a discharge area.

[0032] If the user-selected operation mode is a sleep mode, the controller 102 basically operates the compressor 108 at minimum capacity, and operates the indoor unit fan 110 at a minimum rotation number, such that it maintains a minimum cooling capacity. The controller 102 adjusts a discharge direction of the discharge blade 112 and an opening area of the same, such that it indirectly transmits cool air to a user instead of directly transmitting the cool air. However, if a rapid cooling operation is required, at least one of the cooling capacity of the compressor 108, a rotation number of the indoor unit fan 110, and a cooling-air discharge area is increased, such that the cooling capacity of the compressor 108 is greatly increased. Preferably, if all of the cooling capacity of the compressor 108, a rotation number of the indoor unit fan 110, and a cooling-air discharge area is increased, the above-mentioned cooling capacity of the compressor 108 is more greatly increased than in the aforementioned case.

[0033] FIG. 2 is a graph illustrating temperature characteristics of a sleep mode for use in an air-conditioner in accordance with a preferred embodiment of the present invention. FIG. 3 is a flow chart illustrating a method for controlling a sleep mode of an air-conditioner according to temperature characteristics of the sleep mode shown in FIG. 2 in accordance with a preferred embodiment of the present invention.

[0034] As can be seen from FIGS. 2~3, the sleep mode of the air-conditioner according to the present invention includes a sleep-entrance stage 202, a deep-sleep stage 204, and a wake-up stage 206. The sleep mode shown in FIGS. 2~3 is established to have a standard execution time of 8 hours as a total execution time.

[0035] The sleep-entrance stage 202 is indicative of a predetermined period of time from a first time at which the user selects the sleep mode to a second time at which the user falls asleep, and performs a rapid cooling operation until a room temperatures reaches a first temperature T_{i-z} less than a setup temperature T_i at step 302. In other words, the sleep-entrance stage 202 performs the rapid cooling mode capable of rapidly lowering a room temperature from a current temperature of t_{20} to the first temperature T_{i-z} equal to a specific temperature t_{21}, such that a user's skin temperature is reduced to an appropriate temperature and the central nervous system associated with a human-body temperature control function is minimized. The rapid cooling time equal to the time from t_{20} to t_{21} may be established in the range from a minimum of several minutes to a maximum of 1 hour. During the rapid cooling mode, the cooling capacity of the compressor 108 and the rotation number of the indoor unit fan 110 are increased, and the discharge blade 112 is controlled to adjust a discharge area and a discharge direction, such that air in the room is easily mixed. During the remaining time (i.e., a time from t_{21} to t_{22}) of the sleep-entrance stage 202, the room temperature is maintained at the first temperature T_{i-z} equal to the rapid cooling temperature, such that the user's skin temperature is continuously lowered at step 304. A temperature drop range "z" at the sleep-entrance stage 202 is in the range from 1°C to 4°C, and a total operation time of the sleep-entrance stage 202 is in the range from a minimum of 30 minutes to a maximum of 3 hours.

[0036] The deep-sleep stage 204 is indicative of a predetermined period of time during which the user falls into a deep sleep, increases a room temperature to a second temperature T_{i+x} higher than the setup temperature T_i at step 306, maintains the second temperature T_{i+x} for a predetermined period of time at step 308, and repeatedly increases or reduces the room temperature in a predetermined temperature range from the setup temperature T_i to the second temperature T_{i+x} at steps 310 and 312. In other words, the deep-sleep stage 204 continuously increases a room temperature during a predetermined period of t_{22}~t_{23}, such that the room temperature reaches the second temperature T_{i+x}. As a result, the deep-sleep stage 204 prevents the user's skin temperature from being excessively lowered, resulting in the implementation of an energy saving effect. The time from the temperature t_{22} to the other temperature t_{23} is in the range from 3 hours to 5 hours. During the time of t_{23}~t_{24}, the deep-sleep stage 204 constantly maintains the second temperature T_{i+x}. Thereafter, the reason why the deep-sleep stage 204 repeatedly increases or reduces the room temperature in a predetermined temperature range from the setup temperature T_i to the second temperature T_{i+x} is to prevent the user's skin temperature from being excessively increased or reduced. Furthermore, if the user's skin temperature reaches a normal or steady state, the deep-sleep stage 204 increases the room temperature to the second temperature T_{i+x}, resulting in the implementation of an energy saving effect. In the case of the standard execution time shown in FIG. 2, the time of t_{23}~t_{24} is established in the range from a minimum of 1 hour to a maximum of 3 hours. A repetition time from the rising time of the room temperature to the drop time of the same is equal to or less than a total of 2 hours.

[0037] The wake-up stage 206 increases a user's temperature to facilitate physiological actions of the user. In more detail, the wake-up stage 206 gradually increases the room temperature to a third temperature T_{i+y} higher than the second temperature T_{i+x}, and maintains the third temperature T_{i+y} for a predetermined period of time at step 314. The time of t_{26}~t_{27} during which the wake-up stage 206 is executed is established in the range from a minimum of 30 minutes to a maximum of 2 hours. If the sleep mode setup time elapses during the wake-up stage 206 at step 316, the wake-up mode is terminated.

[0038] In accordance with a preferred embodiment of the present invention, the user can directly enter a total execution time of the sleep mode using the user input unit 104. For example, if the user determines the total execution time of the sleep mode to be 8 hours equal to the standard execution time, the sleep-entrance stage 202, the deep-sleep stage 204, and the wake-up stage 206 of FIGS. 2~3 are executed for individual predetermined times, respectively. In this case, the execution time of the sleep-entrance time 202 is established in the range of a minimum of 30 minutes to a maximum of 3 hours. The execution time of the wake-up stage 206 is in the range of 30 minutes to 2 hours. The deep-sleep stage 204 is located between the sleep-entrance stage 202 and the wake-up stage 206.

[0039] If the user determines a total execution time of the sleep mode to be a specific time (e.g., 4 hours) shorter than the standard execution time, the wake-up stage 206 and some parts of the deep-sleep stage 204 are omitted. Otherwise, if the user determines a total execution time of the sleep mode to be a specific time (e.g., 12 hours) longer than the standard execution time, the deep-sleep stage 204 equal to the time of t_{23}~t_{26} is repeated during the above-mentioned time longer than the standard execution time. The above-mentioned respective preferred embodiments are shown in FIGS. 4~7.

[0040] FIG. 4 is a graph illustrating temperature characteristics of a sleep mode for use in an air-conditioner in accordance with another preferred embodiment of the present invention. FIG. 5 is a flow chart illustrating a method for controlling a sleep mode of an air-conditioner according to sleep-mode temperature characteristics shown in FIG 4 in accordance with another preferred embodiment of the present invention.

[0041] As can be seen from FIGS. 4~5, if a total execution time of the sleep mode is determined to be about 4 hours less than the standard execution time (i.e., 8 hours), a sleep-entrance time 402 is executed, and then only some parts of a deep-sleep stage 404 are executed for the remaining time other than the sleep-entrance time 402.

[0042] In other words, the air-conditioner performs the rapid cooling mode during a specific time of t_{40}~t_{41} of the sleep-entrance stage 402 until a current temperature reaches a first temperature T_{i-z} less than the setup temperature T_i at step 502. Thereafter, the air-conditioner maintains the first temperature T_{i-z} equal to the rapid cooling temperature during a specific time of t_{41} ~ t_{42}, such that the user's skin temperature is continuously reduced at step 504.

[0043] The deep-sleep stage 404 increases the room temperature to a second temperature T_{i+x} higher than the setup temperature T_i, and constantly maintains the second temperature T_{i+x} at steps 506 and 508. According to the preferred embodiments shown in FIGS. 4~5, a total execution time of the sleep mode is short, such that the preferred embodiments cannot perform not only the wake-up stage but also the deep-sleep stage 404. Therefore, when the preferred embodiments perform the deep-sleep stage 404 during the remaining time of t_{42}~t_{44} after executing the sleep-entrance stage 402, it terminates the sleep mode if the sleep-mode setup time (e.g., 4 hours) elapses at step 510.

[0044] FIG. 6 is a graph illustrating temperature characteristics of a sleep mode for use in an air-conditioner in accordance with still another preferred embodiment of the present invention. FIG. 7 is a flow chart illustrating a method for controlling a sleep mode of an air-conditioner according to sleep-mode temperature characteristics shown in FIG. 6 in accordance with still another preferred embodiment of the present invention.

[0045] As can be seen from FIGS. 6~7, if the user sets a total execution time of the sleep mode to about 12 hours, which is longer than the standard execution time, a specific time of t_{63}~t_{66} of the deep-sleep stage 604 is repeated during the time longer than the standard execution time.

[0046] In other words, the air-conditioner performs the rapid cooling mode during a specific time of t_{60}~t_{61} of the sleep-entrance stage 602 until a current temperature reaches a first temperature T_{i-z} less than the setup temperature T_i at step 702. Thereafter, the air-conditioner maintains the first temperature T_{i-z} equal to the rapid cooling temperature during a specific time of t_{61} □ t_{62}, such that the user's skin temperature is continuously reduced at step 704.

[0047] The deep-sleep stage 604 increases the room temperature to a second temperature T_{i+x} higher than the setup temperature T_i at step 706. The deep-sleep stage 604 maintains the room temperature equal to the second temperature T_{i+x} during a predetermined period of time at step 708, and re-reduces the room temperature to the setup temperature T_i at step 710.

[0048] A total execution time of the sleep mode selected by the user is longer than the standard execution time by 4 hours in the case of the preferred embodiments shown in FIGS. 6□7, such that the deep-sleep mode 604 is extended by 4 hours as compared to the deep-sleep stage of the standard execution time. As can be seen from step 608 of FIG. 6 and steps 712, 714, and 716 of FIG 7, the room temperature is repeatedly increased or reduced in the range from the setup temperature T_i to the second temperature T_{i+x} during the above-mentioned extended time, such that an optimum room temperature appropriate for the user's deep sleep is maintained.

[0049] The wake-up stage 606 gradually increases the room temperature to the third temperature T_{i+y} higher than the second temperature T_{i+x} in the same manner as in FIGS. 2□3, and then maintains the third temperature T_{i+y} during a predetermined period of time at step 718. If all of the sleep mode setup time elapses while the wake-up stage 606 is executed at step 720, the sleep mode is terminated.

[0050] FIG. 8 is a graph illustrating time- and temperature- control characteristics for use in the method for controlling the sleep mode of the air-conditioner according to sleep-mode temperature characteristics shown in FIG. 2 according to the present invention. FIG. 8 exemplarily shows the standard execution time of the sleep mode shown in FIGS. 2□3. As can be seen from FIG. 8, the sleep mode for the air-conditioner includes a sleep-entrance stage 202, a deep-sleep stage 204, and a wake-up stage 206. Individual stages 202, 204 and 206 are controlled in 0.5°C units for each 30 minutes. However, when the execution time of each stage is less than 30 minutes in the same manner as in the sleep-entrance stage 202 of FIG. 8 during which the room temperature is quickly reduced to the first temperature (Ti-2.5°C), individual stages are controlled in necessary time units (e.g., 10 minutes).

[0051] FIG. 9 is a graph illustrating other time- and temperature- control characteristics for use in the method for controlling the sleep mode of the air-conditioner according to sleep-mode temperature characteristics shown in FIG. 2 according to the present invention. FIG. 9 exemplarily shows the standard execution time of the sleep mode shown in FIGS. 2□3. As can be seen from FIG. 9, the sleep mode for the air-conditioner includes a sleep-entrance stage 202, a deep-sleep stage 204, and a wake-up stage 206. Individual stages 202, 204 and 206 are controlled in 1°C units for each 1 hour. In more detail, the air-conditioner detects the room temperature for each 1 hour to properly increase or reduce the room temperature. The increasing- or reducing- range of the room temperature is controlled in 1°C units, such that the example of FIG. 9 greatly reduces the number of operations of the compressor 108, the number of operations of the indoor unit fan 110, and the number of operations of the discharge blade 112, as compared to the example of FIG. 8, resulting in the implementation of the power saving effect.

[0052] As is apparent from the above description, the apparatus and method for controlling the sleep mode of the air-conditioner according to the present invention provides an optimum air-conditioning effect suitable for individual sleep stages in consideration of temperature characteristics of the sleep stages of a sleeping human being, such that it can provide the sleeping human being with an optimum sleep mode.

Claims

1. An apparatus for controlling a sleep mode of an air-conditioner comprising:

   a room temperature sensor (106) for detecting a room temperature;
   a user input unit (104) and
   a controller (102) for controlling the sleep mode when the sleep mode begins, such that it executes a sleep-entrance stage (202), executes a deep-sleep stage (204) for gradually increasing the room temperature to a second temperature higher than a setup temperature, and executes a wake-up stage (206) for increasing the room temperature to a third temperature higher than the second temperature,
   characterized in that at the start (t_{20}, t_{40}, t_{60}) of the sleep mode, the controller (102) executes the sleep-entrance stage (202) for a rapid cooling mode during which the room temperature is quickly reduced to a first temperature less than the setup temperature, wherein a total operation time of the sleep mode is determined by a user via the user input unit (104) and the controller allocates a predetermined fixed time to execute the sleep-entrance stage (202) and the wake-up stage (206) from among a total operation time of the sleep mode, and allocates the remaining time other than operation times for the sleep-entrance (202) and wake-up stages (206) to an operation time of the deep-sleep stage (204).

2. The apparatus according to claim 1, wherein the controller (102) maintains the room temperature at the first temperature for a predetermined period of time when the room temperature is reduced to the first temperature during the sleep-entrance stage (202).

3. The apparatus according to claim 1, wherein the controller (102) maintains the room temperature at the second temperature for a predetermined period of time when the room temperature is increased to the second temperature during the deep-sleep stage (204).

4. The apparatus according to claim 1, wherein the controller (102) repeatedly increases or reduces the room temperature in a predetermined temperature range from the setup temperature to the second temperature, when the room temperature is increased to the second temperature during the deep-sleep stage (204).

5. The apparatus according to claim 1, wherein the controller (102) maintains the room temperature at the third temperature when the room temperature is increased to the third temperature during the wake-up

stage (206).

6. The apparatus according to claim 5, wherein the controller (102) terminates the sleep mode if a predetermined sleep mode time elapses on the condition that the room temperature is maintained at the third temperature for a predetermined period of time at the wake-up stage (206).

7. The apparatus according to claim 1, wherein the deep-sleep stage (204) includes:

a) if the room temperature is increased to the second temperature, maintaining the room temperature at the second temperature during a predetermined period of time;
b) repeatedly increasing or reducing the room temperature within a specific temperature range from the setup temperature to the second temperature; and
c) if the operation time allocated to the deep-sleep stage (204) is a short time incapable of executing the steps a) - b), omitting at least one of the step a), the step b), and the wake-up stage (206).

8. The apparatus according to claim 1, wherein the deep-sleep stage (204) includes:

d) if the room temperature is increased to the second temperature, maintaining the room temperature at the second temperature during a predetermined period of time;
e) repeatedly increasing or reducing the room temperature within a specific temperature range from the setup temperature to the second temperature; and
f) if the operation time allocated to the deep-sleep stage (204) is longer than a specific time capable of executing the steps d) - e), repeatedly executing at least one of the steps d) - e).

9. The apparatus according to claim 1, wherein:

the air-conditioner further includes a variable capacity compressor (108), an indoor unit fan (110) for varying a rotation number, and an outlet for varying a discharge direction and a discharge area, and
the controller (102) operates the compressor (108) at minimum capacity, operates the indoor unit fan (110) at a minimum rotation number, and controls the outlet to indirectly provide a user with cool air, and increases at least one of a cooling capacity of the compressor (108), a rotation number of the indoor unit fan (110), and the cool-air discharge area if the rapid cooling mode is required.

10. The apparatus according to claim 1, wherein the controller (102) controls the room temperature in 0.5°C units for each 30 minutes during the sleep mode.

11. The apparatus according to claim 1, wherein the controller (102) controls the room temperature in 1°C units for each 1 hour during the sleep mode.

12. A method for controlling a sleep mode of an air-conditioner comprising:

a) if the sleep mode begins, performing a sleep-entrance stage (202);
b) performing a deep-sleep stage (204) for gradually increasing the room temperature to a second temperature higher than a setup temperature; and
c) executing a wake-up stage (206) for increasing the room temperature to a third temperature higher than the second temperature

characterized in that at the start (t_{20}, t_{40}, t_{60}) of the sleep mode, the sleep-entrance stage (202) is performed for a rapid cooling mode during which a room temperature is quickly reduced to a first temperature less than the setup temperature, wherein an overall operation time of the sleep mode is determined by a user and the method further comprises allocating a predetermined fixed time to execute the sleep-entrance stage (202) and the wake-up stage (206) from among a total operation time of the sleep mode; and allocating the remaining time other than operation times for the sleep-entrance (202) and wake-up stages (206) to an operation time of the deep-sleep stage (204).

13. The method according to claim 12, wherein the sleep-entrance stage (202) maintains the room temperature at the first temperature for a predetermined period of time when the room temperature is reduced to the first temperature.

14. The method according to claim 12, wherein the sleep-entrance stage (202) maintains the room temperature at the second temperature for a predetermined period of time when the room temperature is increased to the second temperature.

15. The method according to claim 12, wherein the deep-sleep stage (204) repeatedly increases or reduces the room temperature in a predetermined temperature range from the setup temperature to the second temperature, when the room temperature is increased to the second temperature.

16. The method according to claim 12, wherein the wake-up stage (206) maintains the room temperature at the third temperature when the room temper-

ature is increased to the third temperature.

17. The method according to claim 16, further comprising:

terminating the sleep mode if a predetermined sleep mode time elapses on the condition that the room temperature is maintained at the third temperature for a predetermined period of time at the wake-up stage (206).

18. The method according to claim 12, wherein the deep-sleep stage b) (204) includes:

b1) if the room temperature is increased to the second temperature, maintaining the room temperature at the second temperature during a predetermined period of time;
b2) repeatedly increasing or reducing the room temperature within a specific temperature range from the setup temperature to the second temperature; and
b3) if the operation time allocated to the deep-sleep stage (204) is a short time incapable of executing the steps a) - b), omitting at least one of the step a), the step b), and the wake-up stage (206).

19. The method according to claim 12, wherein the deep-sleep stage b) (204) includes:

b4) if the room temperature is increased to the second temperature, maintaining the room temperature at the second temperature during a predetermined period of time;
b5) repeatedly increasing or reducing the room temperature within a specific temperature range from the setup temperature to the second temperature; and
b6) if the operation time allocated to the deep-sleep stage (204) is longer than a specific time capable of executing the steps b4) - b5), repeatedly executing at least one of the steps b4) - b5).

20. The method according to claim 12, further comprising:

operating a compressor (108) at minimum capacity, operating an indoor unit fan (110) at a minimum rotation number, and setting a cool-air discharge direction to an upper direction to indirectly provide a user with cool air; and
increasing at least one of cooling capacity of the compressor (108), a rotation number of the indoor unit fan (110), and a cool-air discharge area if the rapid cooling mode is required.

21. The method according to claim 12, further comprising:

controlling the room temperature in 0.5°C units for each 30 minutes during the sleep mode.

22. The method according to claim 12, further comprising:

controlling the room temperature in 1°C units for each 1 hour during the sleep mode.

Patentansprüche

1. Vorrichtung zum Steuern eines Schlaf-Modus einer Klimaanlage, die umfasst:

einen Raumtemperatur-Sensor (106) zum Erfassen einer Raumtemperatur;
eine Benutzereingabe-Einheit (104) und
eine Steuereinrichtung (102), mit der, wenn der Schlaf-Modus beginnt, der Schlaf-Modus so gesteuert wird, dass eine Einschlaf-Stufe (202) ausgeführt wird, eine Tiefschlaf-Stufe (204) ausgeführt wird, mit der die Raumtemperatur allmählich auf eine zweite Temperatur erhöht wird, die höher ist als eine Einstelltemperatur, und eine Aufwach-Stufe (206) ausgeführt wird, mit der die Raumtemperatur auf eine dritte Temperatur erhöht wird, die höher ist als die zweite Temperatur,
dadurch gekennzeichnet, dass beim Beginn (t_{20}, t_{40}, t_{60}) des Schlaf-Modus die Steuereinrichtung (102) die Einschlaf-Stufe (202) für einen Schnellabkühlungs-Modus ausführt, in dessen Verlauf die Raumtemperatur schnell auf eine erste Temperatur verringert wird, die niedriger ist als die Einstelltemperatur, wobei eine Gesamt-Betriebszeit des Schlaf-Modus von einem Benutzer über die Benutzereingabe-Einheit (104) bestimmt wird und die Steuereinrichtung von der Gesamt-Betriebszeit des Schlaf-Modus eine vorgegebene feste Zeit zum Ausführen der Einschlaf-Stufe (202) und der Aufwach-Stufe (206) zuweist und die neben den Betriebszeiten für die Einschlaf-Stufe (202) und die Aufwach-Stufe (206) verbleibende Zeit einer Betriebszeit der Tiefschlaf-Stufe (204) zuweist.

2. Vorrichtung nach Anspruch 1, wobei die Steuereinrichtung (102) die Raumtemperatur über einen vorgegebenen Zeitraum auf der ersten Temperatur hält, wenn die Raumtemperatur während der Einschlaf-Stufe (202) auf die erste Temperatur verringert wird.

3. Vorrichtung nach Anspruch 1, wobei die Steuereinrichtung (102) die Raumtemperatur über einen vorgegebenen Zeitraum auf der zweiten Temperatur

hält, wenn die Raumtemperatur während der Tiefschlaf-Stufe (204) auf die zweite Temperatur erhöht wird.

4. Vorrichtung nach Anspruch 1, wobei die Steuereinrichtung (102) die Raumtemperatur wiederholt in einem vorgegebenen Temperaturbereich von der Einstelltemperatur auf die zweite Temperatur erhöht oder verringert, wenn die Raumtemperatur während der Tiefschlaf-Stufe (204) auf die zweite Temperatur erhöht wird.

5. Vorrichtung nach Anspruch 1, wobei die Steuereinrichtung (102) die Raumtemperatur auf der dritten Temperatur hält, wenn die Raumtemperatur während der Aufwach-Stufe (206) auf die dritte Temperatur erhöht wird.

6. Vorrichtung nach Anspruch 5, wobei die Steuereinrichtung (102) den Schlaf-Modus unter der Bedingung beendet, dass die Raumtemperatur über einen vorgegebenen Zeitraum in der Aufwach-Stufe (206) auf der dritten Temperatur gehalten wird, wenn eine vorgegebene Zeit des Schlaf-Modus abläuft.

7. Vorrichtung nach Anspruch 1, wobei die Tiefschlaf-Stufe (204) einschließt, dass:

a) wenn die Raumtemperatur auf die zweite Temperatur erhöht wird, die Raumtemperatur während eines vorgegebenen Zeitraums auf der zweiten Temperatur gehalten wird;
b) die Raumtemperatur innerhalb eines bestimmten Temperaturbereiches wiederholt von der Einstelltemperatur auf die zweite Temperatur erhöht oder verringert wird; und
c) der Schritt a), der Schritt b) oder/und die Aufwach-Stufe (206) weggelassen wird/werden, wenn die der Tiefschlaf-Stufe (204) zugewiesene Betriebszeit eine kurze Zeit ist, in der die Schritte a) - b) nicht ausgeführt werden können.

8. Vorrichtung nach Anspruch 1, wobei die Tiefschlaf-Stufe (204) einschließt, dass:

d) wenn die Raumtemperatur auf die zweite Temperatur erhöht wird, die Raumtemperatur während eines vorgegebenen Zeitraums auf der zweiten Temperatur gehalten wird;
e) die Raumtemperatur innerhalb eines bestimmten Temperaturbereiches wiederholt von der Einstelltemperatur auf die zweite Temperatur erhöht oder verringert wird; und
f) wenigstens einer der Schritte d) - e) wiederholt ausgeführt wird, wenn die der Tiefschlaf-Stufe (204) zugewiesene Betriebszeit länger ist als eine bestimmte Zeit, in der die Schritte d) - e) ausgeführt werden können.

9. Vorrichtung nach Anspruch 1, wobei:

die Klimaanlage des Weiteren einen Kompressor (108) variabler Kapazität, einen Lüfter (110) der Inneneinheit mit variabler Drehzahl sowie einen Auslass zum Ändern einer Ausstoßrichtung und eines Ausstoßbereiches enthält, und die Steuereinrichtung (102) den Kompressor (108) mit minimaler Kapazität betreibt, den Lüfter (110) der Inneneinheit mit minimaler Drehzahl betreibt und den Auslass so steuert, dass einem Benutzer kühle Luft indirekt zugeleitet wird, und die Kühlkapazität des Kompressors (108), eine Drehzahl des Lüfters (110) der Inneneinheit oder/und den Kühlluft-Ausstoßbereich erhöht/vergrößert, wenn der Schnellabkühlungs-Modus erforderlich ist.

10. Vorrichtung nach Anspruch 1, wobei die Steuereinrichtung (102) die Raumtemperatur während des Schlaf-Modus alle 30 Minuten in Einheiten von 0,5 °C steuert.

11. Vorrichtung nach Anspruch 1, wobei die Steuereinrichtung (102) die Raumtemperatur während des Schlaf-Modus jede Stunde in Einheiten von 1 °C steuert.

12. Verfahren zum Steuern eines Schlaf-Modus einer Klimaanlage, das umfasst:

a) Durchführen einer Einschlaf-Stufe (202), wenn der Schlaf-Modus beginnt;
b) Durchführen einer Tiefschlaf-Stufe (204), mit der die Raumtemperatur allmählich auf eine zweite Temperatur erhöht wird, die höher ist als eine Einstelltemperatur; und
c) Ausführen einer Aufwach-Stufe (206), mit der die Raumtemperatur auf eine dritte Temperatur erhöht wird, die höher ist als die zweite Temperatur,

dadurch gekennzeichnet, dass beim Beginn (t_{20}, t_{40}, t_{60}) des Schlaf-Modus die Einschlaf-Stufe (202) für einen Schnellabkühlungs-Modus durchgeführt wird, in dessen Verlauf eine Raumtemperatur schnell auf eine erste Temperatur verringert wird, die niedriger ist als die Einstelltemperatur, wobei eine Gesamt-Betriebszeit des Schlaf-Modus von einem Benutzer bestimmt wird und das Verfahren des Weiteren umfasst, dass von der Gesamt-Betriebszeit des Schlaf-Modus eine vorgegebene feste Zeit zum Ausführen der Einschlaf-Stufe (202) und der Aufwach-Stufe (206) zugewiesen wird; und
die neben den Betriebszeiten für die Einschlaf-Stufe (202) und die Aufwach-Stufe (206) verbleibende Zeit einer Betriebszeit der Tiefschlaf-Stufe (204) zugewiesen wird.

13. Verfahren nach Anspruch 12, wobei mit der Einschlaf-Stufe (202) die Raumtemperatur über einen vorgegebenen Zeitraum auf der ersten Temperatur gehalten wird, wenn die Raumtemperatur auf die erste Temperatur verringert wird.

14. Verfahren nach Anspruch 12, wobei mit der Einschlaf-Stufe (202) die Raumtemperatur über einen vorgegebenen Zeitraum auf der zweiten Temperatur gehalten wird, wenn die Raumtemperatur auf die zweite Temperatur erhöht wird.

15. Verfahren nach Anspruch 12, wobei mit der Tiefschlaf-Stufe (204) die Raumtemperatur wiederholt in einem vorgegebenen Temperaturbereich von der Einstelltemperatur auf die zweite Temperatur erhöht oder verringert wird, wenn die Raumtemperatur auf die zweite Temperatur erhöht wird.

16. Verfahren nach Anspruch 12, wobei mit der Aufwach-Stufe (206) die Raumtemperatur auf der dritten Temperatur gehalten wird, wenn die Raumtemperatur auf die dritte Temperatur erhöht wird.

17. Verfahren nach Anspruch 16, das des Weiteren umfasst:

Beenden des Schlaf-Modus unter der Bedingung, dass die Raumtemperatur über einen vorgegebenen Zeitraum in der Aufwach-Stufe (206) auf der dritten Temperatur gehalten wird, wenn eine vorgegebene Zeit des Schlaf-Modus abläuft.

18. Verfahren nach Anspruch 12, wobei die Tiefschlaf-Stufe b) (204) einschließt, dass:

b1) wenn die Raumtemperatur auf die zweite Temperatur erhöht wird, die Raumtemperatur während eines vorgegebenen Zeitraums auf der zweiten Temperatur gehalten wird;
b2) die Raumtemperatur innerhalb eines bestimmten Temperaturbereiches wiederholt von der Einstelltemperatur auf die zweite Temperatur erhöht oder verringert wird; und
b3) der Schritt a), der Schritt b) oder/und die Aufwach-Stufe (206) weggelassen wird/werden, wenn die der Tiefschlaf-Stufe (204) zugewiesene Betriebszeit eine kurze Zeit ist, in der die Schritte a) - b) nicht ausgeführt werden können.

19. Verfahren nach Anspruch 12, wobei die Tiefschlaf-Stufe b) (204) einschließt, dass:

b4) wenn die Raumtemperatur auf die zweite Temperatur erhöht wird, die Raumtemperatur während eines vorgegebenen Zeitraums auf der zweiten Temperatur gehalten wird;
b5) die Raumtemperatur innerhalb eines bestimmten Temperaturbereiches wiederholt von der Einstelltemperatur auf die zweite Temperatur erhöht oder verringert wird; und
b6) wenigstens einer der Schritte b4) - b5) wiederholt ausgeführt wird, wenn die der Tiefschlaf-Stufe (204) zugewiesene Betriebszeit länger ist als eine bestimmte Zeit, in der die Schritte b4) - b5) ausgeführt werden können.

20. Verfahren nach Anspruch 12, das des Weiteren umfasst:

Betreiben eines Kompressors (108) mit minimaler Kapazität, Betreiben eines Lüfters (110) der Inneneinheit mit einer minimalen Drehzahl und Einstellen einer Kühlluft-Ausstoßrichtung auf eine obere Richtung, so dass einem Benutzer kühle Luft indirekt zugeleitet wird; und
Erhöhen/Vergrößern von Kühlkapazität des Kompressors (108), einer Drehzahl des Lüfters (110) der Inneneinheit oder/und eines Kühlluft-Ausstoßbereiches, wenn der Schnellabkühlungs-Modus erforderlich ist.

21. Verfahren nach Anspruch 12, das des Weiteren umfasst:

Steuern der Raumtemperatur während des Schlaf-Modus alle 30 Minuten in Einheiten von 0,5 °C.

22. Verfahren nach Anspruch 12, das des Weiteren umfasst:

Steuern der Raumtemperatur während des Schlaf-Modus jede Stunde in Einheiten von 1 °C.

Revendications

1. Appareil de commande d'un mode veille d'un climatiseur comprenant :

un capteur de température ambiante (106) pour détecter une température ambiante ;
une unité d'entrée utilisateur (104) et
une commande (102) pour commander le mode veille lorsque le mode veille débute, de telle manière qu'elle exécute une phase d'entrée en veille (202), exécute une phase de veille profonde (204) pour augmenter progressivement la température ambiante jusqu'à une seconde température supérieure à une température paramétrée, et exécute une phase de réveil (206) pour augmenter la température ambiante jus-

qu'à une troisième température supérieure à la seconde température,
caractérisée en ce qu'au démarrage (t_{20}, t_{40}, t_{60}) du mode veille, la commande (102) exécute la phase d'entrée en veille (202) pour un mode de refroidissement rapide au cours duquel la température ambiante est rapidement réduite jusqu'à une première température inférieure à la température paramétrée, où une durée totale de fonctionnement du mode veille est déterminée par un utilisateur via l'unité d'entrée utilisateur (104) et la commande alloue une durée fixe prédéterminée faisant partie d'une durée totale de fonctionnement du mode veille, pour exécuter la phase d'entrée en veille (202) et la phase de réveil (206), et alloue la durée restante endehors des durées de fonctionnement pour les phases d'entrée en veille (202) et de réveil (206) à une durée de fonctionnement de la phase de veille profonde (204).

2. Appareil selon la revendication 1, où la commande (102) maintient la température ambiante à la première température pour une durée prédéterminée lorsque la température ambiante est réduite à la première température pendant la phase d'entrée en veille (202).

3. Appareil selon la revendication 1, où la commande (102) maintient la température ambiante à la seconde température pour une durée prédéterminée lorsque la température ambiante est augmentée jusqu'à la seconde température pendant la phase de veille profonde (204).

4. Appareil selon la revendication 1, où la commande (102) augmente ou diminue de façon répétée la température ambiante dans une plage de températures prédéterminée allant de la température paramétrée à la seconde température, lorsque la température ambiante est augmentée jusqu'à la seconde température pendant la phase de veille profonde (204).

5. Appareil selon la revendication 1, où la commande (102) maintient la température ambiante à la troisième température lorsque la température ambiante est augmentée jusqu'à la troisième température pendant la phase de réveil (206).

6. Appareil selon la revendication 5, où la commande (102) met fin au mode veille à l'écoulement d'une durée prédéterminée de mode veille, à condition que la température ambiante soit maintenue à la troisième température pour une durée prédéterminée pendant la phase de réveil (206).

7. Appareil selon la revendication 1, où la phase de veille profonde (204) inclut les étapes consistant à :

a) si la température ambiante est augmentée jusqu'à la seconde température, maintenir la température ambiante à la seconde température pendant une durée prédéterminée ;
b) augmenter ou réduire la température ambiante de manière répétée dans une plage de températures spécifique allant de la température paramétrée à la seconde température ; et
c) si la durée de fonctionnement allouée à la phase de veille profonde (204) est une durée courte inadaptée à l'exécution des étapes a) - b), omettre au moins une des étapes parmi l'étape a), l'étape b), et la phase de réveil (206).

8. Appareil selon la revendication 1, où la phase de veille profonde (204) inclut les étapes consistant à :

d) si la température ambiante est augmentée jusqu'à la seconde température, maintenir la température ambiante à la seconde température pendant une durée prédéterminée ;
e) augmenter ou réduire la température ambiante de manière répétée dans une plage de températures spécifique allant de la température paramétrée à la seconde température ; et
f) si la durée de fonctionnement allouée à la phase de veille profonde (204) est plus longue qu'une durée spécifique permettant d'exécuter les étapes d) - e), exécuter de manière répétée au moins une des étapes d) - e).

9. Appareil selon la revendication 1, où :

le climatiseur inclut en outre un compresseur à capacité variable (108), un ventilateur d'unité intérieure (110) pour faire varier un nombre de rotations, et une sortie pour faire varier une direction de décharge et une zone de décharge, et la commande (102) fait fonctionner le compresseur (108) à capacité minimale, fait fonctionner le ventilateur d'unité intérieure (110) à un nombre minimal de rotations, et commande la sortie pour fournir indirectement un utilisateur en air frais, et augmente au moins un des paramètres parmi une capacité de refroidissement du compresseur (108), un nombre de rotations du ventilateur d'unité intérieure (110), et la zone de décharge d'air frais si le mode de refroidissement rapide est requis.

10. Appareil selon la revendication 1, où la commande (102) commande la température ambiante par unités de 0,5°C toutes les 30 minutes lors du mode veille.

11. Appareil selon la revendication 1, où la commande (102) commande la température ambiante par unités de 1°C toutes les heures lors du mode veille.

12. Procédé de commande d'un mode veille d'un climatiseur comprenant les étapes consistant à :

a) si le mode veille débute, effectuer une phase d'entrée en veille (202) ;
b) effectuer une phase de veille profonde (204) pour augmenter progressivement la température ambiante jusqu'à une seconde température supérieure à une température paramétrée ; et,
c) exécuter une phase de réveil (206) pour augmenter la température ambiante jusqu'à une troisième température supérieure à la seconde température

caractérisée en ce qu'au démarrage (t_{20}, t_{40}, t_{60}) du mode veille, la phase d'entrée en veille (202) est effectuée pour un mode de refroidissement rapide au cours duquel la température ambiante est rapidement réduite jusqu'à une première température inférieure à la température paramétrée, où une durée totale de fonctionnement du mode veille est déterminée par un utilisateur et le procédé comprend en outre une allocation d'une durée fixe prédéterminée faisant partie d'une durée totale de fonctionnement du mode veille, pour exécuter la phase d'entrée en veille (202) et la phase de réveil (206) ; et
alloue la durée restante hors des durées de fonctionnement pour les phases d'entrée en veille (202) et de réveil (206) à une durée de fonctionnement de la phase de veille profonde (204).

13. Procédé selon la revendication 12, où la phase d'entrée en veille (202) maintient la température ambiante à la première température pour une durée prédéterminée lorsque la température ambiante est réduite à la première température.

14. Procédé selon la revendication 12, où la phase d'entrée en veille (202) maintient la température ambiante à la seconde température pour une durée prédéterminée lorsque la température ambiante est augmentée à la seconde température.

15. Procédé selon la revendication 12, où la phase de veille profonde (204) augmente ou diminue de façon répétée la température ambiante dans une plage de températures prédéterminée allant de la température paramétrée à la seconde température, lorsque la température ambiante est augmentée jusqu'à la seconde température.

16. Procédé selon la revendication 12, où la phase de réveil (206) maintient la température ambiante à la troisième température lorsque la température ambiante est augmentée jusqu'à la troisième température.

17. Procédé selon la revendication 16, comprenant en outre l'étape consistant à :

mettre fin au mode veille à l'écoulement d'une durée prédéterminée de mode veille à condition que la température ambiante est maintenue à la troisième température pour une durée prédéterminée lors de la phase de réveil (206).

18. Procédé selon la revendication 12, où la phase b) de veille profonde (204) inclut les étapes consistant à :

b1) si la température ambiante est augmentée jusqu'à la seconde température, maintenir la température ambiante à la seconde température pendant une durée prédéterminée ;
b2) augmenter ou réduire la température ambiante de manière répétée dans une plage de températures spécifique allant de la température paramétrée à la seconde température ; et
b3) si la durée de fonctionnement allouée à la phase de veille profonde (204) est une durée courte inadaptée à l'exécution des étapes a) - b), omettre au moins une des étapes parmi l'étape a), l'étape b), et la phase de réveil (206).

19. Procédé selon la revendication 12, où la phase b) de veille profonde (204) inclut les étapes consistant à :

b4) si la température ambiante est augmentée jusqu'à la seconde température, maintenir la température ambiante à la seconde température pendant une durée prédéterminée ;
b5) augmenter ou réduire la température ambiante de manière répétée dans une plage de températures spécifique allant de la température paramétrée à la seconde température ; et
b6) si la durée de fonctionnement allouée à la phase de veille profonde (204) est plus longue qu'une durée spécifique permettant d'exécuter les étapes b4) - b5), exécuter de manière répétée au moins une des étapes b4) - b5).

20. Procédé selon la revendication 12, comprenant en outre les étapes consistant à :

opérer un compresseur (108) à une capacité minimale, opérer un ventilateur d'unité intérieure (110) à un nombre minimal de rotations, et régler une direction de décharge d'air frais sur une direction supérieure pour fournir indirectement un utilisateur en air frais ; et
augmenter au moins un des paramètres parmi une capacité de refroidissement du compresseur (108), un nombre de rotations du ventilateur d'unité intérieure (110), et la zone de décharge d'air frais si le mode de refroidissement

rapide est requis.

21. Procédé selon la revendication 12, comprenant en outre l'étape consistant à :

commander la température ambiante par unités de 0,5°C toutes les 30 minutes lors du mode veille.

22. Procédé selon la revendication 12, comprenant en outre l'étape consistant à :

commander la température ambiante par unités de 1°C toutes les heures lors du mode veille.

Fig.1

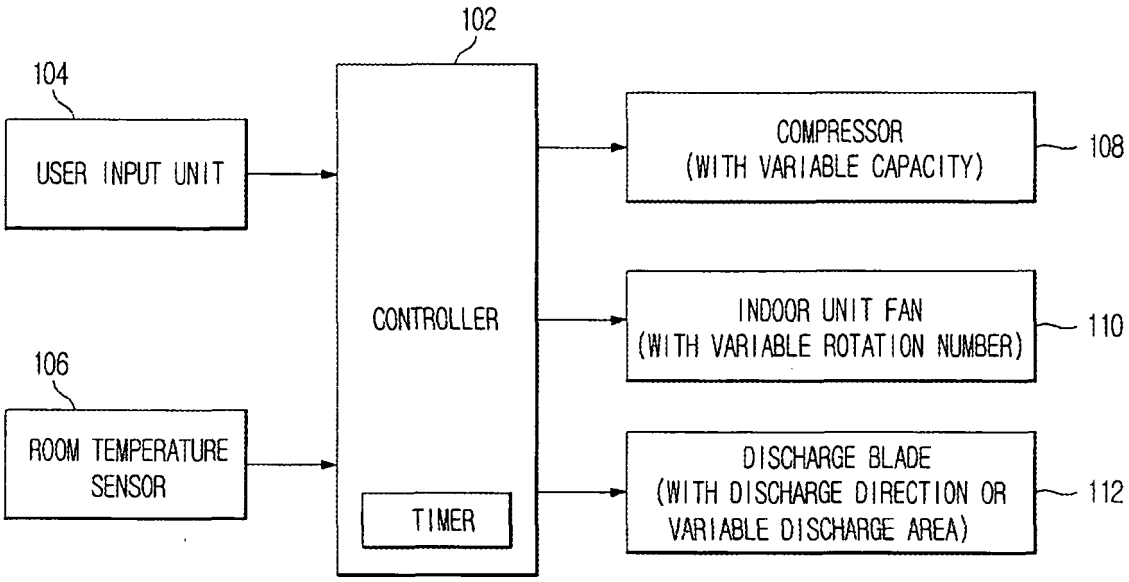

102
104
USER INPUT UNIT
106
ROOM TEMPERATURE SENSOR
CONTROLLER
TIMER
COMPRESSOR (WITH VARIABLE CAPACITY)
108
INDOOR UNIT FAN (WITH VARIABLE ROTATION NUMBER)
110
DISCHARGE BLADE (WITH DISCHARGE DIRECTION OR VARIABLE DISCHARGE AREA)
112

Fig.2

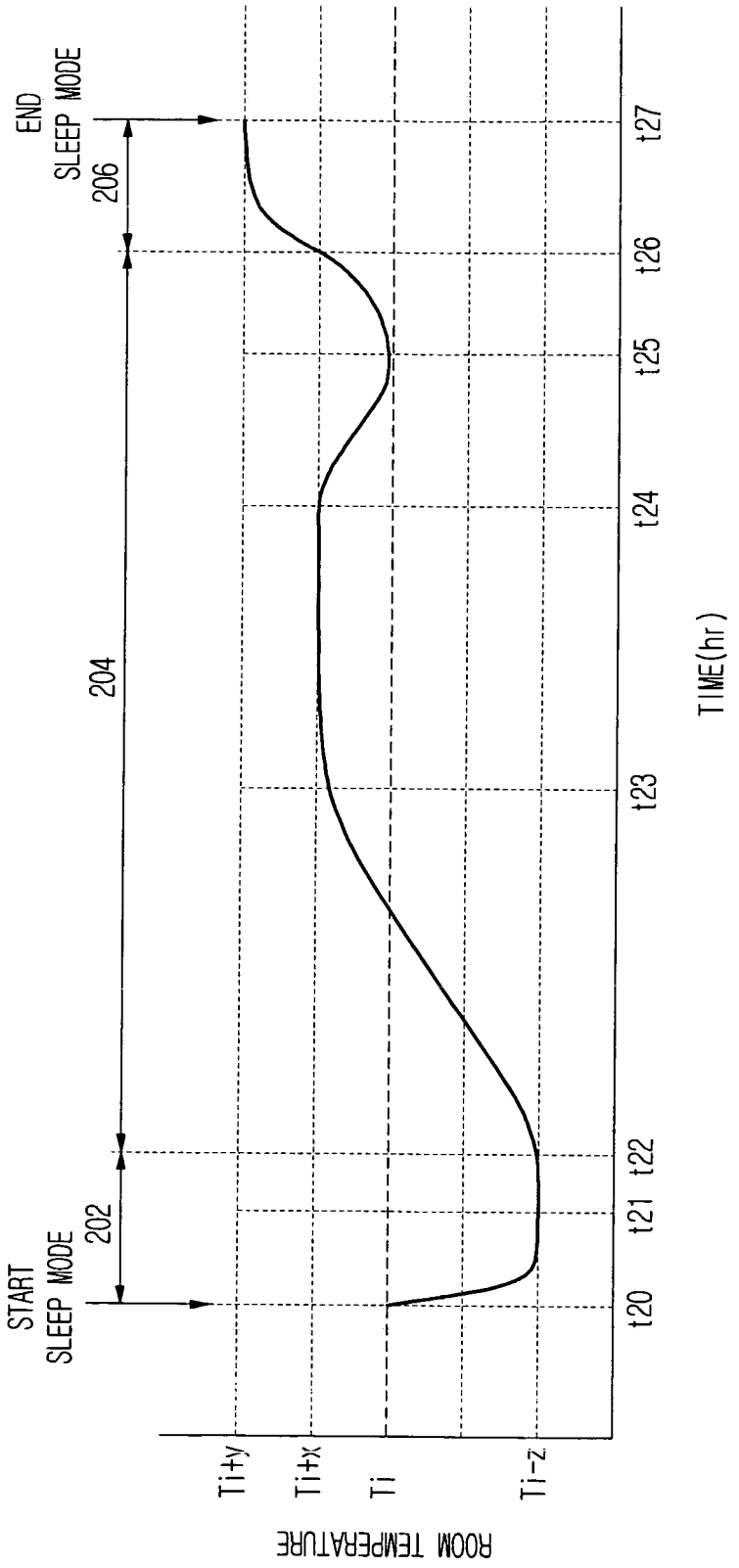

START
SLEEP MODE
202
204
END
SLEEP MODE
206
ROOM TEMPERATURE
Ti+y
Ti+x
Ti
Ti-z
t20
t21
t22
t23
t24
t25
t26
t27
TIME(hr)

Fig.3

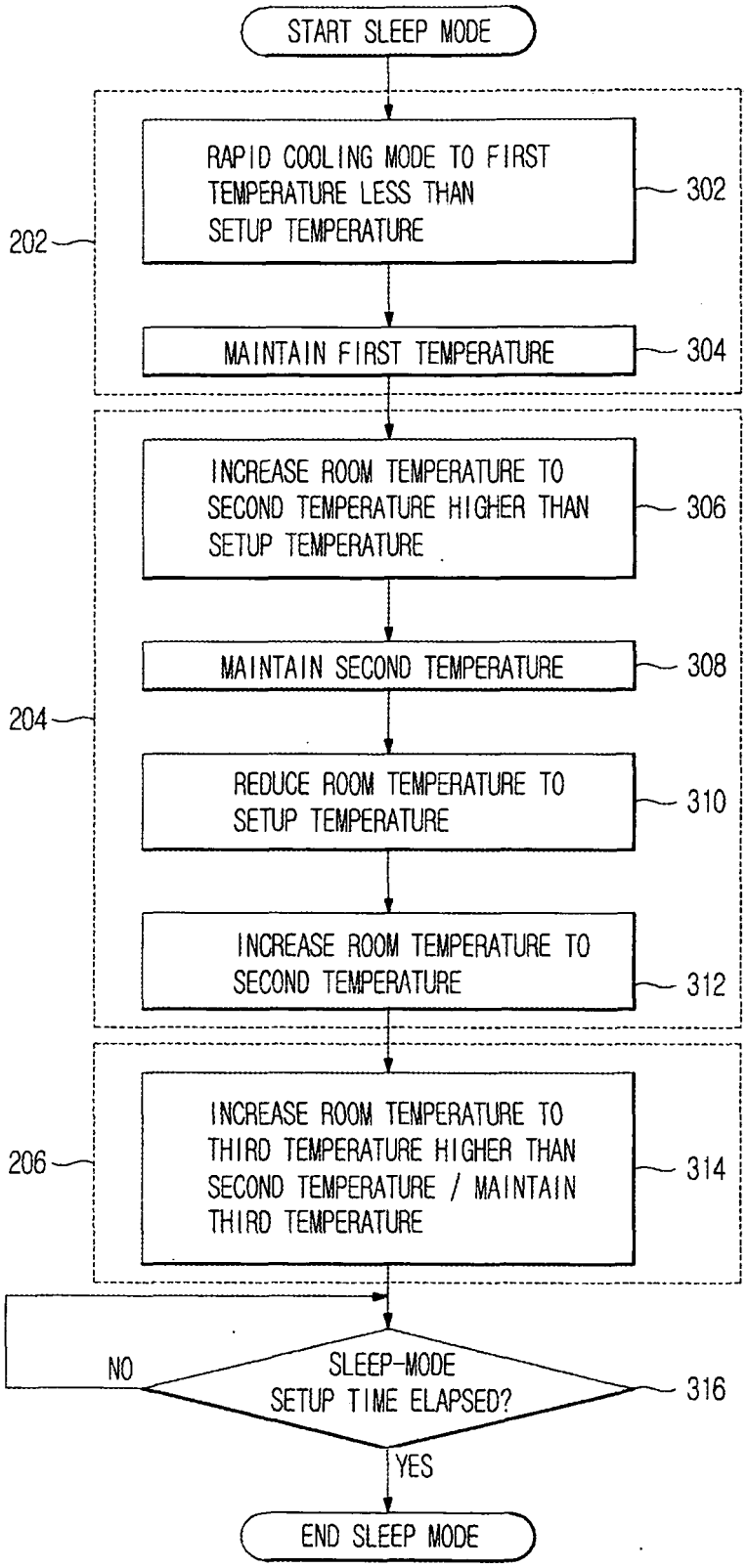

START SLEEP MODE
RAPID COOLING MODE TO FIRST TEMPERATURE LESS THAN SETUP TEMPERATURE
302
202
MAINTAIN FIRST TEMPERATURE
304
INCREASE ROOM TEMPERATURE TO SECOND TEMPERATURE HIGHER THAN SETUP TEMPERATURE
306
MAINTAIN SECOND TEMPERATURE
308
204
REDUCE ROOM TEMPERATURE TO SETUP TEMPERATURE
310
INCREASE ROOM TEMPERATURE TO SECOND TEMPERATURE
312
INCREASE ROOM TEMPERATURE TO THIRD TEMPERATURE HIGHER THAN SECOND TEMPERATURE / MAINTAIN THIRD TEMPERATURE
314
206
NO
SLEEP-MODE SETUP TIME ELAPSED?
316
YES
END SLEEP MODE

Fig.4

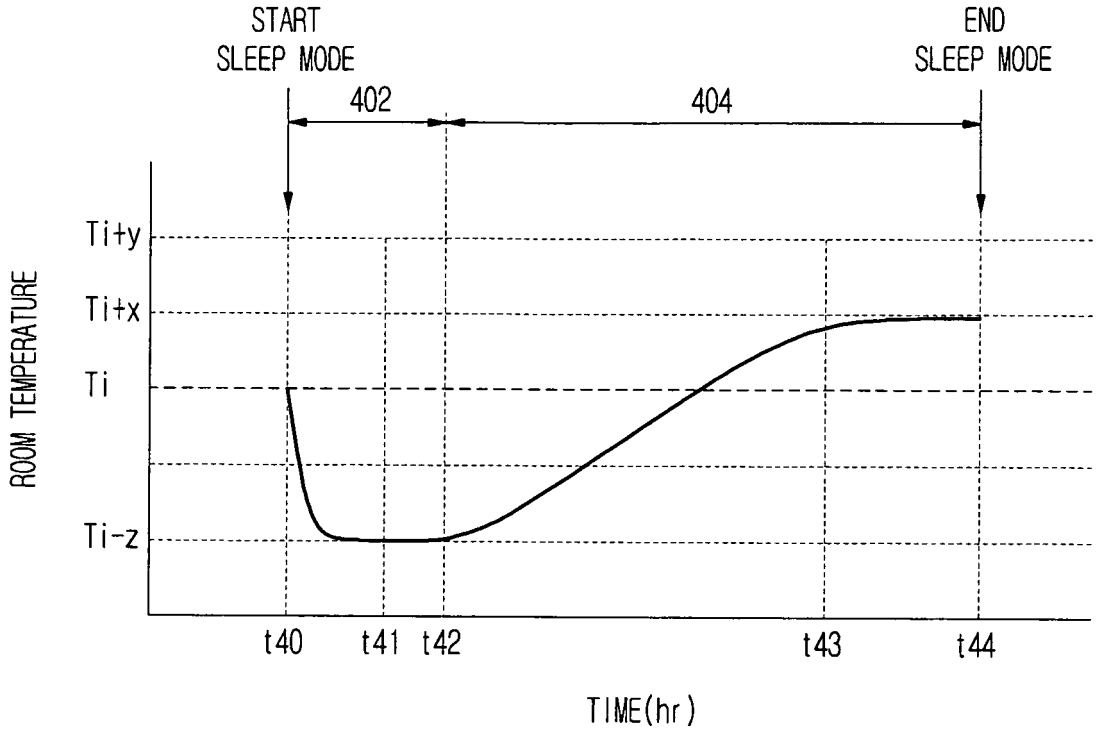

START
SLEEP MODE
END
SLEEP MODE
402
404
Ti+y
Ti+x
Ti
Ti-z
ROOM TEMPERATURE
t40
t41
t42
t43
t44
TIME(hr)

Fig.5

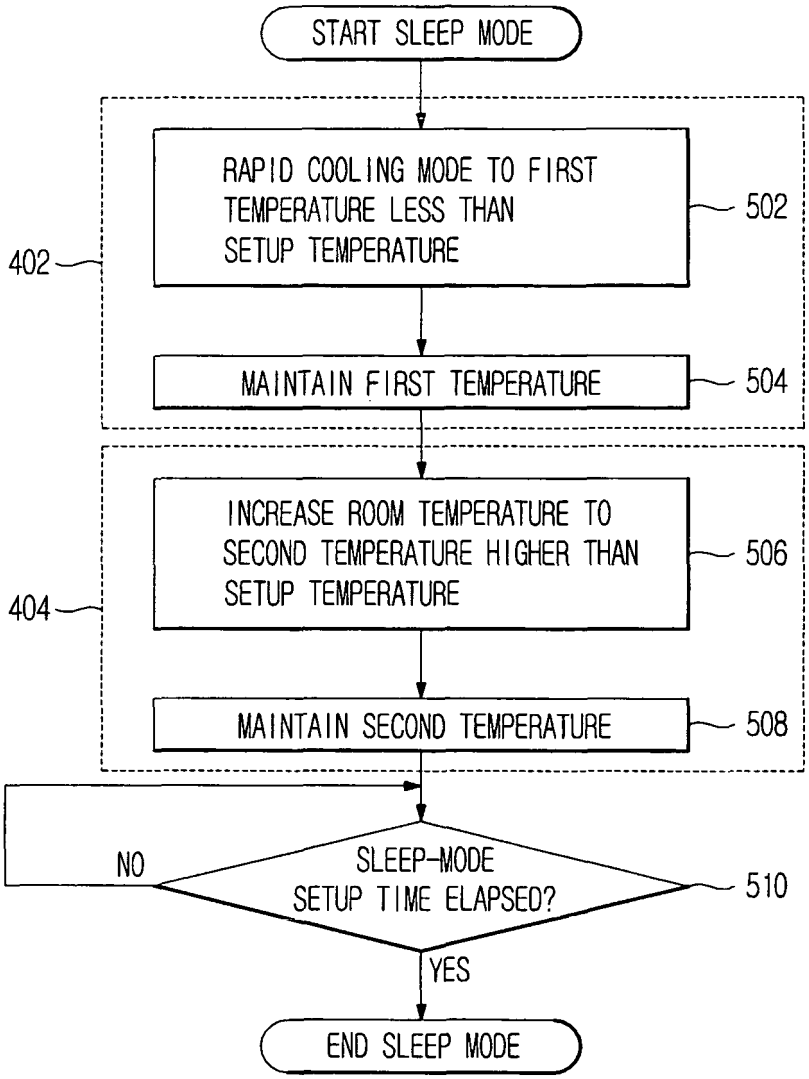

START SLEEP MODE
RAPID COOLING MODE TO FIRST TEMPERATURE LESS THAN SETUP TEMPERATURE
502
402
MAINTAIN FIRST TEMPERATURE
504
INCREASE ROOM TEMPERATURE TO SECOND TEMPERATURE HIGHER THAN SETUP TEMPERATURE
506
404
MAINTAIN SECOND TEMPERATURE
508
NO
SLEEP-MODE SETUP TIME ELAPSED?
510
YES
END SLEEP MODE

Fig.6

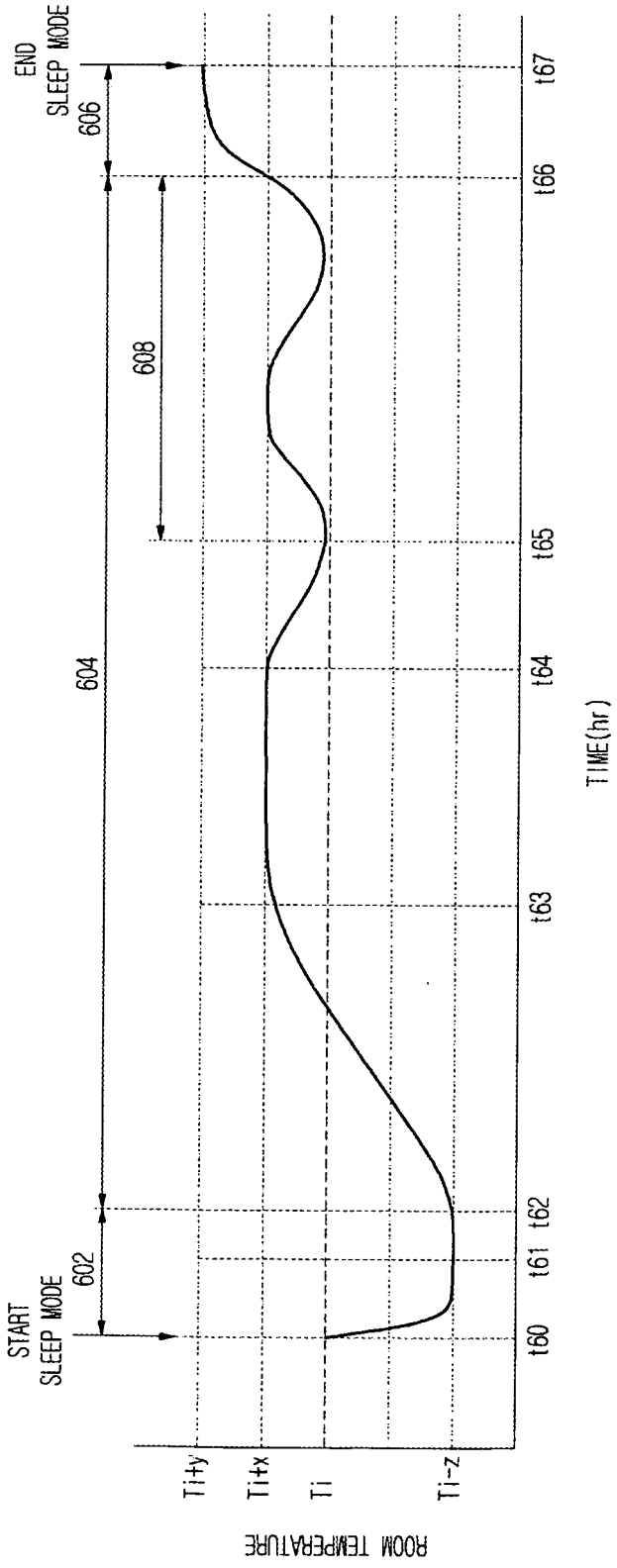

START SLEEP MODE
END SLEEP MODE
602
604
606
608
t60
t61
t62
t63
t64
t65
t66
t67
TIME(hr)
ROOM TEMPERATURE
Ti+y
Ti+x
Ti
Ti-z

Fig.7

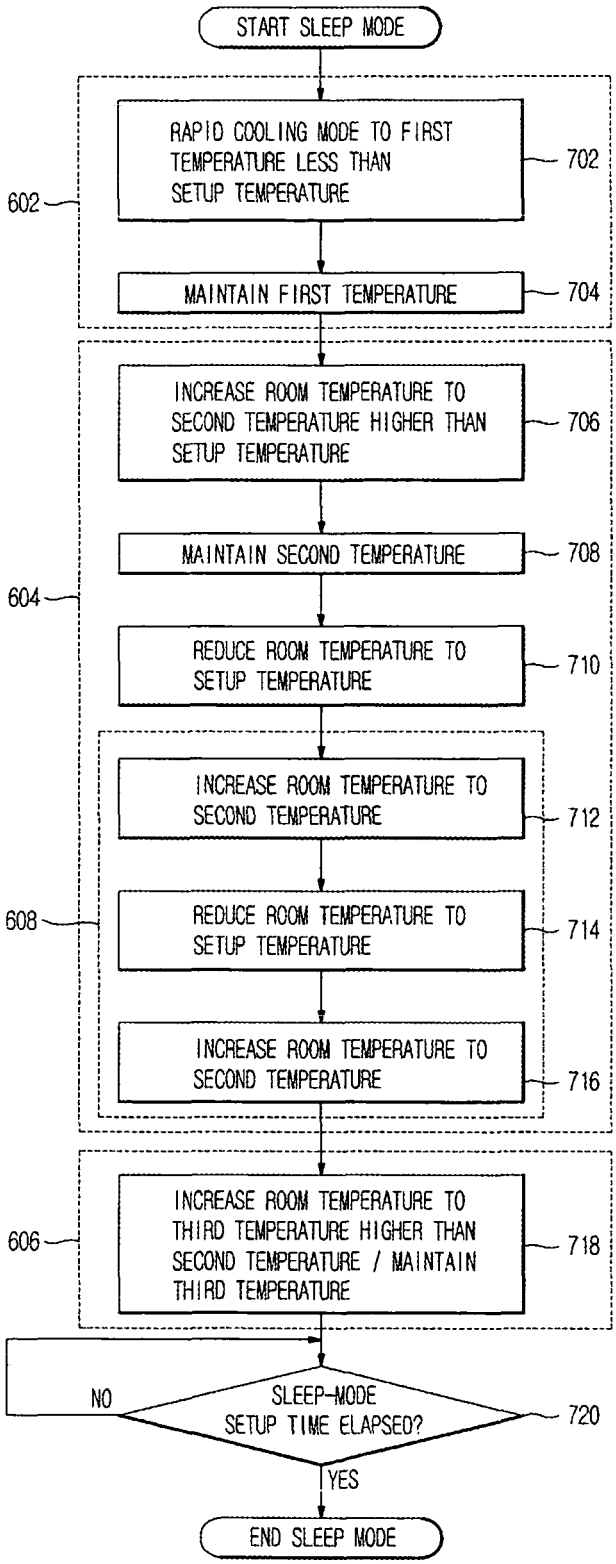

START SLEEP MODE
RAPID COOLING MODE TO FIRST TEMPERATURE LESS THAN SETUP TEMPERATURE
702
602
MAINTAIN FIRST TEMPERATURE
704
INCREASE ROOM TEMPERATURE TO SECOND TEMPERATURE HIGHER THAN SETUP TEMPERATURE
706
MAINTAIN SECOND TEMPERATURE
708
604
REDUCE ROOM TEMPERATURE TO SETUP TEMPERATURE
710
INCREASE ROOM TEMPERATURE TO SECOND TEMPERATURE
712
608
REDUCE ROOM TEMPERATURE TO SETUP TEMPERATURE
714
INCREASE ROOM TEMPERATURE TO SECOND TEMPERATURE
716
INCREASE ROOM TEMPERATURE TO THIRD TEMPERATURE HIGHER THAN SECOND TEMPERATURE / MAINTAIN THIRD TEMPERATURE
606
718
NO
SLEEP-MODE SETUP TIME ELAPSED?
720
YES
END SLEEP MODE

Fig.8

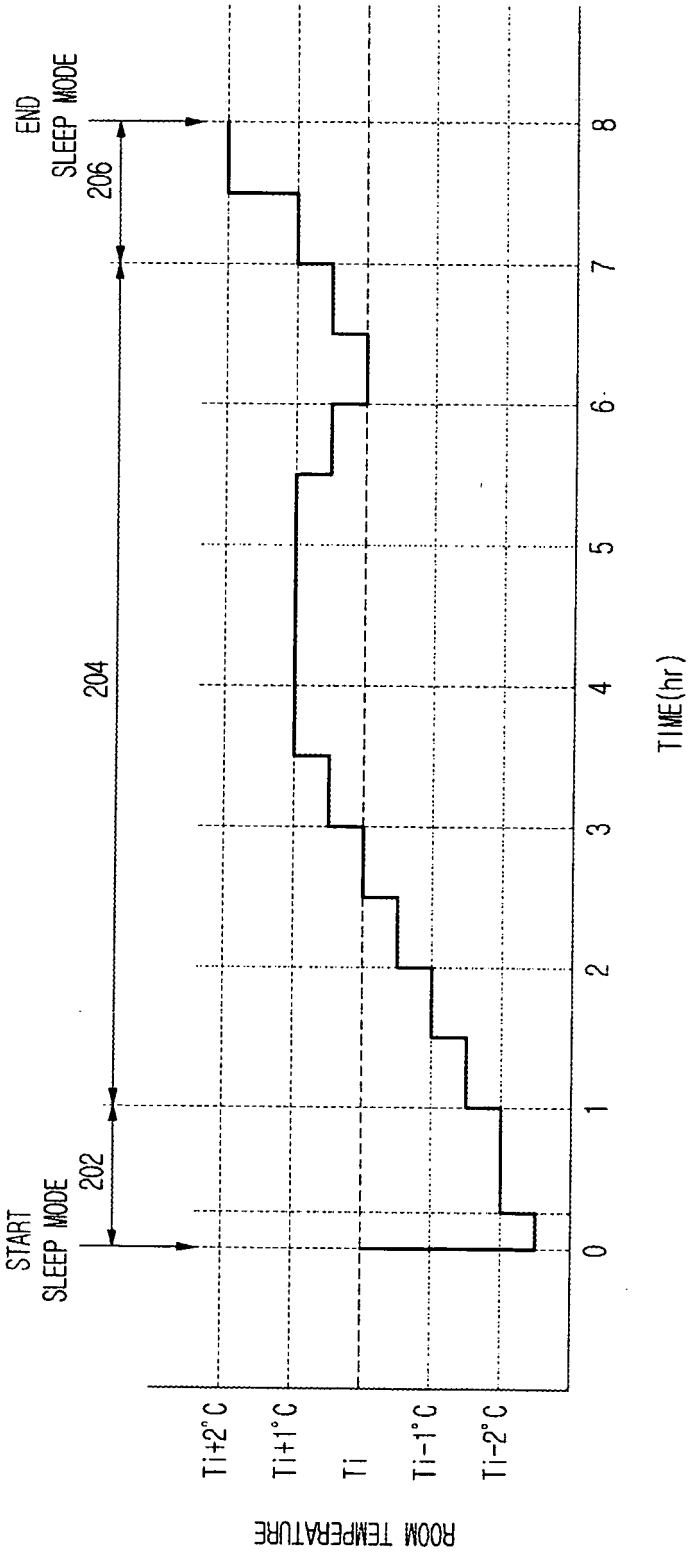
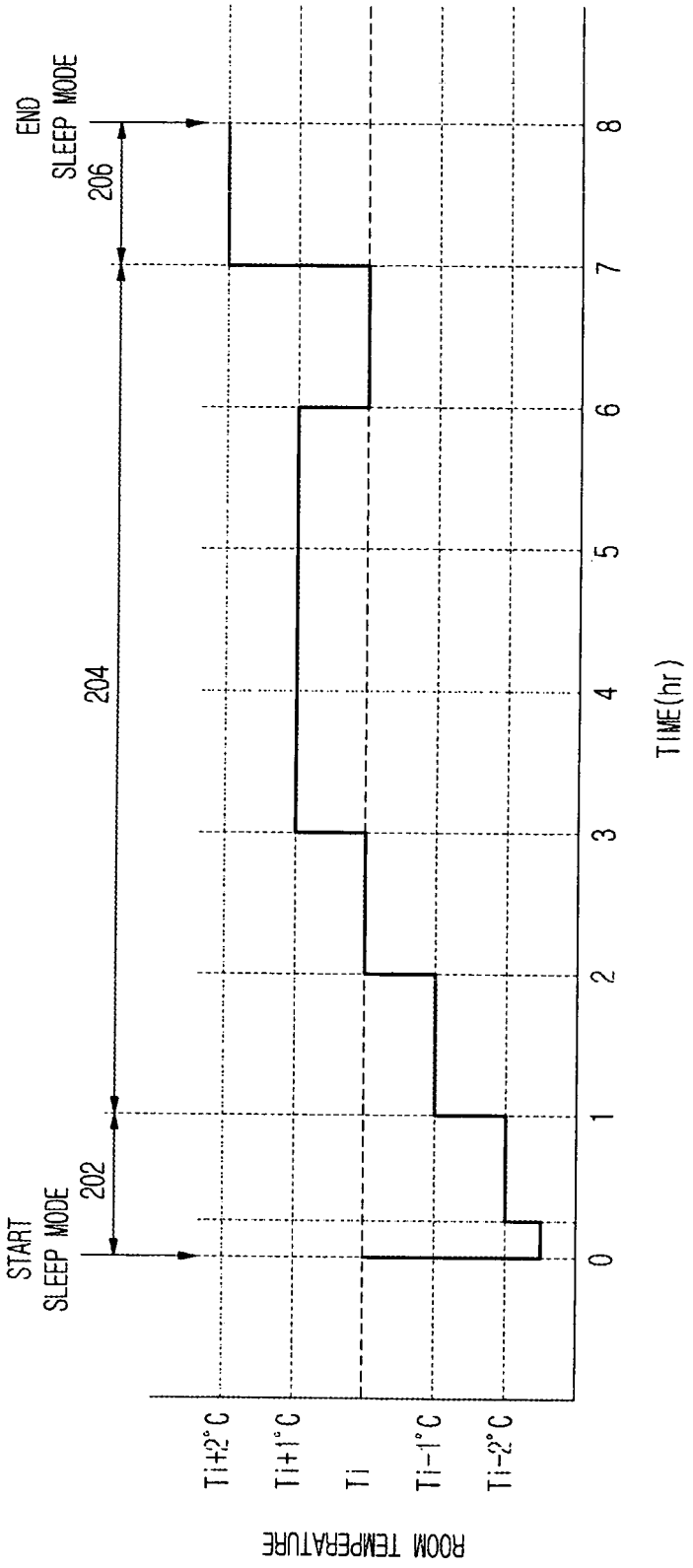

END
SLEEP MODE
206
204
202
START
SLEEP MODE
0
1
2
3
4
5
6
7
8
TIME(hr)
Ti+2°C
Ti+1°C
Ti
Ti-1°C
Ti-2°C
ROOM TEMPERATURE

Fig.9


END
SLEEP MODE
206
204
START
SLEEP MODE
202
Ti+2°C
Ti+1°C
Ti
Ti-1°C
Ti-2°C
ROOM TEMPERATURE
0
1
2
3
4
5
6
7
8
TIME(hr)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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