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• **LIU, Hongsheng**

Shanghai, 201206 (CN)

• **YU, Lei**

Shanghai, 201206 (CN)

• **SHI, Runfu**

Shanghai, 201206 (CN)

• **HUANG, Wei**

Shanghai, 201206 (CN)

• **KUANG, Yuhui**

Shanghai, 201206 (CN)

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(71) Applicant: **Carrier Corporation**

Palm Beach Gardens, FL 33418 (US)

(74) Representative: **Dehns**

10 Old Bailey

London EC4M 7NG (GB)

(72) Inventors:

• **WU, Tiejun**

Shanghai, 201206 (CN)

(54) **METHOD FOR CONTROLLING AIR CONDITIONING SYSTEM, AIR CONDITIONING SYSTEM, COMPUTER-READABLE STORAGE MEDIUM, MOBILE TERMINAL DEVICE AND SERVER**

(57) This invention aims to provides a method for controlling an air conditioning system (1,2), an air conditioning system (1,2), a computer-readable storage medium, a mobile terminal device (30) and a server (40) so as to at least solve or alleviate part of the problems in the prior art. In the first aspect, this invention provides a method for controlling an air conditioning system (1,2), the air conditioning system (1,2) including a plurality of indoor units arranged in different regions. The control method includes: a step for acquiring occupancy information, acquiring occupancy information of the region; a step for acquiring electric energy information, acquiring electric energy information containing an electric energy characteristic; and a step for generating an energy storage instruction, generating an energy storage instruction for a specific region on the basis of the occupancy information when the electric energy information satisfies a predetermined energy storage condition.

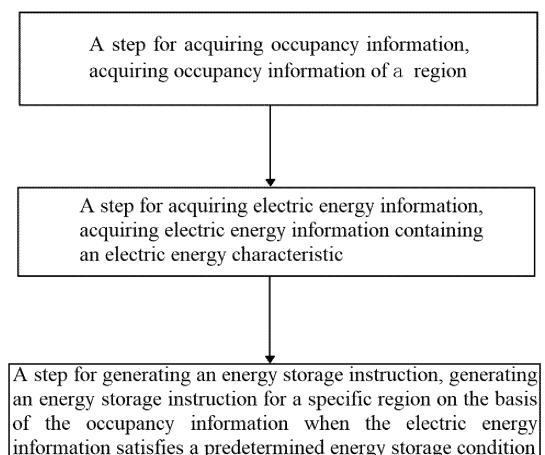


FIG. 1

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Description

Technical Field

[0001] This invention relates to the field of air conditioning, and particularly relates to a method for controlling an air conditioning system, an air conditioning system, a computer-readable storage medium, a mobile terminal device and a server.

Background Art

[0002] For electric energy consumed by a building, an air conditioning system operating therein consumes most of the electric energy. A common method for controlling the air conditioning system aims to reduce the consumed electric energy, and therefore a control method for stabilizing the set temperature of the air conditioning system within a specific range during working hours and turning off the air conditioning system during non-working hours is used. However, reducing the consumed electric energy may not be equivalent to reasonably utilizing the electric energy, and when the common method for controlling the air conditioning system is used, people in the building may feel less comfortable.

Summary of the Invention

[0003] This invention aims to provides a method for controlling an air conditioning system, an air conditioning system, a computer-readable storage medium, a mobile terminal device and a server so as to at least solve or alleviate part of the problems in the prior art.

[0004] According to a first aspect of the invention there is provided a method for controlling an air conditioning system, the air conditioning system including a plurality of indoor units arranged in different regions, where the control method includes: a step for acquiring occupancy information, acquiring occupancy information of the region; a step for acquiring electric energy information, acquiring electric energy information containing an electric energy characteristic; and a step for generating an energy storage instruction, generating an energy storage instruction for a specific region on the basis of the occupancy information when the electric energy information satisfies a predetermined energy storage condition.

[0005] Optionally, the electric energy characteristic refers to any one of a carbon emission index of a power grid, the cleanliness of a power grid, the percentage of clean electric energy, and the percentage of renewable energy sources.

[0006] Optionally, the electric energy characteristic varies over time.

[0007] Optionally, the control method further includes a step for executing the energy storage instruction, making an indoor unit arranged in the specific region execute the energy storage instruction.

[0008] Optionally, the indoor unit includes a tempera-

ture controller, and making an indoor unit arranged in the specific region execute the energy storage instruction specifically includes: adjusting the set temperature of a temperature controller in the specific region.

[0009] Optionally, the indoor unit further includes a fan coil or an air valve, and making an indoor unit arranged in the specific region execute the energy storage instruction specifically includes: making the air speed of a fan coil in the specific region change, or making the opening degree of an air valve in the specific region change, or performing any of the above actions in response to an input from the temperature controller in the specific region.

[0010] Optionally, the electric energy information is historical electric energy information containing a historical electric energy characteristic, and in the step for generating an energy storage instruction, the predetermined energy storage condition is determined on the basis of the result of a comparison of the historical electric energy characteristic with a threshold value.

[0011] Optionally, the electric energy information includes real-time electric energy information containing a real-time electric energy characteristic and historical electric energy information containing a historical electric energy characteristic, and the control method further includes: a step for generating an electric energy prediction point, generating an electric energy prediction point on the basis of the historical electric energy information; in the step for generating an energy storage instruction, the predetermined energy storage condition is determined on the basis of the result of a comparison of the electric energy prediction point with the real-time electric energy information.

[0012] Optionally, the occupancy information is determined on the basis of any one of information about the number of people in the region, pre-stored information about usage of the region, and information about a timetable of the set temperature of the temperature controller.

[0013] Optionally, the control method further includes: a step for generating an energy release instruction, generating an energy release instruction when a predetermined energy release condition is satisfied.

[0014] Optionally, the predetermined energy release condition includes at least any one of that the temperature of the specific region reaches a specified value, the occupancy information of the specific region changes in response to an input, and the execution time of the energy storage instruction reaches a specified value.

[0015] According to a second aspect of the invention there is provided an air conditioning system, including: a plurality of indoor units arranged in different regions, the indoor unit including an air supply port and an air exhaust port; an air supply duct, communicated with the plurality of air supply ports arranged in the different regions; and an air exhaust duct, communicated with the plurality of air exhaust ports arranged in different regions, the air exhaust duct being communicated with the air supply duct; the air conditioning system executes the method for controlling an air conditioning system in any of the above

optional technical solutions.

[0016] According to a third aspect of the invention there is provided a computer-readable storage medium, storing a control program, the control program implementing the method for controlling an air conditioning system in any of the above optional technical solutions when executed by a processor.

[0017] According to a fourth aspect of the invention there is provided a mobile terminal device, including: a processor and a memory, a processor-readable instruction being stored in the memory, and the processor executing the method for controlling an air conditioning system in any of the above optional technical solutions by running the processor-readable instruction.

[0018] According to a fifth aspect of the invention there is provided a server, including: a processor and a memory, a processor-readable instruction being stored in the memory, and the processor executing the method for controlling an air conditioning system in any of the above optional technical solutions by running the processor-readable instruction.

[0019] By means of the method for controlling an air conditioning system, the air conditioning system, the computer-readable storage medium, the mobile terminal device and the server according to this invention, the air conditioner system can more reasonably utilize electric energy.

Descriptions of the Drawings

[0020] Certain exemplary embodiments will now be described in greater detail by way of example only and with reference to the accompanying drawings in which:

- FIG. 1 is a schematic diagram of a method for controlling an air conditioning system;
- FIG. 2 is a schematic diagram of a method for controlling an air conditioning system;
- FIG. 3 is a schematic diagram of a step for generating an electric energy prediction point;
- FIG. 4 is a schematic diagram of an air conditioning system;
- FIG. 5 is a schematic diagram of an air conditioning system;
- FIG. 6 is a schematic diagram of a mobile terminal device; and
- FIG. 7 is a schematic diagram of a server.

List of Reference Numerals:

<Air Conditioning System with Fan Coil Unit>

[0021] Air conditioning system 1, temperature controller 1011, fan coil 1012, fan 10121, hot coil 10122, cold coil 10123, air supply port 1013, air exhaust port 1014, air supply duct 102, fresh air coil 103, fresh air hot coil 1031, fresh air cold coil 1032, air exhaust duct 104, heat recycling heat exchanger 105, and fresh air fan 106.

<Variable-Air Volume Air Conditioning System>

[0022] Air conditioning system 2, temperature controller 2011, air valve 2012, reheating coil 2015, air supply port 2013, air exhaust port 2014, air supply duct 202, central air conditioning coil 203, central air conditioning hot coil 2031, central air conditioning cold coil 2032, air exhaust duct 204, air return duct 205, and air supply fan 206.

<Mobile Terminal Device>

[0023] Mobile terminal device 30, processor 31, and memory 32.

<Server>

[0024] Server 40, processor 41, and memory 42.

Detailed Description

[0025] It is to be noted that: the working principles, features, advantages and the like of a method for controlling an air conditioning system, an air conditioning system, a computer-readable storage medium, a mobile terminal device and a server according to this invention are illustrated below exemplarily. However, it is to be understood that all the description is given only for illustration, and thus cannot be understood as forming any limitation on this invention.

[0026] In addition, for any single technical feature described or implied in the embodiments mentioned herein, or any single technical feature shown or implied in the drawings, this invention still permits any combination or deletion of these technical features (or equivalents thereof) to continue without any technical obstacles, so as to obtain more other embodiments of this invention which may not be directly mentioned herein.

<Overview>

[0027] With reference to the drawings generally, a method for controlling an air conditioning system, an air conditioning system, a server, and a mobile terminal device are shown according to exemplary embodiments. On the basis of electric energy information containing an electric energy characteristic, an energy storage instruction for a specific region may be generated to make the air conditioning system utilize electric energy more rationally and take into account the level of comfort of people in the region.

<Control Method>

[0028] An air conditioning system according to an embodiment of this invention includes a plurality of indoor units arranged in different regions. With reference to FIG. 1, a method for controlling an air conditioning system

according to an embodiment of this invention includes: a step for acquiring occupancy information, acquiring occupancy information of the region; a step for acquiring electric energy information, acquiring electric energy information containing an electric energy characteristic; and a step for generating an energy storage instruction, generating an energy storage instruction for a specific region on the basis of the occupancy information when the electric energy information satisfies a predetermined energy storage condition.

[0029] Specifically, in the step for acquiring occupancy information, acquiring occupancy information of the region, the region mentioned herein refers to a space which is relatively independent in a building where the air conditioning system is used or a similar structure and thus can be subjected to temperature adjustment, such as, a warehouse of a certain company, a conference room, an independent office, etc. in the building. The occupancy information refers to related information about whether the region is occupied or not so as to determine whether to adjust temperature in a large range. For example, if there are usually no staff working in the warehouse, it is considered that the warehouse is not occupied and the temperature can be adjusted to below 16°C for a long period of time. If, because of space transformation, the region becomes an independent office where there are staff working for a long period of time, it is considered that the region is occupied, so the temperature in the region cannot be adjusted in a large range. The range of temperature adjustment is determined according to actual needs and is not specifically limited. The occupancy information is determined on the basis of any one of information about the number of people in the region, pre-stored information about usage of the region, and information about a timetable of the set temperature of the temperature controller.

[0030] By acquiring the occupancy information of the region, the air conditioning system can more easily know the arrangement of the different regions or information about persons in the different regions, so that information such as the level of sensitivity of the different regions to temperature fluctuations can be mastered. For example, if it is determined according to the occupancy information that a certain region is an office region or a rest region occupied by persons, it can be inferred that the region is high sensitive to temperature fluctuations, which means that if the temperature in the region is suddenly lowered or raised, persons in the region will feel a decrease in their level of comfort. For example, if it is determined according to the occupancy information that a certain region is an unoccupied region temporarily or for a long period of time, it can be inferred that the region is less sensitive to temperature fluctuations. For another example, if it is determined according to the occupancy information that a certain region is a control region or a storage region occupied by special machinery equipment, it can be inferred that the region is high sensitive to temperature fluctuations, i.e., if the temperature in the region is sud-

denly lowered or raised, the operational stability of the special machinery equipment in the region is reduced as a result. The occupancy information is determined on the basis of any one of the information about the number of people in the region, the pre-stored information about usage of the region, and the information about a timetable of the set temperature of the temperature controller. For example, the method for acquiring the occupancy information of the region may be any one of the methods for acquiring the occupancy information by means of user instructions, sensor detection, a region occupancy timetable, and the like.

[0031] Further, in the step for acquiring electric energy information, acquiring electric energy information containing an electric energy characteristic, the electric energy characteristic herein refers to related information that reflects the source of electric energy, information about a power grid, the type of electric energy, and the like.

[0032] In some embodiments, the electric energy characteristic refers to a carbon emission index of a power grid. The carbon emission index of a power grid may specifically be a value between 1 and 100. The smaller the value, the smaller the intensity of carbon emissions of a power grid, the less carbon emissions generated by electricity supplied by a power grid, and the higher the cleanliness of the electric energy. The larger the value, the larger the intensity of carbon emissions of a power grid, the more carbon emissions generated by electricity supplied by a power grid, and the lower the cleanliness of the electric energy. The carbon emission index of a power grid varies in different geographic locations, and the carbon emission index of a power grid in a certain geographic location can be acquired by means of information such as the postal code. The carbon emission index of a power grid varies at different times for the same geographical location, in other words, the carbon emission index of a power grid is a value updated in real time. The carbon emission index of a power grid can be calculated by means of a computational model, and data input in the computational model can include data such as carbon emissions of individual power plants, operation of a power grid, weather, renewable energy sources, and the like.

[0033] For example, in a geographic location A, renewable energy sources such as wind energy and solar energy are abundant, the average carbon emission index of a power grid within one month is typically below 50. Therefore, according to information about the geographic location A, the predetermined energy storage condition can be that "the carbon emission index of a power grid is less than or equal to 45", and when the acquired electric energy information conforms to this condition, then it is recommended to increase the amount of usage of electric energy, i.e., the predetermined energy storage condition is satisfied. The predetermined energy storage condition may be determined according to the power grid where the air conditioning system is

located and the actual conditions of the building where the air conditioning system is installed.

[0034] In some embodiments, the electric energy characteristic refers to the price of electric energy available in the building, or the electric energy characteristic refers to the percentage of renewable electric energy used in the building, or the electric energy characteristic refers to any one of the cleanliness of a power grid, the percentage of clean electric energy, and the percentage of renewable energy sources.

[0035] In some embodiments, the electric energy characteristic refers to greenhouse gas emissions per unit of the electric energy, i.e., the purpose of acquiring the electric energy information is to reduce greenhouse gas emissions generated when the air conditioning system uses electricity. In order to achieve the above purpose, then it is desired that the electric energy used by the air conditioning system is more obtained by generating electricity in the form of wind power generation, hydro power generation, solar power generation, etc., and less obtained by generating electricity in the form of thermal power generation. However, the electricity generated in the form of wind power generation, hydro power generation, solar power generation, etc. is less uniform than the electricity generated in the form of thermal power generation, and generating electricity in the form of wind power generation, hydro power generation, solar power generation, etc. is more dependent on the weather. Therefore, when the electricity generated in the form of wind power generation, hydro power generation, solar power generation, etc. is sufficient, the electric energy is more utilized, for example, it is converted into cold energy/heat energy in the air conditioning system and stored, so that when the electricity generated in the form of wind power generation, hydro power generation, solar power generation, etc. is less, it is possible to reduce the electric energy consumed by the air conditioning system by means of the thermal inertia of the stored cold energy/heat energy. In this way, the total amount of electric energy consumed by the air conditioning system may not decrease or may increase to some extent, but the greenhouse gas emissions generated when the air conditioning system uses electricity may decrease.

[0036] By acquiring the electric energy information containing the electric energy characteristic, the air conditioning system can more easily rationalize the time and amount of usage of the electric energy for various purposes. For example, if the purpose is to reduce the cost of electricity used by the air conditioning system, it is required to acquire the electric energy information containing the price of available electric energy. If the purpose is to reduce the amount of carbon emissions of the air conditioning system, it is required to acquire the electric energy information containing any one of the carbon emission index of a power grid, the cleanliness of a power grid, the percentage of clean electric energy, and the percentage of renewable energy sources. In some embodiments, the electric energy characteristic varies over

time, and the electric energy information contains the electric energy characteristic at each point in time.

[0037] Further, in the step for generating an energy storage instruction, when the electric energy information satisfies the predetermined energy storage condition, on the basis of the occupancy information, an energy storage instruction for a specific region is generated. When the electric energy information satisfies the predetermined energy storage condition, i.e., after the electric energy information containing the electric energy characteristic is judged, it is considered that the electric energy information conforms to the condition for recommended electricity usage defined in accordance with the purpose of electricity usage (e.g., the purpose of reducing the cost of used electricity or the purpose of reducing the amount of carbon emissions), that is, it is recommended to increase the amount of usage of electric energy, i.e., it is recommended to store energy by increasing the usage of electric energy. For example, if the purpose is to reduce the cost of electricity used by the air conditioning system, it may be required to acquire electric energy information containing the price of available electric energy, and the predetermined energy storage condition herein may be that "the price of available electric energy is less than or equal to a preset value"; when the acquired electric energy information conforms to the condition, it is recommended to increase the amount of usage of the electric energy, i.e., it is recommended to store energy by increasing the usage of electric energy. For example, if the purpose is to reduce the amount of carbon emissions of the air conditioning system, it may be required to acquire the electric energy information containing the carbon emission index of a power grid, and the predetermined energy storage condition herein may be that "the carbon emission index of a power grid is less than or equal to a preset value or a threshold value"; when the acquired electric energy information conforms to the condition, it is recommended to increase the amount of usage of electric energy, i.e., it is recommended to store energy by increasing the usage of the electric energy.

[0038] In some embodiments, the electric energy information is historical electric energy information containing a historical electric energy characteristic. For example, the electric energy information is information about a historical carbon emission index of a power grid, for example, in the past month, the carbon emission index of a power grid is about 60 at about 8 o'clock, and about 40 at about 7 o'clock, then if the threshold value is set to 45, the predetermined energy storage condition is that "the carbon emission index of a power grid is less than or equal to a preset value or the threshold value"; the predetermined energy storage condition is satisfied, and the energy storage instruction for the specific region is generated.

[0039] The predetermined energy storage condition may be further determined according to factors such as the electric energy characteristic, the power grid where the air conditioning system is located and the

actual conditions of the building where the air conditioning system is installed.

[0040] By generating, on the basis of the occupancy information, the energy storage instruction for the specific region, when the amount of usage of the electric energy increases and the amount of conversion of the electric energy to other forms of energy (e.g., cold energy/heat energy) increases, the increased energy may be stored in an appropriate mode, for example, the increased energy is stored in a region that is less sensitive to temperature fluctuations, and is utilized at an appropriate time.

<Step for Executing the Energy Storage Instruction>

[0041] In some embodiments, the control method includes a step for executing the energy storage instruction, making the indoor unit in the specific region execute the energy storage instruction. Specifically, the indoor unit includes a temperature controller, making the set temperature of the temperature controller in the specific region change. The specific region refers to a region that is less sensitive to temperature fluctuations, which may be, for example, a vacant room in a building. By lowering the set temperature of the temperature controller of the vacant room during cooling operation of the air conditioning system, more cold energy can be obtained in the vacant room, and the cold energy is stored in the vacant room, for example, it is stored in a space, a wall, or furniture of the vacant room for the purpose of storing the cold energy. By raising the set temperature of the temperature controller of the vacant room during heating operation of the air conditioning system, more heat energy can be obtained in the vacant room, and the heat energy is stored in the vacant room, for example, it is stored in a space, a wall, or furniture of the vacant room for the purpose of storing the heat energy.

[0042] In some embodiments, the set temperature of the temperature controller may be adjusted higher or lower in a specific range each time the energy storage instruction is executed. In some embodiments, each time the energy storage instruction is executed, a range for adjusting the temperature higher or lower adapted to the electric energy information may be generated for the temperature controller according to real-time electric energy information and/or historical electric energy information.

[0043] There is no limitation here on the type of the air conditioning system, which may be a fluorine system air conditioner or a water system air conditioner, a multi-connected system, an air-cooled chiller unit or a water-cooled chiller unit, and it is only required to increase the cold energy/heat energy in the vacant room by adjusting the set temperature of the temperature controller in the vacant room.

<Electric Energy Prediction Point>

[0044] It is to be noted that: the electric energy information may also include real-time electric energy information containing a real-time electric energy characteristic and historical electric energy information containing a historical electric energy characteristic, so that the predetermined energy storage condition can be more accurately determined on the basis of the real-time electric energy characteristic. For example, the predetermined energy storage condition may be that "a real-time carbon emission index of a power grid is at a low point compared with the carbon emission index of a power grid one hour later as indicated by a curve of the historical carbon emission index of a power grid", and the predetermined energy storage condition may also be that "a difference value between a real-time carbon emission index of a power grid and the carbon emission index curve of a power grid one hour later as indicated by a curve of the historical carbon emission index of a power grid is greater than a threshold value".

[0045] In some embodiment, the electric energy information includes real-time electric energy information containing a real-time electric energy characteristic and historical electric energy information containing a historical electric energy characteristic, and the method for controlling an air conditioning system further includes: a step for generating an electric energy prediction point, generating an electric energy prediction point on the basis of the historical electric energy information. In the step for generating an energy storage instruction, the predetermined energy storage condition is determined on the basis of the result of a comparison of the electric energy prediction point with the real-time electric energy information.

[0046] By generating the electric energy prediction point on the basis of the historical electric energy information, it is possible to predict electric energy information after a preset duration of time in the future, and accordingly determine whether it is suitable for generating an energy storage instruction at the current moment. For example, if the purpose is to reduce the amount of carbon emissions of the air conditioning system, when it is predicted that the carbon emission index of a power grid after a preset duration of time will increase/significantly increase, i.e., when it is predicted that the cleanliness of the electric energy after a preset duration of the time will decrease, it is possible to generate the energy storage instruction so as to store energy at the current moment when the cleanliness of the electric energy is high, and decrease the consumed electric energy by releasing energy in the future when the cleanliness of the electric energy decreases, thereby achieving the purpose of reducing the amount of carbon emissions of the air conditioning system. By predicting electric energy information for a preset duration of time in the future, it is possible to make the moment/timing for generating the energy storage instruction more appropriate, thereby contribut-

ing to reducing carbon emissions of the air conditioning system and taking into account the level of comfort when the air conditioning system is used.

[0047] In some embodiments, as shown in FIG. 3, the curve depicted by the dashed line in FIG. 3 is a prediction curve formed by fitting the historical carbon emission index of a power grid, and the solid dot represents the real-time carbon emission index of a power grid. The real-time carbon emission index of a power grid at 1 o'clock is a. According to the prediction curve, the carbon emission index of a power grid after 1 hour, i.e., an electric energy prediction point a', can be predicted. When a' is greater than a, and a difference value between a' and a is greater than a set value, it means that the cleanliness of the electric energy at 1 o'clock is higher, and the cleanliness of the electric energy at 2 o'clock is significantly lowered, so it is judged that it is suitable for generating the energy storage instruction at the current moment (1 o'clock), and the specific content of the energy storage instruction can be making the set temperature of the temperature controller drop by 3°C during cooling operation. The real-time carbon emission index of a power grid at 2 o'clock is b. In the same way as the judgment described above, it can be judged that it is also suitable for generating the energy storage instruction at the current moment (2 o'clock). The real-time carbon emission index of a power grid at 3 o'clock is c. In the same way as the judgment described above, it can be judged that it is not suitable for generating the energy storage instruction at the current moment (3 o'clock), and the energy release instruction may be generated at this moment. The real-time carbon emission index of a power grid at 5 o'clock is d. According to the prediction curve, the carbon emission index of a power grid after 1 hour, i.e., an electric energy prediction point d', may be predicted, and the carbon emission index of a power grid after 2 hours, i.e., an electric energy prediction point d'', may be predicted; by comparing d, d' and d'', it indicates that the cleanliness of electric energy at 5 o'clock is higher, the cleanliness of electric energy will continue to decrease thereafter, and therefore it is judged that it is suitable for generating the energy storage instruction at the current moment (5 o'clock), and the specific content of the energy storage instruction may be making the set temperature of the temperature controller drop by 5°C during cooling operation.

[0048] In some embodiments, the carbon emission index of a power grid for a future period of time (e.g., 8 hours) can be predicted, for example, the tendency is predicted by generating a plurality of electric energy prediction points, so that whether it is needed to generate the energy storage instruction can be determined by comparing the real-time carbon emission index of a power grid and the future carbon emission index of a power grid.

<Step for Generating an Energy Release Instruction>

[0049] In some embodiment, the control method

further includes: a step for generating an energy release instruction, generating an energy release instruction when a predetermined energy release condition is satisfied. The predetermined energy release condition includes at least any one of that the temperature of the specific region reaches a specified value, the occupancy information of the specific region changes in response to an input, and the execution time of the energy storage instruction reaches a specified value. By generating the energy release instruction, it is possible to release the cold energy/heat energy stored in the air conditioning system when needed or appropriate, or to better release the cold energy/heat energy stored in the air conditioning system, thereby improving the efficiency for utilizing the stored cold energy/heat energy.

<Air Conditioning System with Fan Coil Unit>

[0050] In some embodiments, an air conditioning system 1 is as shown in FIG. 4, and the air conditioning system 1 includes: an air supply duct 102 communicated with external fresh air, fresh air units (103, 106), indoor units (1011, 1012, 1013, 1014) corresponding to different regions, an air exhaust duct 104, and a heat recycling heat exchanger 105 for recycling energy of exhaust air/fresh air. The fresh air units (103, 106) include a fresh air hot coil 1031, a fresh air cold coil 1032, and a fresh air fan 106 located in the air supply duct 102. The indoor units (1011, 1012, 1013, 1014) include a temperature controller 1011, a fan coil 1012, an air supply port 1013 communicated with the air supply duct 102, and an air exhaust port 1014 communicated with the air exhaust duct 104. The fan coil 1012 includes a fan 10121, a hot coil 10122, and a cold coil 10123. The external fresh air enters the air supply duct 102 by means of the heat recycling heat exchanger 105, and after passing through the fresh air coil 103, the external fresh air is fed to individual different regions by means of the air supply port 1013; air in the region enters the air exhaust duct 104 by means of the air exhaust port 1014, and the air entering the air exhaust duct 104, after pre-treating the fresh air by means of the heat recycling heat exchanger 105, is discharged to the outdoor space. The fan coil 1012 is correspondingly arranged in each region, and by making the air in the region pass through the fan coil 1012 and then be blown out, the cold energy or heat energy of the air which is blown out can be increased so as to adjust the temperature in the region.

[0051] The air conditioning system 1 can operate for cooling and heating. The air conditioning system 1 during cooling operation is illustrated below as an example, and it is to be understood that similar control methods and control logic can also be applied to heating operation.

[0052] The air conditioning system 1 starts to operate for cooling. In a normal operation mode, the set temperature of the temperature controller 1011 in an unoccupied region A is T(A), the set temperature of the temperature controller 1011 in an occupied region B 1 is T(B1), the set

temperature of the temperature controller 1011 in an occupied region B2 is $T(B2)$, $T(A) > T(B1)$ and $T(A) > T(B2)$, i.e., the set temperature of the temperature controller 1011 in the unoccupied region A is higher, thereby making the fan coil 1012 corresponding to the unoccupied region A remain off. At this time, in the occupied regions B1 and B2, by turning on/off the fan coil 1012, that is, turning on/off the fan 10121, or adjusting the rotation speed of a compressor to change the temperature of working fluid in the hot coil 10122 or the cold coil 10123 of the fan coil 1012, the fan coil 1012 is adjusted so as to maintain the indoor set temperature of the occupied regions B1 and B2. At this time, the set temperature of the fresh air units (103, 106) may be an average of the indoor set temperatures in the plurality of regions. The air in each region enters the air exhaust duct 104 by means of the air exhaust port 1014, and the air entering the air exhaust duct 104 pre-treats fresh air by means of the heat recycling heat exchanger 105 to lower the temperature of the external fresh air. The external fresh air passes through the fresh air cold coil 1032 so that the temperature thereof is further lowered to the set temperature of the fresh air unit, and the external fresh air is fed into different regions by means of the fresh air fan 106.

[0053] When the electric energy information satisfies the predetermined energy storage condition, i.e., the current electricity supplied by a power grid is clean, and the carbon emission index of a power grid after a preset duration of time in the future is predicted to increase significantly, i.e., the electricity supplied by a power grid will be prone to generating more carbon emissions, then an energy storage instruction is generated for the unoccupied region A, and the air conditioning system 1 is switched to an energy storage operation mode. In the energy storage operation mode, the electric energy consumed by the air conditioning system 1 will significantly increase for the purpose of obtaining more cold energy and storing the cold energy in the unoccupied region A. In the energy storage operation mode, the indoor unit of the unoccupied region A is made to execute the energy storage instruction, and the set temperature $T(A)$ of the temperature controller 1011 is lowered to satisfy $T(A) < T(B1)$ and $T(A) < T(B2)$, thereby making the fan coil 1012 corresponding to the unoccupied region A operate at a high speed. This allows the unoccupied region A to obtain more cold energy to lower the temperature of air in the unoccupied region A and the temperature of the wall structure and the furniture structure therein for the purpose of storing cold energy. In the energy storage operation mode, the set temperatures of the temperature controllers 1011 in the occupied regions B1 and B2 remain unchanged, and the operation conditions of the fresh air units (103, 106) are maintained the same as in the normal operation mode.

[0054] When the electric energy information does not satisfy the predetermined energy storage condition, i.e., when the current carbon emission index of a power grid increases significantly, it is considered that the predeter-

mined energy release condition is satisfied, and an energy release instruction is generated so that the air conditioning system enters an energy release operation mode. The predetermined energy release condition includes at least any one of that the temperature of the specific region reaches a specified value, the occupancy information of the specific region changes in response to an input, and the execution time of the energy storage instruction reaches a specified value. In the energy release operation mode, the electric energy consumed by the air conditioning system 1 will be significantly reduced, and the cold energy stored in the unoccupied region A is used as much as possible to maintain the indoor set temperature in the occupied regions B1 and B2. In the energy release operation mode, the set temperatures of the temperature controllers 1011 in the occupied regions B1 and B2 remain unchanged, and the indoor set temperature is still maintained by adjusting the operation of the fan coil 1012. In the energy release operation mode, the set temperature $T(A)$ of the temperature controller 1011 of the unoccupied region A is adjusted higher to satisfy $T(A) > T(B1)$ and $T(A) > T(B2)$, and the fan coil 1012 is made to enter a shutdown state. Fresh air is pre-treated by the cold energy stored in the unoccupied region A, i.e., cold air, by means of the air exhaust duct 104 and the heat recycling heat exchanger 105 and then enters the fresh air units (103, 106). In the heat recycling heat exchanger, due to the fact that the temperature of the air returned from the unoccupied region A is lower, which can significantly lower the temperature of the external fresh air, so that the temperature of the air fed into the fresh air units (103, 106) can be lowered, so as to reduce the operating load of the fresh air coil, thereby reducing the operating time or the operating frequency of the compressor on the working fluid side of the fresh air cold coil 1032, so that the consumed electric energy can be significantly reduced.

[0055] In some embodiments, when the electric energy information cannot satisfy the predetermined energy storage condition, no energy release instruction is purposely generated, no energy storage instruction is generated and no energy release instruction is generated. It is to be understood that when the indoor unit of each region is adjusted according to normal conditions, it is possible to allow the cold energy/heat energy that is stored in the specific region to enter the air conditioning system in order to affect the electric energy consumed by the air conditioning system.

<Variable-Air Volume Air Conditioning System>

[0056] In some embodiments, an air conditioning system 2 is as shown in FIG. 5, and the air conditioning system 2 includes: an air supply duct 202 communicated with external fresh air, central air conditioning units (203, 206), indoor units (2011, 2012, 2013, 2014, 2015) corresponding to different regions, an air exhaust duct 204, and an air return duct 205 communicating the air supply

duct 202 with the air exhaust duct 204. The central air conditioning units (203, 206) include a central air conditioning hot coil 2031, a central air conditioning cold coil 2032, and an air supply fan 206 located in the air supply duct 202. The indoor units (2011, 2012, 2013, 2014, 2015) include a temperature controller 2011, an air valve 2012, a reheating coil 2015, an air supply port 2013 communicated with the air supply duct 202, and an air exhaust port 2014 communicated with the air exhaust duct 204. After external fresh air enters the air supply duct 202, and passes through the fresh air coil 203, the external fresh air is fed into individual different regions from the air supply port 2013 after passing through the air valve 2012. The indoor set temperature in the region is adjusted by adjusting the opening degree of the air valve 2012. The air in the region enters the air exhaust duct 204 by means of the air exhaust port 2014, part of the air entering the air exhaust duct 204 enters the air supply duct 202 by means of the air return duct 205, and part of the air entering the air exhaust duct 204 is discharged to the outside.

[0057] The air conditioning system 2 can operate for cooling and heating. The air conditioning system 2 during cooling operation is illustrated below as an example, and it is to be understood that similar control methods and control logic can also be applied to heating operation.

[0058] The air conditioning system 2 starts to operate for cooling. In a normal operation mode, the set temperature of the temperature controller 2011 in an unoccupied region A is $T(A)$, the set temperature of the temperature controller 2011 in an occupied region B1 is $T(B1)$, the set temperature of the temperature controller 2011 in an occupied region B2 is $T(B2)$, $T(A) > T(B1)$ and $T(A) > T(B2)$, i.e., the set temperature of the temperature controller 2011 in the unoccupied region A is higher, thereby making the air valve 2012 corresponding to the unoccupied region A remain a minimum opening degree (FIG. 5 is a schematic view of a maximum opening degree of the air valve 2012). At this time, in the occupied regions B1 and B2, by adjusting the opening degree of the air valve 2012, the requirement of maintaining the indoor set temperature in the occupied regions B1 and B2 is met. At this time, air in the occupied regions B1 and B2 enters the air exhaust duct 204 by means of the air exhaust port 2014, part of the air entering the air exhaust duct 204 is discharged to the outside, and part of the air entering the air exhaust duct 204 enters the air supply duct 202 after being mixed with the external fresh air by means of the air return duct 205. The set temperature of the central air conditioning unit can be maintained on the working fluid side of the central air conditioning unit cold coil 2032 by turning on/off a compressor or adjusting the rotation speed of the compressor.

[0059] When the electric energy information satisfies the predetermined energy storage condition, i.e., the current electricity supplied by a power grid is clean, and the carbon emission index of a power grid after a preset duration of time in the future is predicted to in-

crease significantly, i.e., the electricity supplied by a power grid will be prone to generating more carbon emissions, then an energy storage instruction is generated for the unoccupied region A, and the air conditioning system 2 is switched to an energy storage operation mode. In the energy storage operation mode, the electric energy consumed by the air conditioning system 2 will significantly increase for the purpose of obtaining more cold energy and storing the cold energy in the unoccupied region A. In the energy storage operation mode, the indoor unit in the unoccupied region A is made to execute the energy storage instruction, and the set temperature $T(A)$ of the temperature controller 2011 is lowered to satisfy $T(A) < T(B1)$ and $T(A) < T(B2)$, thereby making the opening degree of the air valve 2012 corresponding to the unoccupied region A become larger or adjusting the air valve 2012 to a maximum opening degree by means of a central controller (FIG. 5 is a schematic view of a maximum opening degree of the air valve 2012). This allows the unoccupied region A to obtain more cold energy to lower the temperature of the air in the unoccupied region A and the temperature of the wall structure and the furniture structure therein for the purpose of storing cold energy. In the energy storage operation mode, the set temperatures of the temperature controllers 2011 in the occupied regions B1 and B2 remain unchanged, and the indoor set temperature is maintained by adjusting the opening degree of the air valve 2012. In the energy storage operation mode, the set temperature of the central air conditioning unit can be lowered and the rotation speed of the air supply fan 206 can be adjusted to increase the amount of air supplied, so that the proportion of the running time of the compressor on the working fluid side of the central air conditioning cold coil 2032 increases or the rotation speed increases, and thus, in the energy storage operation mode, the electric energy consumed by both the compressor and the air supply fan 206 increases.

[0060] When the electric energy information does not satisfy the predetermined energy storage condition, i.e., when the current carbon emission index of a power grid increases significantly, it is considered that the predetermined energy release condition is satisfied, and an energy release instruction is generated so that the air conditioning system enters an energy release operation mode. The predetermined energy release condition includes at least any one of that the temperature of the specific region reaches a specified value, the occupancy information of the specific region changes in response to an input, and the execution time of the energy storage instruction reaches a specified value. In the energy release operation mode, the electric energy consumed by the air conditioning system 2 will be significantly reduced, and cold energy stored in the unoccupied region A is used as much as possible to maintain the indoor set temperature in the occupied regions B1 and B2. In the energy release operation mode, the set temperatures of the temperature controllers 2011 in the occupied regions

B1 and B2 remain unchanged, and the indoor set temperature is still maintained by adjusting the opening degree of the air valve 2012. In the energy release operation mode, the set temperature T(A) of the temperature controller 2011 in the unoccupied region A is adjusted higher to satisfy $T(A) > T(B1)$ and $T(A) > T(B2)$, and the air valve 2012 can be adjusted to a maximum opening degree by means of the central controller to promote circulation of air in the unoccupied region A and heat exchange with the wall of the unoccupied region A and other structures. The cold energy stored in the unoccupied region A, i.e., cold air will return to the central air conditioning units (203, 206) by means of the air exhaust duct 204 and the air return duct 205. In the central air conditioning units (203, 206), the set temperature of the fresh air unit can be appropriately raised. Due to the fact that the temperature of the air returned from the unoccupied region A is lower, the temperature of air at an inlet of the central air conditioning cold coil 2032 can be effectively lowered, so as to reduce the operating load of the central air conditioning cold coil 2032, thereby reducing the operating time or the operating frequency of the compressor on the working fluid side of the central air conditioning cold coil 2032, so that the consumed electric energy can be significantly reduced.

<Computer-Readable Storage Medium>

[0061] A computer-readable storage medium according to an embodiment of this invention stores a control program. The control program implements the method for controlling an air conditioning system introduced in some of the above embodiments when executed by a processor.

<Mobile Terminal Device>

[0062] A mobile terminal device 30 according to an embodiment of this invention, as shown in FIG. 6, includes: a processor 31 and a memory 32. A processor-readable instruction is stored in the memory 32. The processor 31 executes the method for controlling an air conditioning system introduced in some of the above embodiments by running the processor-readable instruction.

<Server>

[0063] A server 40 according to an embodiment of this invention, as shown in FIG. 7, includes: a processor 41 and a memory 42. A processor-readable instruction is stored in the memory 42. The processor 41 executes the method for controlling an air conditioning system introduced in some of the above embodiments by running the processor-readable instruction.

[0064] The description above is only preferred embodiments of this invention and not intended to limit this invention. Any modification, equivalent replacement, im-

provement, etc. made shall fall within the protection scope of this invention as defined by the appended claims.

Claims

1. A method for controlling an air conditioning system (1;2), the air conditioning system comprising a plurality of indoor units arranged in different regions, wherein the control method comprises:

a step for acquiring occupancy information, acquiring occupancy information of the region;
a step for acquiring electric energy information, acquiring electric energy information containing an electric energy characteristic; and
a step for generating an energy storage instruction, generating an energy storage instruction for a specific region on the basis of the occupancy information when the electric energy information satisfies a predetermined energy storage condition.

2. The method for controlling an air conditioning system (1;2) according to claim 1, wherein the electric energy characteristic refers to any one of a carbon emission index of a power grid, the cleanliness of a power grid, the percentage of clean electric energy, and the percentage of renewable energy sources.

3. The method for controlling an air conditioning system (1;2) according to claim 1 or 2, wherein the electric energy characteristic varies over time.

4. The method for controlling an air conditioning system (1;2) according to any preceding claim, further comprising: a step for executing the energy storage instruction, making an indoor unit arranged in the specific region execute the energy storage instruction.

5. The method for controlling an air conditioning system (1;2) according to claim 4, wherein the indoor unit comprises a temperature controller (1011;2011), and making an indoor unit arranged in the specific region execute the energy storage instruction specifically comprises: adjusting the set temperature of a temperature controller (1011;2011) in the specific region.

6. The method for controlling an air conditioning system (1;2) according to claim 5, wherein the indoor unit further comprises a fan coil (1012) or an air valve (2012), and making an indoor unit arranged in the specific region execute the energy storage instruction specifically comprises: making the air speed of a fan coil (1012) in the specific region change, or making the opening

degree of an air valve (2012) in the specific region change, or performing any of the above actions in response to an input from the temperature controller (1011;2011) in the specific region.

7. The method for controlling an air conditioning system (1;2) according to any preceding claim, wherein the electric energy information is historical electric energy information containing a historical electric energy characteristic, and
in the step for generating an energy storage instruction, the predetermined energy storage condition is determined on the basis of the result of a comparison of the historical electric energy characteristic with a threshold value.

8. The method for controlling an air conditioning system (1;2) according to any of claims 1 to 6, wherein the electric energy information comprises real-time electric energy information containing a real-time electric energy characteristic and historical electric energy information containing a historical electric energy characteristic;
the control method further comprises:

a step for generating an electric energy prediction point, generating an electric energy prediction point on the basis of the historical electric energy information;
in the step for generating an energy storage instruction, the predetermined energy storage condition is determined on the basis of the result of a comparison of the electric energy prediction point with the real-time electric energy information.

9. The method for controlling an air conditioning system (1;2) according to any preceding claim, wherein the occupancy information is determined on the basis of any one of information about the number of people in the region, pre-stored information about usage of the region, and information about a timetable of the set temperature of the temperature controller (1011;2011).

10. The method for controlling an air conditioning system (1;2) according to any of claims 1-9, further comprising: a step for generating an energy release instruction, generating an energy release instruction when a predetermined energy release condition is satisfied.

11. The method for controlling an air conditioning system (1;2) according to claim 10, wherein the predetermined energy release condition comprises at least any one of that the temperature of the specific region reaches a specified value, the occupancy information of the specific region changes in response to an

input, and the execution time of the energy storage instruction reaches a specified value.

12. An air conditioning system (1;2), comprising:

a plurality of indoor units arranged in different regions, the indoor unit comprising an air supply port (1013;2013) and an air exhaust port (1014;2014);
an air supply duct (102;202), communicated with the plurality of air supply ports (1013;2013) arranged in the different regions; and
an air exhaust duct (104;204), communicated with the plurality of air exhaust ports (1014;2014) arranged in the different regions, the air exhaust duct (104;204) being communicated with the air supply duct (102;202);
the air conditioning system executing the method for controlling an air conditioning system according to any of claims 1-11.

13. A computer-readable storage medium, storing a control program, wherein the control program implements the method for controlling an air conditioning system (1;2) according to any of claims 1-11 when executed by a processor.

14. A mobile terminal device (30), comprising: a processor (31) and a memory (32), a processor-readable instruction being stored in the memory, and the processor executing the method for controlling an air conditioning system (1;2) according to any of claims 1-11 by running the processor-readable instruction.

15. A server (40), comprising: a processor (41) and a memory (42), a processor-readable instruction being stored in the memory, and the processor executing the method for controlling an air conditioning system (1;2) according to any of claims 1-11 by running the processor-readable instruction.

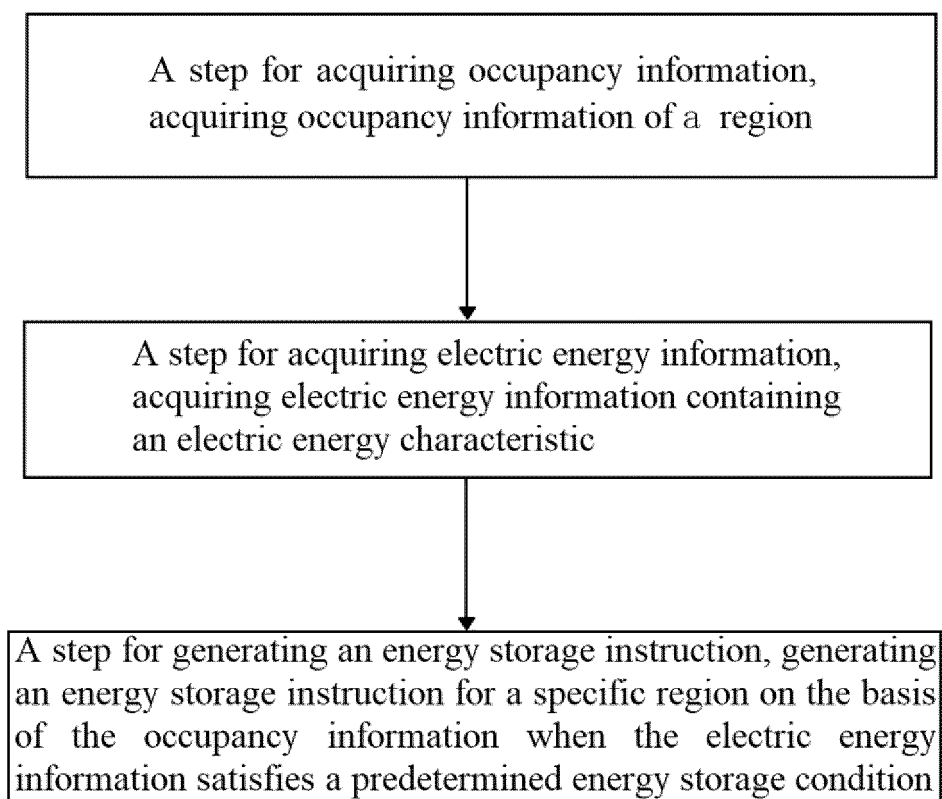


FIG. 1

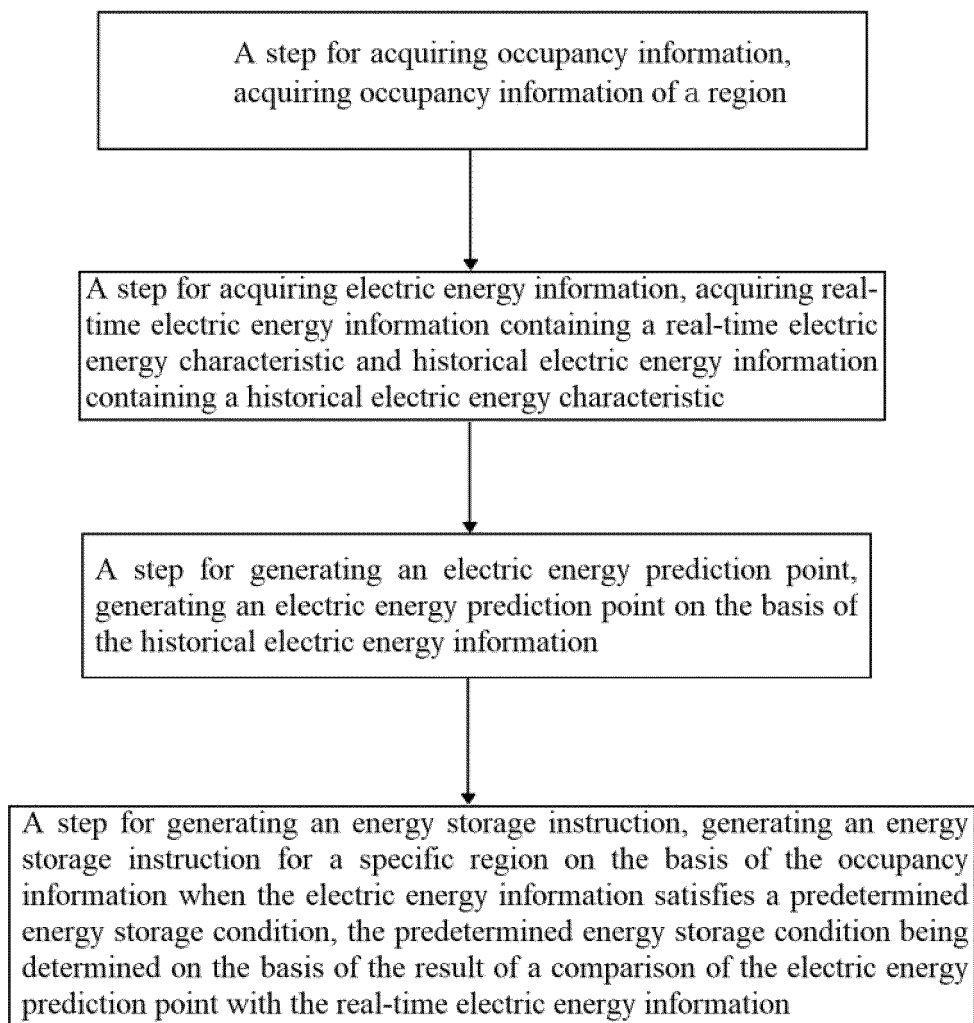


FIG. 2

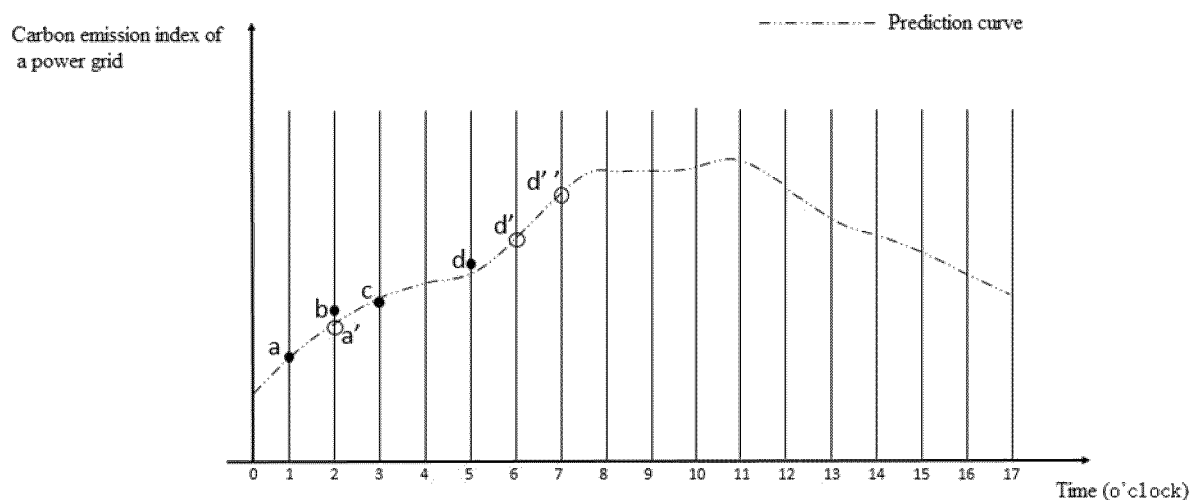


FIG. 3

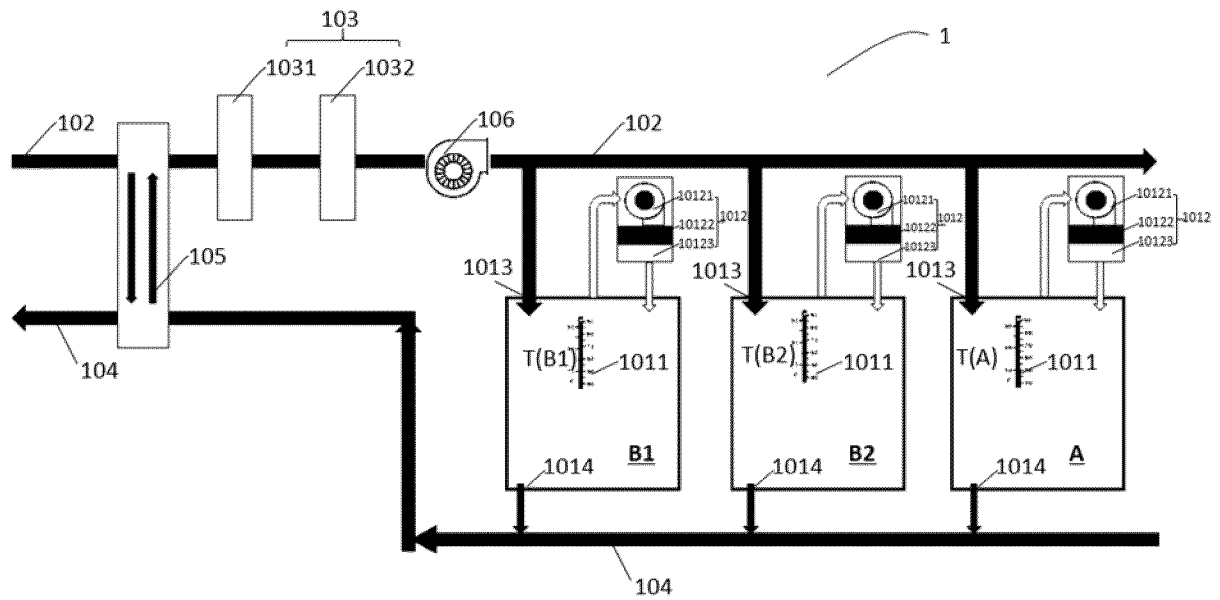


FIG. 4

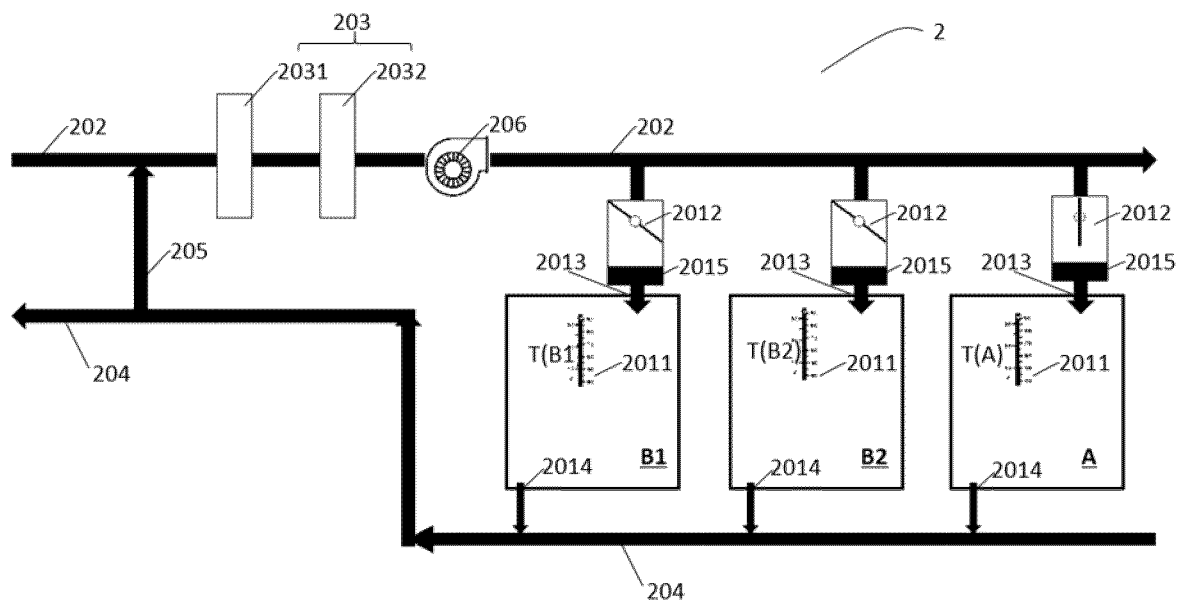


FIG. 5

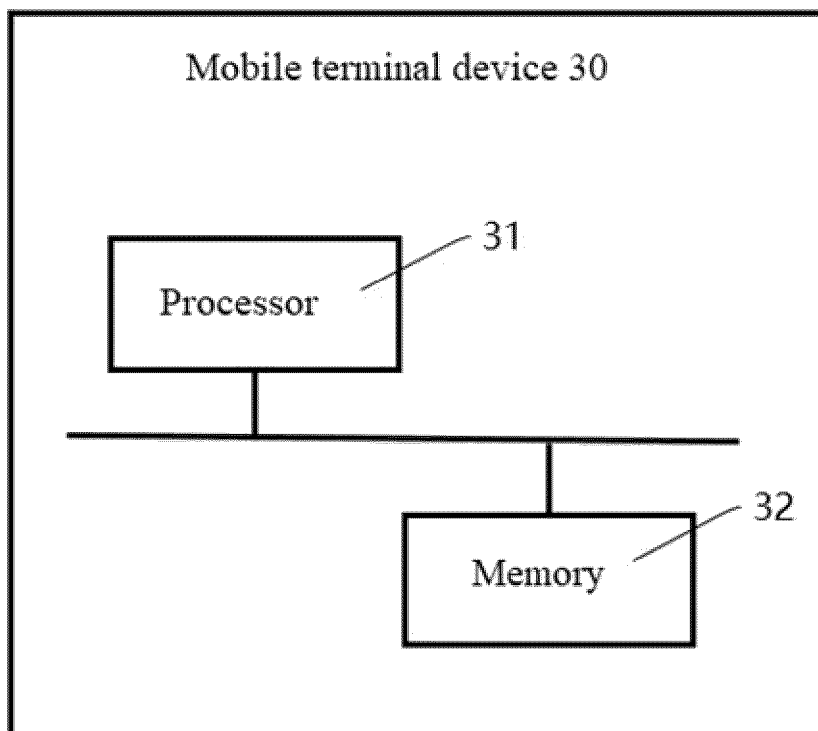


FIG. 6

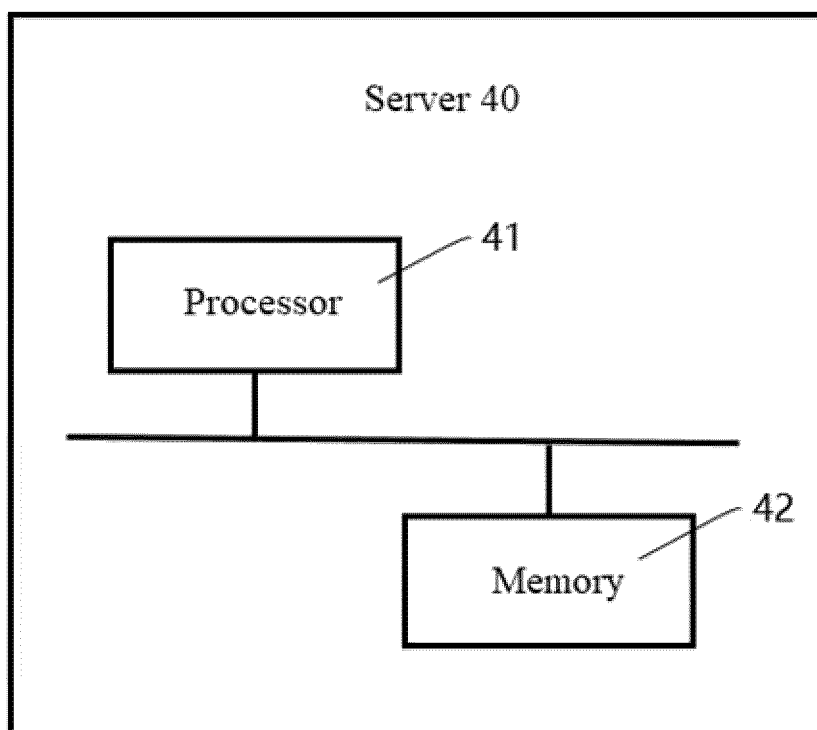


FIG. 7



EUROPEAN SEARCH REPORT

Application Number

EP 24 19 7866

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2011/253796 A1 (POSA JOHN G [US] ET AL) 20 October 2011 (2011-10-20) * the whole document * -----	1 - 15	INV. F24F11/65 F24F11/46 F24F120/10 F24F5/00 F24F11/47
			TECHNICAL FIELDS SEARCHED (IPC)
			F24F
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		11 January 2025	Decking, Oliver
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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11-01-2025

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011253796 A1	20-10-2011	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82