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Nijo

[11] **3,822,564**

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[54] **COMBINATION TYPE REFRIGERATOR**

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[21] Appl. No.: **276,954**

[52] **U.S. Cl.** **62/156,** 62/196, 62/275, 62/278, 165/17

[51] **Int. Cl.** **F25d 21/06**

[58] **Field of Search** 62/156, 275, 278, 196, 62/197, 198; 165/17, 28

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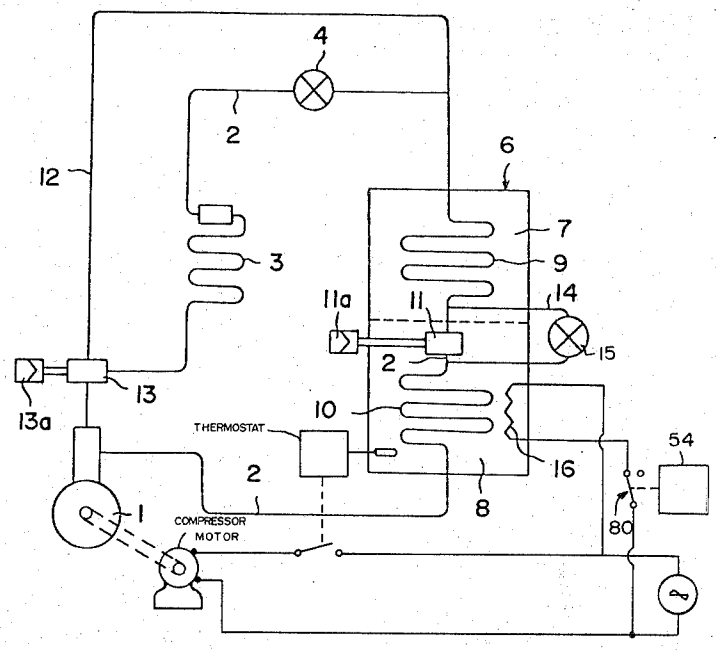
Primary Examiner—Meyer Perlin

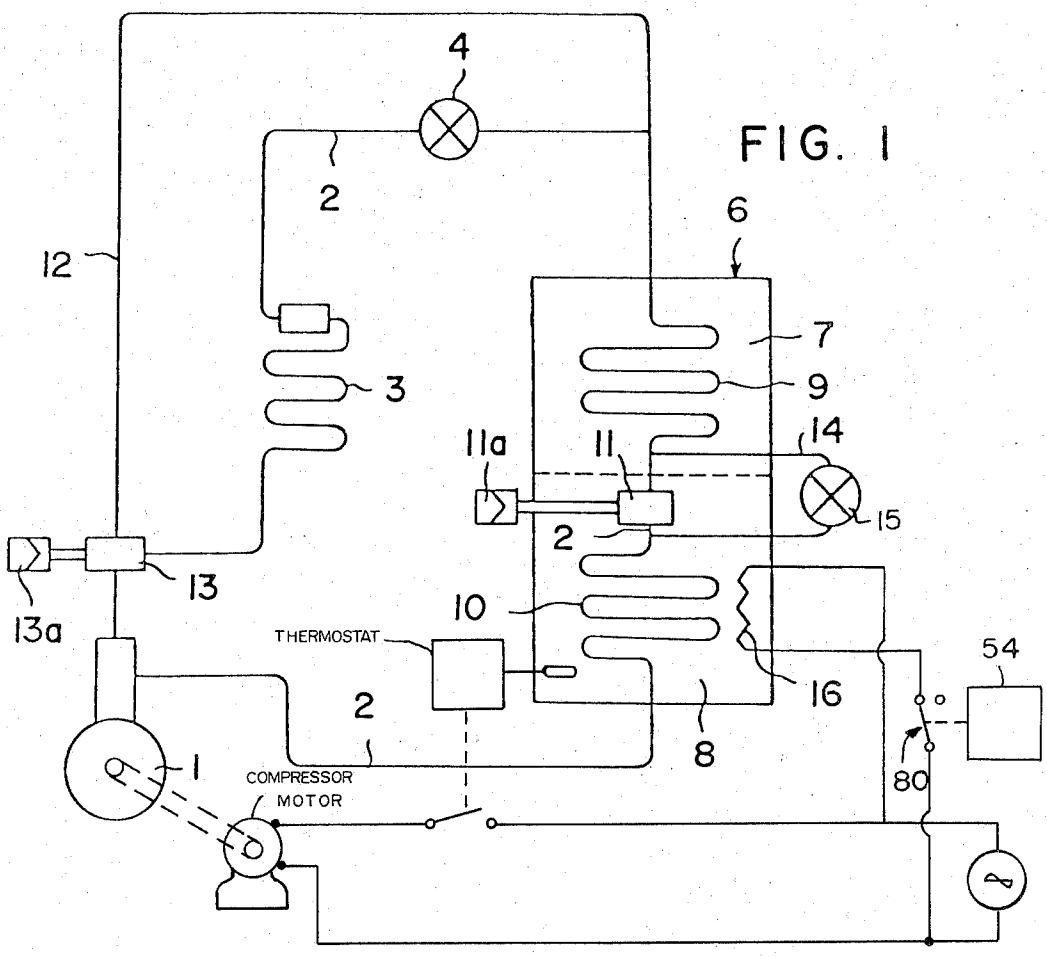
Attorney, Agent, or Firm—Browdy and Neimark

[57] **ABSTRACT**

A combination type refrigerator having a freezing storage compartment provided with a heat exchanger and a cold storage compartment also provided with a heat exchanger, wherein a cooler is on-off controlled in response to the detection of a certain predetermined temperature in the cold storage compartment and the defrosting of the freezing storage compartment is effected by connecting both the heat exchangers in series and directly supplying pressurized hot gas to the heat exchanger for the freezing storage compartment. It is characterized by a heating means disposed in a suitable position within the cold storage compartment, and which heating means is capable of generating an amount of heat just sufficient to permit continuous operation of the cooler without causing any temperature rise in the cold storage compartment during the defrosting operation in the freezing storage compartment and is operated during the defrosting operation in the storage compartment.

4 Claims, 7 Drawing Figures




4
2
12
6
7
3
9
11a
11
14
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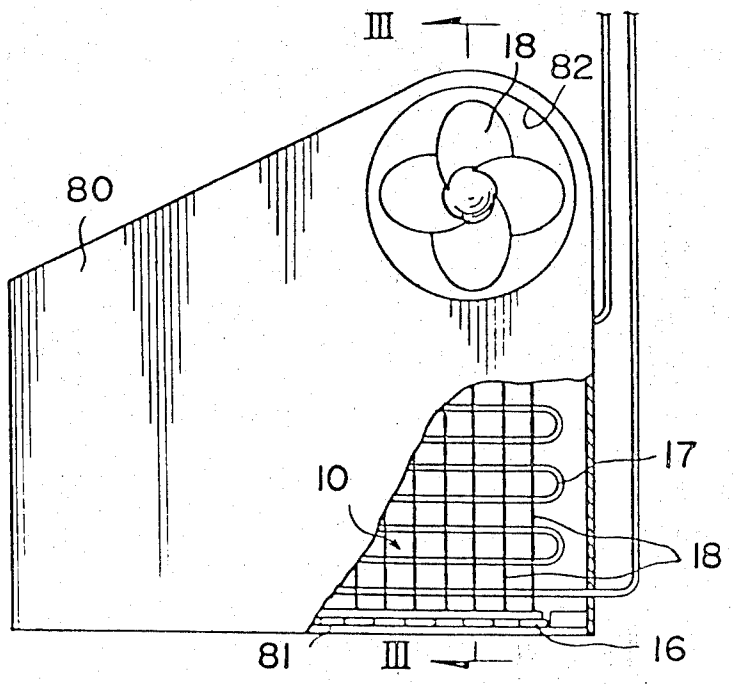
13a
10
THERMOSTAT
54
16
2
8
1
COMPRESSOR
MOTOR
80

FIG. 1


III
18
82
80
17
10
18
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III
16

FIG. 2

FIG. 3

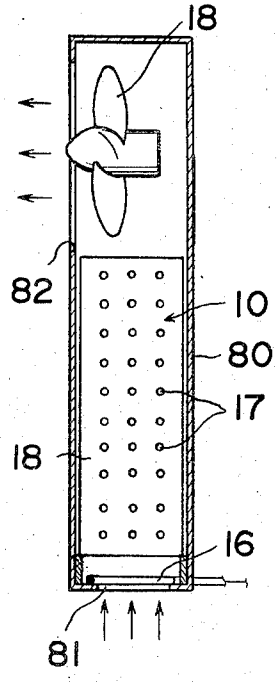


FIG. 4

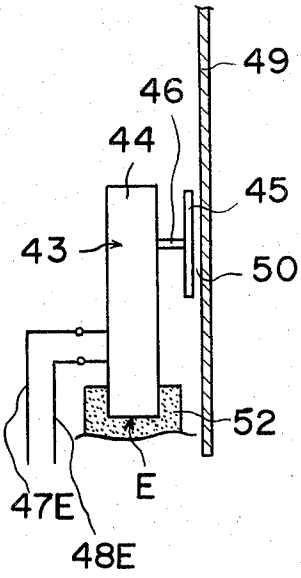


FIG. 6

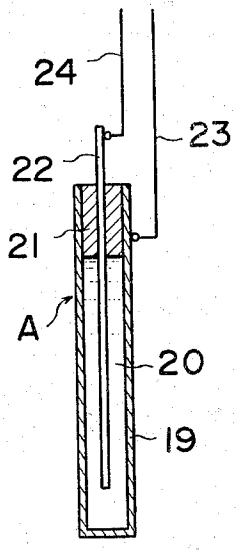


FIG. 7

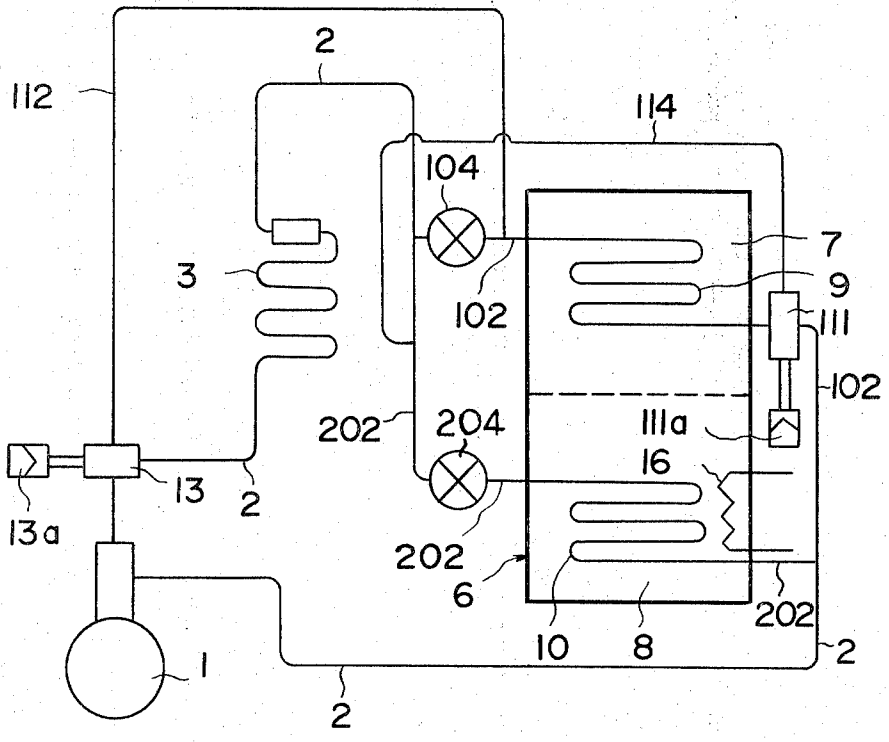
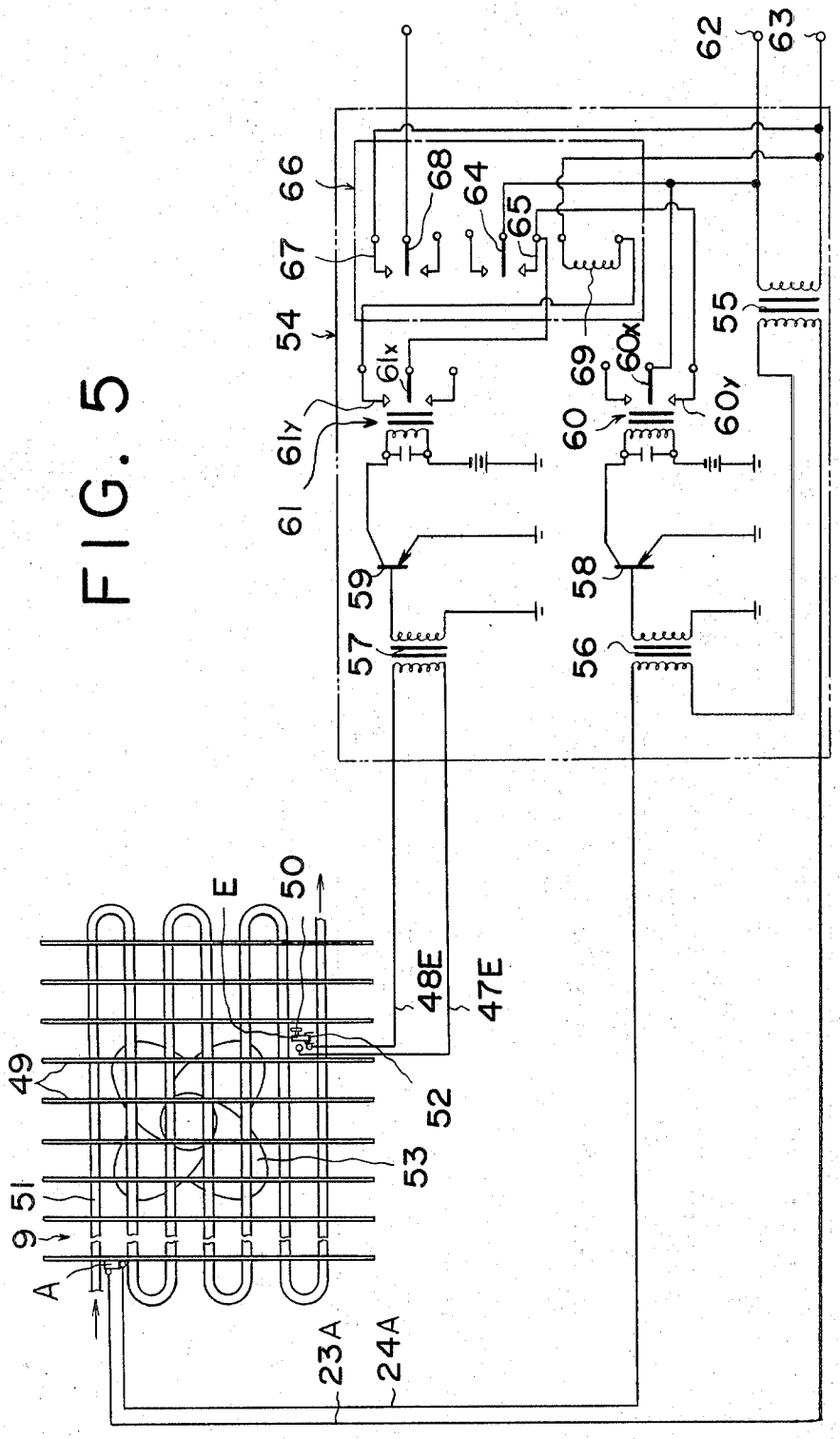


FIG. 5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68
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61x
69
60x
61y
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60y
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59
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57
56
E
50
48E
47E
49
52
53
51
9
A
23A
24A

COMBINATION TYPE REFRIGERATOR

DESCRIPTION OF THE PRIOR ART

This invention relates to refrigerators of a combination type having a freezing storage compartment provided with a heat exchanger and a cold storage compartment also provided with a heat exchanger, both the heat exchangers being normally connected in series or parallel, wherein the temperature control is done by on-off controlling a cooler in response to the temperature detection on the side of the cold storage compartment and the defrosting in the freezing storage compartment is effected by supplying pressurized hot gas directly to the heat exchanger for the freezing storage compartment.

In the refrigerator of this type, the temperature control which is done to maintain a constant temperature in the cold storage compartment, is effective in maintaining not only the cold storage compartment but also the freezing storage compartment at respective constant temperatures, as is disclosed, for instance, in Japanese Patent Publication No. 45-21865/1970.

In such refrigerator, the defrosting on the side of the freezing storage is very important. When the heat exchanger is frosted, its cooling efficiency is extremely lowered. As an effective means or removing the frost formed on the heat exchanger, there is a so-called pressurized hot gas defrosting system, in which pressurized cooling medium is supplied not through condenser and expansion valve but directly to the freezing storage compartment heat exchanger for the defrosting thereof. However, in the refrigerator of the type mentioned above, in which the temperature control is done by on-off controlling the cooler in response to the temperature detection done on the side of the cold storage compartment, when the cold storage compartment is cooled down to a certain low temperature the operation of the cooler is stopped to cut the supply of the cooling medium. If the cooling medium supply is cut during the defrosting operation, the defrosting proceeding in the freezing storage compartment is interrupted since the supply of pressurized hot gas to the heat exchanger for the freezing storage compartment is cut off.

In case of a refrigerator where a timer is used for the defrosting operation, it is liable to happen that before the defrosting goes to completion the hot gas path is switched so that hot gas having been compressed, condensed and then gasified is supplied to the heat exchanger for the freezing storage compartment. In such case, the defrosting operation ends while the defrosting is still incomplete.

OBJECT OF THE INVENTION

The invention has an object of providing a combination type refrigerator of the type mentioned earlier, which is capable of greatly reducing the time required for the defrosting in the freezing storage compartment and ensuring complete defrosting as well as eliminating the occurrence of the flood-back otherwise very likely to occur in this type of refrigerator to dispense with any particular flood-back preventive means.

SUMMARY OF THE INVENTION

According to the invention there is provided a combination type refrigerator of the type mentioned earlier, which uses a heating means capable of generating a substantially equal amount of heat to that absorbed by the heat exchanger for the cold storage compartment, said heating means being disposed within the cold storage compartment or in the vicinity of the heat exchanger for the cold storage compartment and being operated at the time of defrosting the heat exchanger for the freezing storage compartment. Thus, it is featured that the overcooling in the cold storage compartment due to the flow of condensed hot gas into the cold storage compartment heat exchanger as a result of defrosting of the heat exchanger for the freezing storage compartment heat exchanger is avoided, thereby to ensure continuous run of the cooler until the end of the defrosting operation. Also since the temperature of the cold storage compartment heat exchanger never becomes lower than 0°C., this heat exchanger is never frosted, so there is no need of defrosting it.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic representation of one embodiment of the invention.

FIG. 2 is a front elevational view, partly broken away, showing a heat exchanger for the cold storage compartment.

FIG. 3 is a side sectional view of the same.

FIG. 4 is a side view of an example of the frost detector.

FIG. 5 is a schematic showing of a defrosting system for carrying out defrosting on the side of the freezing storage compartment.

FIG. 6 is a sectional view of a temperature sensor.

FIG. 7 is a schematic representation of another embodiment of the invention.

FIG. 1 shows schematically a preferred embodiment of the combination type refrigerator according to the invention. Referring to the Figure, reference numeral **1** designates a compressor. In the normal operation, the cooling medium compressed by the compressor **1** is liquefied by a condenser **3** provided on a main path **2**, and is circulated through an expansion valve **4** also provided in the main path **2** into the combination refrigerator interior **6**. The refrigerator **6** is divided into a freezing storage compartment **7** and a cold storage compartment **8**. The heat exchanger **9** for the freezing storage compartment and the heat exchanger **10** for the cold storage compartment are connected in series. The cooling medium passing through the expansion valve **4** first enters the heat exchanger **9** for the freezing storage compartment. The cooling medium coming out of the heat exchanger **9** after cooling the freezing storage compartment, is circulated either through an electromagnetic valve **11** or an expansion valve **15** into the heat exchanger **10** for the cold storage compartment. The cooling medium after cooling the cold storage compartment is returned through the main path **2** to the compressor **1**.

In addition to the main path described above for the normal operation, there is also provided a separate path, through which the hot gas flows in the defrosting operation. Namely, there is provided a by-pass-part **12** branching from a main path section between compressor **1** and condenser **3** and by-passing the condenser **3** and expansion valve **4**. The by-pass **12** connects with the main path **2** at a three-way valve **13**. There is also provided another by-pass **14** by-passing the aforementioned electromagnetic valve **11** and connecting both

the heat exchangers through an expansion valve **15** therebetween. At the time of the defrosting operation, the three-way valve is changed over to the side of the by-pass **12** by the action of a solenoid **13***a*, while the electromagnetic valve **11** is closed by the action of a solenoid **11***a*. When this state sets in, the hot gas forced from the compressor **1**, so long as the compressor **1** is operative, flows through the threeway valve **13**, by-pass **12**, heat exchanger **9** for freezing storage compartment, by-pass **14**, expansion valve **15** and heat exchanger **10** for the cold storage compartment and returns to the compressor **1**. Numeral **16** designates a heating means provided on the side of the cold storage compartment **8**, to be described hereinafter in detail.

FIGS. **2** and **3** show the construction of the heat exchanger **10** for the cold storage compartment. It consists of a meandering cooling medium pipe **17** and many cooling fins **18** fitted on the cooling pipe **17**, and it is accommodated in a housing **80** open at the bottom **81** and provided with an opening **82** formed on an upper wall portion. Disposed within the housing **80** and facing the opening **82** is a blast fan **18** for forced air flow within the cold storage compartment **8**. Provided under the heat exchanger **10** is the aforementioned heating means **16**, for instance a resistance heater. In the present embodiment, the cooling of the cold storage compartment **8** is effected as the air withdrawn into the heat exchanger housing **80** from the bottom opening **81** by the rotation of the blast fan **18** is cooled while rising within the housing **80** past the heat exchanger **80** and is blown out of the housing **80** through its opening **82** into the compartment **8**.

The heater **16** is adapted to generate substantially the same amount of heat as the heat absorbed from the air within the cold storage compartment **8** by the heat exchanger **10**. Thus, when the heater **16** is operating, even though the cooling medium flows past the heat exchanger **10** the cold storage compartment **8** remains neither cooled nor heated. The heater **16** is operated at the time of the defrosting operation carried out on the side of the freezing storage compartment **7**, as will be described hereinafter in detail.

The temperature control system for the temperature control on the side of the cold storage compartment may be the one as employed in the usual refrigerator using a single temperature sensor for intermittently on-off controlling a cooler according to a temperature detected by the temperature sensor. Also, any well-known temperature sensor may be used such as thermocouple and thermistor. Of course, temperature control of increased precision as may be achieved with a system using two temperature sensors as those invented by the inventors of the present invention and disclosed in the Japanese Patent Publication No. 45-21074/1970 is desirable.

In the present embodiment, the frost detector provided on the side of the freezing storage compartment utilizes the fact that vibration such as that of the compressor under operation, vibrations generated in the cooling medium pipe as the cooling medium passes therethrough and vibrations due to the rotation of the fan are transmitted to the cooling fins to cause vibration thereof. More particularly, vibrations of a fin are adapted to be transmitted through frost or ice formed thereon to the frost detector, whereby the presence of frost or ice may be detected.

FIG. **4** shows an example of the frost detector used in the present embodiment. It comprises a well-known pick-up **43** serving as vibration detector, which consists of a detector body **44**, a vibration sensing plate **45** made of a rust-proof metal, a vibration rod **46** connecting the body **44** and plate **45**, and terminals **47E** and **48E**. The pick-up body **44** is held free from vibration within the cold storage compartment **7** such that the vibration sensing plate **45** faces a cooling fin **49** at a predetermined distance **50**. While vibrations such as those due to the rotation of the fan are always transmitted to the cooling fin **49**, they are not transmitted to the pick-up **43** so long as the gap **50** is present. However, when the freezing storage compartment **7** being cooled reaches a certain low temperature, water vapor within the compartment, such as moisture given off the stored matter, becomes attached as frost or ice on the cooling fin **49**, the frost or ice developing in the gap **50** between the fin **49** and vibration sensing plate **45**. When this situation sets in, the vibrations transmitted to the fin **49** are also transmitted through the vibration sensing plate **45** to the pick-up **43**. Thus, an electric output appears between the terminals **47E** and **47E** of the pick-up **43**.

FIG. **5** shows a defrosting control circuit together with the heat exchanger **9** for the freezing storage compartment. In the Figure, numeral **51** designates a meandering cooling medium pipe **51** extending in the freezing storage compartment **7**, and on the cooling pipe **51** are fitted many cooling fins **49**. The cooling pipe **51** and cooling fins **49** constitute the heat exchanger **9** for the freezing storage compartment. A temperature sensor A is provided in close contact with a cooling fin **49** near the upstream end of the meandering cooling pipe **51**.

FIG. **6** shows the construction of the temperature sensor A. It comprises a hollow metal cylinder **19** serving as one electrode, which is closed at one end and open at the other end and containing water **20**, an insulating plug **21** sealing the open end of the cylinder **19**, a terminal rod **22** serving as the other electrode, which penetrates the plug and is inserted into the hollow cylinder **19**, with an inner portion immersed in the water **20**, a terminal **23** attached to the cylinder **19**, and an opposite terminal **24** attached to the terminal rod **22**. The resistance between the opposite terminals **23** and **24** is small while the water **20** remains in the liquid phase, while it becomes a large value when the water **20** is solidified.

The temperature sensor shown in FIG. **5** is of the construction described above. With a voltage applied between the terminals **23A** and **24A** current flows between the terminals **23A** and **24A** when the water **20** remains in the liquid phase, while no current flows between the terminals **23A** and **24A** when the water **20** is in the solid phase. This is utilized for the detection of the temperature of 0°C, in response to which the cooling operation may be automatically on-off controlled through a cooling operation on-off control circuit connected between these terminals. The voltage applied between these terminals is desirably an a-c voltage from the standpoint of avoiding the electrolytic etching of the temperature and electrolysis of the water in the temperature sensor.

A frost detector E described earlier in connection with FIG. **4** is held free from vibration on a vibration-proof support **52** and faces a cooling fin **49** near the

downstream end of the meandering cooling medium pipe **51.** Numeral **53** designates a blast fan disposed on the back of the heat exchanger **9.**

Connected across the terminals **23** and **24** of the temperature sensor A and across the terminals **47** and **48** of the frost detector E is a defrosting control circuit generally designated at **54.** Connected between the terminals **23** and **24** of the temperature sensor A is a series circuit consisting of the primary winding of a transformer **56** and the secondary winding of a power source transformer **55.** Connected between the terminals **47** and **48** of the frost detector E is the primary winding of a transformer **57.** The secondary windings of the transformers **56** and **57** have one end grounded and the other end connected to the base of respective transistors **58** and **59.** Thus, the current flowing in the emitter-collector path of the transistors **58** and **59** is controlled with the current flowing respectively between the terminals **23** and **24** and between the terminals **47** and **48.** Microrelays **60** and **61** are connected to the respective transistors **58** and **59** so that they may be excited by the current amplified through the respective transistors **60** and **61.** The microrelays **60** and **61** are connected through a relay **66** having self-holding circuits **64** and **65** across source terminals **62** and **63.** The microrelay **60** is constructed such that its contacts **60***x* and **60***y* are in contact with each other in its excited state, while the other microrelay **61** is constructed such that its contacts **61***x* and **61***y* are in contact with each other in its non-excited state and get out of contact when it is excited. Numerals **67** and **68** designate a defrosting operation switch provided in the relay **66.** When this switch is closed, the solenoid **13***a* is activated to switch the three-way electromagnetic valve **13** over to the side of the by-path **12,** while at the same time the solenoid **11***a* is activated to close the electromagnetic valve **11.** When this state is brought about, the hot gas coming from the heat exchanger **9** for the freezing storage compartment **9** flows through the by-path **14** and expansion valve **15** into the heat exchanger **10** for the cold storage compartment. Further upon closure of the defrosting operation switch the afore-mentioned heating means **16** is rendered operative, as will be described hereinafter.

In the operation of the defrosting mechanism described above, when the water contained in the temperature sensor A remains in the liquid phase in the initial state of the operation of the refrigerator, current flows between the terminals **23** and **24** to cause current flowing into the base of the transistor **58** so as to amplify the current through the emitter-collector path of the transistor **58,** thus exciting the microrelay **60** to close the contacts **60***x* and **60***y*. Meanwhile, while the aforesaid gap **50** is present between the defrosting detector E and cooling fin **49,** the vibrations of the cooling fin **49** are not transmitted to the pick-up **43** in the defrosting detector E. Therefore, no current flows between the terminals **47** and **48,** and the microrelay **61** is in the non-excited state so that the contacts **61***x* and **61***y* are in contact with each other. With the contacts **60***x* and **60***y* of the microrelay **60** and contacts **61***x* and **61***y* of the microrelay **61** both in the close state, the relay **66** having the self-holding circuits **64** and **65** is held in the excited state, so that the defrosting operation switch of contacts **67** and **68** is open. Thus, the threeway electromagnetic valve **13** is open to the side of the main path **2** and the electromagnetic valve **11** is open. In this state, the cooling medium from the compressor **1** flows through condenser **3,** expansion valve **4,** heat exchanger for the freezing storage compartment, electromagnetic valve **11** and heat exchanger **10** for the cold storage compartment to the main path **2** leading back to the compressor **1.**

As the cooling in the freezing storage compartment **7** proceeds, the water contained in the temperature sensor A provided on the upstream side of the meandering cooling medium pipe **51** first freezes, thereupon the current between the terminals **23** and **24** vanishes to release the microrelay **60,** thus opening the contacts **60***x* and **60***y*. However, the self-holding circuit switch of contacts **64** and **65** in the relay **66** remains closed owing to the action of a coil **69,** so that the defrosting operation switch of contacts **67** and **68** remains open. Therefore, the defrosting operation is not started.

As the cooling operation continues for further cooling the inside of the freezing storage compartment, the moisture in the air within the compartment condenses and is attached onto the cooling fin **49** and freezes thereon into frost. The frost formed in this manner builds up to eventually fill the gap **50** between the defrosting detector E and vibration sensing plate **45.** When this situation is reached, the vibration of the cooling fin **49** caused by vibrations due to the operation of the compressor **1,** vibrations due to the passage of the cooling medium in the cooling pipe **1,** vibrations due to the rotation of the blast fan **53,** etc., is transmitted through the afore-mentioned frost to the pick-up **43** to cause current between the terminals **47** and **48,** thus causing current to flow into the base of the transistor **59** so as to amplify the current in the emitter-collector path of the transistor **59** for the excitation of the microrelay **61.** As a result, the contacts **61***x* and **61***y* are opened, thus releasing the relay **66** to close the defrosting operation switch of contacts **67** and **68.** Thus, the three-way electromagnetic valve **13** is switched over to the side of the by-pass **12** by the action of the solenoid **13***a* and at the same time the electromagnetic valve **11** is closed by the action of the solenoid **11***a*. (The operation of the heating means at this time will be described hereinafter.) In this state, pressurized hot gas is forced out of the compressor **1** and flows through the by-pass **12** into the heat exchanger **9** for the freezing storage compartment. As the hot gas flows through the heat exchanger **9,** the frost accumulated thereon is melted away. In the above manner, the defrosting is effected. The medium having passed through the heat exchanger **9** for the defrosting is circulated through the by-pass **14** into the expansion valve **15,** and the expanded medium therefrom flows through the heat exchanger **10** for the cold storage compartment and then back to the compressor **1.**

As the defrosting proceeds, the frost filling the gap **50** between the cooling fin **49** and the vibration sensing plate **45** is melted to cut the mechanical contact therebetween, whereby the transmission of vibration of the cooling fin **49** to the pick-up **43** of the frost detector E is cut. As a result, the amplified current in the emitter-collector path of the transistor **59** vanishes, so that the microrelay **61** is released to close its contacts **61***x* and **61***y*. At this time, however, the other microrelay **60** still remains in the excited state so that the self-holding circuit switch contacts **64** and **65** remain out of contact. Therefore, the relay **66** remains released, thus holding

the defrosting operation switch contacts **67** and **68** closed for continued defrosting operation.

The defrosting proceeds toward the upstream end of the cooling medium pipe **51** until the temperature sensor A detects a predetermined temperature, whereupon current is caused to flow between the terminals **23** and **24** to reexcite the microrelay **60,** so that the contacts **60***x* and **60***y* are closed to activate the relay **66** so as to open the defrosting operation switch contacts **67** and **68.** As a result, the defrosting operation is completely stopped, and the circulation of the cooling medium through the main path **2** is resumed. The above sequence is repeated.

The afore-mentioned defrosting effectively proceeds so long as the cooling operation based on the temperature detection on the side of the cold storage compartment **8** continues. During this time, the compressor **1** is operative, so that pressurized hot gas forced out of the compressor **1** flows through the three-way electromagnetic valve **13** into the heat exchanger **9** for the freezing storage compartment for the defrosting operation. However, when the cold storage compartment **8** is sufficiently cooled, the cooling operation is stopped as mentioned earlier. Then, the compressor **1** is no longer operative, and the flow of pressurized hot gas into the heat exchanger **9** for the freezing storage compartment ceases. When this state sets in, the speed of progress of defrosting within the freezing storage compartment **7** is extremely reduced.

According to the invention, the aforementioned heater **16** is operated during the defrosting operation to provide for continuous cooling operation. More particularly, when the defrosting operation switch contacts **67** and **68** are closed, a switch **80** for operating the heater **16** is adapted to be also closed, and upon opening of the defrosting operation switch contacts **67** and **68** the heater operation switch is adapted to be opened. With such circuit construction, during the aforementioned defrosting operation a substantially equal amount of heat to the heat absorbed by the heat exchanger **10** is generated by the heater **16** so that the inside of the cold storage compartment **8** continues to be held under practically optimum temperature condition. Thus, during the defrosting operation the pressurized hot gas always flows into the heat exchanger **9** for the freezing storage compartment, so that the defrosting proceeds promptly. Besides, since with the heater **16** operated in the above manner the temperature inside the cold storage compartment may be held substantially constant, the flood-back to the compressor **1** can be eliminated.

While one preferred embodiment of the invention has been described above, it will be readily understood by one skilled in the art that various changes and modifications in the detailed construction are possible in carrying out the invention. For example, while in the preceding embodiment a pressurized hot gas defrosting system has been used to effect defrosting on the freezing storage compartment side, any well-known defrosting system such as water spray system and electric heater system may be used in addition to the above hot gas system to obtain increased defrosting speed. Also, it will be apparent from the foregoing description that the invention is also applicable where the defrosting is intermittently done by using a timer or manual switch as frost detector means to detect frosting on the freezing storage compartment side. Further, while the resistance heater has been described as an example of the heating means provided in the cold storage compartment, this heating means is by no means limitative but various modifications are possible. For example, a hot oil or hot water passage may be provided in the cooling fins of the heat exchanger for circulating hot oil or hot water at a suitable temperature through such passage to effect the heating.

FIG. 7 shows another embodiment of the invention applied to the case where a heat exchanger **9** for the freezing storage compartment **7** and a heat exchanger **10** for the cold storage compartment **8** are connected in parallel. In this embodiment, the main path **2** branches into two branch paths **102** and **202.** The branch path **102** leads to the heat exchanger **9** for the freezing storage compartment, while the branch path **202** leads to the heat exchanger **10** for the cold storage compartment. The branch paths **102** and **202** after the respective heat exchangers **9** and **10** re-unite into the main path **2.** Expansion valves **104** and **204** are provided on the respective branch paths **102** and **202.** By appropriately adjusting the throttle aperture of these expansion valves the inside of the freezing storage compartment **7** may also be held at a desired permanent low temperature, as well as providing for the aforementioned temperature control on the side of the cold storage compartment. For the defrosting medium path, there is provided a by-pass path **112** leading from a three-way electromagnetic valve **13** and terminating in the branch path **102** after the expansion valve **104** and another by-pass path **114** leading from a three-way electromagnetic valve **111** provided on the branch path **102** after the heat exchanger **9** for the freezing storage compartment and terminating in the branch path **202** before the expansion valve **204.** During the defrosting operation, pressurized hot gas forced from the compressor **1** is circulated through three-way electromagnetic valve **13,** by-pass **112,** branch path **102,** heat exchanger **9** for the freezing storage compartment, three-way electromagnetic valve **111,** by-pass **114,** branch path **202,** expansion valve **204,** heat exchanger **10** for the cold storage compartment, main path **2** and back to the compressor **1.** It will be readily apparent that prompt defrosting in the freezing storage compartment can be obtained in the entirely same manner as in the previous embodiment.

As has been described in the foregoing, according to the invention in the combination type refrigerator as described in the outset of this specification, use is made of a heating means, which can generate substantially the same amount of heat as the heat absorbed by the heat exchanger for the cold storage compartment, that is, an amount of heat just sufficient to permit continuous operation of the cooler without causing any temperature rise in the cold storage compartment during the defrosting operation in the freezing storage compartment, and which is disposed within the cold storage compartment or in the vicinity of the heat for the cold storage compartment and is operated during the defrosting operation on the side of the freezing storage compartment. Thus, during the defrosting operation the cooling on the side of the cold storage compartment can be such that the inside thereof is held under a practically optimum temperature condition to ensure continuous operation of the cooler. During this time, therefore, pressurized hot gas may always be supplied to the heat exchanger for the freezing storage compart-

ment to effect prompt and complete defrosting. Furthermore, by the provision of the heating means there is no possibility of excessively lowering the temperature in the cold storage compartment, thus eliminating the occurrence of the so-called flood-back or flowing of the cooling medium after heat exchanger for the cold storage compartment in the liquid phase back to the compressor. Thus, there is no need of providing any particular flood-back preventive means.

What is claimed is:

1. In a combination type refrigerator having a freezing storage compartment provided with a heat exchanger, a cold storage compartment also provided with a heat exchanger, cooling means including a compressor for circulating coolant through said heat exchangers, switch means for on-off controlling said cooling means in response to the detection of a predetermined temperature in said cold storage compartment, and means for defrosting said freezing storage compartment by connecting both of said heat exchangers in series with a valve acting as an expansion valve between said heat exchangers and directly supplying pressurized hot gas to the heat exchanger for the freezing storage compartment, the improvement comprising:

heating means provided in said cold storage compartment for generating an amount of heat sufficient to permit continuous operation of said cooling means without causing any temperature rise in said cold storage compartment during the defrosting operation in said freezing storage compartment, and means for operating said heating means only during the defrosting operation in said freezing storage compartment.

2. In a combination type refrigerator having a freezing storage compartment provided with a heat exchanger, a cold storage compartment also provided with a heat exchanger, cooling means including a compressor for circulating coolant through said heat exchanger, switch means for on-off controlling said cooling means in response to the detection of a predetermined temperature in said cold storage compartment, and means for defrosting said freezing storage compartment by connecting both of said heat exchangers in series with a valve acting as an expansion valve between said heat exchangers and directly supplying pressurized hot gas to the heat exchanger for the freezing storage compartment, the improvement comprising:

heating means provided in the vicinity of the heat exchanger for said cold storage compartment for generating an amount of heat sufficient to permit continuous operation of said cooling means without causing any temperature rise in said cold storage compartment during the defrosting operation in said freezing storage compartment, and means for operating said heating means only during the defrosting operation in said freezing storage compartment.

3. A method of defrosting storage compartment of a combination type refrigerator having a freezing storage compartment provided with a heat exchanger, a cold storage compartment also provided with a heat exchanger, cooling means including a compressor for circulating coolant through said heat exchangers, and switch means for on-off controlling said cooling means in response to the detection of a predetermined temperature in said cold storage compartment, comprising, at intervals when the freezing storage department is in need of defrosting:

connecting both of said heat exchangers in series through an expansion valve positioned therebetween, if said heat exchangers are not already so connected;

directly supplying pressurized hot gas to the heat exchanger for the freezing compartment; and

heating said cold storage compartment with sufficient heat to permit continuous operation of said cooling means without causing any temperature rise in said cold storage compartment during the defrosting operation in said freezing compartment.

4. A method of defrosting the freezing storage compartment of a combination type refrigerator having a freezing storage compartment provided with a heat exchanger, a cold storage compartment also provided with a heat exchanger, cooling means including a compressor for circulating coolant through said heat exchangers, and switch means for on-off controlling said cooling means in response to the detection of a predetermined temperature in said cold storage compartment, comprising, at intervals when the freezing storage department is in need of defrosting:

connecting both of said heat exchangers in series through an expansion valve positioned therebetween, if said heat exchangers are not already so connected,

directly supplying pressurized hot gas to the heat exchanger for the freezing compartment; and

heating the heat exchanger of said cold storage compartment with sufficient heat to permit continuous operation of said cooling means without causing any temperature rise in said cold storage compartment during the defrosting operation in said freezing compartment.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,822,564 Dated July 9, 1974

Inventor(s) Kiyoichi NIJO

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 2, line 61, delete "by-pass-part" and insert therefor --by-pass-path--;

Col. 4, line 63, after "temperature" insert -- sensor A -- .

Signed and sealed this 8th day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

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