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METHOD, DEVICE AND MEDIUM FOR CONTROLLING WATER CHILLER IN CENTRAL AIR CONDITIONING SYSTEM

(57) Embodiments of the present disclosure relate to methods, devices and medium for controlling a water chiller in a central air conditioning system. The method comprises acquiring a current prioritization rule when a to-be-started water chiller in a central air conditioning system needs to be started; determining a plurality of data each to-be-started water chiller respectively associated with one or more of the plurality of prioritization dimensions; adjusting a ranking order of the plurality of prioritization dimensions based on the acquired plurality of data to obtain an adjusted prioritization rule; ranking the plurality of to-be-started water chillers based on an adjusted prioritization rule; and determining, based on a final ranking result of the plurality of to-be-started water chillers, a currently most suitable to-be-started water chiller so as to control to start the determined a to-be-started water chiller. Thus, a prioritization rule can be dynamically adjusted, and a currently most suitable to-be-started water chiller can be quickly and accurately determined.

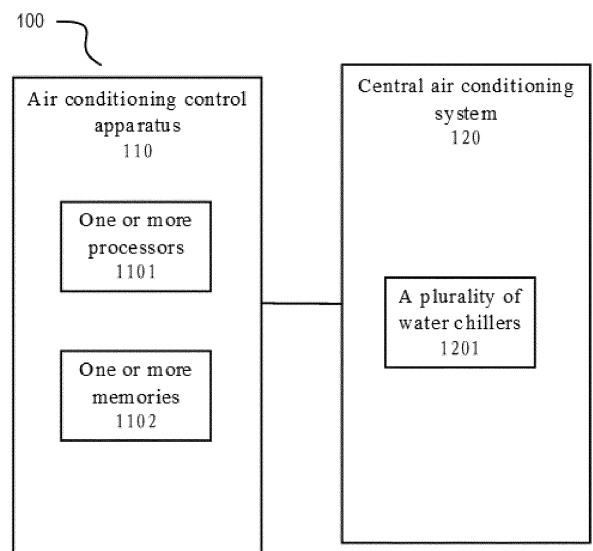


Figure 1

Description

FIELD

[0001] Embodiments of the present disclosure generally relate to the field of air conditioning control, and more specifically, to methods, devices and medium for controlling a water chiller in a central air conditioning system.

BACKGROUND

[0002] In a central air conditioning system, it is often necessary to control to start a water chiller based on priority of water chillers on the premise of not specifying a start-up sequence. At present, it is common to predetermine priority levels of the water chillers, and select a corresponding water chiller to start directly on the basis of the determined priority levels for control. However, since the use in the central air conditioning system varies depending on the ambient (e.g., indoor and outdoor temperatures of a building), a single priority level may lead to inability to accurately determine a currently most suitable to-be-started water chiller, thereby possibly reducing the use efficiency in the central air conditioning system, resulting in waste of energy consumption, and reducing the service life in the central air conditioning system.

SUMMARY

[0003] In response to the above-mentioned problems, the present disclosure provides methods, devices and medium for controlling a water chiller in a central air conditioning system such that a prioritization rule can be dynamically adjusted. As a result, a currently most suitable to-be-started water chiller can be quickly and accurately determined, thereby contributing to improving the use efficiency in the central air conditioning system, saving energy consumption, and improving the service life in the central air conditioning system.

[0004] According to a first aspect of the present disclosure, there is provided a method for controlling a water chiller in a central air conditioning system. The method comprises: acquiring a current prioritization rule when a to-be-started water chiller in a central air conditioning system needs to be started, the current prioritization rule specifying a plurality of prioritization dimensions for prioritizing a plurality of to-be-started water chillers included in the central air conditioning system and a ranking order of the plurality of prioritization dimensions; determining a plurality of data each to-be-started water chiller respectively associated with one or more of the plurality of prioritization dimensions; adjusting a ranking order of the plurality of prioritization dimensions based on the acquired plurality of data to obtain an adjusted prioritization rule; ranking the plurality of to-be-started water chillers based on an adjusted prioritization rule; and determining, based on a final ranking result of the plurality of to-be-

started water chillers, a currently most suitable to-be-started water chiller so as to control to start the determined a to-be-started water chiller.

[0005] According to a second aspect of the present disclosure, there is provided a computing device comprising: at least one processor; and a memory communicatively coupled to the at least one processor; the memory stores instructions executable by the at least one processor to enable the at least one processor to perform the method of the first aspect.

[0006] In a third aspect of the present disclosure, there is provided a non-transitory computer-readable storage medium storing computer instructions for causing a computer to perform the method of the first aspect.

[0007] In some embodiments, the plurality of prioritization dimensions comprise two or more of water chiller type, rated power, total operating time, and Coefficient Of Performance (COP), and adjusting a ranking order of the plurality of prioritization dimensions based on the acquired plurality of data comprises: if a plurality of prioritization dimensions of the current prioritization rule comprising a total operating time of a water chiller, and a difference between the maximum total operating time and the minimum total operating time in the acquired plurality of total operating times of the plurality of to-be-started water chillers being greater than or equal to a first set value, then a total operating time of a water chiller being adjusted to be the highest-ranked prioritization dimension in the plurality of prioritization dimensions; if the plurality of prioritization dimensions further comprising a COP of a water chiller, and a difference between the maximum COP data and the minimum COP data in the acquired plurality of COP data of the plurality of to-be-started water chillers being greater than or equal to a second set value, then a COP of a water chiller being adjusted to be the second-ranked prioritization dimension in the plurality of prioritization dimensions.

[0008] In some embodiments, the plurality of prioritization dimensions comprise two or more of water chiller type, rated power, total operating time, and COP, and adjusting a ranking order of the plurality of prioritization dimensions based on the acquired plurality of data comprises: if the plurality of prioritization dimensions comprising a total operating time of a water chiller, and a difference between the maximum total operating time and the minimum total operating time in the acquired plurality of total operating times of the plurality of to-be-started water chillers being less than a first set value, then a total operating time of a water chiller being adjusted to be the lowest-ranked prioritization dimension in the plurality of prioritization dimensions; if the plurality of prioritization dimensions further comprising a COP of a water chiller, and a difference between the maximum COP data and the minimum COP data in the acquired plurality of COP data of the plurality of to-be-started water chillers being greater than or equal to a second set value, then a COP of a water chiller being adjusted to be the highest-ranked prioritization dimension in the plurality of prioritization dimensions.

zation dimensions.

[0009] In some embodiments, the plurality of prioritization dimensions comprise two or more of water chiller type, rated power, total operating time, and COP, and adjusting a ranking order of the plurality of prioritization dimensions based on the acquired plurality of data comprises: if the plurality of prioritization dimensions not comprising a total operating time of a water chiller but comprising a COP of a water chiller, and a difference between the maximum COP data and the minimum COP data in the acquired plurality of COP data of the plurality of to-be-started water chillers being greater than or equal to a second set value, then a COP of a water chiller being adjusted to be the highest-ranked prioritization dimension in the plurality of prioritization dimensions.

[0010] In some embodiments, ranking the plurality of to-be-started water chillers based on an adjusted prioritization rule comprises: ranking the plurality of to-be-started water chillers based on a first prioritization dimension highest-ranked in the adjusted prioritization rule so as to obtain a first priority ranking result; if one or more first priority ranking levels in the first priority ranking result relating to a plurality of to-be-started water chillers, then respectively further ranking the to-be-started water chillers related to the one or more first priority ranking levels based on a second prioritization dimension second-ranked in the adjusted prioritization rule so as to obtain a second priority ranking result.

[0011] In some embodiments, the current prioritization rule specifies two prioritization dimensions, and ranking the plurality of to-be-started water chillers based on an adjusted prioritization rule further comprises: if each second priority ranking level in the second priority ranking result only relating to one to-be-started water chiller, taking the second priority ranking result as a final priority ranking result of the plurality of to-be-started water chillers; if one or more second priority ranking levels in the second priority ranking result relating to a plurality of to-be-started water chillers, further ranking to-be-started water chillers related to the one or more second priority ranking levels respectively in a random manner so as to obtain a final priority ranking result of the plurality of to-be-started water chillers.

[0012] In some embodiments, the current prioritization rule specifies four prioritization dimensions, and ranking the plurality of to-be-started water chillers based on an adjusted prioritization rule further comprises: if each second priority ranking level in the second priority ranking result only relating to one to-be-started water chiller, taking the second priority ranking result as a final priority ranking result of the plurality of to-be-started water chillers; if one or more second priority ranking levels in the second priority ranking result relating to a plurality of to-be-started water chillers, then respectively further ranking to-be-started water chillers related to the one or more second priority ranking levels based on a third prioritization dimension third-ranked in the adjusted prioritization rule so as to obtain a third priority ranking result; if each

third priority ranking level in the third priority ranking result only relating to one to-be-started water chiller, taking the third priority ranking result as a final priority ranking result of the plurality of to-be-started water chillers; if one or more third priority ranking levels in the third priority ranking result relating a plurality of to-be-started water chillers, then respectively further ranking water chillers related to one or more third priority ranking levels based on a fourth prioritization dimension fourth-ranked in the adjusted prioritization rule so as to obtain a fourth priority ranking result; if each fourth priority ranking level in the fourth priority ranking result only relating to one to-be-started water chiller, taking the fourth priority ranking result as a final priority ranking result of the plurality of to-be-started water chillers; if one or more fourth priority ranking levels in the fourth priority ranking result relating to a plurality of to-be-started water chillers, further ranking to-be-started water chillers related to the one or more fourth priority ranking levels respectively in a random manner so as to obtain a final priority ranking result of the plurality of to-be-started water chillers.

[0013] In some embodiments, determining, based on a final ranking result of the plurality of to-be-started water chillers, a currently most suitable to-be-started water chiller for a central air conditioning system comprises: selecting one or more to-be-started water chillers with the highest priority ranking level in the final ranking result as a currently most suitable to-be-started water chiller.

[0014] It should be understood that this Summary is not intended to identify key features or essential features of the present disclosure, nor is it intended to be used to limit the scope of the present disclosure. Other features of the present disclosure will become readily apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Through the following detailed description with reference to the accompanying drawings, the above and other features, advantages and aspects of example embodiments of the present disclosure will become more apparent. In the example embodiments of the present disclosure, the same reference numerals usually refer to the same components.

FIG. 1 illustrates a schematic diagram of a system 100 for implementing a method for controlling a central air conditioning system according to an embodiment of the present invention.

FIG. 2 illustrates a flowchart of a method 200 for controlling a water chiller in a central air conditioning system according to an embodiment of the present disclosure.

FIG. 3 illustrates a schematic flow diagram of a method 300 for adjusting a ranking order of a plurality of prioritization dimensions according to an embodi-

ment of the present disclosure.

FIG. 4 illustrates a flow diagram of a method 400 for ranking a plurality of to-be-started water chillers based on an adjusted prioritization rule, in case a current prioritization rule specifies two prioritization dimensions, according to an embodiment of the present disclosure.

FIG. 5 illustrates a block diagram of an electronic device 500 according to an embodiment of the present disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

[0016] The following description of the exemplary embodiments of the disclosure, taken in conjunction with the accompanying drawings, includes various details of the embodiments of the disclosure to facilitate understanding and is to be construed as exemplary only. Accordingly, those of ordinary skill in the art will recognize that various changes and modifications may be made to the embodiments described herein without departing from the scope and spirit of the present disclosure. Also, descriptions of well-known functions and constructions are omitted from the following description for clarity and conciseness.

[0017] As used herein, the term "includes" and its variants are to be read as open-ended terms that mean "includes, but is not limited to." The term "or" is to be read as "and/or" unless the context clearly indicates otherwise. The term "based on" is to be read as "based at least in part on." The terms "one example embodiment" and "one embodiment" are to be read as "at least one example embodiment." The term "a further embodiment" is to be read as "at least a further embodiment." The terms "first", "second" and so on can refer to same or different objects. The following text also can include other explicit and implicit definitions.

[0018] As mentioned above, at present, it is common to predetermine priority levels of these water chillers and to select the corresponding water chillers to start directly on the basis of the determined priority levels for control. However, since the use in the central air conditioning system varies depending on the ambient (e.g., indoor and outdoor temperatures of a building), if a single priority level is used, it may lead to an inability to accurately determine a currently most suitable water chiller to start, thereby possibly reducing the use efficiency in the central air conditioning system, resulting in waste of energy consumption, and reducing the service life in the central air conditioning system.

[0019] To at least partially address one or more of the above problems and other potential problems, example embodiments of the present disclosure provide a method for controlling a water chiller in a central air conditioning system, comprising: acquiring a current prioritization rule when a to-be-started water chiller in a central air condi-

tioning system needs to be started, the current prioritization rule specifying a plurality of prioritization dimensions for prioritizing a plurality of to-be-started water chillers included in the central air conditioning system and a ranking order of the plurality of prioritization dimensions; determining a plurality of data each to-be-started water chiller respectively associated with one or more of the plurality of prioritization dimensions; adjusting a ranking order of the plurality of prioritization dimensions based on the acquired plurality of data to obtain an adjusted prioritization rule; ranking the plurality of to-be-started water chillers based on an adjusted prioritization rule; and determining, based on a final ranking result of the plurality of to-be-started water chillers, a currently most suitable to-be-started water chiller so as to control to start the determined a to-be-started water chiller. In this way, a prioritization rule can be dynamically adjusted, and a currently most suitable to-be-started water chiller can be quickly and accurately determined, attributing to improve use efficiency in the central air conditioning system.

[0020] FIG. 1 shows a schematic diagram of a system 100 for implementing a method for controlling a central air conditioning system according to an embodiment of the present invention. As shown in FIG. 1, the system 100 includes an air conditioning control apparatus 110 and a central air conditioning system 120. The central air conditioning system 120 may include a plurality of water chillers and other air conditioning device such refrigeration pumps, cooling pumps, and the like. The air conditioning control apparatus 110 can perform data interaction with the central air conditioning system 120 to achieve control of each water chiller and each other air conditioning device in the central air conditioning system 120. In the present disclosure, control of the water chillers by the air conditioning control apparatus 110 includes control of start of each water chiller. The air conditioning control apparatus 110 may be coupled to the central air conditioning system 120 (e.g., wired or wirelessly connected to each water chiller in the central conditioning system) or may be part in the central air conditioning system 120. The air conditioning control apparatus 110 may be implemented via a microcontroller such as a PLC, or may be implemented by an electronic device such as a desktop computer, a laptop computer, an industrial control computer, an embedded control device, or the like, the specific structure of which may be described below in connection with FIG. 5, for example. The air conditioning control apparatus 110 may include one or more processors 1101 and one or more memories 1102 coupled to the one or more processors 1101, the memory 1102 having stored therein instructions executable by the one or more processors 1101 which, when executed by the at least one processor 1101, perform the method 200 as described below.

[0021] FIG. 2 shows a flowchart of a method 200 for controlling a water chiller in a central air conditioning system according to an embodiment of the present disclosure. The method 200 may be performed by the air con-

ditioning control apparatus 110 shown in FIG. 1, or may be performed at the electronic device 500 shown in FIG. 5. It should be appreciated that method 200 may also include additional blocks not shown and/or may omit the blocks shown, and the scope of the present disclosure is not limited in this respect.

[0022] In step 202, a current prioritization rule is acquired when a to-be-started water chiller in a central air conditioning system needs to be started, and the current prioritization rule specifies a plurality of prioritization dimensions for prioritizing a plurality of to-be-started water chillers included in the central air conditioning system and a ranking order of the plurality of prioritization dimensions;

[0023] In the present disclosure, a to-be-started water chiller refers to a water chiller not currently started in a central air conditioning system. In some cases, the current prioritization rule is the default prioritization rule, and in other cases, the current prioritization rule is the prioritization rule used the last time the to-be-started water chiller was started.

[0024] Specifically, in some implementations, after the central air conditioning system is powered on, when it is desired to first start a certain to-be-started water chiller included in the central air conditioning system, if no start-up sequence number is specified for the water chiller, a default prioritization rule is obtained. The default prioritization rule in the present disclosure may be specified when the central air conditioning system is shipped, or may be configured by the user as desired. Thus, the current prioritization rule referred to in step 202 now refers to the default prioritization rule. For example only, in a default prioritization rule, four prioritization dimensions such as water chiller type, rated power, total operating time, and COP of a water chiller may be specified for prioritizing a plurality of to-be-started water chillers included in a central air conditioning system, for example, and the COP of the water chiller may be specified as the highest-ranked prioritization dimension of the four prioritization dimensions, the water chiller type of the water chiller being the second-ranked prioritization dimension, and the rated power of the water chiller being the third-ranked prioritization dimension. and the total operating time of the water chiller being the fourth-ranked prioritization dimension (namely, the lowest ranking).

[0025] In other implementations, when one or more new to-be-started water chiller need to be started again during use in the central air conditioning system, the prioritization rule used the last time the to-be-started water chiller was started is acquired. Thus, the current prioritization rule referred to in step 202 now refers to the prioritization rule used the last time the to-be-started water chiller was started.

[0026] In step 204, a plurality of data associated with one or more of a plurality of prioritization dimensions (i. e., the plurality of prioritization dimensions in step 202), respectively, for each water chiller group to be started is determined.

[0027] For example, if the current prioritization rule specifies four prioritization dimensions of the water chiller type, the rated power, the total operating time and the COP of the water chillers for prioritizing the plurality of to-be-started water chillers included in the central air conditioning system, the water chiller type data, the rated power data, the total operating time data and the COP data of each to-be-started water chiller can be respectively determined in step 204, wherein the device type data is used for indicating what the equipment type of the corresponding to-be-started water chiller is, the rated power data is used for indicating how much the rated power of the corresponding to-be-started water chiller is, the total operating time data is used for indicating how much time the corresponding water chiller to be operated in total so far, and the COP (COP) data is used for indicating how much the ratio between the refrigerating capacity of the compressor of the corresponding water chiller and the electric power consumed is.

[0028] In the present disclosure, the equipment type data and the rated power data for each to-be-started water chiller may be input directly by the user before using the central air conditioning system. In the present disclosure, the type of equipment of the water chiller can be a magnetic levitation type, a frequency conversion type, or a general type.

[0029] The current total operating time data of each to-be-started water chiller can be measured by a corresponding timer. If the measured total operating time data is less than or equal to zero or greater than or equal to the difference between the current time and the delivery time of the water chiller (namely, a maximum operating time value), it is indicated that the measured total operating time data is incorrect (for example, when the corresponding timer has a fault, the measured total operating time data is incorrect), and then the total operating time data of the to-be-started water chiller can be determined as a corresponding maximum operating time value.

[0030] The current COP for each to-be-started water chiller can be determined using a pre-constructed COP prediction model. The COP prediction model may be trained based on a BP neural network or other similar neural network with a plurality of sample data sets collected at a predetermined sampling frequency (e.g., once per minute, etc.) over a certain period of time in the past (e.g., one week in the past, two weeks in the past, one month in the past, etc.), and each sample data set may include, for example, a cold load ration PLR, a chilled water supply temperature Tg, a chilled return water temperature Th, a chilled water supply temperature Tgcl, and a chilled return water temperature Thcl of the respective water chiller. With regard to such an COP prediction model, by inputting the cold load ration PLR, the chilled water supply temperature Tg, the chilled return water temperature Th, the chilled water supply temperature Tgcl and the chilled return water temperature Thcl measured by the corresponding to-be-started water chiller at the cur-

rent moment into the model, the current COP data of the to-be-started water chiller can be obtained.

[0031] In step 206, the ranking order of the plurality of prioritization dimensions in step 202 is adjusted based on the acquired plurality of data to obtain an adjusted prioritization rule.

[0032] In the present disclosure, the ranking order of each prioritization dimension in the current prioritization rule can be adjusted based on each data acquired in step 204, so as to find a currently most suitable to-be-started water chiller in the central air conditioning system, so as to reduce the use efficiency in the central air conditioning system and reduce the waste of energy consumption.

[0033] Step 206 is described in further detail below in conjunction with FIG. 3.

[0034] In step 208, the plurality of to-be-started water chillers are ranked based on the adjusted prioritization rules.

[0035] Step 208 is described in further detail below in conjunction with FIG. 4.

[0036] In step 210, based on a final ranking result of the plurality of to-be-started water chillers, a currently most suitable to-be-started water chiller is determined so as to control to start the determined to-be-started water chiller.

[0037] In some embodiments, step 210 may include selecting the one or more to-be-started water chillers with the highest priority ranking in the final ranking result as a currently most suitable to-be-started water chiller, and the number of to-be-started water chillers selected may depend on the number of to-be-started water chillers currently required to be started.

[0038] FIG. 3 illustrates a schematic flow diagram of a method 300 for adjusting ranking order of a plurality of prioritization dimensions in accordance with an embodiment of the present disclosure. The method 300 may be performed by the air conditioning control apparatus 110 shown in FIG. 1, or may be performed at the electronic device 500 shown in FIG. 5. It should be understood that method 300 may also include additional blocks not shown and/or may omit the blocks shown, and the scope of the present disclosure is not limited in this respect.

[0039] On the one hand (a first branch), as shown in the flow on the right side of FIG. 3, in step 302, if the plurality of prioritization dimensions of the current prioritization rule comprise a total operating time of a water chiller, and a difference between the maximum total operating time and the minimum total operating time in the acquired plurality of total operating times of the plurality of to-be-started water chillers (namely, the plurality of to-be-started water chillers included in the central air conditioning system) is greater than or equal to a first set value, then the total operating time of the water chiller is adjusted to be the highest-ranked prioritization dimension in the plurality of prioritization dimensions.

[0040] In step 304, if the plurality of prioritization dimensions further comprise an COP of a water chiller, and a difference between the maximum COP data and the

minimum COP data in the acquired plurality of COP data of the plurality of to-be-started water chillers is greater than or equal to a second set value, then the COP of the water chiller is adjusted to be the second-ranked prioritization dimension in the plurality of prioritization dimensions.

[0041] On the other hand (a second branch), as shown in the middle flow of FIG. 3, in step 306, i. e., if the plurality of prioritization dimensions (i. e., the plurality of prioritizing dimensions specified in the current prioritizing rule) comprise a total operating time of the water chiller, and a difference between the maximum total operating time and the minimum total operating time in the acquired plurality of total operating times of the plurality of to-be-started water chillers (i. e., the plurality of to-be-started water chillers included in the central air conditioning system) is less than a first set value, then the total operating time of the water chiller is adjusted to be the lowest-ranked prioritization dimension in the plurality of prioritization dimensions;

[0042] In step 308, if the plurality of prioritization dimensions further comprise an COP of a water chiller, and a difference between the maximum COP data and the minimum COP data in the acquired plurality of COP data of the plurality of to-be-started water chillers is greater than or equal to a second set value, then the COP of the water chiller is adjusted to be the highest-ranked prioritization dimension in the plurality of prioritization dimensions.

[0043] On the further other hand (a third branch), as shown in the flow on the left side of FIG. 3, in step 310, if the plurality of prioritization dimensions (namely, the plurality of prioritization dimensions specified in the current prioritization rule) does not comprise a total operating time of the water chiller but comprises an COP of a water chiller, and a difference between the maximum COP data and the minimum COP data in the acquired plurality of COP data of the plurality of to-be-started water chillers (namely, the plurality of to-be-started water chillers included in the central air conditioning system) is greater than or equal to a second set value, then the COP of the water chiller is adjusted to be the highest-ranked prioritization dimension in the plurality of prioritization dimensions.

[0044] In yet another aspect, if none of the conditions mentioned in steps 302, 306 and 308 are met, the current prioritization rule may be kept unchanged and the ranking of the respective to-be-started water chillers continues in step 208 using the current prioritization rule.

[0045] By adopting the above means, the present disclosure enables a dynamic adjustment of the prioritization rules, thereby facilitating a quick and accurate determination of the currently most suitable to-be-started water chiller.

[0046] FIG. 4 shows a flow diagram of a method 400 for ranking a plurality of to-be-started water chillers based on an adjusted prioritization rule, in case a current prioritization rule specifies two prioritization dimensions, ac-

cording to an embodiment of the present disclosure. The method 400 may be performed by the air conditioning control apparatus 110 shown in FIG. 1, or may be performed at the electronic device 500 shown in FIG. 5. It should be appreciated that method 400 may also include additional blocks not shown and/or may omit the illustrated blocks, and the scope of the present disclosure is not limited in this respect.

[0047] In step 402, the plurality of to-be-started water chillers (namely, the plurality of to-be-started water chillers included in the central air conditioning system) are ranked based on a first prioritization dimension highest-ranked in the adjusted prioritization rule (namely, the adjusted prioritization rule obtained in step 206) so as to obtain a first priority ranking result

[0048] Assuming by way of example only, for example, the two prioritization dimensions specified by the current prioritization rule are COP and water chiller type, after adjusting the two prioritization dimensions, the first prioritization dimension highest-ranked is COP and the second prioritization dimension second-ranked is water chiller type. If the central air conditioning system comprises water chiller 1, water chiller 2, water chiller 3 and water chiller 4, the first priority ranking result obtained after ranking the water chillers based on the first prioritization dimension (e.g., COP) is, for example: the first priority ranking level relates to the water chiller 4, the second priority ranking level relates to the second water chiller 1, and the third priority ranking level relates to the water chiller 2 and the water chiller 3.

[0049] In step 404, if one or more first priority ranking levels in the first priority ranking result obtained in step 402 relate to a plurality of to-be-started water chillers (namely, relating to a plurality of water chillers in a plurality of to-be-started water chillers included in a central air conditioning system), the to-be-started water chillers related to the one or more first priority ranking levels are then respectively further ranked based on a second prioritization dimension second-ranked in the adjusted prioritization rule so as to obtain a second priority ranking result.

[0050] For example, in the previous example, since the third priority ranking level relates to two water chillers in the first priority ranking result, in step 404, the water chillers 2 and 3 would be further ranked based on the second prioritization dimension (e.g., water chiller type) second-ranked in the adjusted prioritization rule. Assuming that after the water chillers 2 and 3 are further ranked based on the second prioritization dimension, the priority ranking level of the water chiller 3 is higher than the priority ranking level of the water chiller 2, and it can be determined therefrom that the second priority ranking result is: the first priority ranking level relates to the water chiller 4, the second priority ranking level relates to the second water chiller 1, the third priority ranking level relates to the water chiller 3, and the fourth priority ranking level relates to the water chiller 2.

[0051] In step 406, if each second priority ranking level

in the second priority ranking result only relates to one to-be-started water chiller, the second priority ranking result is taken as a final priority ranking result of the plurality of to-be-started water chillers (i. e., The plurality of to-be-started water chillers included in the central air conditioning system).

[0052] Continuing with the previous example, the second priority ranking result is: the first priority ranking level relates to the water chiller 4, the second priority ranking level relates to the second water chiller 1, the third priority ranking level relates to the water chiller 3, and the fourth priority ranking level relates to the water chiller 2. It can be seen therefrom that each second priority ranking level therein only relates to one to-be-started water chiller, and therefore the final priority ranking result in this example is the second priority ranking result.

[0053] In step 408, if one or more second priority ranking levels in the second priority ranking result relate to a plurality of to-be-started water chillers (namely, relating to a plurality of to-be-started water chillers included in the central air conditioning system), the to-be-started water chillers related to the one or more second priority ranking levels are further ranked respectively in a random manner so as to obtain a final priority ranking result of the plurality of to-be-started water chillers

[0054] By way of example only, if the second priority ranking result is: the first priority ranking level relates to the water chiller 4, the second priority ranking level relates to the second water chiller 1, the third priority ranking level relates to the water chiller 3, and the fourth priority ranking level relates to the water chiller 2 and the water chiller 5. It can be seen therefrom that the fourth priority ranking level at this moment relates to two water chillers. Thus, in step 408, the water chiller 2 and the water chiller 5 may be randomly ordered, assuming that the randomly ordered water chiller 5 has a priority ranking before water chiller 2. Thus, in this example, the final priority ranking result is: the first priority ranking level relates to the water chiller 4, the second priority ranking level relates to the second water chiller 1, the third priority ranking level relates to the water chiller 3, the fourth priority ranking level relates to the water chiller 5, and the fifth priority ranking level relates to the water chiller 2.

[0055] Although an embodiment in which the ranking order of two prioritization dimensions is adjusted if the current prioritization rule specifies two prioritization dimensions is presented in the embodiment shown in FIG. 4, it should be understood that the current prioritization rule may also specify three, four, or more prioritization dimensions in the present disclosure. In case the current prioritization rule specifies three, four or more prioritization dimensions, the method of ranking a plurality of to-be-started water chillers based on the adjusted prioritization rule is similar to the method 400 as shown in FIG. 4.

[0056] For example, in the case that the current prioritization rule specifies four prioritization dimensions, the method of ranking the plurality of to-be-started water chillers based on the adjusted prioritization rule may com-

prise: ranking the plurality of to-be-started water chillers (namely, a plurality of to-be-started water chillers included in the central air conditioning system) based on a first prioritization dimension highest-ranked in the adjusted prioritization rule so as to obtain a first priority ranking result

[0057] If one or more first priority ranking levels in the first priority ranking result relate to a plurality of to-be-started water chillers (namely, a plurality of water chillers in the plurality of to-be-started water chillers included in the central air conditioning system), then the to-be-started water chillers related to the one or more first prioritization levels are respectively further ranked based on a second prioritization dimension second-ranked in the adjusted prioritization rule so as to obtain a second priority ranking result.

[0058] If each second priority ranking level in the second priority ranking result only relates to one to-be-started water chiller, the second priority ranking result is taken as a final priority ranking result of the plurality of to-be-started water chillers.

[0059] If one or more second priority ranking levels in the second priority ranking result relate to a plurality of to-be-started water chillers, the to-be-started water chillers related to the one or more second priority ranking levels are then respectively further ranked based on a third prioritization dimension third-ranked in the adjusted prioritization rule so as to obtain a third priority ranking result.

[0060] If each third priority ranking level in the third priority ranking result only relates to one to-be-started water chiller, the third priority ranking result is taken as a final priority ranking result of the plurality of to-be-started water chillers.

[0061] If one or more third priority ranking levels in the third priority ranking result relate to a plurality of to-be-started water chillers, the water chillers related to the one or more third priority ranking levels are then respectively further ranked based on a fourth prioritization dimension fourth-ranked in the adjusted prioritization rule so as to obtain a fourth priority ranking result.

[0062] If each fourth priority ranking level in the fourth priority ranking result only relates to one to-be-started water chiller, the fourth priority ranking result is taken as a final priority ranking result of the plurality of to-be-started water chillers.

[0063] If one or more fourth priority ranking levels in the fourth priority ranking result relate to a plurality of to-be-started water chillers, the to-be-started water chillers related to the one or more fourth priority ranking levels are further ranked respectively in a random manner so as to obtain a final priority ranking result of the plurality of to-be-started water chillers.

[0064] By adopting the above means, the present disclosure is able to quickly and accurately determine the currently most suitable to-be-started water chiller.

[0065] FIG. 5 illustrates a block diagram of an electronic device 500 according to an embodiment of the present

disclosure. For example, the air conditioning control apparatus 110 shown in FIG. 1 can be implemented by the device 500. As shown, the device 500 includes a central process unit (CPU) 501, which can execute various suitable actions and processing based on the computer program instructions stored in the read-only memory (ROM) 502 or computer program instructions loaded in the random-access memory (RAM) 503 from a storage unit 508. The RAM 503 can also store all kinds of programs and data required by the operations of the device 500. CPU 501, ROM 502 and RAM 503 are connected to each other via a bus 504. The input/output (I/O) interface 505 is also connected to the bus 504.

[0066] A plurality of components in the device 500 is connected to the I/O interface 505, including: an input unit 506, such as keyboard, mouse, microphone and the like; an output unit 507, e.g., various kinds of display and loudspeakers etc.; a storage unit 508, such as magnetic disk and optical disk etc.; and a communication unit 509, such as network card, modem, wireless transceiver and the like. The communication unit 509 allows the device 500 to exchange information/data with other devices via the computer network, such as Internet, and/or various telecommunication networks.

[0067] The above described each procedure and processing, such as the methods 200-400, can also be executed by the processing unit 501. For example, in some embodiments, methods 200-400 can be implemented as a computer software program tangibly included in the machine-readable medium, e.g., storage unit 508. In some embodiments, the computer program can be partially or fully loaded and/or mounted to the device 500 via ROM 502 and/or communication unit 509. When the computer program is loaded to RAM 503 and executed by the CPU 501, one or more steps of the above described methods 200-400 can be implemented.

[0068] The present disclosure can be method, apparatus, system, electronic device, a computer-readable storage medium and/or computer program product. The computer program product can include a computer-readable storage medium, on which the computer-readable program instructions for executing various aspects of the present disclosure are loaded.

[0069] The computer-readable storage medium can be a tangible apparatus that maintains and stores instructions utilized by the instruction executing apparatuses. The computer-readable storage medium can be, but not limited to, such as electrical storage device, magnetic storage device, optical storage device, electromagnetic storage device, semiconductor storage device or any appropriate combinations of the above. More concrete examples of the computer-readable storage medium (non-exhaustive list) include: portable computer disk, hard disk, random-access memory (RAM), read-only memory (ROM), erasable programmable read-only memory (EPROM or flash), static random-access memory (SRAM), portable compact disk read-only memory (CD-ROM), digital versatile disk (DVD), memory stick, floppy

disk, mechanical coding devices, punched card stored with instructions thereon, or a projection in a slot, and any appropriate combinations of the above. The computer-readable storage medium utilized here is not interpreted as transient signals per se, such as radio waves or freely propagated electromagnetic waves, electromagnetic waves propagated via waveguide or other transmission media (such as optical pulses via fiber-optic cables), or electric signals propagated via electric wires.

[0070] The described computer-readable program instruction can be downloaded from the computer-readable storage medium to each computing/processing device, or to an external computer or external storage via Internet, local area network, wide area network and/or wireless network. The network can include copper-transmitted cable, optical fiber transmission, wireless transmission, router, firewall, switch, network gate computer and/or edge server. The network adapter card or network interface in each computing/processing device receives computer-readable program instructions from the network and forwards the computer-readable program instructions for storage in the computer-readable storage medium of each computing/processing device.

[0071] The computer program instructions for executing operations of the present disclosure can be assembly instructions, instructions of instruction set architecture (ISA), machine instructions, machine-related instructions, microcodes, firmware instructions, state setting data, or source codes or target codes written in any combinations of one or more programming languages, wherein the programming languages consist of object-oriented programming languages, e.g., Smalltalk, C++ and so on, and traditional procedural programming languages, such as "C" language or similar programming languages. The computer-readable program instructions can be implemented fully on the user computer, partially on the user computer, as an independent software package, partially on the user computer and partially on the remote computer, or completely on the remote computer or server. In the case where remote computer is involved, the remote computer can be connected to the user computer via any type of networks, including local area network (LAN) and wide area network (WAN), or to the external computer (e.g., connected via Internet using the Internet service provider). In some embodiments, state information of the computer-readable program instructions is used to customize an electronic circuit, e.g., programmable logic circuit, field programmable gate array (FPGA) or programmable logic array (PLA). The electronic circuit can execute computer-readable program instructions to implement various aspects of the present disclosure.

[0072] Various aspects of the present disclosure are described here with reference to flow chart and/or block diagram of method, apparatus (system) and computer program products according to embodiments of the present disclosure. It should be understood that each block of the flow chart and/or block diagram and the com-

bination of various blocks in the flow chart and/or block diagram can be implemented by computer-readable program instructions.

[0073] The computer-readable program instructions can be provided to the processing unit of general-purpose computer, dedicated computer or other programmable data processing apparatuses to manufacture a machine, such that the instructions that, when executed by the processing unit of the computer or other programmable data processing apparatuses, generate an apparatus for implementing functions/actions stipulated in one or more blocks in the flow chart and/or block diagram. The computer-readable program instructions can also be stored in the computer-readable storage medium and cause the computer, programmable data processing apparatus and/or other devices to work in a particular manner, such that the computer-readable medium stored with instructions contains an article of manufacture, including instructions for implementing various aspects of the functions/actions stipulated in one or more blocks of the flow chart and/or block diagram.

[0074] The computer-readable program instructions can also be loaded into computer, other programmable data processing apparatuses or other devices, so as to execute a series of operation steps on the computer, other programmable data processing apparatuses or other devices to generate a computer-implemented procedure. Therefore, the instructions executed on the computer, other programmable data processing apparatuses or other devices implement functions/actions stipulated in one or more blocks of the flow chart and/or block diagram.

[0075] The flow chart and block diagram in the drawings illustrate system architecture, functions and operations that may be implemented by system, method and computer program product according to multiple implementations of the present disclosure. In this regard, each block in the flow chart or block diagram can represent a module, a part of program segment or code, wherein the module and the part of program segment or code include one or more executable instructions for performing stipulated logic functions. In some alternative implementations, it should be noted that the functions indicated in the block can also take place in an order different from the one indicated in the drawings. For example, two successive blocks can be in fact executed in parallel or sometimes in a reverse order dependent on the involved functions. It should also be noted that each block in the block diagram and/or flow chart and combinations of the blocks in the block diagram and/or flow chart can be implemented by a hardware-based system exclusive for executing stipulated functions or actions, or by a combination of dedicated hardware and computer instructions.

[0076] Various implementations of the present disclosure have been described above and the above description is only exemplary rather than exhaustive and is not limited to the implementations of the present disclosure. Many modifications and alterations, without deviating from the scope and spirit of the explained various imple-

mentations, are obvious for those skilled in the art. The selection of terms in the text aims to best explain principles and actual applications of each implementation and technical improvements made in the market by each embodiment, or enable other ordinary skilled in the art to understand implementations of the present disclosure.

Claims

1. A method for controlling a water chiller in a central air conditioning system, comprising:

acquiring a current prioritization rule when a to-be-started water chiller in a central air conditioning system needs to be started, the current prioritization rule specifying a plurality of prioritization dimensions for prioritizing a plurality of to-be-started water chillers included in the central air conditioning system and a ranking order of the plurality of prioritization dimensions;
determining a plurality of data each to-be-started water chiller respectively associated with one or more of the plurality of prioritization dimensions;
adjusting a ranking order of the plurality of prioritization dimensions based on the acquired plurality of data to obtain an adjusted prioritization rule;
ranking the plurality of to-be-started water chillers based on an adjusted prioritization rule; and
determining, based on a final ranking result of the plurality of to-be-started water chillers, a currently most suitable to-be-started water chiller so as to control to start the determined a to-be-started water chiller.

2. The method of claim 1, wherein the plurality of prioritization dimensions comprising two or more of water chiller type, rated power, total operating time, and Coefficient Of Performance (COP), and adjusting a ranking order of the plurality of prioritization dimensions based on the acquired plurality of data comprises:

if a plurality of prioritization dimensions of the current prioritization rule comprising a total operating time of a water chiller, and a difference between the maximum total operating time and the minimum total operating time in the acquired plurality of total operating times of the plurality of to-be-started water chillers being greater than or equal to a first set value, then a total operating time of a water chiller being adjusted to be the highest-ranked prioritization dimension in the plurality of prioritization dimensions;
if the plurality of prioritization dimensions further comprising a COP of a water chiller, and a dif-

ference between the maximum COP data and the minimum COP data in the acquired plurality of COP data of the plurality of to-be-started water chillers being greater than or equal to a second set value, then a COP of a water chiller being adjusted to be the second-ranked prioritization dimension in the plurality of prioritization dimensions.

3. The method of claim 1, wherein the plurality of prioritization dimensions comprising two or more of water chiller type, rated power, total operating time, and COP, and adjusting a ranking order of the plurality of prioritization dimensions based on the acquired plurality of data comprises:

if the plurality of prioritization dimensions comprising a total operating time of a water chiller, and a difference between the maximum total operating time and the minimum total operating time in the acquired plurality of total operating times of the plurality of to-be-started water chillers being less than a first set value, then a total operating time of a water chiller being adjusted to be the lowest-ranked prioritization dimension in the plurality of prioritization dimensions;
if the plurality of prioritization dimensions further comprising a COP of a water chiller, and a difference between the maximum COP data and the minimum COP data in the acquired plurality of COP data of the plurality of to-be-started water chillers being greater than or equal to a second set value, then a COP of a water chiller being adjusted to be the highest-ranked prioritization dimension in the plurality of prioritization dimensions.

4. The method of claim 1, wherein the plurality of prioritization dimensions comprising two or more of water chiller type, rated power, total operating time, and COP, and adjusting a ranking order of the plurality of prioritization dimensions based on the acquired plurality of data comprises:

if the plurality of prioritization dimensions not comprising a total operating time of a water chiller but comprising a COP of a water chiller, and a difference between the maximum COP data and the minimum COP data in the acquired plurality of COP data of the plurality of to-be-started water chillers being greater than or equal to a second set value, then a COP of a water chiller being adjusted to be the highest-ranked prioritization dimension in the plurality of prioritization dimensions.

5. The method of claim 1, wherein ranking the plurality of to-be-started water chillers based on an adjusted prioritization rule comprises:

- ranking the plurality of to-be-started water chillers based on a first prioritization dimension highest-ranked in the adjusted prioritization rule so as to obtain a first priority ranking result;
 if one or more first priority ranking levels in the first priority ranking result relating to a plurality of to-be-started water chillers, then respectively further ranking the to-be-started water chillers related to the one or more first priority ranking levels based on a second prioritization dimension second-ranked in the adjusted prioritization rule so as to obtain a second priority ranking result.
6. The method of claim 5, wherein the current prioritization rule specifies two prioritization dimensions, and ranking the plurality of to-be-started water chillers based on an adjusted prioritization rule further comprises:
- if each second priority ranking level in the second priority ranking result only relating to one to-be-started water chiller, taking the second priority ranking result as a final priority ranking result of the plurality of to-be-started water chillers;
 if one or more second priority ranking levels in the second priority ranking result relating to a plurality of to-be-started water chillers, further ranking to-be-started water chillers related to the one or more second priority ranking levels respectively in a random manner so as to obtain a final priority ranking result of the plurality of to-be-started water chillers.
7. The method of claim 1, wherein the current prioritization rule specifies four prioritization dimensions, and ranking the plurality of to-be-started water chillers based on an adjusted prioritization rule further comprises:
- if each second priority ranking level in the second priority ranking result only relating to one to-be-started water chiller, taking the second priority ranking result as a final priority ranking result of the plurality of to-be-started water chillers;
 if one or more second priority ranking levels in the second priority ranking result relating to a plurality of to-be-started water chillers, then respectively further ranking to-be-started water chillers related to the one or more second priority ranking levels based on a third prioritization dimension third-ranked in the adjusted prioritization rule so as to obtain a third priority ranking result;
 if each third priority ranking level in the third priority ranking result only relating to one to-be-started water chiller, taking the third priority ranking result as a final priority ranking result of the plurality of to-be-started water chillers;
 if one or more third priority ranking levels in the third priority ranking result relating to a plurality of to-be-started water chillers, then respectively further ranking water chillers related to one or more third priority ranking levels based on a fourth prioritization dimension fourth-ranked in the adjusted prioritization rule so as to obtain a fourth priority ranking result;
 if each fourth priority ranking level in the fourth priority ranking result only relating to one to-be-started water chiller, taking the fourth priority ranking result as a final priority ranking result of the plurality of to-be-started water chillers;
 if one or more fourth priority ranking levels in the fourth priority ranking result relating to a plurality of to-be-started water chillers, further ranking to-be-started water chillers related to the one or more fourth priority ranking levels respectively in a random manner so as to obtain a final priority ranking result of the plurality of to-be-started water chillers.
8. The method according to claim 1, wherein determining, based on a final ranking result of the plurality of to-be-started water chillers, a currently most suitable to-be-started water chiller for a central air conditioning system comprises:
 selecting one or more to-be-started water chillers with the highest priority ranking level in the final ranking result as a currently most suitable to-be-started water chiller.
9. A computing device comprising:
 at least one processor; and
 a memory communicatively coupled to the at least one processor;
 the memory storing instructions executable by the at least one processor to enable the at least one processor to perform the method of any of claims 1-8.
10. A non-transitory computer-readable storage medium storing computer instructions for causing a computer to perform the method of any of claims 1-8.

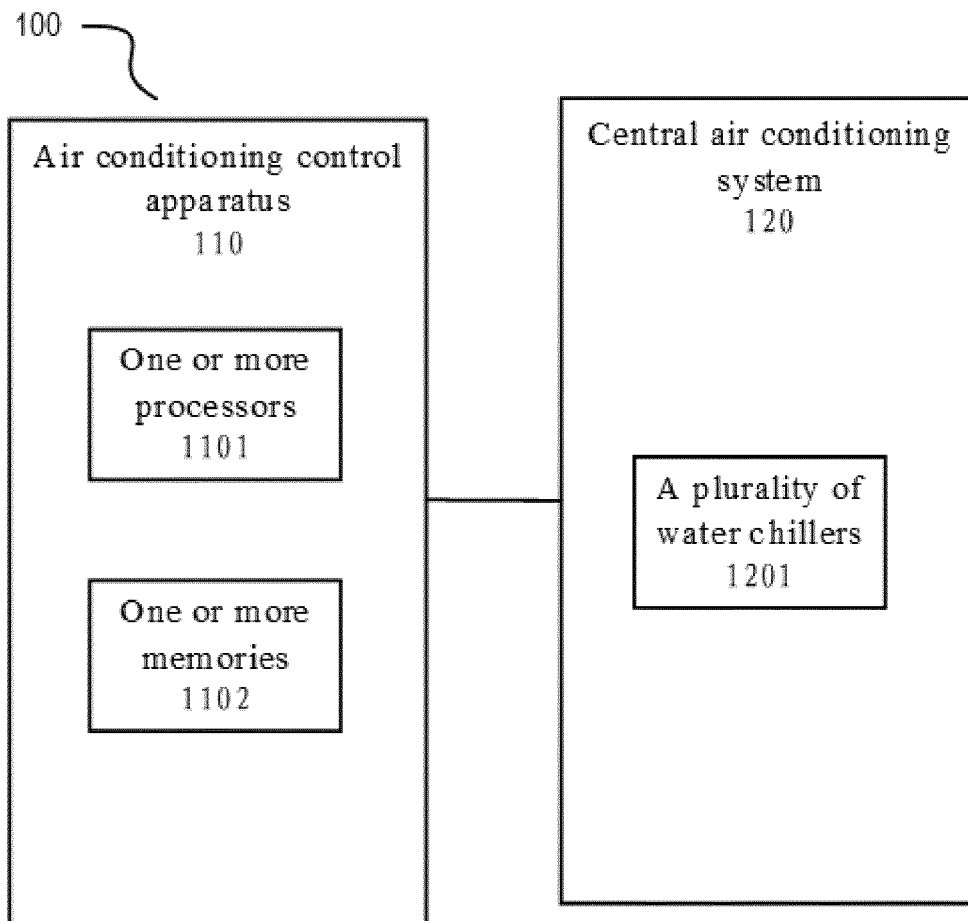


Figure 1

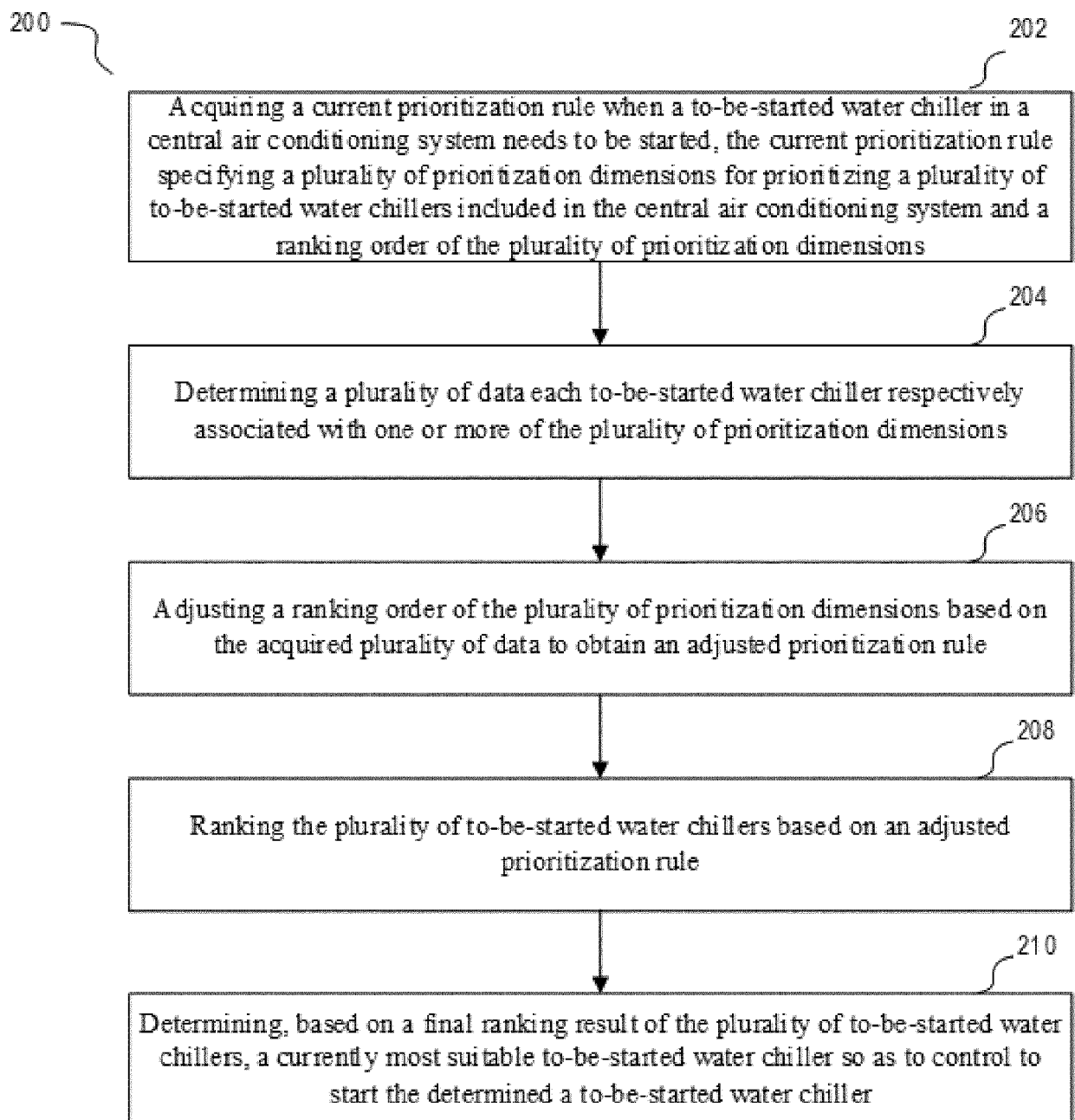


Figure 2

300

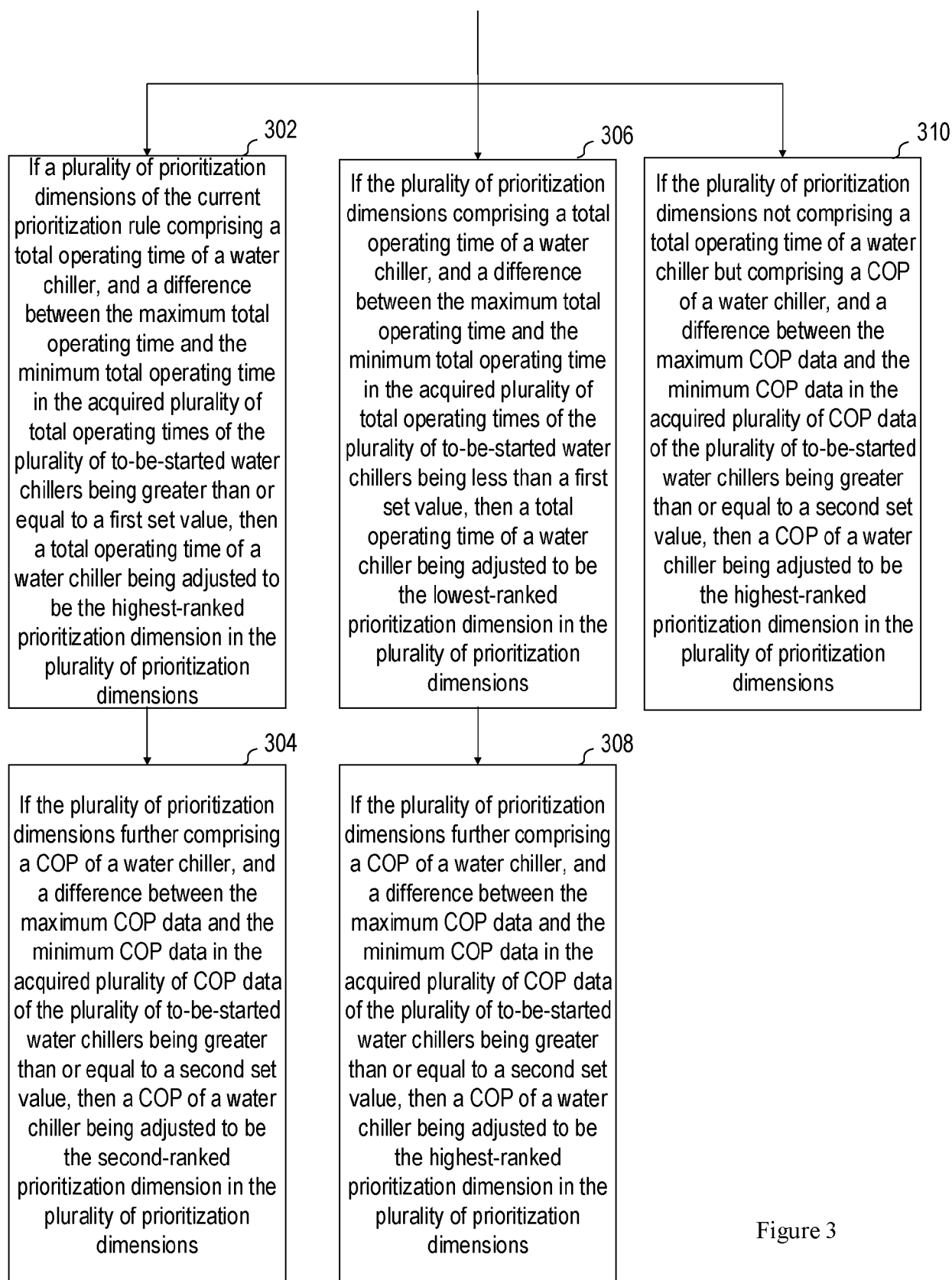


Figure 3

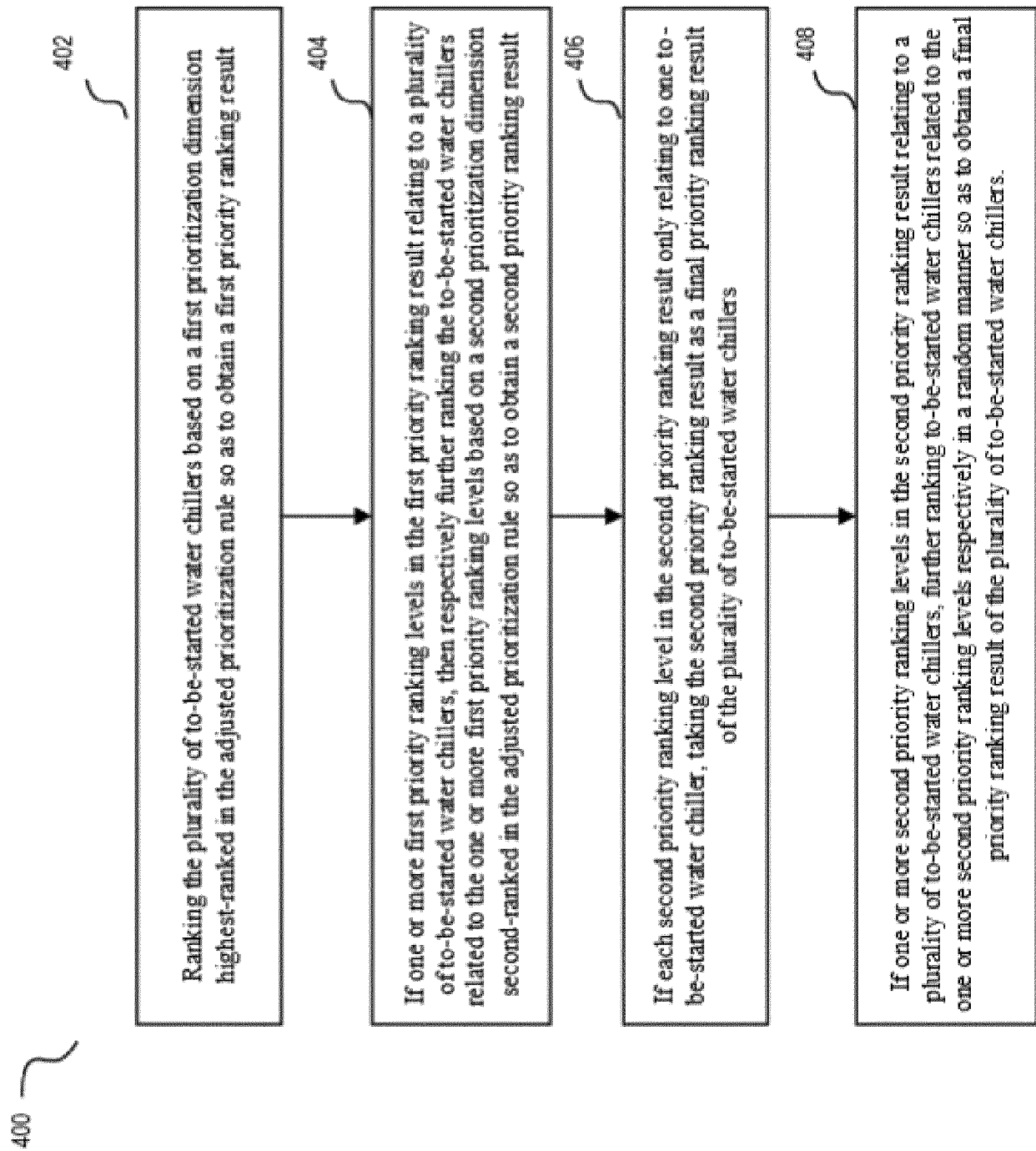


Figure 4

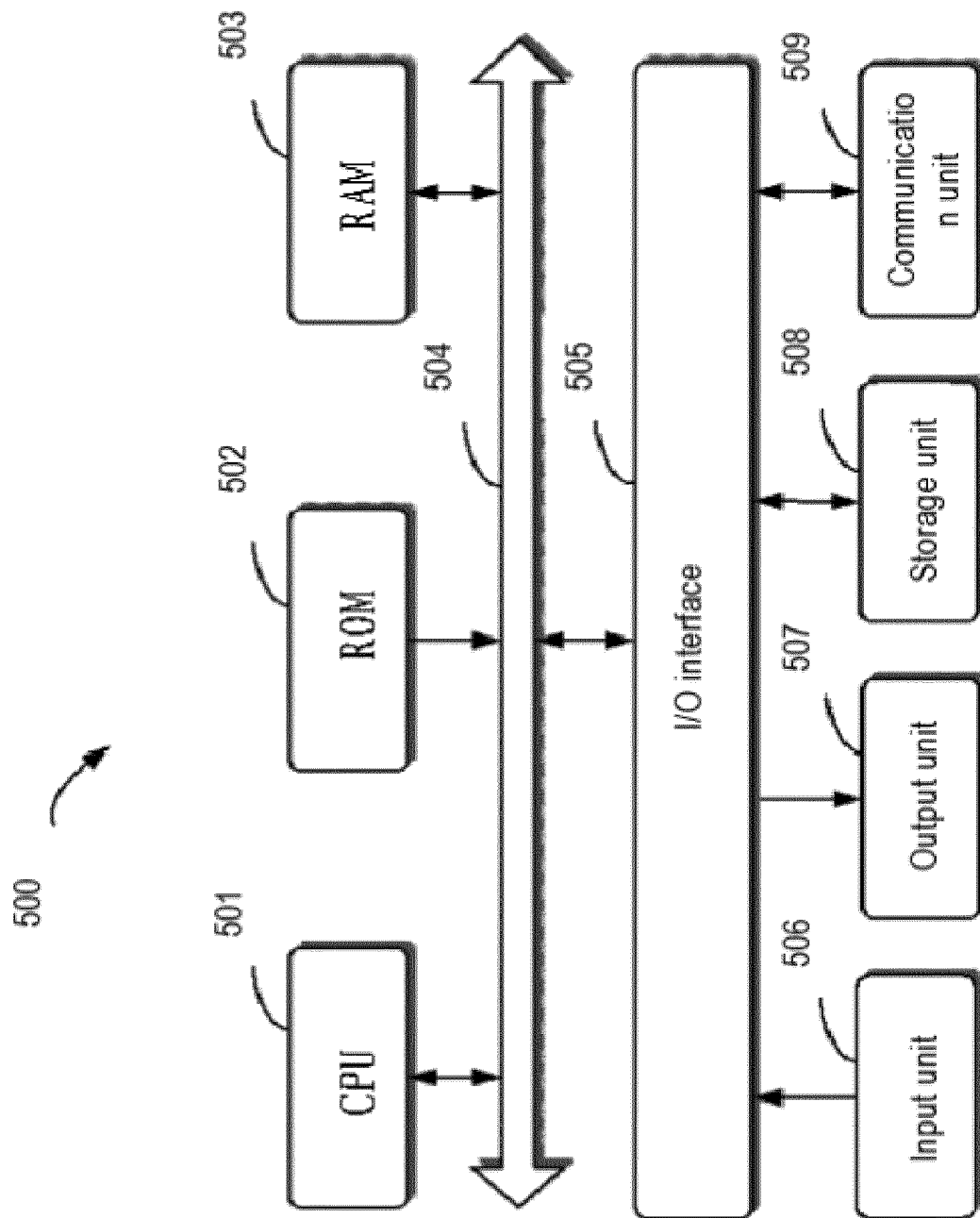


Figure 5