

[Name of Document] SPECIFICATION

[Title of the Invention] REFRIGERATOR

[Technical Field]

[0001]

The present invention relates to a refrigerator that displays an operation load state.

[Background Art]

[0002]

In a prior-art refrigerator provided with a rotating-speed variable compressor, each stage indicating a rotation speed of the compressor is displayed on a display portion for displaying a temperature or the like of the refrigerator, and a user may limit opening / closing of a door if the rotation speed of the compressor is high so that power consumption is reduced (See Patent Document 1, for example).

[0003]

Also, in a refrigerator provided with means for counting an operation time of the compressor for a predetermined period (24 hours, for example), if the operation time of the compressor exceeds a certain length of time, an image stored in advance is displayed on the display portion so that to what degree the compressor has been operated can be notified to the user (See Patent Document 2, for example).

[0004]

[Patent Document 1] WO2005/026632 (page 13, Fig. 4)

[Patent Document 2] Japanese Unexamined Patent  
Application Publication No. 2000-329450 (page 9, Fig. 3)

[Disclosure of the Invention]

[Problems to be Solved by the Invention]

[0005]

However, the above refrigerator notifies the user only of the operation state of the compressor, but an actual operation state of the refrigerator is not determined only by the operation state of the compressor but changed by set temperatures of storage compartments, outside air temperature and the like, and there has been a problem that grasping of a comprehensive operation state is difficult.

[0006]

The present invention was made in order to solve the above problem and has an object to provide a refrigerator that notifies a user of more accurate operation state of a refrigerator by comprehensively determining an operation load state of the refrigerator not only by an operation state of a compressor but also by set temperatures of storage compartments, outside air temperature and the like and by displaying it.

[Means for Solving the Problems]

[0007]

The refrigerator according to the present invention

comprises a plurality of storage compartments, a freezing cycle apparatus including a compressor for cooling the storage compartments, operating means for making various settings and various operations, display means for displaying information set by the operating means and an operation state of the refrigerator, storage means for storing information set by the operating means, and a controller for controlling the freezing cycle apparatus and the display means, and the controller calculates a current load level of the refrigerator on the basis of a use state of the refrigerator and comprehensively determines the current operation load state of the refrigerator on the basis of the load level, and the display means displays the operation load state.

[Advantages]

[0008]

The refrigerator according to the present invention can notify a user of more accurate operation state of the refrigerator by comprehensively determining the operation load state of the refrigerator on the basis of the operation state of the compressor, set temperatures of the storage compartments or the outside air temperature or the like and by displaying it. Also, by notifying the operation state of the refrigerator, the user can be prompted for an operation with a smaller load.

[Best Mode for Carrying Out the Invention]

[0009]

An embodiment of the present invention will be described referring to the attached drawings.

Fig. 1 is a front view of a refrigerator according to the embodiment. A refrigerator 100 is provided with a refrigerating compartment 101 on an uppermost stage, and the refrigerating compartment 101 has a refrigerating compartment door 111. Below the refrigerating compartment 101, an ice-making compartment 102 having an ice-making compartment door 112, a vegetable compartment 103 having a vegetable-compartment door 113, a freezing compartment 104 having a freezing-compartment door 114, and a switching compartment 105 having a switching-compartment door 115 are provided. On the refrigerating-compartment door 111, an operation panel 1 is mounted. Also, on each of the storage compartments, a door switch 23 for detecting opening / closing of the door (see Fig. 4, which will be described later) and a temperature sensor 24 (See Fig. 4, which will be described later) for detecting a temperature in each of the storage compartments are provided.

If the refrigerating compartment 101 is opened, a refrigerator light in the refrigerating compartment 101 is switched on.

[0010]

Fig. 2 is a side sectional view of the refrigerator in Fig. 1. On an upper part on the back face of the refrigerator 100, a controller 2 is mounted. Below the controller 2, inside the refrigerator 100, a cooler 3, a compressor 4, and a fan 5 are installed. Also, inside the ice-making compartment 102, an ice maker 6 is mounted. Here, the controller 2 is provided with a calculating device such as a microcontroller or the like.

Cold air generated by a freezing cycle apparatus constituted by the cooler 3, the compressor 4 and the like is circulated by the fan 5 through an air trunk in the refrigerator. The controller 2 obtains the temperature in each of the storage compartments through the temperature sensor 24 and carries out opening / closing of an opening / closing valve (not shown) mounted in the air trunk communicating with each of the storage compartments so that the temperature becomes a set temperature. Moreover, the controller 2 executes control of ON / OFF of driving of the compressor 4, the fan 5 and the like.

[0011]

Fig. 3 is a front view of the operation panel of the refrigerator in Fig. 1. On the operation panel 1, a compartment selection switch 11 for selecting a refrigerating compartment to carry out an operation, a temperature setting switch 12 for changing the set

temperature of the selected refrigerating compartment by the compartment selection switch 11, a rapid cooling switch 13 for rapid cooling operation of the selected refrigerating compartment, and an ice-making switch 14 for switching an operation state of ice making are provided. Also, in the operation panel 1, a display portion 15 for displaying setting information or the like selected by the user and an outside air sensor 25 for detecting an outside air temperature (See Fig. 4, which will be described later) are provided. The display portion 15 is provided with an operation state display portion 16 for displaying the operation load state of the refrigerator in several stages (four stages, for example). Moreover, the operation state display portion 16 is provided with operation state lamps 16a, 16b, 16c which are turned on according to the load level of the refrigerator.

If the load level of the refrigerator is low, all the operation state lamps 16a, 16b, 16c are turned on, while if the load level is high, all the operation state lamps 16a, 16b, 16c are turned off. If the load level is intermediate, only the operation state lamp 16a or the operation state lamps 16a and 16b are turned on according to the load level.

[0012]

Fig. 4 is a control block diagram of the refrigerator according to the embodiment. To the controller 2, the

temperature sensor 24 installed in each of the storage compartments, the outside air sensor 25 installed on the operation panel 1, each actuator of the compressor 4, the fan 5 and the like, and the operation panel 1 are connected. Also, the controller 2 is provided with a storage device 21 for storing settings and operation states and further with a door open-frequency counting means 26, a door open-time measuring timer 27, a rotation-speed detecting means 28, and an operation-time measuring timer 29. To the door open-frequency counting means 26 and the door open-time measuring timer 27 provided in the controller 2, the door switch 23 installed at each of the storage compartments is connected. Also, to the rotation-speed detecting means 28 and the operation-time measuring timer 29 provided similarly in the controller 2, the compressor 4 is connected. An operation-state detecting means 51 is constituted by several of or all of the outside air sensor 25, the door open-frequency counting means 26, the door open-time measuring timer 27, the rotation-speed detecting means 28, and the operation-time measuring timer 29 and comprehensively detects information regarding the operation state of the refrigerator according to the embodiment.

The door open-frequency counting means 26 and the door open-time measuring timer 27 count the number of times that the door is opened and measure time when the door is open,

respectively, on the basis of a detection result of opening / closing of the door of each of the storage compartments by the door switch 23. The temperature sensor 24 detects a temperature in each storage compartment and outputs the temperature to the controller 2. Similarly, the outside air sensor 25 detects an outside air temperature and outputs the outside air temperature to the controller 2. The operation panel 1 outputs the information subjected to operation or set by the user to the controller 2, and the controller 2 stores the information in the storage device 21. On the other hand, the controller 2 outputs information such as the operation state of the refrigerator, setting contents and the like to the operation panel 1, and the operation panel 1 displays received information on the display portion 15. Also, the controller 2 outputs a driving signal to the compressor 4 and the fan 5 so as to drive them. The rotation-speed detecting means 28 detects the rotation speed of the compressor 4, and the operation-time measuring timer measures the operation time of the compressor 4.

[0013]

An operation of the refrigerator constituted as above will be described below referring to a flowchart.

[0014]

Fig. 5 is an operation flowchart of the refrigerator according to the embodiment. First, at S1, the controller 2

calculates a load level A on the basis of a set temperature of each of the storage compartments set by a user through operation of the operation panel 1. Hereinafter, calculation of the load level and the determination of the operation load state are assumed to be executed by the controller 2. Subsequently, a load level B is calculated on the basis of an open / closed state of the door of each of the storage compartments (S2). Subsequently, a load level C is calculated on the basis of the operation state of the compressor (S3), a load level D is calculated on the basis of the outside air temperature detected by the outside air sensor 25 (S4), and a load level E is calculated on the basis of an execution state of a rapid cooling operation of each of the storage compartments carried out by operation of the operation panel 1 (S5). After the calculation of the load levels is executed at S1 to S5, the total of the load levels A to E is calculated as a load level  $\alpha$  of the refrigerator (S6). If the load level  $\alpha$  of the refrigerator is less than a predetermined value (-3, for example) stored in the storage device 21 (S7), the operation load state is determined to be "extremely low" (S8). If the load level  $\alpha$  is not less than -3, it is determined if the level is smaller than the subsequent predetermined value (0, for example) stored in the storage device 21 or not (S9), and if it is less than 0, the operation load state is determined to

be "low" (S10). If the load level  $\alpha$  is 0 or more, it is determined if the level is smaller than the subsequent predetermined value (3, for example) stored in the storage device 21 or not (S11), and if the level is less than 3, the operation load state is determined to be "medium" (S12). Moreover, if the load level  $\alpha$  is not less than 3, the operation load state is determined to be "high" (S13).

[0015]

Fig. 6 shows display examples of the operation load states of the refrigerator on the basis of the operation result of the flowchart in Fig. 5. As mentioned above, if the operation load state is determined to be "extremely low", as shown in Fig. 6A, all the operation state lamps 16a, 16b, and 16c on the operation state display portion 16 on the operation panel 1 are turned on. If the operation load state is determined to be "low", as shown in Fig. 6B, only the operation state lamps 16a and 16b are turned on. If the operation load state is determined to be "medium", as shown in Fig. 6C, only the operation state lamp 16a is turned on. Moreover, if the operation load state is determined to be "high", as shown in Fig. 6D, all the operation state lamps 16a, 16b, and 16c are turned off.

[0016]

In Fig. 5, all the five factors of the load levels A to E are used as determining factors of the load level  $\alpha$  of the

refrigerator, but the determining factors of the load level  $\alpha$  are not limited to these five factors, that is, as shown in Fig. 7, for example, the load level  $\alpha$  may be calculated from a specific factor such as a load level A calculated on the basis of a set temperature of each of the storage compartments and a load level B calculated on the basis of an open / closed state of the door of each of the storage compartments.

Also, in Fig. 5, the operation load states are divided into four stages in the determination, but are not limited to four stages, that is, for example, the states may be divided into arbitrary stages or divided by other methods. For example, as shown in Fig. 7, in the description for Fig. 5, if the load level  $\alpha$  is not less than 3, it may be so configured that determination is made on whether the level is smaller than another predetermined value (6, for example) stored in the storage device 21 or not (S14), and if the level is less than 6, the operation load state is determined to be "high", while if the load level  $\alpha$  is not less than 6, the operation load state is determined to be "extremely high" (S15). At this time, in Fig. 6, since the operation state display portion 16 displays the operation load state in stages, display is made by a combination of lighting of the three lamps, namely, the operation state lamps 16a, 16b, and 16c, but display is not limited to the above, that is,

for example, a different number of lamps may be installed so as to display the state in arbitrary stages, or display may be made by installing a lamp of a different pattern or shape or other display means. Also, instead of display of the operation load states in several stages, the states may be displayed by continuous numeral values or by other methods.

Also, in Fig. 5, the load levels A, B, C, D, E are calculated in this order, but not limited to that, as shown in Fig. 8, the calculation order of the load level by each factor may be arbitrary.

[0017]

Subsequently, a calculation method of the load level by each factor will be described.

Fig. 9 is a flowchart of the calculation of the load level A on the basis of the set temperature of each of the storage compartments (S1). The user selects the refrigerating compartment 101 as a storage compartment for which the set temperature is to be set by operating the compartment selection switch 11 on the operation panel 1 in advance and then, by operating the temperature setting switch 12, the set temperature of the refrigerating compartment 101 can be selected in advance in several stages from "weak" (high temperature) to "strong" (low temperature) (five stages, for example). The controller 2 determines if the set temperature is lower than "medium" (medium setting)

or not (S101). If it is determined that the set temperature is lower than "medium", the temperature inside the refrigerating compartment 101 should be adjusted to a lower temperature, and the load level A is given +1 (S102). Hereinafter, the determination of the set temperature and the calculation of the load level A are assumed to be executed by the controller 2. If the temperature is determined to be not low, it is determined whether the set temperature is higher than "medium" or not (S103). If the set temperature is determined to be higher than "medium", since the temperature in the refrigerating compartment 101 does not have to be cooled much, the load level A is given - 1 (S104). If it is determined to be not high, since "medium" has been selected, the load level A is kept as is. Here, "medium" is set as a reference in the above, but the reference is not limited to "medium", that is, another set temperature may be used as a reference.

[0018]

Subsequently, determination is made on the basis of the set temperature of the switching compartment 105. Here, the user can select the switching compartment 105 as the storage compartment for which the set temperature is to be set by operating the compartment selection switch 11 on the operation panel 1 in advance and then, switch to any of the four stages, namely, "freezing" setting at approximately -

18°C, "soft freezing" setting at approximately -7°C, "chilled" setting at approximately -1°C and "refrigerating" setting at approximately 3°C so as to set the set temperature of the switching compartment 105 by operating the temperature setting switch 12. It is determined if the set temperature is lower than the "soft freezing" or not (S105). If it is determined that the set temperature is lower than the "soft freezing", since the temperature in the switching compartment 105 should be adjusted to a lower temperature, the load level A is given +1 (S106). If the temperature is determined to be not low, determination is made on whether the set temperature is higher than the "soft freezing" or not (S107). If it is determined that the set temperature is higher than the "soft freezing", since a load is not applied to the cooling in the switching compartment 105 much, the load level A is given -1 (S108). If the temperature is determined to be not high, since the "soft freezing" has been selected, the load level is kept as it is. Here, the "soft freezing" is used as a reference in the above, but not limited to that, another set temperature may be used as a reference.

[0019]

Subsequently, the determination and the calculation of the load level A are carried out on the basis of the set temperatures of vegetable compartment 103 and then, for the

freezing compartment 104 (S109 to S116), but they are similar to the determination on the basis of the set temperature of the refrigerating compartment 101. As the result of calculation for the load level A at each set temperature of each of the storage compartments, the load level A is finally calculated. For example, with regard to the set temperature of each of the storage compartments, if "weak" is set for the refrigerating compartment 101, "refrigerating" for the switching compartment 105, "strong" for the vegetable compartment 103, and "medium" for the freezing compartment 104, the load level A is calculated as -1 ( $= -1 - 1 + 1 + 0$ ) on the basis of those set temperatures.

[0020]

In Fig. 9, the set temperatures of all the storage compartments are used as a determination material of the load level A, but not limited to that, a set temperature of only a specific storage compartment such as the refrigerating compartment 101 and the freezing compartment 104 may be used as the determination material.

Also, the load level A is given  $\pm 1$  in the calculation of the load level A on the basis of the set temperature of any storage compartment, but not limited to that, the calculation of the load level A may be weighed for each storage compartment such as  $\pm 2$  in the calculation of the

load level A on the basis of the set temperature of the refrigerating compartment 101 and  $\pm 3$  in the calculation of the load level A on the basis of the set temperature of the freezing compartment 104.

Moreover, in Fig. 9, the load level A is calculated on the basis of the respective set temperatures in the order of the refrigerating compartment 101, the switching compartment 105, the vegetable compartment 103, and the freezing compartment 104, but not limited to that, the calculation may be made in an arbitrary order.

[0021]

Fig. 10 is a flowchart of calculation of a load level B on the basis of the frequency of opening / closing of the door of a specific storage compartment (S2). First, the controller 2 determines if defrosting has been started or not (S201). Then, if it is determined that the defrosting has been started, the controller 2 resets the frequency of opening / closing of the door of a specific storage compartment counted by the door open-frequency counting means 26 (See Fig. 4) to 0 times. If it is determined that the defrosting has not been started yet, the routine goes to the subsequent step. If the defrosting is conducted approximately once a day, the frequency of opening / closing of the door of the specific storage compartment from start of the defrosting to the start of the subsequent defrosting

is counted by the door open-frequency counting means 2 so that the frequency of opening / closing in approximately one day can be counted.

[0022]

At the subsequent step, the controller 2 determines if the frequency of opening / closing of the door of the specific storage compartment counted by the door open-frequency counting means 26 has exceeded a predetermined frequency (20 times, for example) stored in the storage device 21 or not (S203). If the controller 2 determines that the frequency of opening / closing has exceeded 20 times, it is determined that a load due to the door opening / closing is high, and the load level B is given +1 (S204). If it is determined that the number is not exceeded, the determination on the load level B is finished at that time.

[0023]

In Fig. 10, the determination on the load level B is made on the basis of the frequency of opening / closing of the door of the specific storage compartment, but not limited to that, the load level B may be determined on the basis of time during which the door of the specific storage compartment is open, measured by the door open-time measuring timer 27 (See Fig. 4), as shown in Fig. 11 (S211 to S214). For example, the controller 2 determines if the open time during which the door of the specific storage

compartment is opened once exceeds a predetermined time (20 seconds, for example) stored in the storage device 21 (S213), and if it is determined that the predetermined time is exceeded, the load level B may be given +1 (S214). If it is determined that the predetermined time is not exceeded, the determination on the load level B is finished at that time. The timing when the door open time is reset is the same as the timing when the frequency of door opening / closing shown in Fig. 10 (S211, S212) is reset.

Also, in Fig. 11, the determination on the load level B is made on the basis of the open time when the door of the specific storage compartment is opened once, but not limited to that, the accumulated open time of the door of the specific storage compartment from the start of the defrosting to the start of the subsequent defrosting may be measured by the door open-time measuring timer 27, for example. At this time, the controller 2 determines if the accumulated door open time has exceeded the predetermined time (20 minutes, for example) stored in the storage device 21 or not, and if it is determined that the predetermined time is exceeded, the load level B may be given +1.

Also, as shown in Fig. 12, both the frequency of door opening / closing and the open time of the specific storage compartment described in the above may be used as the determination material of the load level B (S221 to S226).

At this time, in Fig. 12, the determination on the frequency of opening / closing (S225, S226) is made after the determination on the open time (S223, S224), but they may be in the reverse order. At this time, the timing when the open time and the opening / closing time are reset is the same as those in Figs. 10 and 11 (S221, S222).

Also, in the above description, the opening / closing frequency and the open time of the door of the specific storage compartment are reset if the controller 2 determines that the defrosting has been started, but not limited to that, reset may be made under another condition.

Also, in the above description, the door opening / closing frequency or the open time of the door of the specific storage compartment is used as the determination material of the load level B, but not limited to that, the door opening / closing frequency or open time of a plurality of or all the storage compartments may be used as the determination material of the load level B.

Moreover, in the above description, when the load level B is calculated, +1 is given, but not limited to that, the weighting may be changed to +2, +3 and the like, for example.

[0024]

Fig. 13 is a flowchart illustrating calculation of a load level C on the basis of the rotation speed of the compressor (S3). First, the controller 2 determines if the

rotation speed of the compressor detected by the rotation-speed detecting means 28 (See Fig. 4) exceeds a predetermined rotation speed (70 rps, for example) stored in the storage device 21 or not (S301). If the controller 2 determines that the rotation speed exceeds 70 rps, it is determined that the load is high due to the operation at a high-speed rotation, and the load level C is given +1 (S302). If it is determined that 70 rps is not exceeded, the determination on the load level C is finished at that time.

[0025]

In Fig. 13, the determination on the load level C is made on the basis of the rotation speed of the compressor, but not limited to that, the load level C may be determined on the basis of a single continuous operation time of the compressor measured by the operation-time measuring timer 29 (See Fig. 4) as shown in Fig. 14 (S311, S312). For example, the controller 2 determines if the continuous operation time has exceeded a predetermined time (3 hours, for example) stored in the storage device 21 or not (S311), and if it is determined that the predetermined time is exceeded, the load level C is given +1 (S312). If it is determined that the predetermined time is not exceeded, the determination on the load level C is finished at that time.

Also, in Fig. 14, the load level C is determined on the basis of the single continuous operation time of the

compressor, but not limited to that, the accumulated operation time of the compressor may be measured by the operation-time measuring timer 29. At this time, the controller 2 determines if the accumulated operation time has exceeded a predetermined time (10 hours, for example) stored in the storage device 21 or not, and if it is determined that the predetermined time is exceeded, the load level C may be given +1.

Also, as shown in Fig. 15, both the rotation speed and the continuous operation time of the compressor described in the above may be used as the determination material of the load level C (S321 to S324). At this time, in Fig. 15, the determination on the continuous operation time is made (S323, S324) after the determination is made on the rotation speed (S321, S322), but they may be carried out in the reverse order.

Moreover, in the description above, when the load level C is calculated, +1 is given, but not limited to that, the weighting may be changed to +2 or +3, for example.

[0026]

Fig. 16 is a flowchart illustrating calculation of a load level D on the basis of an outside air temperature (S4). Also, the controller 2 determines if the outside air temperature detected by the outside air sensor 25 (See Fig. 4) has exceeded a predetermined temperature (30°C, for

example) stored in the storage device 21 or not (S401). If the controller 2 determines that the outside air temperature has exceeded 30°C, it is determined that the load is high due to the high outside air temperature, and the load level D is given +1 (S402). If it is determined that the temperature is not exceeded, the determination on the load level D is finished at that time.

[0027]

In Fig. 16, only one reference value for determination of the outside air temperature is provided, but not limited to that, two (or more) reference values for the determination of the outside air temperature may be provided as shown in Fig. 17 (S411 to S414). For example, first, the controller 2 determines if the outside air temperature detected by the outside air sensor 25 has exceeded 15°C or not (S411), and if it is determined that the temperature is exceeded, the load level D is given +1 (S412). If it is determined that the temperature is not exceeded, the determination on the load level D is finished at that time. Also, if it is determined that 15°C is exceeded, the controller 2 subsequently determines if the outside air temperature has exceeded 30°C or not (S413), and if the controller determines that the temperature is exceeded, the load level D is further given +1 (S414).

Moreover, in the description above, when the load level

D is calculated, +1 is given, but not limited to that, the weighting may be changed to +2, +3, for example.

[0028]

Fig. 18 is a flowchart illustrating calculation of a load level E on the basis of an execution state of the rapid cooling operation (S5). First, the controller 2 determines if the rapid cooling operation of the refrigerating compartment 101 is being executed or not (S501). If the controller 2 determines that the rapid cooling operation is being executed, the load level E is given +1 (S502).

[0029]

Subsequently, it is similarly determined if the rapid cooling operation is being executed or not for the ice-making compartment 102, the switching compartment 105, the vegetable compartment 103, and the freezing compartment 104 in this order (S503, S505, S507, S509), and if it is determined that the operation is being executed, the load level E is given +1 at the respective steps (S504, S506, S508, S510). As the result of the calculation for the load level E for the execution state of the rapid cooling operation in each of the storage compartments, the load level E is finally calculated. For example, if the rapid cooling operation is carried out for the refrigerating compartment 101, the switching compartment 105, and the vegetable compartment 103, the load level E is calculated as

3 (= 1 + 1 + 1).

[0030]

In Fig. 18, the execution states of the rapid cooling operation of all the storage compartments are used as the determination material of the load level E, but not limited to that, only the execution state of the rapid cooling operation of a specific storage compartment may be used as the determination material such as the refrigerating compartment 101 and the freezing compartment 104, for example.

Also, the load level E is given +1 if the rapid cooling operation is executed for any of the storage compartments, but not limited to that, the weighting may be given to the calculation of the load level E for each storage compartment such as +2 if the rapid cooling operation of the refrigerating compartment 101 is executed or +3 is given for the rapid cooling operation of the freezing compartment 104.

Moreover, in Fig. 18, the load level E is calculated on the basis of the execution state of the rapid cooling operation of each of the storage compartments in the order of the refrigerating compartment 101, the ice-making compartment 102, the switching compartment 105, the vegetable compartment 103, and the freezing compartment 104, but not limited to that, the calculation may be made in an arbitrary order.

[0031]

As mentioned above, in this embodiment, the operation load state of the refrigerator is comprehensively determined on the basis of the set temperature of each storage compartment, the door open / closed state, the operation state of the compressor, the outside air temperature, and the execution state of the rapid cooling operation of each storage compartment, and by displaying that, the operation state of the refrigerator can be notified to the user more accurately. Also, by notifying the operation state, the user can be prompted for an operation with smaller load.

[Brief Description of the Drawings]

[0032]

[Fig. 1] Fig. 1 is a front view of a refrigerator according to an embodiment.

[Fig. 2] Fig. 2 is a side sectional view of the refrigerator according to the embodiment.

[Fig. 3] Fig. 3 is a front view of an operation panel of the refrigerator according to the embodiment.

[Fig. 4] Fig. 4 is a control block diagram of the refrigerator according to the embodiment.

[Fig. 5] Fig. 5 is an operation flowchart (example 1) of the refrigerator according to the embodiment.

[Fig. 6] Fig. 6 is a display example of an operation load state of the refrigerator according to the embodiment.

[Fig. 7] Fig. 7 is an operation flowchart (example 2) of the refrigerator according to the embodiment.

[Fig. 8] Fig. 8 is an operation flowchart (example 3) of the refrigerator according to the embodiment.

[Fig. 9] Fig. 9 is a flowchart for calculation of a load level A on the basis of a set temperature of a storage compartment.

[Fig. 10] Fig. 10 is a flowchart for calculation of a load level B on the basis of the frequency of opening / closing of a door of the storage compartment.

[Fig. 11] Fig. 11 is a flowchart for calculation of the load level B on the basis of an open time of the door of the storage compartment.

[Fig. 12] Fig. 12 is a flowchart for calculation of the load level B on the basis of the frequency of opening / closing and the open time of a door of the storage compartment.

[Fig. 13] Fig. 13 is a flowchart for calculation of a load level C on the basis of a rotation speed of a compressor.

[Fig. 14] Fig. 14 is a flowchart for calculation of the load level C on the basis of an operation time of the compressor.

[Fig. 15] Fig. 15 is a flowchart for calculation of the load level C on the basis of the rotation speed and the

operation time of the compressor.

[Fig. 16] Fig. 16 is a flowchart (example 1) for calculation of a load level D on the basis of an outside air temperature.

[Fig. 17] Fig. 17 is a flowchart (example 2) for calculation of the load level D on the basis of the outside air temperature.

[Fig. 18] Fig. 18 is a flowchart for calculation of a load level E on the basis of an execution state of a rapid cooling operation.

[Reference Numerals]

[0033]

- 1: operation panel
- 2: controller
- 3: cooler
- 4: compressor
- 5: fan
- 6: ice maker
- 11: compartment selection switch
- 12: temperature setting switch
- 13: rapid cooling switch
- 14: ice-making switch
- 15: display portion
- 16: operation state display portion
- 16a to 16c: operation state lamp

21: storage device  
23: door switch  
24: temperature sensor  
25: outside air sensor  
26: door open-frequency counting means  
27: door open-time measuring timer  
28: rotation-speed detecting means  
29: operation-time measuring timer  
51: operation-state detecting means  
100: refrigerator  
101: refrigerating compartment  
102: ice-making compartment  
103: vegetable compartment  
104: freezing compartment  
105: switching compartment  
111: refrigerating compartment door  
112: ice-making compartment door  
113: vegetable compartment door  
114: freezing compartment door  
115: switching compartment door

[Name of Document] CLAIMS

[Claim 1]

A refrigerator comprising:

a plurality of storage compartments;

a freezing cycle apparatus including a compressor for cooling said storage compartments;

operating means for making various settings and various operations;

display means for displaying information set by said operating means and an operation state of the refrigerator;

storage means for storing information set by said operating means; and

a controller for controlling said freezing cycle apparatus and said display means, wherein

said controller calculates a current load level of said refrigerator on the basis of a use state of said refrigerator and determines the current operation load state of said refrigerator on the basis of the load level; and

said display means displays said operation load state.

[Claim 2]

The refrigerator according to Claim 1, wherein said controller determines the current operation load state of said refrigerator in several stages on the basis of said load level.

[Claim 3]

The refrigerator according to Claim 1 or 2, wherein said storage means stores a predetermined reference set temperature;

said operating means sets a set temperature for any of or all of the plurality of said storage compartments; and

if said controller determines that said set temperature is lower than said reference set temperature, said controller increases said load level, while if said controller determines it to be higher than said reference set temperature, said controller decreases said load level.

[Claim 4]

The refrigerator according to any one of Claims 1 to 3, further comprising

door open-frequency counting means for counting the frequency of opening of any of or all of the doors of the plurality of said storage compartments, wherein

said storage means stores a predetermined frequency of reference door opening; and

if said controller determines that said frequency of opening counted by said door open-frequency counting means has exceeded said reference door opening, said controller increases said load level.

[Claim 5]

The refrigerator according to any one of Claims 1 to 4, further comprising

door open-time measuring means for measuring an open time when any of or all of the doors of the plurality of said storage compartments are opened once or accumulated open time, wherein

said storage means stores a predetermined reference door-opened time; and

if said controller determines that said open time measured by said door open-time measuring means has exceeded said reference door open time, said controller increases said load level.

[Claim 6]

The refrigerator according to any one of Claims 1 to 5, further comprising

rotation-speed detecting means for detecting a rotation speed of said compressor, wherein

said storage means stores a predetermined reference rotation speed; and

if said controller determines that said rotation speed detected by said rotation-speed detecting means has exceeded said reference rotation speed, said controller increases said load level.

[Claim 7]

The refrigerator according to any one of Claims 1 to 6, further comprising operation time measuring means for measuring an operation time or an accumulated operation time

from once said compressor is started till said compressor is stopped the next time, wherein

said storage means stores a predetermined reference operation time; and

if said controller determines that said operation time measured by said operation time measuring means has exceeded said reference operation time, said controller increases said load level.

[Claim 8]

The refrigerator according to any one of Claims 1 to 7, further comprising outside air temperature detecting means for detecting an outside air temperature of a place where said refrigerator is installed, wherein

said storage means stores a predetermined reference outside air temperature; and

if said controller determines that said outside air temperature detected by said outside air temperature detecting means has exceeded said reference outside air temperature, said controller increases said load level.

[Claim 9]

The refrigerator according to any one of Claims 1 to 8, wherein if said controller determines that a rapid cooling operation is executed by said operating means, said controller increases said load level.

[Claim 10]

A refrigerator comprising:

a plurality of storage compartments:

a freezing cycle apparatus including a compressor for cooling said storage compartments;

operating means for making various settings and various operations;

display means for displaying information set by said operating means and an operation state of the refrigerator;

storage means for storing information set by said operating means;

a controller for controlling said freezing cycle apparatus and said display means; and

operation state detecting means constituted by several of or all of door open-frequency counting means for counting the frequency of opening of any of or all of the doors of the plurality of said storage compartments, door open-time measuring means for measuring an open time when any of or all of the doors of the plurality of said storage compartments are opened once or accumulated open time, rotation-speed detecting means for detecting a rotation speed of said compressor, operation time measuring means for measuring an operation time or an accumulated operation time from once said compressor is started till said compressor is stopped the next time, and outside air temperature detecting means for detecting an outside air temperature of a place

where said refrigerator is installed, wherein

said controller calculates a current load level of said refrigerator on the basis of several of or all of any of or all of the set temperatures of the plurality of said storage compartments set by said operating means, an operation state result outputted by said operation state detecting means, and presence of a rapid cooling operation by said operating means and determines the current operation load state of said refrigerator; and

said display means displays said operation load state.