

REFRIGERATOR-FREEZER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a refrigerator-freezer.

2. Description of the Related Art

In recent years, refrigerator-freezers for home use are further increased in capacity and reduced in power consumption. According to an increasing tendency to power saving, there is also an increasing need for realizing power saving by contriving a way of use of a refrigerator-freezer by a user.

As a method of solving such a problem, it is known to set the temperatures of storage compartments higher. It is also proposed to provide setting for turning off cooling of a refrigeration compartment (e.g., Japanese Patent Application Laid-open No. 2004-251515). Specifically, cold-air-channel switching means for switching a channel of cold air can switch a mode for supplying cold air generated by a cooler to both of a refrigeration temperature zone compartment and a freezing temperature zone compartment and a mode for supplying the cold air only to the freezing temperature zone compartment. When the cooling of the

refrigeration compartment is turned off, the cold-air-channel switching means performs control to select the mode for supplying the cold air only to the freezing temperature zone compartment and not to supply the cold air to the refrigeration compartment.

However, in the refrigerator-freezer in the past, when the cooling control is once stopped, even if the temperature of the storage compartment for which the cooling control is stopped abnormally rises thereafter, the cooling stop state is continued until a user releases the setting. Therefore, when the cooling control is stopped by mistake, foods stored in the storage compartment go bad before the user notices it.

SUMMARY OF THE INVENTION

It is an object of the present invention to at least partially solve the problems in the conventional technology.

There is provided a refrigerator-freezer according to an aspect of the present invention including: a plurality of divided storage compartments; a cooler configured to cool ambient air and generate cold air supplied to the storage compartments; an air duct configured to cause the cold air generated by the cooler to flow into the storage compartments; air-volume adjusting units configured to respectively adjust inflows of the cold air from the air

duct into the storage compartments; temperature detecting units configured to respectively detect temperatures of the storage compartments; cooling-stop setting units capable of individually setting stop of cooling control for the storage compartments; and a control unit configured to stop, concerning the storage compartment for which the cooling control is set to be stopped by the cooling-stop setting unit, inflow of the cold air into the storage compartment using the air-volume adjusting unit and stop the cooling control and, when the temperature detecting unit continuously detects, for a fixed time or more, abnormal temperature equal to or higher than first temperature set in advance, even during the setting for stopping the cooling control, release the control for stopping the inflow of the cold air into the storage compartment by the air-volume adjusting unit, and perform the cooling control until the temperature detected by the temperature detecting unit returns to temperature equal to or lower than second temperature set in advance lower than the first temperature.

The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a front view of an example of a refrigerator-freezer according to a first embodiment of the present invention;

Fig. 2 is a sectional view of the refrigerator-freezer taken along A-A in Fig. 1;

Fig. 3 is a sectional view of the refrigerator-freezer taken along B-B in Fig. 1;

Fig. 4 is a control block diagram of the refrigerator-freezer;

Fig. 5 is a flowchart for explaining an operation in the first embodiment;

Fig. 6 is a flowchart for explaining an operation in a second embodiment;

Fig. 7 is a flowchart for explaining an operation in a third embodiment;

Fig. 8 is a diagram of an example of the configuration of a switching compartment of a refrigerator-freezer according to a fourth embodiment;

Fig. 9 is a graph of an example of a relation between weight and a detected voltage;

Fig. 10 is a flowchart for explaining an operation in the fourth embodiment;

Fig. 11 is a diagram of an example of the

configuration of a switching compartment of a refrigerator-freezer according to a fifth embodiment;

Fig. 12 is a diagram of another example of the configuration of the switching compartment of the refrigerator-freezer according to the fifth embodiment;

Fig. 13 is a graph of an example of a relation between a distance and a detected voltage;

Fig. 14 is a diagram of an example of the configuration of an operation panel in a sixth embodiment; and

Fig. 15 is a time chart for explaining an operation in a seventh embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of Refrigerator-freezers according to the present invention are explained in detail below with reference to the accompanying drawings. The invention is not limited by the embodiments.

First Embodiment

Fig. 1 is a front view of an example of a refrigerator-freezer according to a first embodiment of the present invention. Fig. 2 is a sectional view of the refrigerator-freezer taken along A-A in Fig. 1. Fig. 3 is a sectional view of the refrigerator-freezer taken along B-

B in Fig. 1.

As shown in Fig. 1, a refrigerator-freezer 1 includes a divided plurality of storage compartments. Specifically, a refrigeration compartment 100 provided with, for example, a pair of left and right front doors that is a double door, an ice-making compartment 200 and a switching compartment 300 provided side by side on the left and right under the refrigeration compartment 100, a vegetable compartment 400 provided under the ice-making compartment 200 and the switching compartment 300, and a freezing compartment 500 provided under the vegetable compartment 400. The ice-making compartment 200, the switching compartment 300, the vegetable compartment 400, and the freezing compartment 500 respectively include front doors. The switching compartment 300 is a storage compartment for which temperature switching is possible. An operation panel 5 with which settings for the storage compartments can be adjusted is provided on the door surface of the refrigeration compartment 100. As explained below, buttons (operation units) with which cooling control for all or a part of the storage compartments of the refrigerator-freezer 1 can be set to be stopped are provided in the operation panel 5. An insulation heater 42 for dew prevention is provided in a partitioning section of the left and right doors of the refrigeration compartment 100.

An internal configuration of the refrigerator-freezer 1 is explained with reference to Figs. 1 to 3. An air duct 4 is extended in the up down direction on the rear surface side in the refrigerator-freezer 1. The air duct 4 allows the freezing compartment 500 and the refrigeration compartment 100 to communicate with each other. In the air duct 4, a cooler 3 that cools the ambient air and generates cold air supplied to the storage compartments and a fan 2 (an air blowing unit) that is arranged, for example, above the cooler 3 and circulates the cold air generated by the cooler 3 are provided. The cooler 3 and the fan 2 are arranged, for example, on the rear surface side of the vegetable compartment 400. A compressor 7 that compresses a refrigerant is arranged in a lower part on the rear surface side in the refrigerator-freezer 1. The cooler 3 and the compressor 7 form a freezing cycle.

In the refrigerator-freezer 1, dampers functioning as air-volume adjusting units that adjust volumes of the cold air directly or indirectly flowing in from the air duct 4 are provided respectively for the refrigeration compartment 100, the ice-making compartment 200, the switching compartment 300, and the vegetable compartment 400. Specifically, for the refrigeration compartment 100, a refrigeration-compartment damper 21 is provided at the upper end of the air duct 4. An inflow of the cold air

directly flowing from the air duct 4 into the refrigeration compartment 100 is adjusted by opening and closing the refrigeration-compartment damper 21. For the ice-making compartment 200, an ice-making-compartment damper 24 is provided in an air duct 25a that allows the ice-making compartment 200 and the air duct 4 to communicate with each other. An inflow of the cold air directly flowing from the air duct 4 into the ice-making compartment 200 is adjusted by opening and closing the ice-making-compartment damper 24. A refrigeration-compartment feedback path 8, one end of which communicates with the refrigeration compartment 100 and the other end of which communicates with the vegetable compartment 400, is provided in the ice-making compartment 200. The refrigeration-compartment feedback path 8 forms a return air duct for the cold air sent to the refrigeration compartment 100 by the fan 2. An ice maker 210 is provided in the ice-making compartment 200. For the switching compartment 300, a switching-compartment damper 22 is provided in an air duct 25b that allows the switching compartment 300 and the air duct 4 to communicate with each other. An inflow of the cold air directly flowing from the air duct 4 into the switching compartment 300 is adjusted by opening and closing the switching-compartment damper 22. The refrigeration-compartment feedback path 8, one end of which communicates with the refrigeration compartment 100

and the other end of which communicates with the vegetable compartment 400, is provided in the switching compartment 300. For the vegetable compartment 400, vegetable-compartment dampers 23 are respectively provided on the refrigeration-compartment feedback paths 8 in the ice-making compartment 200 and the switching compartment 300. An inflow of the cold air indirectly flowing from the air duct 4 into the vegetable compartment 400 is adjusted by opening and closing the vegetable-compartment dampers 23. A vegetable-compartment feedback path 9, which is an air duct that allows the vegetable compartment 400 and the freezing compartment 500 to communicate with each other, forms a return air duct for the cold air sent to the refrigeration compartment 100 by the fan 2. Although not shown in the figure, a freezing-compartment damper can be provided in the air duct 4. An inflow of the cold air directly flowing from the air duct 4 into the freezing compartment 500 can be adjusted by opening and closing the freezing-compartment damper. The air-volume adjusting units can be units other than the dampers as long as the units can adjust inflows of the cold air from the air duct 4 to the storage compartments.

An insulation heater 41 is provided in the vegetable compartment 400. The insulation heater 41 is used to adjust compartment temperature to appropriate temperature.

In a pipe 61 for pouring water from a water supply tank 110 into the ice maker 210, an insulation heater 43 is provided to prevent freezing of the pipe 61.

Temperature measuring units are respectively provided in the storage compartments of the refrigerator-freezer 1. Specifically, a freezing-compartment thermistor 34 is provided in the freezing compartment 500, a vegetable-compartment thermistor 33 is provided in the vegetable compartment 400, an ice-making-compartment thermistor 35 is provided in the ice-making compartment 200, a switching-compartment thermistor 32 is provided in the switching compartment 300, and a refrigeration-compartment thermistor 31 is provided in the refrigeration compartment 100.

Door switches (door-opening-closing detecting units) respectively provided in the storage compartments detect opening and closing states of the doors of the storage compartments. Specifically, a refrigeration-compartment door switch 11 outputs a signal to a control board 6 according to an opening and closing state of the refrigeration compartment door. The same applies to a switching-compartment door switch 12, a vegetable-compartment door switch 13, a freezing-compartment door switch 14, and an ice-making-compartment door switch 15. The control board 6 is provided on the rear surface of the refrigerator-freezer 1.

An overview of cooling of the refrigerator-freezer 1 is explained with reference to Figs. 1 to 3. The refrigerant circulates according to the operation of the compressor 7 and exchanges heat with the ambient air, whereby the cooler 3 is cooled. When air is blown against the cooled cooler 3 by the fan 2, cold air passes through the air duct 4 and circulates through the refrigeration compartment 100, the ice-making compartment 200, the switching compartment 300, the vegetable compartment 400, and the freezing compartment 500, whereby the storage compartments are cooled. In this case, the refrigeration-compartment feedback path 8 and the vegetable-compartment feedback path 9 form a return air duct for the cold air sent by the fan 2.

In general, the temperature of the cold air blown out from the cooler 3 is low temperature equal to or lower than -20°C . Therefore, if the cold air is directly sent into the storage compartments, the storage compartments in a refrigeration temperature zone for keeping the temperature in the refrigerator-freezer 1 at temperature equal to or higher than 0°C (the refrigeration compartment 100, the vegetable compartment 400, and the switching compartment 300 set in the refrigeration temperature zone) cannot be controlled to set temperatures. Consequently, foods in the

storage compartments are frozen. To prevent this situation, the refrigeration-compartment damper 21, the switching-compartment damper 22, the vegetable-compartment dampers 23, and the ice-making-compartment damper 24 are controlled to be opened and closed to adjust inflows of the cold air from the air duct 4 or the insulation heater 41 is energized to maintain the storage compartments at appropriate temperatures. The appropriate temperatures are, for example, about 4°C for the refrigeration compartment 100 and about 7°C for the vegetable compartment 400. In the case of the storage compartments in a freezing temperature zone for keeping the temperature in the refrigerator-freezer 1 at temperature equal to or lower than 0° (the ice-making compartment 200, the freezing compartment 500, and the switching compartment 300 set in the freezing temperature zone), appropriate temperatures are, for example, about -18°C.

Fig. 4 is a control block diagram of the refrigerator-freezer 1. The control board 6 includes microcomputers 51 and 52. The temperatures of the storage compartments obtained by the refrigeration-compartment thermistor 31, the switching-compartment thermistor 32, the vegetable-compartment thermistor 33, the freezing-compartment thermistor 34, and the ice-making-compartment thermistor 35

are input to the microcomputer 51. The control board 6 detects the temperatures of the storage compartments. The microcomputer 51 manages, based on the obtained temperatures of the storage compartments, control of the entire refrigerator-freezer 1. For example, the microcomputer 51 performs opening and closing control of the dampers for the storage compartments (the refrigeration-compartment damper 21, the switching-compartment damper 22, the vegetable-compartment dampers 23, the ice-making-compartment damper 24, and the like), performs control of the number of revolutions of the fan 2, performs control of the number of revolutions of the compressor 7 by giving a command to the microcomputer 52, which is a compressor driver, and performs control of the insulation heaters 41 to 43. The microcomputer 51 can detect opening and closing states and door opening and closing frequencies of the storage compartments according to the input of signals from the refrigeration-compartment door switch 11, the switching-compartment door switch 12, the vegetable-compartment door switch 13, the freezing-compartment door switch 14, and the ice-making-compartment door switch 15. In other words, the microcomputer 51 has a function of counting, based on output signals from the door switches, the numbers of times of door opening and closing. Therefore, the microcomputer 51 can calculate door opening

and closing frequencies as the numbers of times of door opening and closing within a fixed period.

In the operation panel 5, buttons with which cooling control for all or a part of the storage compartments of the refrigerator-freezer 1 can be set to be stopped are provided (cooling-stop setting units). Information input by the operation of the buttons is sent to the microcomputer 51. The refrigerator-freezer 1 is controlled according to the setting for stopping the cooling control. Specifically, when setting for stopping the cooling control for the storage compartments is performed, the microcomputer 51 closes the dampers that can adjust the cold air flowing into the storage compartments.

An operation performed when the cooling of the storage compartments in the freezing temperature zone is stopped in the refrigerator-freezer 1 according to this embodiment is explained. As an example, an operation performed when the cooling of the ice-making compartment 200, which is the storage compartment in the freezing temperature zone, is stopped is explained with reference to a flowchart of Fig. 5. Fig. 5 is a flowchart for explaining an operation in this embodiment.

First, the microcomputer 51 determines presence or absence of cooling stop setting (S1). The microcomputer 51 can determine presence or absence of cooling stop setting

according to setting information input from the operation panel 5. When cooling stop setting is performed via the operation panel 5, the microcomputer 51 determines that cooling stop setting is present. Otherwise, the microcomputer 51 determines that cooling stop setting is absent. As a result of the determination, when cooling stop setting is not performed (No at S1), the microcomputer 51 controls the refrigerator-freezer 1 to continue a normal operation (S2). On the other hand, when cooling stop setting for the ice-making compartment 200 is performed (Yes at S1), the microcomputer 51 determines, according to the input of temperature information from the ice-making-compartment thermistor 35, whether abnormal temperature lasts a certain fixed time T1 (S3). The abnormal temperature is defined as temperature equal to or higher than temperature $\theta 1$ (first temperature) set in advance. The temperature $\theta 1$ is set from the viewpoint of protection of foods in the storage compartments. As a result of the determination, when the microcomputer 51 determines that the abnormal temperature does not last the fixed time T1 (No at S3), the microcomputer 51 continues the cooling stop control and keeps the ice-making-compartment damper 24 closed (S5).

On the other hand, when the microcomputer 51

determines that the abnormal temperature lasts the fixed time T1 (Yes at S3), the microcomputer 51 opens the ice-making-compartment damper 24 and resumes the cooling (S4). Subsequently, the microcomputer 51 determines whether the temperature of the ice-making compartment 200 drops to temperature equal to or lower than temperature $\theta 2$ (second temperature) (S6). The temperature $\theta 2$ is set in advance as temperature lower than the temperature $\theta 1$ and is normal temperature different from the abnormal temperature. When the temperature of the ice-making compartment 200 drops to temperature equal to or lower than the temperature $\theta 2$ (Yes at S6), the microcomputer 51 closes the ice-making-compartment damper 24 and causes the refrigerator-freezer 1 to return the cooling stop control (S5). On the other hand, when the temperature of the ice-making compartment 200 does not drop to temperature equal to or lower than the temperature $\theta 2$ (No at S6), the microcomputer 51 returns to the processing at S1. T1, $\theta 1$, and $\theta 2$ are, for example, 10 minutes, 0°C , and -10°C .

The above explanation applies when the cooling of the freezing compartment 500 or the switching compartment 300 set in the freezing temperature zone is stopped.

Furthermore, the cooling of the storage compartments in the refrigeration temperature zone can be stopped in the

refrigerator-freezer 1. Similarly, the refrigerator-freezer 1 is controlled according to the flowchart of Fig. 5. For example, when the cooling of the refrigeration compartment 100 is set to be stopped, T1, θ_1 , and θ_2 can be set to 10 minutes, 15°C, and 4°C.

As explained above, according to this embodiment, when the abnormal temperature lasts the fixed time in the storage compartment for which the cooling control is set to be stopped, even during the setting for stopping the cooling control, the closing of the damper is temporarily released and the cooling control is carried out until the temperature of the storage compartment returns to the normal temperature. Therefore, it is possible to realize protection of foods in the storage compartment for which the cooling control is set to be stopped. The storage compartments for which the cooling control can be stopped are the storage compartments in one of the freezing temperature zone and the refrigeration temperature zone or both. In particular, it is possible to obtain a large power saving effect equal to or larger than about 10% by stopping the cooling of the storage compartments in the freezing temperature zone having large temperature differences from the ambient temperature of the refrigerator-freezer 1. On the other hand, in the

refrigerator-freezer in the past, the cooling control is stopped for only the storage compartments in the refrigeration temperature zone. Therefore, temperature differences between the temperatures of the storage compartments and the ambient temperature of the refrigerator-freezer is small. As a result, a large power saving effect cannot be obtained.

Second Embodiment

Fig. 6 is a flowchart for explaining an operation in a second embodiment. Detailed explanation of the configuration of the refrigerator-freezer 1 according to the second embodiment is omitted because the configuration is the same as the configuration in the first embodiment. An operation performed when, for example, the cooling control for the vegetable compartment 400, the ice-making compartment 200, or the refrigeration compartment 100 is stopped is explained below with reference to Fig. 6.

First, the microcomputer 51 determines presence or absence of cooling stop setting (S11). As a result of the determination, when cooling stop setting is not performed (No at S11), the microcomputer 51 controls the refrigerator-freezer 1 to continue a normal operation (S12).

When cooling stop setting is performed (Yes at S11), the microcomputer 51 determines whether the cooling control

for the vegetable compartment 400 is stopped (S13). Specifically, as explained in the first embodiment, the microcomputer 51 determines whether the vegetable compartment 400 is in a state in which cooling is stopped by closing the vegetable-compartment dampers 23. As a result of the determination, when the cooling control for the vegetable compartment 400 is stopped (Yes at S13), the microcomputer 51 turns off the insulation heater 41 (S14). In other words, energization of the insulation heater 41 is stopped. The microcomputer 51 can reduce the energization instead of stopping the energization. A reason for stopping or reducing the energization of the insulation heater 41 is that, in the storage compartment for which the cooling control is set to be stopped, because compartment temperature rises when the damper is closed, it is unnecessary to heat the storage compartment using an insulation heater. When the cooling control for the vegetable compartment 400 is not stopped (No at S13), the microcomputer 51 proceeds to processing at S15.

Subsequently, the microcomputer 51 determines whether the cooling control for the ice-making compartment 200 is stopped (S15). As a result of the determination, when the cooling control for the ice-making compartment 200 is stopped (Yes at S15), the microcomputer 51 turns off the insulation heater 43 (S16). In other words, energization

of the insulation heater 43 is stopped. The microcomputer 51 can reduce the energization instead of stopping the energization. When the cooling control for the ice-making compartment 200 is not stopped (No at S15), the microcomputer 51 proceeds to processing at S17.

The microcomputer 51 determines whether the cooling control for the refrigeration compartment 100 is stopped (S17). As a result of the determination, when the cooling control for the refrigeration compartment 100 is stopped (Yes at S17), the microcomputer 51 turns off the insulation heater 42 (S18). In other words, energization of the insulation heater 42 is stopped. The microcomputer 51 can reduce the energization instead of stopping the energization. When the cooling control for the refrigeration compartment 100 is not stopped (No at S17), the microcomputer 51 returns to the processing at S11.

As explained above, according to this embodiment, it is possible to obtain a larger power saving effect by controlling, in accordance with the storage compartment for which the cooling control is set to be stopped, the refrigerator-freezer to turn off the insulation heater unnecessary to be heated. It goes without saying that this embodiment can be applied to an arbitrary storage compartment including the insulation heater. The other operations and effects of this embodiment are the same as

those of the first embodiment.

Third Embodiment

Fig. 7 is a flowchart for explaining an operation in a third embodiment. Detailed explanation of the configuration of the refrigerator-freezer 1 according to the third embodiment is omitted because the configuration is the same as the configuration in the first embodiment. An operation performed when, for example, the cooling control for the ice-making compartment 200 is stopped is explained below with reference to Fig. 7.

First, the microcomputer 51 determines presence or absence of cooling stop setting (S21). As a result of the determination, when cooling stop setting is not performed (No at S21), the microcomputer 51 controls the refrigerator-freezer 1 to continue a normal operation (S22).

When cooling stop setting for the ice-making compartment 200 is performed (Yes at S21), the microcomputer 51 counts a door opening and closing frequency of the ice-making compartment 200 (S23). Specifically, the microcomputer 51 counts the number of times of door opening and closing of the ice-making compartment 200 within a fixed time T2 according to an output signal from the ice-making-compartment door switch 15 and calculates a door opening and closing frequency from

the number of times of door opening and closing. The fixed time T2 is time set in advance.

Subsequently, the microcomputer 51 determines whether the number of times of door opening and closing within the predetermined time T2 is smaller than N1 (S24). N1 is a natural number set in advance. As a result of the determination, when the number of times of door opening and closing is equal to or larger than N1 (No at S24), the microcomputer 51 controls the refrigerator-freezer 1 to return to the normal operation (S22). On the other hand, when the number of times of door opening and closing is smaller than N1 (Yes at S24), the microcomputer 51 counts a cumulative number of times of door opening and closing. Specifically, the microcomputer 51 calculates a cumulative number of times of door opening and closing from a certain reference time and determines whether the cumulative number of times is smaller than N2 (S25). N2 is a natural number set in advance. As a result of the determination, when the cumulative number of times of door opening and closing is equal to or larger than N2 (No at S25), the microcomputer 51 controls the refrigerator-freezer 1 to return to the normal operation (S22). When the cumulative number of times of door opening and closing is smaller than N2 (Yes at S25), the microcomputer 51 continues the cooling stop control (S26). In the above explanation, for example, N1

is three times, N2 is ten times, and T2 is one hour.

When the cooling of the refrigeration compartment 100, the switching compartment 300, the vegetable compartment 400, or the freezing compartment 500 is stopped, the refrigerator-freezer 1 is also controlled according to the flowchart of Fig. 7.

As explained above, according to this embodiment, the number of times of door opening and closing of the storage compartment for which cooling control is set to be stopped is measured and, when a door opening and closing frequency is high, even during setting for stopping the cooling control, the refrigerator-freezer 1 is controlled to return to the normal operation control. Therefore, it is possible to realize protection of foods in the storage compartment. The operation operations and effects of this embodiment are the same as those in the first embodiment. This embodiment and the second embodiment can be combined.

Fourth Embodiment

Fig. 8 is a diagram of an example of the configuration of the switching compartment 300 of the refrigerator-freezer 1 according to a fourth embodiment. As shown in Fig. 8, a storage case 302 separated from a switching compartment door 301 is arranged in the switching compartment 300. The storage case 302 is arranged on a

partition 303 via a weight sensor 71. That is, the weight sensor 71 is set between the bottom of the storage case 302 and the partition 303, and the weight sensor 71 and the storage case 302 are set in contact with each other. Food 81 is stored in the storage case 302. The weight sensor 71 measures the weight of the storage case 302 including the food 81. The other components of the refrigerator-freezer 1 according to this embodiment are the same as those in the first embodiment.

Fig. 9 is a graph of an example of a relation between weight measured by the weight sensor 71 and a detected voltage. An output from the weight sensor 71 changes as shown in Fig. 9 according to the weight of a measurement target of the weight sensor 71. In Fig. 9, the weight of the storage case 302 not including the food 81 is m_0 . A detected voltage in the case of the weight m_0 is V_0 . In the figure, m_1 represents minimum weight detectable when the food 81 is included in the storage case 302. A detected voltage in the case of the minimum weight m_1 is V_1 . In the figure, m_2 represents the weight of the storage case 302 including arbitrary food 81. A detected voltage in the case of the weight m_2 is V_2 . In this way, presence or absence of the food 81 in the storage case 302 can be determined from the detected voltage of the weight sensor 71.

The detected voltage of the weight sensor 71 is input to the microcomputer 51 of the control board 6. The microcomputer 51 detects weight based on the relation between weight and a detected voltage shown in Fig. 9 to detect presence or absence of the food 81 in the storage case 302.

An operation performed when cooling of, for example, the switching compartment 300 in which the food 81 is stored is stopped in the refrigerator-freezer 1 according to this embodiment is explained with reference to Fig. 10. Fig. 10 is a flowchart for explaining the operation in this embodiment.

First, the microcomputer 51 determines presence or absence of cooling stop setting (S31). As a result of the determination, when cooling stop setting is not performed (No at S31), the microcomputer 51 controls the refrigerator-freezer 1 to continue a normal operation (S32). It is assumed that cooling of the switching compartment 300 is stopped (Yes at S31). Therefore, the microcomputer 51 proceeds to S33. The microcomputer 51 measures the weight of the switching compartment 300. Specifically, the microcomputer 51 detects the weight of the storage case 302 based on a detected voltage, which is an output from the weight sensor 71 (a food detecting unit), and the relation shown in Fig. 9.

Subsequently, the microcomputer 51 determines whether the detected weight is smaller than m1 (S34). When the detected weight is smaller than m1 (Yes at S34), the microcomputer 51 carries out cooling stop control (S35). On the other hand, when the detected weight is equal to or larger than m1 (No at S34), the microcomputer 51 returns to normal operation control (S32). Specifically, even if setting for stopping cooling control is performed, when the food 81 is stored in the switching compartment 300, the microcomputer 51 releases the setting for stopping the cooling control and performs the cooling control. For example, even if the food 81 is not stored in the switching compartment 300 in the beginning, when the food 81 is stored in the switching compartment 300 anew thereafter, the microcomputer 51 releases the cooling stop setting for the switching compartment 300 and carries out the cooling control.

When the cooling of the refrigeration compartment 100, the ice-making compartment 200, the vegetable compartment 400, or the freezing compartment 500 is stopped, the refrigerator-freezer 1 is also controlled according to the flowchart of Fig. 10 by the application of the same configuration.

As explained above, according to this embodiment, even if the storage compartment for which cooling is stopped is

set by mistake or even if some food is stored in the storage compartment while the cooling stop setting is kept, the microcomputer 51 detects the food in the storage compartment by measuring the weight of the storage compartment and controls the refrigerator-freezer 1 to return to the normal control. Therefore, it is possible to realize protection of the food in the storage compartment.

In this embodiment, the microcomputer 51 can inform by, for example, display on the operation panel 5, that the refrigerator-freezer 1 returns to the normal control. As means for obtaining the same effect, the microcomputer 51 can inform that the food is present in the storage compartment. The other operations and effects of this embodiment are the same as those of the first embodiment. This embodiment and the second and third embodiments can be combined.

Fifth Embodiment

In the fourth embodiment, the weight sensor is used as the food detecting unit that detects presence or absence of foods. However, presence or absence of foods can be detected using a distance sensor.

Fig. 11 is a diagram of an example of the configuration of the switching compartment 300 of the refrigerator-freezer 1 according to a fifth embodiment. In

the figure, food are absent in the storage case 302. Fig. 12 is a diagram of another example of the configuration of the switching compartment 300 of the refrigerator-freezer 1 according to this embodiment. In the figure, some food is present in the storage case 302. As shown in Figs. 11 and 12, in this embodiment, a distance sensor 72 is provided at the bottom on the rear surface of the storage case 302. The distance sensor 72 radiates an infrared ray and measures time until return of the infrared ray to the distance sensor 72 by reflection to thereby detect presence or absence of some food. In other words, the time until the infrared ray radiated from the distance sensor 72 is reflected to return to the distance sensor 72 changes according to presence or absence of some food. The distance sensor 72 outputs a detected voltage corresponding to the measured time. In Figs. 11 and 12, components same as those shown in Fig. 8 are denoted by the same reference numerals and signs. The other components of the refrigerator-freezer 1 according to this embodiment are the same as those in the first embodiment.

Fig. 13 is a graph of an example of a relation between a distance measured by the distance sensor 72 and a detected voltage. In Fig. 13, d_0 represents a distance (a distance from the distance sensor 72 to the opposite surface in the storage case 302) detected by the distance

sensor 72 in a state in which no foods are included in the storage case 302. A detected voltage in the case of the distance d_0 is V_0 . In the figure, d_1 represents a maximum distance detectable when the food 81 is included in the storage case 302. A detected voltage in the case of the maximum distance d_1 is V_1 . In the figure, d_2 represents an arbitrary distance from the distance sensor 72 to the food 81. A detected voltage in the case of the distance d_2 is V_2 .

The detected voltage of the distance sensor 72 is input to the microcomputer 51 of the control board 6. The microcomputer 51 detects a distance based on the relation between a distance and a detected voltage shown in Fig. 13 to detect presence or absence of the food 81 in the storage case 302.

An operation in this embodiment is the same as the operation in the fourth embodiment. Specifically, in the flowchart of Fig. 10, "measure weight" only has to be replaced with "measure distance" at S33 and "is weight smaller than m_1 ?" only has to be replaced with "is distance larger than d_1 ?" at S34.

As explained above, according to this embodiment, even if the storage compartment for which cooling is stopped is set by mistake or even if some food is stored in the storage compartment while the cooling stop setting is kept,

the microcomputer 51 detects the food 81 from the reflection time of the distance sensor 72 and controls the refrigerator-freezer 1 to return to the normal control. Therefore, it is possible to realize protection of the food in the storage compartment. The other operations and effects of this embodiment are the same as those of the fourth embodiment.

Sixth Embodiment

Fig. 14 is a diagram of an example of the configuration of the operation panel 5 in a sixth embodiment. The operation panel 5 includes operation units (buttons, etc.) with which various kinds of setting are possible and a display unit that can display an operation result of the operation units and the like. As explained in the first embodiment, the operation panel 5 has the function of the cooling-stop setting unit. However, in this embodiment, when setting for stopping cooling control is performed or during the setting for stopping the cooling control, lighting or flashing display explained below is performed on the display unit. Specifically, as shown in Fig. 14, the operation panel 5 is caused to light or flash the display of cooling stop setting and display of a storage compartment for which cooling stop is set. Consequently, a user perceives that the cooling stop is set

and which storage compartment is stopped being cooled.

For example, when cooling of the ice-making compartment 200 is stopped, display of cooling stop ("cooling stop") and display of an ice-making compartment ("ice making") are lit or flashed. At this point, to inform that power saving is performed, "ECO" display can be lit or flashed.

According to this embodiment, the user can easily recognize that, for example, cooling stop is set and which storage compartment is stopped being cooled. When the ECO display is lit or flashed, the user can easily recognize that power saving is performed. The other components, operations, and effects of this embodiment are the same as those of the first to fifth embodiments.

Seventh Embodiment

Fig. 15 is a time chart for explaining an operation in a seventh embodiment. An operation performed when, for example, cooling operation for the ice-making compartment 200 is stopped is explained below with reference to Fig. 15. The configuration of the refrigerator-freezer 1 according to this embodiment is the same as that in the first embodiment.

As shown in Fig. 15, at time $t=t_1$, when cooling stop setting for the ice-making compartment 200 is performed,

the damper (the ice-making-compartment damper 24) is closed to stop cooling of the ice-making compartment 200. Consequently, it is possible to reduce a cooling ability by the volume of the ice-making compartment 200. Therefore, the number of revolutions of the fan 2 is reduced from f_3 to f_1 and the number of revolutions of the compressor 7 is reduced from F_3 to F_1 . The insulation heater 43 in the ice-making compartment 200 is turned off because heating is unnecessary. The temperature of the ice-making compartment 200 at this point is represented as θ_{11} .

At time $t=t_2$, when the temperature of the ice-making compartment 200 stopped being cooled rises to θ_{13} , the damper (the ice-making-compartment damper 24) is opened according to food protection control. At this point, the number of revolutions of the fan 2 is increased from f_1 to f_2 and the number of revolutions of the compressor 7 is increased from F_1 to F_2 to quickly cool the ice-making compartment 200 again. At time $t=t_3$, when the temperature of the ice-making compartment 200 drops to temperature equal to or lower than θ_{12} , the damper (the ice-making-compartment damper 24) is closed again, the number of revolutions of the fan 2 is reduced from f_2 to f_1 , and the number of revolutions of the compressor 7 is reduced from F_2 to F_1 . The control board 6 (the microcomputer 51)

controls the operation explained above. For example, f1 is 800 rpm, f2 is 1000 rpm, f3 is 1200 rpm, F1 is 18 rps, F2 is 30 rps, F3 is 40 rps, θ_{11} is -20°C , θ_{12} is -7°C , and θ_{13} is 0°C .

In the above explanation, the ice-making compartment 200 is explained as an example. However, the same explanation applies when cooling of the refrigeration compartment 100, the switching compartment 300, the vegetable compartment 400, or the freezing compartment 500 is stopped. When the cooling of the refrigeration compartment 100 is stopped, the insulation heater 42 is turned off. When the cooling of the vegetable compartment 400 is stopped, the insulation heater 41 is turned off.

As explained above, according to this embodiment, the number of revolutions of the fan 2 and the number of revolutions of the compressor 7 are reduced according to the storage compartment stopped being cooled. Therefore, it is possible to obtain a larger power saving effect.

After the temperature of the storage compartment reaches food protection temperature (abnormal temperature) θ_{13} , the number of revolutions of the fan 2 and the number of revolutions of the compressor 7 are increased to quickly cool the storage compartment. Therefore, it is possible to more steadily protect foods.

According to the present invention, there is an effect that it is possible to realize protection of foods in a storage compartment for which cooling control is set to be stopped.

In the explanation of the first to seventh embodiments, the cooling control for any one of the storage compartments is stopped. However, the cooling control can be simultaneously stopped for two or more of the storage compartments. In this case, it is possible to obtain a larger power saving effect.

Although the invention has been described with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching herein set forth.

What is claimed is:

1. A refrigerator-freezer comprising:

a plurality of divided storage compartments;

a cooler configured to cool ambient air and generate cold air supplied to the storage compartments;

an air duct configured to cause the cold air generated by the cooler to flow into the storage compartments;

air-volume adjusting units configured to respectively adjust inflows of the cold air from the air duct into the storage compartments;

temperature detecting units configured to respectively detect temperatures of the storage compartments;

cooling-stop setting units capable of individually setting stop of cooling control for the storage compartments; and

a control unit configured to stop, concerning the storage compartment for which the cooling control is set to be stopped by the cooling-stop setting unit, inflow of the cold air into the storage compartment using the air-volume adjusting unit and stop the cooling control and, when the temperature detecting unit continuously detects, for a fixed time or more, abnormal temperature equal to or higher than first temperature set in advance, even during the setting for stopping the cooling control, release the control for stopping the inflow of the cold air into the

storage compartment by the air-volume adjusting unit, and perform the cooling control until the temperature detected by the temperature detecting unit returns to temperature equal to or lower than second temperature set in advance lower than the first temperature.

2. The refrigerator-freezer according to claim 1, wherein at least a part of the storage compartments includes an insulation heater that raises temperature or prevents freezing or dew condensation due to a drop of temperature, and

when setting for stopping the cooling control is performed concerning the storage compartment including the insulation heater, the control unit stops or reduces energization of the insulation heater.

3. The refrigerator-freezer according to claim 1 or 2, further comprising door-opening-closing detecting units configured to detect opening and closing of doors of the storage compartments, wherein

the control unit has a function of counting, based on outputs from the door-opening-closing detecting units, numbers of times of door opening and closing, and

the control unit counts, concerning the storage compartment for which the cooling control is set to be

stopped, a door opening and closing frequency of the storage compartment as a number of times of door opening and closing within a fixed time and, when the door opening and closing frequency is equal to or larger than a fixed number of times set in advance, even during the setting for stopping the cooling control, releases the setting for stopping the cooling control.

4. The refrigerator-freezer according to any one of claims 1 to 3, wherein

at least a part of the storage compartments includes a food detecting unit capable of determining whether some food is stored in the storage compartment, and

when setting for stopping the cooling control is performed concerning the storage compartment including the food detecting unit, the control unit determines, based on an output from the food detecting unit, whether some food is stored in the storage compartment and, as a result of the determination, when some food is stored in the storage compartment, releases the setting for stopping the cooling control and performs the cooling control.

5. The refrigerator-freezer according to claim 4, wherein, when some food is stored in the storage compartment anew in a state in which the cooling control for the storage

compartment is stopped, the control unit detects, based on an output from the food detecting unit, that the new food is stored in the storage compartment, releases the setting of the cooling stop for the storage compartment, and performs the cooling control.

6. The refrigerator-freezer according to claim 5, wherein, when the setting of the cooling stop for the storage compartment is released and the cooling control is started by the control unit, the cooling-stop setting unit informs that the setting of the cooling stop is released.

7. The refrigerator-freezer according to any one of claims 1 to 6, wherein

the cooling-stop setting unit includes an operation unit with which cooling stop can be set and a display unit capable of displaying an operation result of the operation unit, and

when setting for stopping the cooling control is performed or during the setting for stopping the cooling control, the cooling-stop setting unit causes the display unit to light or flash display of the cooling stop setting and display of the storage compartment for which the cooling stop is set.

8. The refrigerator-freezer according to any one of claims 1 to 7, further comprising:

a compressor configured to form a freezing cycle in conjunction with the cooler; and

a fan configured to circulate the cold air generated by the cooler, wherein

when setting for stopping the cooling control for all or a part of the storage compartments is performed, the control unit reduces a number of revolutions of the compressor and a number of revolutions of the fan.

9. The refrigerator-freezer according to any one of claims 1 to 8, wherein

the storage compartments include a storage compartment in a refrigeration temperature zone for keeping temperature in the refrigerator-freezer at temperature equal to or higher than 0°C and a storage compartment in a freezing temperature zone for keeping the temperature in the refrigerator-freezer at temperature lower than 0°C, and

the cooling-stop setting unit enables setting for stopping the cooling control for the storage compartment in the freezing temperature zone.

10. The refrigerator-freezer according to any one of

claims 1 to 9, wherein the cooling-stop setting unit enables setting for simultaneously stopping the cooling control for two or more storage compartments.