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(54) **CONTROL METHOD AND APPARATUS FOR ON-BOARD REFRIGERATOR, AND MEDIUM, CONTROLLER AND ON-BOARD REFRIGERATOR**

(57) A method and an apparatus for controlling an in-vehicle refrigerator, a medium, a controller, and an in-vehicle refrigerator are provided. A running mode of the in-vehicle refrigerator includes a normal cooling mode and a rapid cooling mode, and a target cooling temperature of the in-vehicle refrigerator is within a temperature range of the normal cooling mode. The method includes: when a load is newly added to the in-

vehicle refrigerator, controlling the in-vehicle refrigerator to run in the rapid cooling mode; and if a rapid cooling completion condition is met, controlling the in-vehicle refrigerator to switch from running in the rapid cooling mode to running in the normal cooling mode, where a lower limit of a temperature range of the rapid cooling mode is lower than a lower limit of the temperature range of the normal cooling mode.

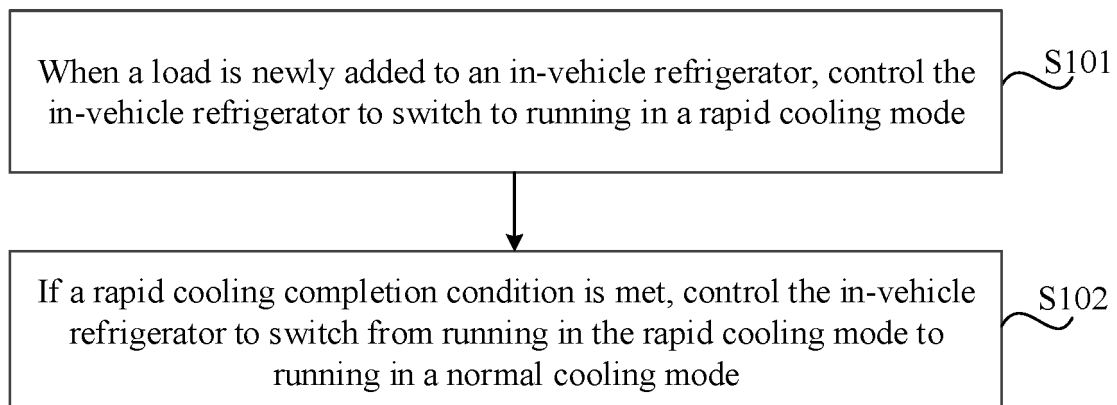


FIG. 1

## Description

### CROSS-REFERENCE TO RELATED APPLICATIONS

**[0001]** The present disclosure claims priority to Chinese Patent Application No. 202311734951.7, filed with the China National Intellectual Property Administration on December 15, 2023 and entitled "METHOD AND APPARATUS FOR CONTROLLING IN-VEHICLE REFRIGERATOR, MEDIUM, CONTROLLER, AND IN-VEHICLE REFRIGERATOR", which is incorporated herein by reference in its entirety.

### TECHNICAL FIELD

**[0002]** The present disclosure relates to the field of in-vehicle device control technologies, and specifically, to a method and an apparatus for controlling an in-vehicle refrigerator, a medium, a controller, and an in-vehicle refrigerator.

### BACKGROUND

**[0003]** With the development of vehicle technologies, users have increasingly high requirements for the intelligence of in-vehicle products. An in-vehicle refrigerator is a refrigeration cabinet that can be carried in a vehicle. The in-vehicle refrigerators are a new generation of cooling and refrigeration devices that have become popular in the market in recent years.

### SUMMARY

**[0004]** An objective of the present disclosure is to provide a method and an apparatus for controlling an in-vehicle refrigerator, a medium, a controller, and an in-vehicle refrigerator, to accelerate a cooling speed of a load.

**[0005]** To achieve the foregoing objective, the present disclosure provides a method for controlling an in-vehicle refrigerator. A running mode of the in-vehicle refrigerator includes a normal cooling mode and a rapid cooling mode, and a target cooling temperature of the in-vehicle refrigerator is within a temperature range of the normal cooling mode. The method includes:

when a load is newly added to the in-vehicle refrigerator, controlling the in-vehicle refrigerator to run in the rapid cooling mode; and  
if a rapid cooling completion condition is met, controlling the in-vehicle refrigerator to switch from running in the rapid cooling mode to running in the normal cooling mode.

**[0006]** A lower limit of a temperature range of the rapid cooling mode is lower than a lower limit of the temperature range of the normal cooling mode.

**[0007]** Optionally, before controlling the in-vehicle re-

frigerator to run in the rapid cooling mode, the method further includes:

determining the temperature range of the rapid cooling mode.

**[0008]** Optionally, determining the temperature range of the rapid cooling mode includes:

determining the temperature range of the rapid cooling mode based on a temperature in a passenger compartment and an influence factor, wherein the influence factor includes at least one of a heat load of the newly added load and the target cooling temperature.

**[0009]** Optionally, determining the temperature range of the rapid cooling mode based on the temperature in the passenger compartment and the influence factor includes:

finding, in a predetermined first correspondence, a temperature range corresponding to a current temperature in the passenger compartment and a current influence factor, and using the temperature range as the temperature range of the rapid cooling mode, wherein the first correspondence includes a correspondence between a temperature range and each of the temperature in the passenger compartment and the influence factor.

**[0010]** Optionally, after controlling the in-vehicle refrigerator to run in the rapid cooling mode, the method further includes:

updating the temperature range of the rapid cooling mode based on a temperature change rate in the in-vehicle refrigerator after the load is newly added.

**[0011]** Optionally, the rapid cooling completion condition meets at least one of the following:

a quantity of hysteresis times of a temperature in the in-vehicle refrigerator within the temperature range of the rapid cooling mode reaches a quantity threshold; and

duration in which the in-vehicle refrigerator runs in the rapid cooling mode reaches a duration threshold.

**[0012]** Optionally, the method further includes:

determining the quantity threshold based on the temperature in the passenger compartment and the influence factor, wherein the influence factor includes at least one of the heat load of the newly added load and the target cooling temperature.

**[0013]** Optionally, determining the quantity threshold based on the temperature in the passenger compartment and the influence factor includes:

finding, in a predetermined second correspondence, a quantity of times corresponding to a current temperature in the passenger compartment and a current influence factor, and using the quantity of times as the quantity threshold, where the second correspondence includes a correspondence between a quantity of times and each of the temperature in the passenger compartment and the influence factor.

**[0014]** Optionally, after determining the quantity threshold based on the temperature in the passenger compartment and the influence factor, the method further includes:

updating the quantity threshold based on the temperature change rate in the in-vehicle refrigerator after the load is newly added.

**[0015]** Optionally, the method further includes:

if the following condition is met, determining that a load is newly added to the in-vehicle refrigerator: a door of the in-vehicle refrigerator is opened; and/or a weight carried by a shelf in the in-vehicle refrigerator is increased.

**[0016]** The present disclosure further provides an apparatus for controlling an in-vehicle refrigerator. A running mode of the in-vehicle refrigerator includes a normal cooling mode and a rapid cooling mode, and a target cooling temperature of the in-vehicle refrigerator is within a temperature range of the normal cooling mode. The apparatus includes:

a first control module, configured to: when a load is newly added to the in-vehicle refrigerator, control the in-vehicle refrigerator to run in the rapid cooling mode; and

a second control module, configured to: if a rapid cooling completion condition is met, control the in-vehicle refrigerator to switch from running in the rapid cooling mode to running in the normal cooling mode.

**[0017]** A lower limit of a temperature range of the rapid cooling mode is lower than a lower limit of the temperature range of the normal cooling mode.

**[0018]** The present disclosure further provides a non-temporary computer-readable storage medium. The non-temporary computer-readable storage medium stores computer program instructions, and when the program instructions are executed by a processor, the steps of the foregoing method provided in the present disclosure are implemented.

**[0019]** The present disclosure further provides a controller, applied to an in-vehicle refrigerator. A running mode of the in-vehicle refrigerator includes a normal cooling mode and a rapid cooling mode, and a target cooling temperature of the in-vehicle refrigerator is within a temperature range of the normal cooling mode. The controller includes:

a memory, where the memory stores a computer program; and

a processor, configured to execute the computer program in the memory to implement the following operations:

when a load is newly added to the in-vehicle refrigerator, controlling the in-vehicle refrigerator to run in the rapid cooling mode; and

if a rapid cooling completion condition is met, controlling the in-vehicle refrigerator to switch from running in the rapid cooling mode to running in the normal cooling mode.

**[0020]** A lower limit of a temperature range of the rapid cooling mode is lower than a lower limit of the temperature range of the normal cooling mode.

**[0021]** The present disclosure further provides an in-vehicle refrigerator, including the foregoing controller provided in the present disclosure.

**[0022]** According to the foregoing technical solution, the rapid cooling mode is newly added to the in-vehicle refrigerator. When a load is newly added to the in-vehicle refrigerator, the in-vehicle refrigerator is controlled to run in the rapid cooling mode, and when the rapid cooling completion condition is met, the in-vehicle refrigerator is controlled to switch from running in the rapid cooling mode to running in the normal cooling mode. The lower limit of the temperature range of the rapid cooling mode is lower than the lower limit of the temperature range of the normal cooling mode. Therefore, when a load is newly added to the in-vehicle refrigerator, a temperature increase in the in-vehicle refrigerator caused by the new load can be rapidly mitigated, so that the load can be more rapidly cooled, thereby improving user experience. In addition, an implementation method in this solution is simple, and no long-term experiments are required to develop a control policy, thereby reducing experimental costs and facilitating rapid application.

**[0023]** Other features and advantages of the present disclosure will be described in detail in the subsequent description of embodiments.

## BRIEF DESCRIPTION OF DRAWINGS

**[0024]** The accompanying drawings are intended to provide a further understanding of the present disclosure and constitute a part of the specification, and are used together with the following specific implementations to explain the present disclosure, but do not constitute a limitation on the present disclosure. In the accompanying drawings:

FIG. 1 is a flowchart of a method for controlling an in-vehicle refrigerator according to an exemplary embodiment;

FIG. 2 is a graph showing a change of a temperature in an in-vehicle refrigerator over time according to an exemplary embodiment;

FIG. 3 is a flowchart of a method for controlling an in-vehicle refrigerator according to another exemplary embodiment; and

FIG. 4 is a block diagram of an apparatus for controlling an in-vehicle refrigerator according to an exemplary embodiment.

## DESCRIPTION OF EMBODIMENTS

**[0025]** Specific implementations of the present disclosure will be described in detail below in combination with the accompanying drawings. It will be understood that the specific implementations described herein are merely intended to describe and explain the present disclosure and are not intended to limit the present disclosure.

**[0026]** In related technologies, a new load added to an in-vehicle refrigerator is usually cooled relatively slowly. How the in-vehicle refrigerator rapidly cools the load to meet a requirement of a customer is central to user experience.

**[0027]** FIG. 1 is a flowchart of a method for controlling an in-vehicle refrigerator according to an exemplary embodiment. As shown in FIG. 1, the method includes the following steps:

In step S101, when a load is newly added to the in-vehicle refrigerator, the in-vehicle refrigerator is controlled to run in a rapid cooling mode.

**[0028]** In step S102, if a rapid cooling completion condition is met, the in-vehicle refrigerator is controlled to switch from running in the rapid cooling mode to running in a normal cooling mode.

**[0029]** A running mode of the in-vehicle refrigerator includes the normal cooling mode and the rapid cooling mode. A lower limit of a temperature range of the rapid cooling mode is lower than a lower limit of a temperature range of the normal cooling mode, and a target cooling temperature of the in-vehicle refrigerator is within the temperature range of the normal cooling mode.

**[0030]** A load is an item that a user places in the in-vehicle refrigerator with an expectation of cooling the item. Newly adding a load to the in-vehicle refrigerator may be the following: a user placing a new item requiring cooling in the in-vehicle refrigerator. The in-vehicle refrigerator may autonomously determine whether a load is newly added, or may determine, in response to receiving an instruction sent by a user or another device, that a load is newly added. For example, the in-vehicle refrigerator may receive an instruction sent through a wireless communication technology by a mobile terminal bound to the in-vehicle refrigerator.

**[0031]** The target cooling temperature of the in-vehicle refrigerator is a temperature that a load in the in-vehicle refrigerator is expected to ultimately reach after cooling, and may be a temperature set by a user on a control panel (for example, a refrigerator compartment is set to 2°C, and a freezer compartment is set to -18°C), or a temperature set for the in-vehicle refrigerator at delivery.

**[0032]** The normal cooling mode may be, for example, a mode in which the in-vehicle refrigerator performs cooling in the related technologies. The temperature range of the normal cooling mode is a range within which hysteresis of a temperature in the in-vehicle re-

frigerator is controlled in the normal cooling mode. The temperature range of the rapid cooling mode is a range within which hysteresis of a temperature in the in-vehicle refrigerator is controlled in the rapid cooling mode.

**[0033]** The target cooling temperature of the in-vehicle refrigerator may be within the temperature range of the normal cooling mode, may be an upper limit or a lower limit, or may be a temperature between the upper limit and the lower limit.

**[0034]** For example, a target cooling temperature in the refrigerator compartment of the in-vehicle refrigerator is 3°C, the temperature range of the normal cooling mode is from 2°C to 4°C, where 4°C is the upper limit, and 2°C is the lower limit; and the temperature range of the rapid cooling mode is from 0°C to 2°C, where 2°C is the upper limit, and 0°C is the lower limit.

**[0035]** Hysteresis within a temperature range refers to oscillation back and forth within the temperature range. For example, when a temperature in the in-vehicle refrigerator reaches an upper limit of a temperature range, the in-vehicle refrigerator may be controlled to enable cooling, to decrease the temperature in the in-vehicle refrigerator. When the temperature in the in-vehicle refrigerator reaches a lower limit of the temperature range, the in-vehicle refrigerator may be controlled to pause cooling, to maintain the temperature. The temperature in the in-vehicle refrigerator may be derived from an evaporation temperature detected by a temperature sensor provided inside the in-vehicle refrigerator.

**[0036]** The rapid cooling completion condition may be preset, or may be determined in real time. If the rapid cooling completion condition is met, it may be considered that a relatively good cooling effect is achieved after a load is newly added, and a temperature of the new load is close to the target cooling temperature. In this case, the in-vehicle refrigerator may switch to the normal cooling mode to save power.

**[0037]** Because the lower limit of the temperature range of the rapid cooling mode is lower than the lower limit of the temperature range of the normal cooling mode, a cooling speed of the in-vehicle refrigerator in the rapid cooling mode is higher than that in the normal cooling mode. An upper limit of the temperature range of the rapid cooling mode may be higher than or lower than an upper limit of the temperature range of the normal cooling mode, and preferably, is lower than the upper limit of the temperature range of the normal cooling mode. When the upper limit of the temperature range of the rapid cooling mode is lower than the lower limit of the temperature range of the normal cooling mode, a cooling speed is the highest and a better effect is achieved.

**[0038]** According to the foregoing technical solution, the rapid cooling mode is newly added to the in-vehicle refrigerator. When a load is newly added to the in-vehicle refrigerator, the in-vehicle refrigerator is controlled to run in the rapid cooling mode, and when the rapid

cooling completion condition is met, the in-vehicle refrigerator is controlled to switch from running in the rapid cooling mode to running in the normal cooling mode. The lower limit of the temperature range of the rapid cooling mode is lower than the lower limit of the temperature range of the normal cooling mode. Therefore, when a load is newly added to the in-vehicle refrigerator, a temperature increase in the in-vehicle refrigerator caused by the new load can be rapidly mitigated, so that the load can be more rapidly cooled, thereby improving user experience. In addition, an implementation method in this solution is simple, and no long-term experiments are required to develop a control policy, thereby reducing experimental costs and facilitating rapid application.

**[0039]** The temperature range of the rapid cooling mode may be fixed, or may be determined in real time; and may be automatically adjusted based on an environment in which the in-vehicle refrigerator is located and a load, or may be changed based on settings of a user. In another embodiment, before the in-vehicle refrigerator is controlled to run in the rapid cooling mode, the method further includes: determining the temperature range of the rapid cooling mode.

**[0040]** There may be a plurality of methods of determining the temperature range of the rapid cooling mode. For example, the temperature range of the rapid cooling mode may be determined based on factors such as humidity in a passenger compartment, an ambient temperature and humidity outside a vehicle, and a weight of a newly added load. For example, the factor, namely, the ambient temperature outside the vehicle is taken into consideration. When the ambient temperature outside the vehicle is lower than a temperature threshold (for example, 0°C), considering that a newly added load may come from outside the vehicle and a temperature of the newly added load is relatively low, the lower limit of the temperature range of the rapid cooling mode may be set higher than that set when the ambient temperature outside the vehicle is higher than the temperature threshold.

**[0041]** In this embodiment, the temperature range of the rapid cooling mode can be determined in real time based on an actual situation, so that rapid cooling for the new load is more flexible.

**[0042]** In addition, the temperature range of the normal cooling mode may also be determined in real time based on the target cooling temperature, may be automatically adjusted based on an environment in which the in-vehicle refrigerator is located and a load, or may be changed based on settings of a user.

**[0043]** In another embodiment, determining the temperature range of the rapid cooling mode includes: determining the temperature range of the rapid cooling mode based on a temperature in a passenger compartment and an influence factor, where the influence factor includes at least one of a heat load of the newly added load and the target cooling temperature.

**[0044]** A new load in the in-vehicle refrigerator is located in the passenger compartment before being placed in the in-vehicle refrigerator, and the temperature in the passenger compartment affects the temperature of the new load. Therefore, the temperature in the passenger compartment may be used as an influence factor for determining the temperature range of the rapid cooling mode, and a proper rapid cooling degree may be correspondingly determined based on the temperature in the passenger compartment. When the temperature in the passenger compartment is relatively high (for example, higher than a threshold), a rapid cooling degree may be relatively high, and the lower limit of the temperature range of the rapid cooling mode or an overall temperature of the range may be relatively low. When the temperature in the passenger compartment is relatively low (for example, lower than the threshold), a required rapid cooling degree may be relatively small, and the lower limit of the temperature range of the rapid cooling mode or an overall temperature of the range may be relatively high.

**[0045]** A heat load of a newly added load may be calculated based on parameters such as a weight, a temperature, and a material of the newly added load, and is a heat load that needs to be borne by the in-vehicle refrigerator. For example, a user may directly enter parameters such as a weight, a temperature, and a material of an item on a display screen of the in-vehicle refrigerator. A controller of the in-vehicle refrigerator determines a heat load of the newly added load by using a predetermined algorithm. Alternatively, the in-vehicle refrigerator may automatically weigh a load, and estimate a heat load based on a weight of the newly added load. A larger load weight indicates a lower cooling speed. To rapidly cool a load, corresponding to a load with a relatively large weight, an estimated heat load is relatively large, and the lower limit of the temperature range of the rapid cooling mode or an overall temperature of the range may be relatively low; and corresponding to a load with a relatively small weight, an estimated heat load is relatively small, and the lower limit of the temperature range of the rapid cooling mode or an overall temperature of the range may be relatively high.

**[0046]** The target cooling temperature may also be used as an influence factor for determining the temperature range of the rapid cooling mode. Corresponding to a relatively high target cooling temperature, the lower limit of the temperature range of the rapid cooling mode or an overall temperature of the range may be relatively high; and corresponding to a relatively low target cooling temperature, the lower limit of the temperature range of the rapid cooling mode or an overall temperature of the range may be relatively low.

**[0047]** In this embodiment, the temperature range of the rapid cooling mode is determined in real time based on one or more influence factors, so that rapid cooling has relatively good flexibility.

**[0048]** In another embodiment, determining the temperature range of the rapid cooling mode based on a temperature in a passenger compartment and an influence factor includes:

finding, in a predetermined first correspondence, a temperature range corresponding to a current temperature in the passenger compartment and a current influence factor, and using the temperature range as the temperature range of the rapid cooling mode.

**[0049]** The first correspondence includes a correspondence between a temperature range and each of the current temperature in the passenger compartment and the influence factor.

**[0050]** For example, the first correspondence may be pre-determined based on a test by using an interpolation method, and is stored. During running of the in-vehicle refrigerator, the temperature range of the rapid cooling mode can be directly determined through searching. The method is simple and reliable, and has a high processing speed.

**[0051]** In another embodiment, after the in-vehicle refrigerator is controlled to run in the rapid cooling mode, the method further includes: updating the temperature range of the rapid cooling mode based on a temperature change rate in the in-vehicle refrigerator after the load is newly added.

**[0052]** The temperature change rate in the in-vehicle refrigerator is a temperature change amount in the in-vehicle refrigerator in unit time, and reflects a speed of a temperature change in the in-vehicle refrigerator. The temperature change rate may be a positive value (a temperature increase) or a negative value (a temperature decrease). For example, if the temperature change rate is a positive value and is relatively high, it indicates that running in the rapid cooling mode after the load is newly added leads to a relatively fast temperature increase in the refrigerator. In this case, the lower limit of the temperature range of the rapid cooling mode or an overall temperature of the range may be updated to a relatively small value. If the temperature change rate is a negative value and is relatively high, it indicates that running in the rapid cooling mode after the load is newly added leads to a relatively fast temperature decrease in the refrigerator. In this case, the lower limit of the temperature range of the rapid cooling mode or an overall temperature of the range may be updated to a relatively large value.

**[0053]** In this embodiment, the temperature change rate in the in-vehicle refrigerator after the load is newly added is considered, to adjust the temperature range of the rapid cooling mode in real time, so that rapid cooling matches the load, and a cooling policy is more flexible.

**[0054]** In another embodiment, the rapid cooling completion condition includes at least one of the following:

a quantity of hysteresis times of a temperature in

the in-vehicle refrigerator within the temperature range of the rapid cooling mode reaches a quantity threshold; and

duration in which the in-vehicle refrigerator runs in the rapid cooling mode reaches a duration threshold.

**[0055]** Hysteresis refers to oscillation back and forth. Generally, when the temperature in the in-vehicle refrigerator reaches an upper limit of a temperature range, the in-vehicle refrigerator is controlled to enable cooling, to decrease the temperature in the in-vehicle refrigerator. When the temperature in the in-vehicle refrigerator reaches a lower limit of the temperature range, the in-vehicle refrigerator is controlled to pause cooling, to maintain the temperature. Therefore, the temperature in the in-vehicle refrigerator undergoes hysteresis in the temperature range. From the temperature in the in-vehicle refrigerator reaching the lower limit of the temperature range to the temperature in the in-vehicle refrigerator reaching the lower limit next time may be considered as one time of hysteresis.

**[0056]** FIG. 2 is a graph showing a change of a temperature in an in-vehicle refrigerator over time according to an exemplary embodiment. As shown in FIG. 2, a horizontal coordinate represents time, and a vertical coordinate represents the temperature in the in-vehicle refrigerator. Starting from a moment  $t=0$ , there is a new load in the in-vehicle refrigerator, and the in-vehicle refrigerator enters the rapid cooling mode. The temperature range of the rapid cooling mode is a temperature range  $[T_2, T_1]$ . The temperature range of the rapid cooling mode has a lower limit  $T_2$  and an upper limit  $T_1$ . The temperature range of the normal cooling mode is a temperature range  $[T_4, T_3]$ . The temperature range of the normal cooling mode has a lower limit  $T_4$  and an upper limit  $T_3$ . The temperature in the in-vehicle refrigerator reaches the lower limit  $T_2$  of the temperature range of the rapid cooling mode at a moment  $t_1$ , and reaches the lower limit  $T_2$  again at a moment  $t_2$ , and a range from the moment  $t_1$  to the moment  $t_2$  may be a hysteresis range.

**[0057]** In the embodiment of FIG. 2, the quantity threshold is 3. The temperature in the in-vehicle refrigerator separately reaches the lower limit  $T_2$  of the temperature range of the rapid cooling mode four times at moments  $t_1$ ,  $t_2$ ,  $t_3$ , and  $t_4$ . Then, the in-vehicle refrigerator may be controlled to enter the normal cooling mode, so that the temperature in the in-vehicle refrigerator undergoes hysteresis in the temperature range  $[T_4, T_3]$  of the normal cooling mode.

**[0058]** When the quantity of hysteresis times of the temperature in the in-vehicle refrigerator within the temperature range of the rapid cooling mode reaches the quantity threshold, it is usually considered that a temperature of a new load is close to the target cooling temperature, and the in-vehicle refrigerator may switch to the normal cooling mode, and no longer performs rapid

cooling.

**[0059]** In addition, duration in which the in-vehicle refrigerator enters the rapid cooling mode can also reflect a cooling effect. When the duration in which the in-vehicle refrigerator enters the rapid cooling mode reaches the duration threshold, it can also be considered that the temperature of the new load is close to the target cooling temperature.

**[0060]** In this embodiment, an occasion for switching from the rapid cooling mode to the normal cooling mode is determined based on a quantity of hysteresis times and running duration, which saves energy while ensuring a rapid cooling effect.

**[0061]** The quantity threshold may be predetermined, or may be determined in real time during running of the in-vehicle refrigerator. In another embodiment, the method further includes: determining the quantity threshold based on the temperature in the passenger compartment and the influence factor. The influence factor includes at least one of the heat load of the newly added load and the target cooling temperature.

**[0062]** The temperature in the passenger compartment, the heat load of the newly added load, and the target cooling temperature can all reflect a rapid cooling requirement to some extent. Therefore, similar to the temperature range of the rapid cooling mode, the quantity threshold may also be determined based on the foregoing influence factor. For example, a higher temperature in the passenger compartment indicates a larger quantity threshold, a larger heat load of the newly added load indicates a larger quantity threshold, and a lower target cooling temperature indicates a larger quantity threshold.

**[0063]** In this embodiment, the quantity threshold is determined in real time based on one or more influence factors, so that rapid cooling has relatively good flexibility.

**[0064]** In another embodiment, determining the quantity threshold based on the temperature in the passenger compartment and the influence factor includes: finding, in a predetermined second correspondence, a quantity of times corresponding to a current temperature in the passenger compartment and a current influence factor, and using the quantity of times as the quantity threshold. The second correspondence includes a correspondence between a quantity of times and each of the temperature in the passenger compartment and the influence factor.

**[0065]** For example, the second correspondence may be pre-determined based on a test by using an interpolation method, and is stored. During running of the in-vehicle refrigerator, the quantity threshold can be directly determined through searching. The method is simple and reliable, and has a high processing speed.

**[0066]** In another embodiment, after determining the quantity threshold based on the temperature in the passenger compartment and the influence factor, the method further includes: updating the quantity threshold

based on the temperature change rate in the in-vehicle refrigerator after the load is newly added.

**[0067]** If the temperature change rate is a positive value and is relatively high, it indicates that running in the rapid cooling mode after the load is newly added leads to a relatively fast temperature increase in the refrigerator. In this case, to make rapid cooling more stable, the quantity threshold may be updated to a relatively large value. If the temperature change rate is a negative value and is relatively high, it indicates that running in the rapid cooling mode after the load is newly added leads to a relatively fast temperature decrease in the refrigerator. In this case, to reduce power consumption of the in-vehicle refrigerator, the quantity threshold may be updated to a relatively small value.

**[0068]** In this embodiment, the temperature change rate in the in-vehicle refrigerator after the load is newly added is considered, to adjust the quantity threshold in real time, so that rapid cooling matches the load, and a cooling policy is more flexible.

**[0069]** In another embodiment, the method may further include: if the following condition is met, determining that a load is newly added to the in-vehicle refrigerator: a door of the in-vehicle refrigerator is opened; and/or a weight carried by a shelf in the in-vehicle refrigerator is increased.

**[0070]** A weight detection apparatus may be provided in the in-vehicle refrigerator to detect the weight carried by the shelf, that is, a weight of a load in the in-vehicle refrigerator. When it is detected that an increment of the weight carried by the shelf exceeds a threshold (for example, 200 g), it may be determined that the weight carried by the shelf in the in-vehicle refrigerator is increased.

**[0071]** Alternatively, when it is detected that the door of the in-vehicle refrigerator is opened, it may be considered by default that a load is newly added to the in-vehicle refrigerator.

**[0072]** In this embodiment, whether a load is newly added is determined by the door of the in-vehicle refrigerator being opened and/or the weight carried by the shelf being increased.

**[0073]** FIG. 3 is a flowchart of a method for controlling an in-vehicle refrigerator according to another exemplary embodiment. As shown in FIG. 3, the method for controlling an in-vehicle refrigerator includes the following steps:

- (1) Detect whether a door of the in-vehicle refrigerator is opened.
- (2) If the door of the in-vehicle refrigerator is opened, enter a rapid cooling mode.
- (3) Reset a quantity of rapid cooling hysteresis times, and reset rapid cooling duration.
- (4) Enter a normal cooling mode if a quantity of hysteresis times reaches a quantity threshold, or running duration of the rapid cooling mode reaches a duration threshold.

**[0074]** Based on the same invention concept, the present disclosure further provides an apparatus for controlling an in-vehicle refrigerator. A running mode of the in-vehicle refrigerator includes a normal cooling mode and a rapid cooling mode, and a target cooling temperature of the in-vehicle refrigerator is within a temperature range of the normal cooling mode. FIG. 4 is a block diagram of an apparatus for controlling an in-vehicle refrigerator according to an exemplary embodiment. As shown in FIG. 4, an apparatus 400 for controlling an in-vehicle refrigerator includes a first control module 401 and a second control module 402.

**[0075]** The first control module 401 is configured to: when a load is newly added to the in-vehicle refrigerator, control the in-vehicle refrigerator to run in a rapid cooling mode.

**[0076]** The second control module 402 is configured to: if a rapid cooling completion condition is met, control the in-vehicle refrigerator to switch from running in the rapid cooling mode to running in a normal cooling mode.

**[0077]** A lower limit of a temperature range of the rapid cooling mode is lower than a lower limit of a temperature range of the normal cooling mode.

**[0078]** Optionally, the apparatus 400 for controlling the in-vehicle refrigerator further includes a first determining module.

**[0079]** The first determining module is configured to determine the temperature range of the rapid cooling mode.

**[0080]** Optionally, the first determining module includes a first determining submodule.

**[0081]** The first determining submodule is configured to determine the temperature range of the rapid cooling mode based on a temperature in a passenger compartment and an influence factor, where the influence factor includes at least one of a heat load of the newly added load and a target cooling temperature.

**[0082]** Optionally, the first determining submodule is further configured to find, in a predetermined first correspondence, a temperature range corresponding to a current temperature in the passenger compartment and a current influence factor, and use the temperature range as the temperature range of the rapid cooling mode, where the first correspondence includes a correspondence between a temperature range and each of the temperature in the passenger compartment and the influence factor.

**[0083]** Optionally, the apparatus 400 for controlling the in-vehicle refrigerator further includes a first updating module.

**[0084]** The first updating module is configured to update the temperature range of the rapid cooling mode based on a temperature change rate in the in-vehicle refrigerator after the load is newly added.

**[0085]** Optionally, the rapid cooling completion condition meets at least one of the following:

a quantity of hysteresis times of a temperature in the in-vehicle refrigerator within the temperature range of the rapid cooling mode reaches a quantity threshold; and

duration in which the in-vehicle refrigerator runs in the rapid cooling mode reaches a duration threshold.

**[0086]** Optionally, the apparatus 400 for controlling the in-vehicle refrigerator further includes a second determining module.

**[0087]** The second determining module is configured to determine the quantity threshold based on the temperature in the passenger compartment and the influence factor, where the influence factor includes at least one of the heat load of the newly added load and the target cooling temperature.

**[0088]** Optionally, the second determining module is further configured to: find, in a predetermined second correspondence, a quantity of times corresponding to a current temperature in the passenger compartment and a current influence factor, and use the quantity of times as the quantity threshold, where the second correspondence includes a correspondence between a quantity of times and each of the temperature in the passenger compartment and the influence factor.

**[0089]** Optionally, the apparatus 400 for controlling the in-vehicle refrigerator further includes a second updating module.

**[0090]** The second updating module is configured to update the quantity threshold based on the temperature change rate in the in-vehicle refrigerator after the load is newly added.

**[0091]** Optionally, the apparatus 400 for controlling the in-vehicle refrigerator further includes a determining module.

**[0092]** The determining module is configured to: if the following condition is met, determine that a load is newly added to the in-vehicle refrigerator: a door of the in-vehicle refrigerator is opened; and/or a weight carried by a shelf in the in-vehicle refrigerator is increased.

**[0093]** According to the foregoing technical solution, the rapid cooling mode is newly added to the in-vehicle refrigerator. When a load is newly added to the in-vehicle refrigerator, the in-vehicle refrigerator is controlled to run in the rapid cooling mode, and when the rapid cooling completion condition is met, the in-vehicle refrigerator is controlled to switch from running in the rapid cooling mode to running in the normal cooling mode. The lower limit of the temperature range of the rapid cooling mode is lower than the lower limit of the temperature range of the normal cooling mode. Therefore, when a load is newly added to the in-vehicle refrigerator, a temperature increase in the in-vehicle refrigerator caused by the new load can be rapidly mitigated, so that the load can be more rapidly cooled, thereby improving user experience. In addition, an implementation method in this solution is simple, and no

long-term experiments are required to develop a control policy, thereby reducing experimental costs and facilitating rapid application.

[0094] The present disclosure further provides a non-temporary computer-readable storage medium. The non-temporary computer-readable storage medium stores computer program instructions, and when the program instructions are executed by a processor, the steps of the foregoing method provided in the present disclosure are implemented.

[0095] The present disclosure further provides a controller, including a memory and a processor. The memory stores a computer program. The processor is configured to execute the computer program in the memory, to implement the steps of the foregoing method provided in the present disclosure.

[0096] The present disclosure further provides an in-vehicle refrigerator, including the foregoing controller provided in the present disclosure.

[0097] The foregoing describes in detail preferred implementations of the present disclosure with reference to the accompanying drawings. However, the present disclosure is not limited to specific details in the foregoing implementations. A plurality of simple variations can be made to the technical solutions of the present disclosure within the technical concept scope of the present disclosure, and all these simple variations fall within the protection scope of the present disclosure.

[0098] In addition, it will be noted that the specific technical features described in the foregoing specific implementations may be combined in any proper manner without a contradiction. To avoid unnecessary repetition, various possible combination manners are not otherwise described in the present disclosure.

[0099] In addition, various different implementations of the present disclosure may also be combined in any manner, and the combination shall also be considered as the content disclosed in the present disclosure, provided that the combination does not deviate from the idea of the present disclosure.

## Claims

1. A method for controlling an in-vehicle refrigerator, a running mode of the in-vehicle refrigerator comprising a normal cooling mode and a rapid cooling mode, a target cooling temperature of the in-vehicle refrigerator being within a temperature range of the normal cooling mode, and the method comprising:

when a load is newly added to the in-vehicle refrigerator, controlling the in-vehicle refrigerator to run in the rapid cooling mode; and  
if a rapid cooling completion condition is met, controlling the in-vehicle refrigerator to switch from running in the rapid cooling mode to run-

ning in the normal cooling mode, wherein a lower limit of a temperature range of the rapid cooling mode is lower than a lower limit of the temperature range of the normal cooling mode.

2. The method according to claim 1, wherein before controlling the in-vehicle refrigerator to run in the rapid cooling mode, the method further comprises: determining the temperature range of the rapid cooling mode.
3. The method according to claim 2, wherein determining the temperature range of the rapid cooling mode comprises: determining the temperature range of the rapid cooling mode based on a temperature in a passenger compartment and an influence factor, wherein the influence factor comprises at least one of a heat load of the newly added load and the target cooling temperature.
4. The method according to claim 3, wherein determining the temperature range of the rapid cooling mode based on a temperature in a passenger compartment and an influence factor comprises: finding, in a predetermined first correspondence, a temperature range corresponding to a current temperature in the passenger compartment and a current influence factor, and using the temperature range as the temperature range of the rapid cooling mode, wherein the first correspondence comprises a correspondence between a temperature range and each of the temperature in the passenger compartment and the influence factor.
5. The method according to any one of claims 2 to 4, wherein after controlling the in-vehicle refrigerator to run in the rapid cooling mode, the method further comprises: updating the temperature range of the rapid cooling mode based on a temperature change rate in the in-vehicle refrigerator after the load is newly added.
6. The method according to any one of claims 1 to 5, wherein the rapid cooling completion condition meets at least one of the following:
  - a quantity of hysteresis times of a temperature in the in-vehicle refrigerator within the temperature range of the rapid cooling mode reaches a quantity threshold; and
  - duration in which the in-vehicle refrigerator runs in the rapid cooling mode reaches a duration threshold.
7. The method according to claim 6, wherein the

method further comprises:

determining the quantity threshold based on the temperature in the passenger compartment and the influence factor, wherein the influence factor comprises at least one of the heat load of the newly added load and the target cooling temperature.

8. The method according to claim 7, wherein determining the quantity threshold based on the temperature in the passenger compartment and the influence factor comprises:  
finding, in a predetermined second correspondence, a quantity of times corresponding to a current temperature in the passenger compartment and a current influence factor, and using the quantity of times as the quantity threshold, wherein the second correspondence comprises a correspondence between a quantity of times and each of the temperature in the passenger compartment and the influence factor.
9. The method according to claim 7, wherein after determining the quantity threshold based on the temperature in the passenger compartment and the influence factor, the method further comprises:  
updating the quantity threshold based on the temperature change rate in the in-vehicle refrigerator after the load is newly added.
10. The method according to any one of claims 1 to 9, wherein the method further comprises:  
if the following condition is met, determining that a load is newly added to the in-vehicle refrigerator: a door of the in-vehicle refrigerator is opened; and/or a weight carried by a shelf in the in-vehicle refrigerator is increased.
11. An apparatus for controlling an in-vehicle refrigerator, a running mode of the in-vehicle refrigerator comprising a normal cooling mode and a rapid cooling mode, a target cooling temperature of the in-vehicle refrigerator being within a temperature range of the normal cooling mode, and the apparatus comprising:  
a first control module, configured to: when a load is newly added to the in-vehicle refrigerator, control the in-vehicle refrigerator to run in the rapid cooling mode; and  
a second control module, configured to: if a rapid cooling completion condition is met, control the in-vehicle refrigerator to switch from running in the rapid cooling mode to running in the normal cooling mode, wherein  
a lower limit of a temperature range of the rapid cooling mode is lower than a lower limit of the temperature range of the normal cooling mode.

12. A non-temporary computer-readable storage medium, the non-temporary computer-readable storage medium storing computer program instructions, wherein when the program instructions are executed by a processor, the steps of the method according to any one of claims 1 to 10 are implemented.

13. A controller, applied to an in-vehicle refrigerator, a running mode of the in-vehicle refrigerator comprising a normal cooling mode and a rapid cooling mode, a target cooling temperature of the in-vehicle refrigerator being within a temperature range of the normal cooling mode, and the controller comprising:

a memory, wherein the memory stores a computer program; and  
a processor, configured to execute the computer program in the memory to implement the following operations:

when a load is newly added to the in-vehicle refrigerator, controlling the in-vehicle refrigerator to run in the rapid cooling mode; and

if a rapid cooling completion condition is met, controlling the in-vehicle refrigerator to switch from running in the rapid cooling mode to running in the normal cooling mode, wherein

a lower limit of a temperature range of the rapid cooling mode is lower than a lower limit of the temperature range of the normal cooling mode.

14. An in-vehicle refrigerator, comprising the controller according to claim 13.

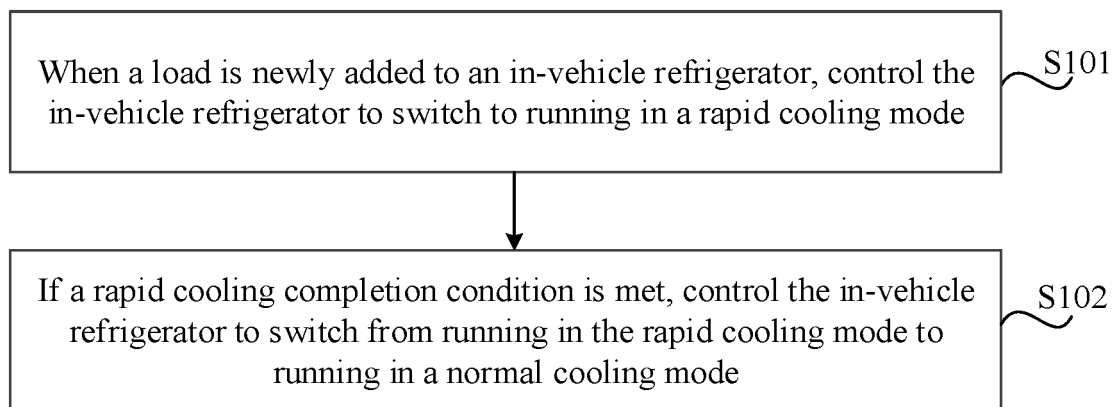


FIG. 1

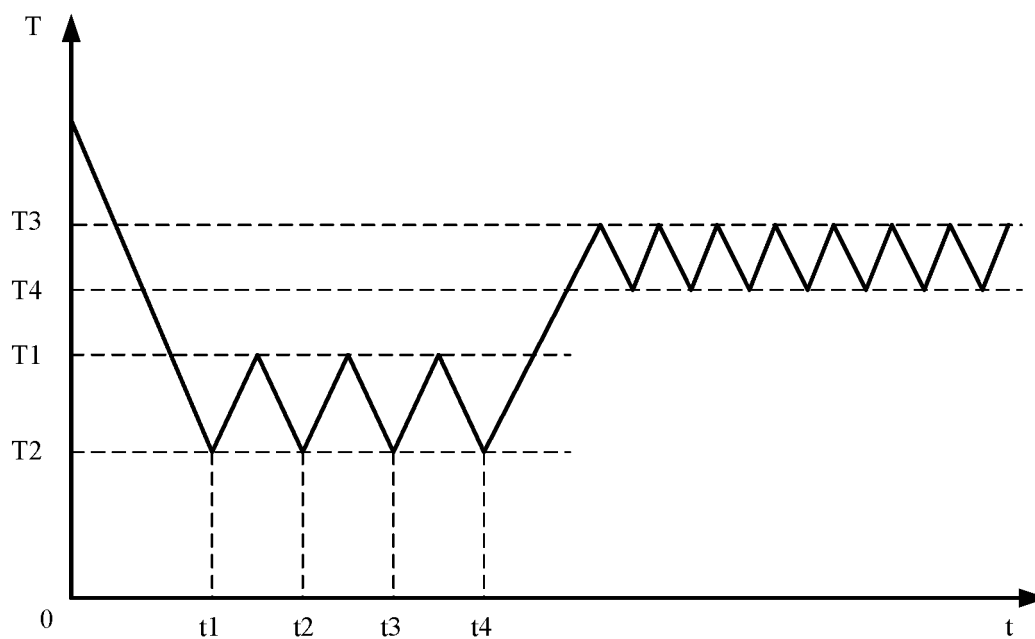


FIG. 2

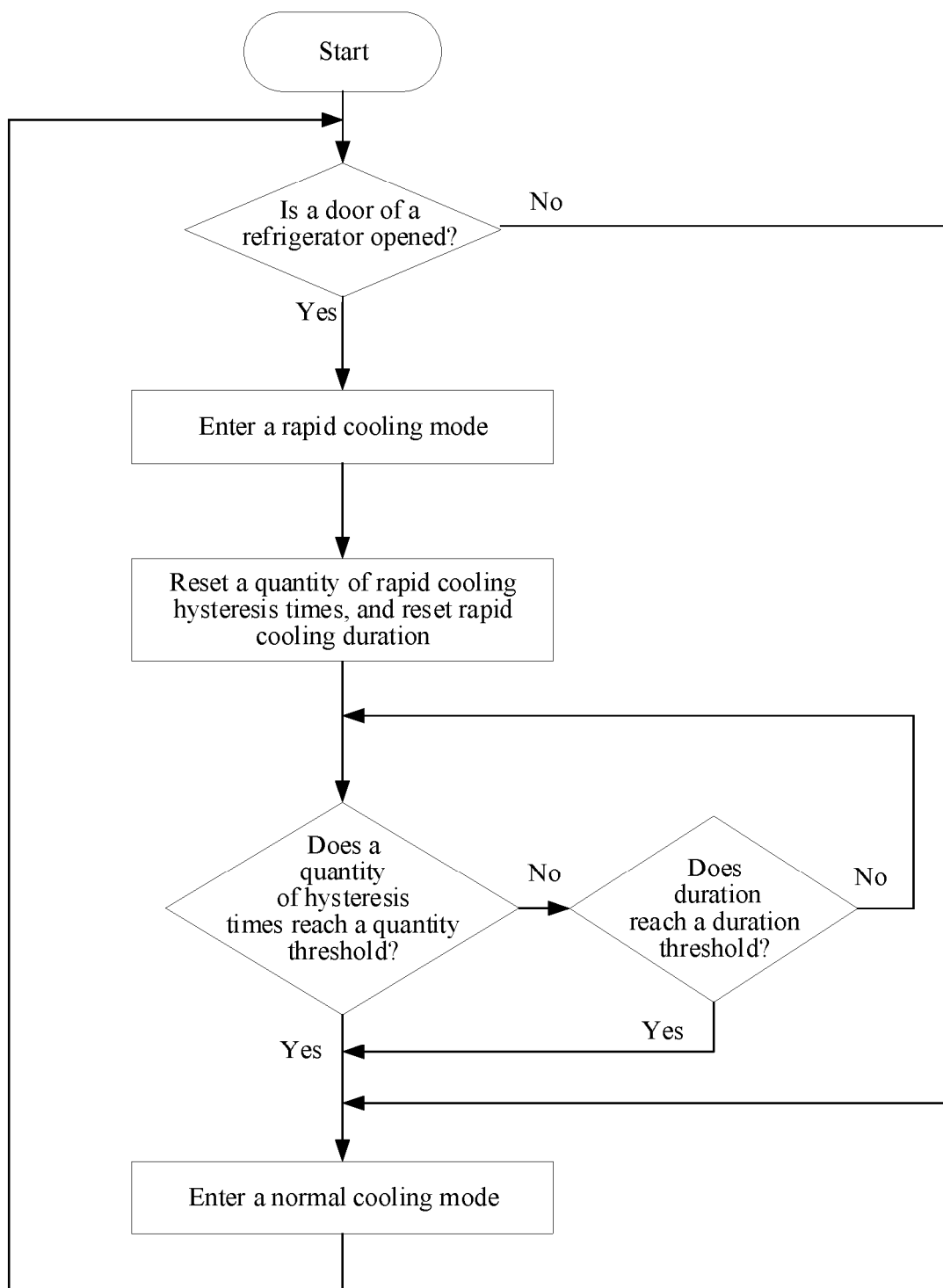


FIG. 3

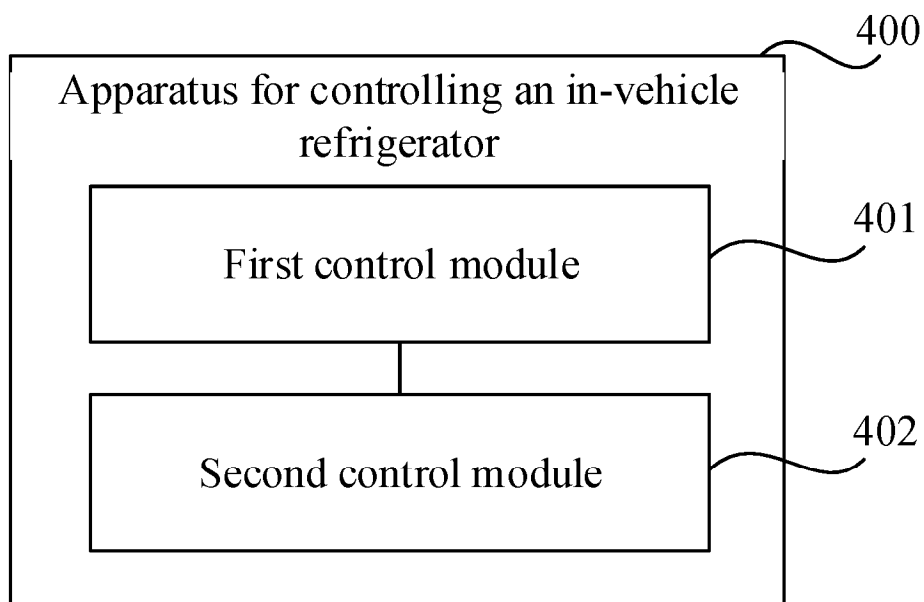


FIG. 4

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2024/135927

**A. CLASSIFICATION OF SUBJECT MATTER**

F25D29/00(2006.01)i; F25D11/02(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

F25D29/-; F25D11/-

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNXTX, ENTXT, ENTXTC, VEN, CJFD, Himmpt, 百度, BAIDU: 比亚迪, BYD, 车载冰箱, 极速制冷, 急冷, 加快制冷, 快速制冷, 速冷, 常规制冷, 正常制冷, 制冷 D 模式, 负荷, 负载, 容量, 需求, 载荷, 上升, 新增, 增长, 增大, 增加, Vehicle refrigerator, load, demand, growth, increas+, ris+, new, mode, Quenching, Fast refrigeration, Extreme refrigeration, Refrigerat +, Expedited refrigeration, Fast cooling

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                        | Relevant to claim No. |
|-----------|-----------------------------------------------------------------------------------------------------------|-----------------------|
| PX        | CN 118224816 A (BYD CO., LTD.) 21 June 2024 (2024-06-21)<br>claims 1-14                                   | 1-14                  |
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☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

|                                                                                                                                                                         |                                                                                                                                                                                                                                                  |
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| * Special categories of cited documents:                                                                                                                                | "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention                                              |
| "A" document defining the general state of the art which is not considered to be of particular relevance                                                                | "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone                                                                     |
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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Date of the actual completion of the international search<br><b>06 January 2025</b>                                                                                                            | Date of mailing of the international search report<br><b>10 January 2025</b> |
| Name and mailing address of the ISA/CN<br><b>China National Intellectual Property Administration (ISA/CN)<br/>China No. 6, Xitucheng Road, Jimenqiao, Haidian District,<br/>Beijing 100088</b> | Authorized officer<br><br><br>Telephone No.                                  |

INTERNATIONAL SEARCH REPORT  
Information on patent family members

International application No.  
**PCT/CN2024/135927**

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| Patent document cited in search report |             |   | Publication date (day/month/year) | Patent family member(s) |            |    | Publication date (day/month/year) |
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**REFERENCES CITED IN THE DESCRIPTION**

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