July 14, 1931. M. C. TERRY 1,814,013

REFRIGERATOR CONTROL MECHANISM

Filed Feb. 21, 1927 2 Sheets-Sheet 1

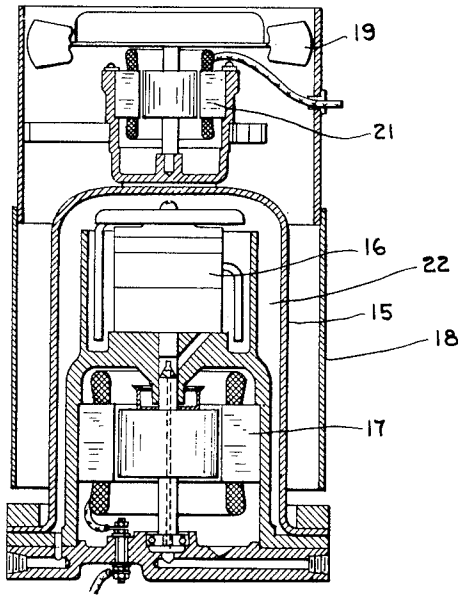

Fig. 2.

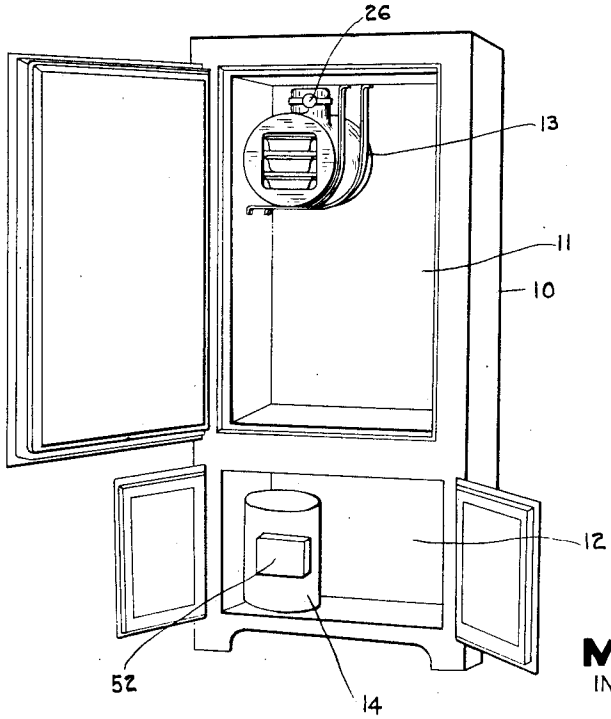

Fig. 1.

WITNESS
E. Lutz.

M.C.Terry
INVENTOR

BY A. B. Reavis
ATTORNEY

July 14, 1931. M. C. TERRY 1,814,013

REFRIGERATOR CONTROL MECHANISM

Filed Feb. 21, 1927 2 Sheets-Sheet 2

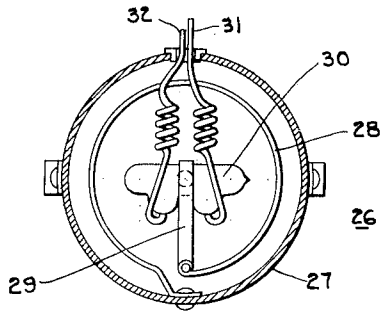

Fig. 4.

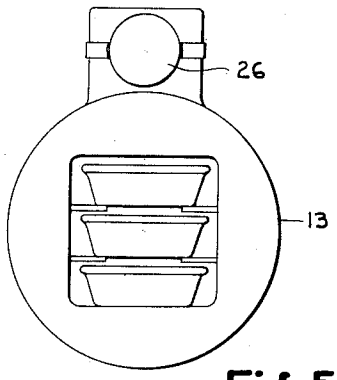

Fig. 5.

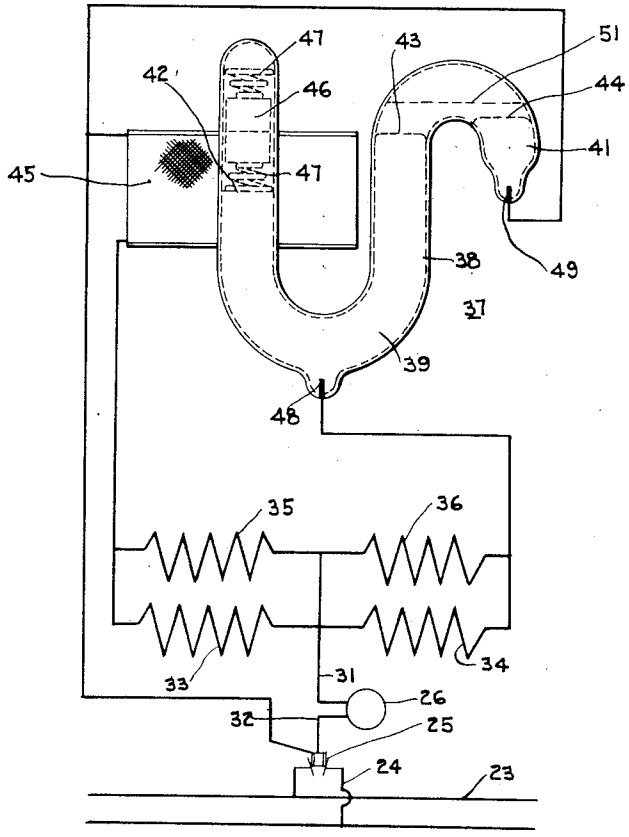

Fig. 3.

WITNESS
E. Lutz.

M.C. Terry
INVENTOR

BY A. B. Reavis
ATTORNEY

Patented July 14, 1931 1,814,013

UNITED STATES PATENT OFFICE

MATSON C. TERRY, OF MANSFIELD, OHIO, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA

REFRIGERATOR CONTROL MECHANISM

Application filed February 21, 1927. Serial No. 169,895.

My invention relates to control mechanisms, particularly to mechanisms adapted for controlling the action of motor driven compression refrigerating machines of the household type, and it has for an object to provide apparatus of the character designated which shall be capable of operating automatically and reliably for an indefinite period of time.

It has for a further object to provide a control mechanism of the aforementioned character which shall be especially adapted for use with a refrigerator in which is employed a motor having both starting and running windings and in which the motor is totally enclosed in a fluid-tight casing.

A further object of my invention is to provide, in connection with a refrigerating apparatus having a driving motor with starting and running windings, control mechanism embodying thermostatically and magnetically operated switches arranged in series, the magnetically operated switch being responsive to the initial current surge upon closure of the thermostatic switch to energize the starting winding.

These and other objects, which will be made apparent throughout the further description of my invention, may be attained by the employment of the apparatus hereinafter described and illustrated in the accompanying drawings in which:

Fig. 1 is a perspective view of an electric household refrigerator equipped with one form of control mechanism arranged in accordance with my invention;

Fig. 2 is an enlarged view, in sectional elevation, of the condensing and compression mechanism embodied in the refrigerator shown in Fig. 1;

Fig. 3 is a wiring diagram of one form of my control system;

Fig. 4 is a view, in sectional elevation, of the temperature responsive element shown diagrammatically in Fig. 3; and,

Fig. 5 is a view, in elevation, showing the application of the temperature responsive element illustrated in Fig. 4 to the evaporator of the refrigerator shown in Fig. 1.

In order that a household refrigerating machine may be connected to the 110 volt lighting circuit normally provided in most households, it is advisable that the current draw never exceed 15 amperes. Furthermore, in some types of machines, the motor and the compressor driven by the motor are totally enclosed in a single hermetically sealed casing so as to avoid the requirement of a stuffing box. In refrigerating machines of this character, it has been found that motors of the split-phase type having both starting and running windings give excellent operating results for the reason that such motors have no commutator or brushes to wear and require servicing. When motors of this type are employed, some means must be provided for controlling the flow of current through the starting winding circuits so that, when the machine is started, the circuit through the starting winding is closed until the machine has attained normal running speed whereupon the circuit through the starting winding must be broken. It has been the general practice heretofore to employ some form of centrifugal switch which is normally closed when the motor is inactive and which is thrown to an open position by centrifugal force when the motor has attained its normal running speed. When switches of this form are employed, they must necessarily be mechanically connected or directly associated with the motor shaft so that, in refrigerating machines wherein the motor is totally enclosed, the switch is made relatively inaccessible. Furthermore, frequently in refrigerating machines of the enclosed type, the motor operates in a region of refrigerant vapor and as most refrigerants in common use today are somewhat inflammable, the operation of a centrifugal switch under such conditions is rather undesirable from a safety standpoint.

It has heretofore been proposed to control the flow of current through the starting winding of a split-phase motor by means of a solenoid operated switch of the fluid type, the solenoid being momentarily energized by the initial surge of current created upon

the motor being placed in circuit with a source of electrical energy.

I have therefore conceived of the idea of applying a solenoid operated switch to refrigerating machines of the enclosed type for controlling the flow of current through the starting winding of the motor. The use of this type switch requires no mechanical connection with the motor shaft and hence it may be located exteriorly of the casing enclosing the motor and the compressor, the connecting wires passing through suitable fluid-tight fittings located in the casing.

In accordance with my invention, a second or master switch is combined with the first switch for controlling the flow of current from the main or source of supply to both the starting and running windings of the motor, this switch being actuated by automatic temperature or pressure responsive means in a manner well understood in the art. In such a combination, the thermostat of the refrigerator is utilized not only to control the supply of current to the refrigerator motor in response to the temperature of the refrigerator box but also to control the movements of the separate switch associated with the motor starting winding, the initial surge of current created upon the automatic closing of the master switch temporarily energizing the solenoid of the fluid switch and thus placing the starting winding in circuit temporarily. Such an arrangement permits the starting winding switch to be located exteriorly of the casing enclosing the motor so that it is readily accessible at all times for inspection and repair. In this way, the fire hazard is eliminated, the reliability of operation is improved while the cost of proper maintenance is materially lessened.

Referring to the drawings for a more detailed description of my invention, I show, in Fig. 1, a refrigerator box 10 having an upper cooling compartment 11 and a lower machinery compartment 12. Located within the cooling compartment 11 is an evaporator or cooling element 13 while disposed below in the machinery compartment 12 is a unit 14 embodying the condensing and compression mechanisms. The unit 14 and the evaporator 13 are connected by suitable conduits (not shown) in a manner well understood in the art.

As shown in Fig. 2, the unit 14 comprises a fluid-tight casing 15 within which is disposed a compressor 16 driven by a motor 17. The motor 17 is of the split-phase type having separate starting and running windings. Surrounding the casing 15 is a draft tube 18 which is open at both ends and has located in its upper portion a fan 19 driven by a motor 21. The fan 19 is arranged to circulate air through the draft tube 18 over the casing 15, the cooling action created being sufficient to permit utilization of the interior space 22 of the casing 15 as a condensing chamber. In the present application, it has been assumed that the motor 21 which drives the fan 19 is, like the main motor 17, provided with starting and running windings although frequently it is provided with a shading winding which, unlike a starting winding, is always in circuit during operation of the motor.

Referring now to Fig. 3, 23 represents a source of electrical energy or supply main. Connected to the main 23 is a circuit 24 in which is located suitable fuses 25 and a thermostat 26.

In Fig. 4, I show one form of thermostat which I may employ, although it is perfectly obvious that I may employ in my system any form of control mechanism responsive to either temperature or pressure and capable of starting and stopping the main motor so as to maintain the required temperature within the refrigerator box as well as maintain the ice which is formed in the ice trays. Referring to this figure, 27 indicates a casing within which is disposed a bi-metal spiral 28 pivotally connected through a link 29 to a switch 30 preferably of the mercury tilting type. The switch 30 is provided with suitable leads 31 and 32. As shown in Figs. 1 and 5, the thermostat 26 may be located in heat transfer relation with the evaporator 13 so that it is responsive to the temperature of the refrigerant fluid contained therein.

Referring again to Fig. 3, 33 represents the running winding, and 34 the starting winding of the main motor 17, while 35 and 36 indicate respectively the running and starting windings of the fan motor 21, one side of each of the running windings of both motors being connected through a lead 31 and thermostat 26 to the main 23.

The starting winding switch is represented at 37. This switch may be composed of a transparent glass casing 38 preferably formed in the manner illustrated and containing bodies of conducting liquid, such as mercury, 39 and 41 having normal levels such as indicated at 42, 43 and 44. Associated with one leg of the casing 38 is a solenoid winding or coil 45 connected at one of its terminals with the motor running windings 33 and 35 and at its other terminal directly with the main through the fuses 25. A member 46 of suitable magnetic material is provided in the casing 38 and serves as an armature member for the coil 45. Interposed between the armature member 46 and the liquid level 42 is a resilient member, such as a spring 47, while interposed between the opposite end of the armature member 46 and the end of the casing 38 is a similar resilient member 47, these resilient

members being provided for cushioning the sudden movements of the armature member. Terminal connections 48 and 49 are provided in the casing 38 as shown, the first of these connecting with the starting windings 34 and 36 of both motors and the other 49 connecting directly with the main through the fuses 25.

From the foregoing description, the operation of my control mechanism will be apparent. When the refrigerating machine is inactive, the switch 30 of the thermostat is so positioned as to break the circuit. In addition, the solenoid 46 and the levels of liquid in the casing 38 are such as indicated in Fig. 3. However, upon the temperature in the refrigerator box 10 rising to a predetermined degree and a consequent increase in the temperature of the evaporator element 13, the bi-metal spiral 28 expands sufficiently to move the mercury switch 30 to close the circuit through the terminals 31 and 32. This results in a sudden abnormal or initial surge of current through the running windings 33 and 35 as well as the solenoid winding 45 whereupon the solenoid 46 is drawn downwardly, displacing some of the conducting liquid in the left hand portion of the casing 38 and causing a rising of the liquid level in the right hand portion of the casing to an overflow level, such as indicated at 51, whereupon the conducting liquid closes the circuit between the terminals 48 and 49 and places the starting windings 34 and 36 in circuit with the main 23. By the time the main motor has attained its normal running speed, the current flow has returned to normal and thereafter is insufficient to retain the solenoid 46 in its downward position, whereupon it returns to the position illustrated and the circuit through the starting windings is broken. The running windings 33 and 35 however, remain in circuit until such time as the thermostat 26 opens the circuit whereupon the machine becomes inactive. As soon as the temperature in the refrigerator box and the evaporator has increased sufficiently, the cycle of operation is repeated.

From the foregoing description, it will be apparent that I have invented a form of control mechanism which is especially adapted for refrigerating machines in which the motor is totally enclosed. By means of my arrangement, the switch and control mechanism may be completely arranged outside of the casing enclosing the motor so that it may be readily inspected and repaired. As shown in Fig. 1, I prefer to arrange the fluid switch 37 in a casing 52 supported upon the front portion of the condensing and compression mechanisms where it is readily accessible.

While I have described my control mechanism as being especially adapted for use in refrigerating machines having their motors totally enclosed, nevertheless it is apparent that it may be utilized with any refrigerating machine in which the motor is provided with a winding which is only temporarily in circuit.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:—

1. The combination with a refrigerating machine having a compressor, a motor for driving the compressor, a fluid tight casing enclosing the motor, a condenser, a fan for circulating air over the condenser, a motor for driving the fan, both the compressor motor and the fan motor being provided with starting and running windings connected in parallel with the source of electrical energy, and control means for automatically opening and closing the circuit between the motors and the source of electrical energy, of a switch disposed outside of the compressor motor casing for opening or closing the circuit through the starting windings of both the fan motor and the compressor motor, and an electromagnet for actuating said switch, said electromagnet being energized by the flow of current created upon the closing of the circuit between the source of electrical energy and the windings of both motors by the automatic control means.

2. The combination with a refrigerating machine having a compressor, a motor for driving the compressor, a fluid tight casing enclosing the motor, a condenser, an evaporator, a fan for circulating air over the condenser, a motor for driving the fan, both the compressor motor and the fan motor being provided with starting and running windings connected in parallel with the source of electrical energy, and control means for automatically opening and closing the circuit between the motors and the source of electrical energy, of a switch disposed outside of the compressor motor casing for opening or closing the circuit through the starting windings of both the fan motor and the compressor motor, and an electromagnet for actuating said switch, said electromagnet being energized by the initial surge of current created upon the closing of the circuit between the source of electrical energy and the windings of both motors by the automatic control means.

3. The combination with a refrigerating machine having a compressor, a motor for driving the compressor, a fluid tight casing

enclosing the motor, a condenser, an evaporator, a fan for circulating air over the condenser, a motor for driving the fan, both the compressor motor and the fan motor being provided with starting and running windings connected in parallel with the source of electrical energy, and control means for automatically opening and closing the circuit between the motors and the source of electrical energy, of a switch disposed outside of the compressor motor casing for opening or closing the circuit through the starting windings of both the fan motor and the compressor motor, and means responsive to the initial surge of current created upon the closing of the circuit between the source of electrical energy and the windings of both motors for energizing said switch.

4. The combination with a refrigerating machine having a compressor, a motor for driving the compressor, a fluid tight casing enclosing the motor, a condenser, an evaporator, a fan for circulating air over the condenser, a motor for driving the fan, both the compressor motor and the fan motor being provided with starting and running windings connected in parallel with the source of electrical energy, and control means located outside the casing for automatically opening and closing the circuit between the motors and the source of electrical energy, of a switch disposed outside of the compressor-motor casing for opening or closing the circuit through the starting windings of both the fan motor and the compressor motor, and an electromagnet for actuating said switch, said electromagnet being energized by the flow of current created upon the closing of the circuit between the source of electrical energy and the windings of both motors by the automatic control means.

In testimony whereof, I have hereunto subscribed my name this tenth day of February, 1927.

MATSON C. TERRY.