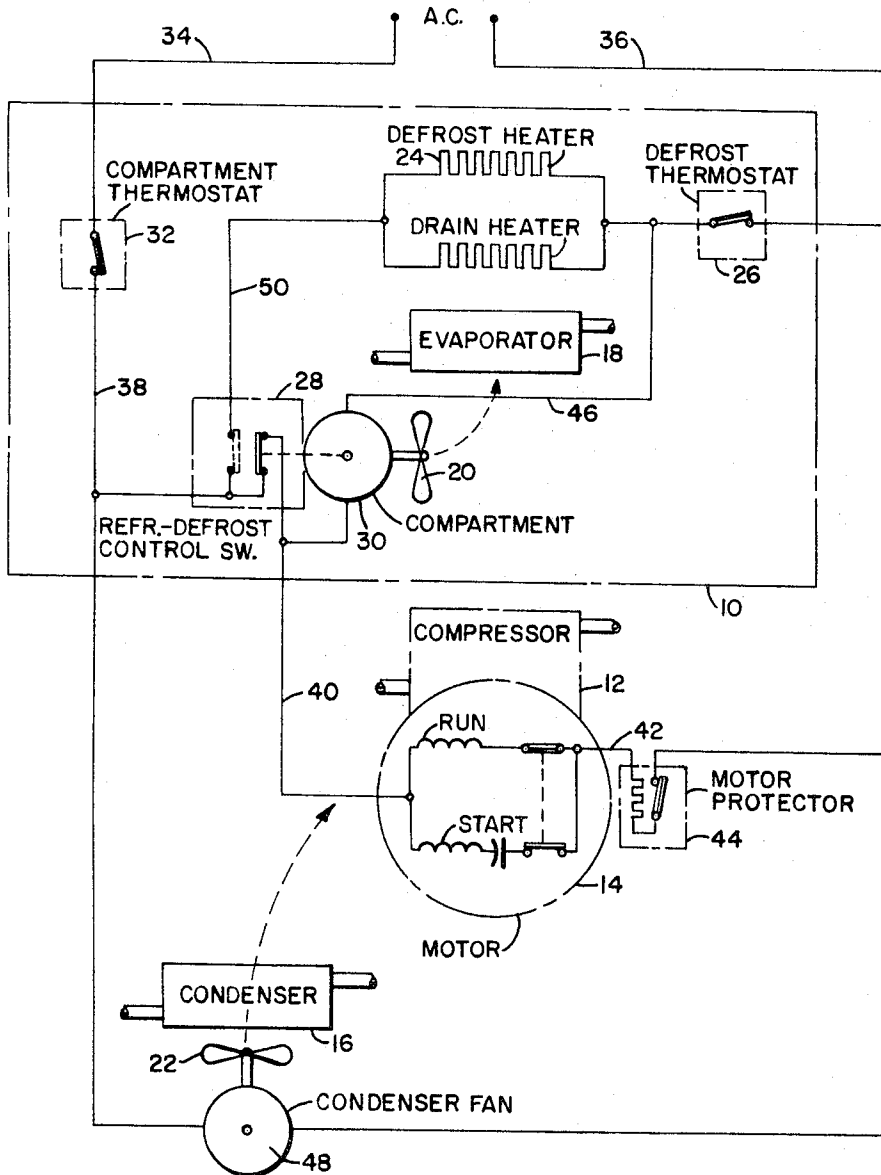


April 8, 1969

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REFRIGERATION DEFROST CONTROL RESPONSIVE TO OPERATION
OF COMPARTMENT AIR CIRCULATING FAN
Filed Sept. 29, 1967

3,436,929



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REFRIGERATION DEFROST CONTROL RESPONSIVE TO OPERATION OF COMPARTMENT AIR CIRCULATING FAN

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Filed Sept. 29, 1967, Ser. No. 671,686

Int. Cl. F25d 21/06; G05d 23/32

U.S. Cl. 62—155

6 Claims

ABSTRACT OF THE DISCLOSURE

Refrigerator circuit arrangement in which a refrigeration-defrost control switch directly driven by the compartment air circulating fan motor is moved from a defrost to a refrigeration position by the fan motor at the end of evaporator defrost through opening of a shunt connection made by the defrost thermostat. The impedances of the compartment fan motor and compressor motor are related to preclude an attempted compressor start during the momentary energization, and in a preferred arrangement the condenser fan motor operates during defrost to reduce starting load upon the compressor after defrost.

BACKGROUND OF THE INVENTION

Field of the invention

The invention pertains to the art of controlling refrigeration devices.

Description of the prior art

It has been heretofore proposed to eliminate the usual separate timer motor used to control switch means for periodically effecting defrost of the refrigerator evaporator by instead driving the refrigeration-defrost control switch means directly from the motor driving the fan which circulates air over the evaporator and through the refrigerated compartment. One published example of such an arrangement is found in U.S. Patent 3,159,980 in which the duration of the defrost cycle is controlled by a dashpot arrangement so that a refrigeration cycle is not again initiated until the dashpot controlled time has expired. This dashpot technique has the inherent advantage of permitting the duration of the defrost cycle to be set in excess of the actual time required for completing the defrost of the evaporator. This allows the evaporator to cool somewhat before the compressor and compartment fan are again energized, and accordingly reduces the load upon the compressor when it again starts. This overage of time for a defrost cycle is conventional also in those arrangements in which a separate timer motor is used to control the defrost period, since the timer is typically set to allow a period of, say, 25 minutes for defrost, while the evaporator is typically defrosted in, say, 10 minutes. While as noted the dashpot arrangement does have the inherent advantage of permitting the setting of a duration of refrigeration system dormancy to exceed the actual time required for defrost, the dashpot arrangement may be considered to constitute a timer of sorts itself so that in effect one timer (the dashpot) has been substituted for another.

SUMMARY OF THE INVENTION

It is proposed in accordance with the present invention that the restoration of the refrigeration-defrost control switch means to a refrigeration position be effected by a circuit arrangement and switching means devoid of a dashpot timer, and as soon as the evaporator has been defrosted. The circuit is also arranged to permit the early

resumption of compressor operation for refrigeration purposes without imposing such a load upon the compressor that overload tripping occurs.

In brief, the invention provides that the compartment fan motor (which drives the refrigeration-defrost control switch between its alternate refrigeration and defrost positions at the expiration of selected accumulated times of fan motor operation), and the compressor motor, be shunted by a defrost thermostat during the defrost operation to prevent the energization of the compartment fan motor and compressor motor. Completion of defrost opens the defrost thermostat to momentarily energize the compartment fan motor through a completed circuit which includes the defrost heater, the fan motor and the compressor motor, to shift the control switch back to a refrigeration position. The high impedance of the compartment fan motor relative to the compressor motor precludes any attempt of the compressor motor to start while the shifting of the switch takes place. Restoration of the control switch to the refrigeration position deenergizes the compartment fan motor and energizes the compressor motor. After the compressor operation has pulled down the temperature of the evaporator to a level which causes the defrost thermostat to close, the compartment fan is again energized. In the preferred embodiment of the invention, which is particularly adaptable to larger size refrigerators, the condenser fan is connected in the circuit arrangement so that it operates independently of the refrigeration-defrost control switch position. The result of this arrangement is that the condenser fan circulates air over the condenser during the defrost operation, and also over the compressor, so that lower condenser temperatures and lower compressor motor winding temperatures exist at restart. The lower condensing temperature promotes more rapid condensation of gas in the high side and therefore reduces the load against which the compressor must work. Of course the lower winding temperatures in the compressor motor also means lower winding resistance allowing the compressor motor to produce a higher starting torque.

DRAWING DESCRIPTION

The single figure is an electrical schematic and diagrammatic representation of a refrigerator incorporating a circuit arrangement according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawing, the broken line outline 10 represents the storage compartment of the refrigerating device (hereinafter called the refrigerator), which may be a typical domestic refrigerator or freezer.

The refrigeration system includes the usual refrigeration components such as the refrigerant compressor 12 driven by motor 14, refrigerant condenser 16, and refrigerant evaporator 18. The refrigerant conducting conduits connecting the refrigerant components are omitted for clarity. Also, the drawing does not illustrate the specific locational relationships between the parts of the refrigeration system, although it is noted that the evaporator will conventionally be located in a passageway separate from the interior of the storage compartment 10 with the compartment fan 20 located to direct a draft of air through the passageway, the compartment and back into the passageway. The compressor 12 and its motor 14, along with the condenser 16 are conventionally located in the machine compartment of the refrigerator outside of the general confines of the storage compartment 10. These latter elements are physically located so that the condenser fan 22 creates a draft of air through the condenser and over the compressor and motor casing. The general direction of air flow created by the two fans 20 and 22 is indicated by the broken line arrows associated therewith.

The defrost heater 24 is disposed in heat exchange relation with the evaporator 18 in the noted separate passageway to effect its defrost. The defrost thermostat 26 is located so as to be responsive to the temperature condition of the evaporator. The defrost thermostat has a normally closed position in response to a temperature indicating a normal refrigerated condition of the refrigerator. Upon detecting a defrosted condition of the evaporator, the thermostat opens.

Among the other main components of the arrangement of concern in connection with the invention are the refrigeration-defrost control switch 28 which has a refrigeration position (solid line) and an alternate defrost position (broken line) to which it is periodically moved through a gear system after a predetermined accumulated running time of the compartment fan motor 30. The period of time during one repeating cycle of fan motor operation that the switch 28 is in a defrost position is very minute compared to the period during which the switch is in a refrigeration position; it only being necessary that the switch does not move through the defrost position and back to a refrigeration cycle while the fan motor coasts to a stop. The storage compartment is provided with a compartment thermostat 32 which, under normal conditions, initiates and terminates the operation of the refrigeration system in accordance with variations in the compartment temperature above and below, respectively, the set point to which the thermostat is adjusted. The opposite sides of the electrical power source are identified as 34 and 36.

Operation

Under normal refrigerating operation of the system, the compartment thermostat 32 closes in response to a compartment temperature calling for cooling. This completes a refrigeration producing circuit from the thermostat 32 through line 38, switch 28 in its refrigeration position, line 40 connecting one side of the compressor motor 14 to the switch 28, and line 42 connecting the other side of the compressor motor through a thermal overload motor protector 44 to the opposite line 36 of the power source. The compartment fan motor 30 is also energized at this time through the control switch 28 in its refrigeration position, line 40 connected to one side of the fan motor, and line 46 connecting the other side of the fan motor to the defrost circuit between the defrost heater 24 and the defrost thermostat 26. It will be appreciated that the defrost thermostat 26 is in a normally closed position due to the undefrosted condition of the evaporator 18. The condenser fan motor 48 is also energized when the compartment thermostat 32 closes since line 38 is connected to one side of the motor, and the other side of the motor is connected to the power line 36.

After the compartment fan motor 30 has accumulated a predetermined amount of running time (corresponding to an expected defrost need), the control switch 28 is driven by the motor rotation from its refrigeration position to its alternate defrost position. The defrost circuit will then be energized through the control switch 28 in its defrost position, line 50 connecting the switch 28 to the defrost heater 24, and line 46 connecting the defrost heater to the one side of the closed defrost thermostat 26. When the switch 28 is moved to its defrost position, the compartment fan motor 30 and the compressor motor 14 are deenergized by loss of their direct connection through switch 28 and by being shunted by closed defrost thermostat 26 with respect to their connection through line 46 and the defrost heater.

After sufficient heat has been generated by the energized defrost heater 24 to defrost the evaporator 18, the defrost thermostat 26 opens. Removal of the shunt circuit across the compartment fan motor 30 and compressor 12 by opening of the defrost thermostat 26 results in the energization of the fan motor 30 through a completed circuit including the control switch 28 in the defrost posi-

tion, line 50, defrost heater 24, line 46, the compartment fan motor 30, line 40, compressor motor 14, line 42, and motor protector 44 to the power line 36. However the fan motor energization is only momentary since the motor operation shifts the control switch 28 back to its illustrated solid line refrigeration position. The impedance relationship between the defrost heater 24, compartment fan motor 30, and the compressor motor 14 precludes the compressor motor from attempting to start during this momentary energization of the fan motor. The compartment fan motor 30 has a relatively high impedance (e.g., 300 ohms) as compared to the defrost heater (e.g., 35 ohms) and compressor motor (e.g., 8 ohms) so that the voltage drop produced across the compartment fan motor is adequate to energize it, but the drop across the compressor motor is negligible. With control switch 28 back in its refrigeration position, the compartment fan motor 30 is deenergized and the compressor motor 14 is energized. Until the evaporator is adequately chilled by compressor operation, the defrost thermostat 26 remains open and the compartment fan motor does not operate. This avoids forcing warm air into the storage compartment. Then when the defrost thermostat closes, the compartment fan operates again in its usual way under the control of the compartment thermostat.

As noted before, in the preferred embodiment the condenser fan motor 48 is energized during the defrost cycle to circulate air through the condenser 16 during the defrost period and over the compressor 12 and compressor motor 14. Thus, when the compressor is energized after the defrost, the load against which the compressor must work is reduced as compared to the load against it which would work if the condenser fan were not operating during defrost.

It is noted that in certain instances, where the refrigerating system is more than marginally sized for the potential load, the one side of the condenser fan motor 48 may be connected to line 40 rather than directly to line 38 so that it does not run during the defrost operation. However, in either case it will be appreciated that the circuit arrangement is such that the refrigeration-defrost control switch is directly driven from the compartment fan motor, thereby avoiding any requirement of a substitute timing element in place of a separate timing motor as has normally been conventional.

I claim as my invention:

1. In a refrigerated storage device of the type in which the fan motor for circulating air through the storage compartment and evaporator moves a two position switch from a refrigerating position to a defrost position in accordance with accumulated running time of said motor, a circuit arrangement between one side of a compartment temperature responsive switch and one side of a power source comprising:

- a defrost effecting circuit including, in series, said two position switch in a defrost position, a defrost heater, and a defrost thermostat having a closed position in response to normal evaporator temperatures and operable to an open position in response to a defrosted condition of said evaporator;
- a refrigeration effecting circuit including, in series, said two position switch in a refrigeration position and a refrigerant compressor motor;
- a circulating fan motor circuit connecting one side of said fan motor to said defrost effecting circuit between said defrost heater and defrost thermostat, and the other side of said fan motor to said refrigeration effecting circuit between said two position switch and said compressor motor;

whereby said circulating fan motor, in shunt with said defrost thermostat during a defrost operation, is prevented from being energized until said defrost thermostat opens, and is then energized momentarily through a series circuit including said two position switch in said defrost position, said defrost heater

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and said compressor motor to move said two position switch back to said refrigeration position.

2. A circuit arrangement according to claim 1 wherein: said circulating fan motor and said defrost heater together have a high impedance relative to said compressor motor so that the voltage drop across said compressor motor during said momentary energization of said circulating fan motor is sufficiently low that said compressor motor does not attempt to start.

3. In a refrigerated storage device having a circuit arrangement according to claim 1:

a condenser fan circuit including a condenser fan motor having one side connected to said compartment temperature responsive switch and its other side connected to said one side of said power source so that said condenser fan motor is energized independently of said two position switch position, and thereby operates during defrosting of said evaporator.

4. In a refrigeration device:

a refrigerated compartment;

a refrigeration system including compressor means, condenser and evaporator;

compartment fan means for creating a flow of air over said evaporator and compartment;

condenser fan means for creating a flow of air over said condenser and said compressor;

a compartment thermostat;

a refrigeration-defrost control switch driven to alternate refrigeration and defrost positions by accumulated running time of said compartment fan means;

a defrost heater associated with said evaporator;

a defrost thermostat having a normally closed position in response to a chilled position of said evaporator and operable to an open position in response to a defrosted condition thereof;

an electrical power source;

a compressor circuit connecting said compressor means to said control switch for energization when said control switch is in said refrigeration position;

a defrost circuit connecting said defrost heater and defrost thermostat in series to said control switch for

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energization of said defrost heater when said control switch is operated to said defrost position, said defrost circuit being opened by said defrost thermostat responding to a defrosted condition of said evaporator;

a compartment fan circuit connecting one side of said compartment fan means to said defrost circuit between said defrost heater and said defrost thermostat, and the other side of said compartment fan means to said compressor circuit between said control switch and said compressor means;

whereby said defrost thermostat is in shunt with said compartment fan means and compressor means during defrost to prevent their operation and, upon said defrost thermostat opening in response to a defrosted condition of said evaporator said compartment fan means is energized through said defrost heater to move said control switch back to said refrigeration position.

5. In a refrigeration device according to claim 4:

said compartment fan means has a high impedance relative to said compressor means so that the voltage drop across said compressor means when said defrost thermostat opens is sufficiently small that said compressor means does not attempt to start.

6. In a refrigeration device according to claim 4 including:

a condenser fan circuit connecting said condenser fan means to said power source directly through said compartment thermostat for energization of said condenser fan means independently of said control switch.

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MEYER PERLIN, *Primary Examiner*.

U.S. Cl. X.R.

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