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CONTROLLING DEVICE FOR A REFRIGERATOR

BACKGROUND OF THE INVENTION

This invention relates to a controlling device for a refrigerator of the type wherein a damper is opened and closed to quickly refrigerate a refrigerating chamber of the refrigerator.

A typical one of conventional controlling devices for a refrigerator includes a refrigerator body in which a plurality of chambers including a freezing chamber, a refrigerating chamber and a vegetable chamber are formed by partitioning the inside of the refrigerator with the refrigerating chamber located below the freezing chamber and above the vegetable chamber. A compressor is located at a lower portion of the body. A cooler is located in the interior of the freezing chamber and a blower is located above the cooler and connected to be driven by an electric motor. An air course extends from the rear of the cooler to the refrigerating chamber, and a thermal damper of the gas type including a body and a baffle is located near a blow-out port of the air course to the refrigerating chamber.

In operation, while the compressor is operating, also the blower is rotating so that cooling air having passed through the cooler is blown out directly into the freezing chamber and also into the air course. In this instance, if the temperature within the refrigerating chamber is higher than a preset level, then the thermal damper will detect it and open the baffle to allow a large amount of cooling air to blow out into the refrigerating chamber to cool within the refrigerating chamber. On the contrary, if the

temperature within the refrigerating chamber is lower than the preset level, the baffle of the damper is controlled to be a little closed to decrease the amount of cooling air to be blown out into the refrigerating chamber. In such a
5 controlling manner, the temperature within the refrigerating chamber is held to the preset temperature.

Such a conventional controlling device for a refrigerator as described above has various problems: since the amount of cooling air blown into the refrigerating chamber is regulated to control the temperature within the refrigerating chamber, even when a large amount of food is
10 additionally stored into the refrigerating chamber, the refrigerating speed cannot be raised as it is and hence the preset condition of the damper must be changed over to
15 raise the refrigerating speed; however, in order to raise the refrigerating speed, the thermal damper must be set to "strong", but if the thermal damper is left set to "strong", food stored in the refrigerator will become frozen, and therefore, the thermal damper must be re-set to its normal
20 condition after it has been once set to "strong".

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a controlling device for a refrigerator wherein, when a large amount of food is additionally stored into a refrigerating chamber, the food can be cooled rapidly by a simple
25 operation.

It is another object of the invention to provide a controlling device for a refrigerator wherein a large amount

116

- 4 -

of food can be cooled rapidly and after it has been cooled, it can be maintained automatically at an optimum temperature.

It is a further object of the invention to provide a controlling device for a refrigerator which eliminates a bad influence of a change of the temperature of the external air on stored food in the refrigerator.

According to one aspect of the present invention, a controlling device for a refrigerator of the type wherein a damper is opened or closed to control the amount of supply of cooling air to regulate the temperature within the refrigerator comprises a quick refrigeration switch, and controlling means operable in response to operation of the switch for compulsorily lowering a preset temperature within the refrigerator to perform quick refrigerating operation of the refrigerator, said controlling means incorporating detecting means for detecting that the number of opening and closing motions of said damper reaches a predetermined number during quick refrigerating operation of said refrigerator, said controlling means being operable to stop the quick refrigerating operation of said refrigerator in response to a detection signal from said detecting means.

Since the quick refrigeration switch is provided, when a large amount of food is stored in the refrigerator, the damper is controlled automatically by operation of the switch so that quick refrigerating operation of the refrigerator is performed to cool the stored food quickly.

Thus, since quick refrigerating operation is performed compulsorily in response to operation of the quick refrigeration switch, even when a large amount of food is stored in the refrigerator, quick refrigeration can be effected by a simple operation, resulting in improvement in operability of the system.

According to another aspect of the invention, a controlling device for a refrigerator of the type wherein cooling air cooled by a cooler is blasted into a refrigerating chamber by a blower and a damper is opened and closed to regulate the amount of air blasted into the refrigerating chamber in response to a temperature within the refrigerating chamber to control the temperature within the refrigerating chamber to a preset temperature comprises a quick refrigeration switch, an external air temperature detector for detecting a temperature of the external air, a preset temperature lowering means operable in response to operation of the quick refrigeration switch for lowering the preset temperature for the refrigerating chamber in response to an output of the external air temperature detector, means for detecting that either the number of opening and closing motions of the damper reaches a predetermined value or the duration of the quick refrigerating operation reaches a predetermined time during quick refrigerating operation of the refrigerator started in response to lower of the preset temperature, and a quick refrigeration stopping means operable in response to a detection signal from the detecting means for developing an instruction to stop the quick refrigerating operation of the refrigerator.

Thus, if the quick refrigeration switch is operated, the preset temperature for the refrigerating chamber is

18

6

lowered in response to a temperature of the external air to cause quick refrigerating operation of the refrigerator to lower the temperature within the refrigerating chamber, and then if predetermined requirements are met during the quick refrigerating operation, the quick refrigerating operation of the refrigerator is stopped.

Thus, after starting the quick refrigerating operation the quick refrigerating operation of the refrigerator is stopped either when the number of opening and closing motions reaches a predetermined fixed value or when the time of the quick refrigerating operation reaches a predetermined fixed time during the quick refrigerating operation. Accordingly, even when a large amount of food is additionally stored into the refrigerating chamber, the food can be cooled rapidly, and that overcooling when the external air temperature is too low can be prevented.

BRIEF DESCRIPTION OF THE DRAWING

Fig. 1 is a block diagram showing an embodiment of a controlling device for a refrigerator according to the present invention;

Fig. 2 is a cross sectional view of a refrigerator to which the controlling device according to the invention is applied;

Fig. 3 is a circuit diagram illustrating a circuit construction of the controlling device of Fig. 1;

Fig. 4 is a block diagram of a microcomputer of Fig. 3;

Fig. 5 is a flowchart illustrating an entire flow of operations of the controlling device of Fig. 1;

Figs. 6, 7 and 8 are flowcharts showing details of a temperature input taking in routine, an input judging routine and a damper outputting routine of Fig. 3,

respectively; and

Fig. 9 is a vertical sectional view showing a typical one of conventional controlling devices for a refrigerator.

DESCRIPTION OF THE PREFERRED EMBODIMENT

5 At first, a typical one of conventional controlling devices for a refrigerator is described with reference to Fig. 9. A refrigerator shown includes a refrigerator body 1 in which a plurality of storage chambers including a freezing chamber 2, a refrigerating chamber 3 and a vegetable
10 chamber 4 are formed by partitioning the inside thereof. A compressor 5 for compressing a cooling medium is located at a lower portion of the refrigerator body 1, and a cooler 6 is located in a cooler chamber partitioned in the interior of the freezing chamber 2. A blower 7 is located above the
15 cooler 6 and connected to be driven by an electric motor 8. An air course or blow-out duct 9 for supplying cooling air into the refrigerating chamber 3 extends from the rear of the cooler 6 to the refrigerating chamber 3, and a thermal damper 10 of the gas type for regulating the temperature
20 within the refrigerating chamber 3 is located near a blow-out port of the air course 9 to the refrigerating chamber 3. The thermal damper 10 includes a body 10a and a baffle 10b.

25 Now, an embodiment of a controlling device for a refrigerator according to the present invention will be described in detail with reference to Figs. 1 to 3.

At first, a refrigerator to which a controlling device



according to the invention is applied will be described with reference to Fig. 2. In Fig. 2, reference numerals 1 to 9 denote like or equivalent parts to those of the conventional device described above with reference to Fig.

5 9. A refrigerator shown in Fig. 2 includes a refrigerator body 1 in which a freezing chamber 2, a refrigerating chamber 3 and a vegetable chamber 4 are formed with the refrigerating chamber 3 located below the freezing chamber 2 and above the vegetable chamber 4. A compressor 5 is located at a lower portion of the refrigerator body 1 and a cooler 6 is
10 located in the interior of the freezing chamber 2. A fan 7 is located above the cooler 6 and connected to be driven by an electric motor 8. A blow-out duct or air course 9 extends downwardly from behind the cooler 6. An electrical-
15 ly driven damper 21 having a baffle 21a is located in an opposing relationship at a blow-out port of the air course 9 to the refrigerating chamber 3 and is mounted for opening and closing movement to allow and interrupt passage of cooling air thereby. A refrigerating chamber temperature
20 detector 14 such as a thermistor for detecting a temperature within the refrigerating chamber 3 is located near the damper 21. A controlling device 22 is accommodated in an upper rear portion of the refrigerator body 1, and an operation panel 23 is mounted on a door 24 for the freezing
25 chamber 2. The operation panel 23 has thereon a quick refrigeration switch 12, a quick refrigeration display lamp 18 composed of a light emitting diode or the like, and a variable resistor 25 for setting a temperature for the refrigerating chamber 3.

30 Referring now to Fig. 1 which is a block diagram showing general construction of an entire controlling device for

a refrigerator. The controlling device includes the quick refrigeration switch 12, an external air temperature detector 13 and the refrigerating chamber temperature detector 14. In response to a signal received from the external temperature detector 13, a preset temperature for the refrigerating chamber 3 is lowered by a preset temperature lowering means 15 which receives an output of the quick refrigeration switch 12, and the damper 21 is opened or closed by means of a damper relay driving circuit 17 in response to outputs of the preset temperature lowering means 15 and the refrigerating chamber temperature detector 14 under control of a controlling means 16 to control the temperature of the refrigerating chamber 3 to a thus lower preset temperature. Simultaneously, a quick refrigeration display lamp 18 is lit. When the number of opening and closing motions of the damper reaches a predetermined value, a quick refrigeration stopping means 19 is rendered operative to close the damper 21 by way of the damper relay driving circuit 17 and the display lamp 18 is extinguished.

Referring now to Fig. 3 which is a circuit diagram of an electric circuit of the controlling device of Fig. 1, the controlling device 22 includes a microcomputer 26 which in turn includes a central processing unit (CPU) 26A, a memory 26B, an input circuit 26C and an output circuit 26D, as shown in a block diagram of Fig. 4. Connected to the input circuit 26C are the quick refrigeration switch 12, the refrigerating chamber temperature setting variable resistor 25, the refrigerating chamber temperature detector 14, the external air temperature detector 13, and resistors 27 to 29. Meanwhile, connected to the output circuit 26D

23

are the damper relay driving circuit 17, a compressor relay driving circuit 30 and the display lamp 18 via a current limiting resistor 31. The resistors 27 to 29 are voltage dividing resistors for the variable resistor 25, the
5 refrigerating chamber temperature detector 14 and the external temperature detector 13, respectively, and are provided for taking a refrigerating chamber preset temperature, a refrigerating chamber temperature and an external air temperature into the microcomputer 26. Where the
10 external air temperature detector 13 is omitted, the resistor 29 may be omitted and the resistor 27 may be connected at an end remote from the variable resistor 25 to an end of the resistor 28 remote from the refrigerating chamber temperature detector 14. A compressor relay 32 is connected
15 to the compressor relay driving circuit 30. When the compressor relay 32 is energized, a contact 32a thereof is closed to allow power of an AC power source 33 to be supplied to the compressor 5 and the blower 8. Meanwhile, a damper relay 34 is connected to the damper relay driving circuit
20 17, and when the damper relay 34 is energized, a contact 34a thereof is closed to allow power of the AC power source 33 to be supplied to the damper 21.

Now, operation of the embodiment described above will be described with reference to flowcharts of Figs. 5 to 8
25 which illustrate a program stored in the memory 26B of the microcomputer 26. Referring first to Fig. 5 showing an entire general flow of steps of operation of the controlling device, the program includes a step 100 which is executed only after the power source 33 has been turned on, and at
30 this step 100, the microcomputer 26 is initialized. Following steps 200 to 600 form a main loop which is usually

passed by during operation of the controlling device. At step 200, digital inputs such as an input from the quick refrigeration switch 2 are taken in, and at step 300, analog inputs such as inputs from the refrigerating chamber temperature detector 14, the external air temperature detector 13 and the variable resistor 28 are taken into the microcomputer 19. Then, at step 400, the inputs are judged in accordance with such input data, and at step 500, an output to the damper 21 is determined. After then, at step 600, various timer processings are effected, and after such processings, the process returns to step 200.

Reference is now made to Fig. 6 which shows details of the temperature input taking in operation 300 of the flow-chart of Fig. 5. In the temperature input taking in operation 300, at first a voltage applied to the refrigerating chamber temperature detector 14 is read in and data of the voltage value converted into the temperature is taken into a refrigerating chamber temperature register Ta at step 301. Then at step 302, similarly a voltage applied to the variable resistor 18 is converted into a preset temperature and data of the preset temperature is taken into a preset temperature register Ts. At step 303, an external air temperature is similarly taken into an air temperature register Tg. Where an influence of the temperature of the external air is negligible, the step 303 can be omitted.

Now, description will be given of processings when the quick refrigeration switch 12 is depressed with reference to Fig. 7 which shows details of the input judging operation 400 of Fig. 5. In the input judging operation 400, it is

judged at step 401 whether or not the quick refrigerating switch 12 is depressed, and when it is found that the switch 12 is depressed, a twice reading preventing flag F1 is judged at step 402. In case F1 is 0 (in case of first reading),
5 the flag F1 is set to "1" at step 403. Thus, since the flag F1 is thereafter judged as "1", processings following the step 403 are bypassed, that is, second reading is prevented. Then at step 404, a quick refrigeration flag F2 is judged, and when the flag F2 is "1", it is judged
10 that the quick refrigeration switch 12 has been depressed again during quick refrigerating operation so that at step 405, the quick refrigeration flag F2 is set to "0" to stop the quick refrigeration and the display lamp 18 (represented as LED in the drawing, which will apply also
15 in the following description) 18 is extinguished at step 406. On the contrary when the flag F2 is judged as "0", the quick refrigeration flag F2 is set to "1" to start quick refrigeration at step 407 and the display lamp 18 is lit at step 408.

20 Subsequently, the electric damper outputting operation 500 of Fig. 5 will be described in detail with reference to Fig. 8. In the electric damper outputting operation 500, it is judged at step 501 whether the refrigerator is in a quick refrigeration mode, and when it is found that
25 the refrigerator is in the quick refrigeration mode (F2="1"), it is judged at step 503 whether or not the external air temperature is lower than 10°C. When the external air temperature is lower than 10°C, a preset temperature Ts is set, at step 504, to a value lower by 1.5 degrees than
30 the preset temperature Ts, but on the contrary when the external air temperature is higher than 10°C, the preset

temperature T_s is set, at step 505, to a value lower by 3.0 degrees than the preset temperature T_s . where an influence of the external air temperature is negligible, the step 503 and either the step 504 or 505 can be omitted. Subsequently
5 at step 506, it is judged whether the electric damper 21 is in an open condition or in a closed condition at preset, and in case of an open condition of the electric damper 21, at step 507, the temperature T_a within the refrigerating chamber 3 is subtracted from the preset temperature T_s and it is
10 judged whether or not the difference is greater than 1 degree.

If the difference is greater than 1 degree, that at step 509, it is judged whether the refrigerator is during quick refrigeration, and when it is found that the refrige-
15 rator is during quick refrigeration, a counter C_1 is incremented by one at step 510. Then, it is judged at step 511 whether the value of the counter C_1 is equal to 3, and when the value of the counter C_1 is 3, F_2 is set to 0 at
20 step 512 to stop the quick refrigeration and the display lamp 18 is extinguished at step 513. On the contrary, when it is judged at step 506 that the damper 21 is in a closed condition at present, at step 514, the preset temperature T_s is subtracted from the refrigerating chamber temperature T_a and it is judged whether the difference is greater than 1
25 degree or not. When the difference is greater than 1 degree, an output for opening the damper 21 is developed at step 515.

In this manner, quick refrigerating operation of the refrigerator is performed compulsorily in response to
30 operation of the quick refrigeration switch 12, and then after the inside of the refrigerator has been cooled

sufficiently, the quick refrigerating operation is automatically cancelled. In this instance because the operation switch 12 is located on a front face of the opening and closing door 24, it can be readily operated, and besides since the operation of the switch 16 is displayed, it is very useful for a user.

Further, in case the quick refrigeration switch 12 is depressed to put the refrigerator into the quick refrigeration mode, the preset temperature is re-set to a lower level with a small width (1.5 degrees in the embodiment) when the external air temperature is lower than 10°C and with a greater width (3 degrees in the embodiment) when the external air temperature is higher than 10°C. Thus, the damper 21 is controlled with fixed differentials (± 1 degrees in the embodiment). When the damper 21 is closed three times, the quick refrigeration mode is automatically cancelled. Accordingly, even if the external air temperature is low, over cooling can be prevented when quick refrigeration is performed.

It is to be noted that stopping of quick refrigeration is determined, in the embodiment described above, by counting the number of opening and closing motions of the damper 21 and the preset temperature can be varied relative to a change of the external air temperature. In addition the control may include a timer for measuring the duration of quick refrigeration so that when the measuring time by the timer reaches a preset time, the quick refrigeration is ended and the preset time of the timer is varied in response to the external air temperature.



- 16 -

CLAIMS

1. A controlling device for a refrigerator of the type wherein a damper is opened or closed to control the amount of supply of cooling air to regulate the temperature within said refrigerator, comprising: a quick refrigeration switch; and controlling means operable in response to operation of said quick refrigeration switch for compulsorily lowering a preset temperature within said refrigerator to perform quick refrigerating operation of said refrigerator, said controlling means incorporating detecting means for detecting that the number of opening and closing motions of said damper reaches a predetermined number during quick refrigerating operation of said refrigerator, said controlling means being operable to stop the quick refrigerating operation of said refrigerator in response to a detection signal from said detecting means.
2. A controlling device for a refrigerator according to claim 1, further comprising means for displaying quick refrigerating operation of said refrigerator during such operation under control of said controlling means.
3. A controlling device for a refrigerator according to claim 1, wherein said controlling means includes further means for detecting that quick refrigerating operation of said refrigerator has continued for a predetermined period of time, said controlling means being operable to stop the quick refrigerating operation of said refrigerator in response to a detection signal from said detecting means.



- 17 -

4. A controlling device for a refrigerator according to claim 1, further comprising means located near said damper for detecting a temperature within a refrigerating chamber of said refrigerator.

5. A controlling device for a refrigerator according to claim 1, wherein said quick refrigeration switch is located on an operation panel mounted on a front face of a door for a freezing chamber of said refrigerator.

6. A controlling device for a refrigerator according to claim 5, further comprising means for displaying quick refrigerating operation of said refrigerator during such operation under control of said controlling means, said display means being located on said operation panel.

7. A controlling device for a refrigerator of the type wherein cooling air cooled by a cooler is blasted into a refrigerating chamber by a blower and a damper is opened and closed to regulate the amount of air blasted into said refrigerating chamber in response to a temperature within said refrigerating chamber to control the temperature within said refrigerating chamber to a preset temperature, comprising: a quick refrigeration switch; an external air temperature detector for detecting a temperature of the external air; a preset temperature lowering means operable in response to operation of said quick refrigeration switch for lowering the preset temperature for said refrigerating chamber in response to an output of said external air temperature detector; means for detecting that either the number of opening and closing motions of said damper reaches a predetermined value or the duration of the quick refrigerating operation reaches a predetermined time during quick



- 18 -

refrigerating operation of said refrigerator started in response to lowering of the preset temperature; and a quick refrigeration stopping means operable in response to a detection signal from said detecting means for developing an instruction to stop the quick refrigerating operation of said refrigerator.

8. A controlling device for a refrigerator according to claim 7, further comprising means for displaying quick refrigerating operation of said refrigerator during such operation.
