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REFRIGERATING APPARATUS

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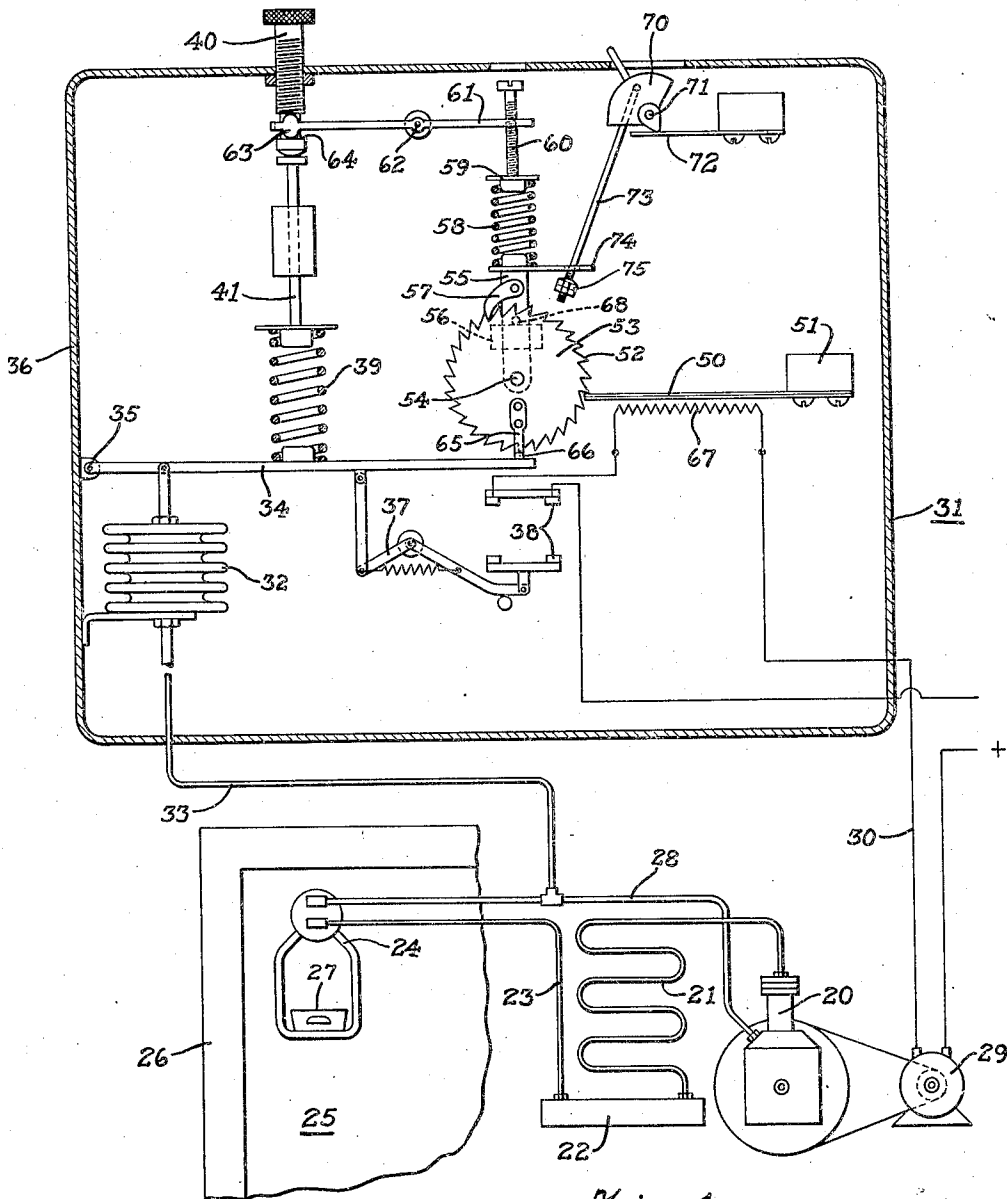


Fig. 1

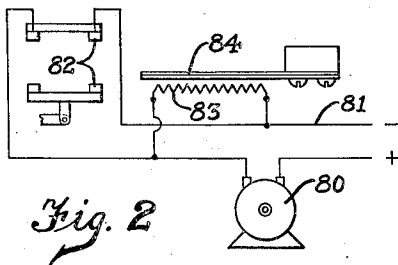


Fig. 2

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## UNITED STATES PATENT OFFICE

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## REFRIGERATING APPARATUS

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17 Claims. (Cl. 62-4)

This invention relates to refrigerating apparatus and more particularly to control means therefor.

Ordinarily the evaporator of a mechanical refrigerating system is operated at freezing temperatures. This causes frost to collect upon the evaporator which retards the cooling action of the evaporator and lowers the thermal efficiency of the system. It has been proposed to defrost the evaporator periodically by employing a ratchet device operated by the opening or closing of the temperature controlling switch to periodically raise the evaporator temperature for defrosting.

I have found that at least in some situations, particularly where a small switch mechanism is used and where low evaporator temperatures with a rather small differential are required, that such a defrosting arrangement places a greater load upon the switch operating mechanism than can properly be performed thereby and this reduces the sensitiveness of the switch operation. It is therefore an object of my invention to provide a means for periodically varying the temperature of the evaporating means which does not place an additional load upon the switch operating mechanism or effect the sensitivity of the switch mechanism.

It is another object of my invention to compensate the defrosting means for changes in the temperature regulating mechanism of the switch means so that substantially the same defrosting temperatures are obtained regardless of the setting of the temperature mechanism, and to provide means for rendering the defrosting means ineffective.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred form of the present invention is clearly shown.

In the drawing:

Fig. 1 is a diagrammatic view of a refrigerating system together with a sectional view of a control means embodying my invention; and

Fig. 2 is a fragmentary view showing a modified form of my invention.

Referring to the drawing there is shown a compressor 20 for compressing the refrigerant and for forwarding the compressed refrigerant to a condenser 21 where the compressed refrigerant is liquefied and collected in a receiver 22. From the receiver 22 the liquid refrigerant is forwarded through a supply conduit 23 to an evaporator or cooling unit 24 shown as of the flooded low side float controlled type. This evaporator 24 is located within the food compartment

25 of a refrigerator cabinet 26. The evaporator 24 cools the air within the food compartment 25 and also freezes water in the ice tray 27 in order to make ice cubes. In cooling the food compartment and freezing ice cubes, the liquid refrigerant within the evaporator 24 evaporates and is returned to the compressor through the return conduit 28. The compressor 20 is driven by an electric motor 29 which is supplied with electric energy through an electric circuit 30 which is under the control of my improved control means 31.

The control means 31 is operated by a metal bellows 32 connected by tubing 33 to the return conduit 28 so that it is responsive to the pressure and therefore the temperature of the flooded low side float type of evaporator 24. The bellows 32 operates the main switch lever 34 pivoted at 35 to the casing 36 of the control means. The main switch lever 34 is connected to a toggle type of snap acting mechanism 37 through which opens and closes the set of switch contacts 38 located in the electric motor circuit 30. The expansion of the bellows 32 is opposed by a compression type coil spring 39 which so controls the movement of the main switch lever 34 as to cause the switch contacts 38 to be opened and closed in order to maintain proper refrigerating temperatures within the evaporator 24. In order to vary the temperatures of the evaporating means 24, I provide a temperature regulating screw 40 which through a follower 41 controls the tension of the temperature regulating spring 39. By varying the tension of the temperature regulating spring 39, the temperatures at which the switch contacts 38 are opened and closed may be controlled.

In order to maintain proper temperatures within the food compartment 25 and to freeze any water in the ice tray 27 it is ordinarily necessary to maintain an evaporator 24 at freezing temperatures. This causes frost to collect and accumulate upon the surfaces of the evaporator 24 by the condensation and freezing of moisture from the air upon its surfaces. This retards the cooling effect of the evaporator 24 and lowers the thermal efficiency of the system since this frost acts as a sort of an insulator.

It has been proposed to provide a ratchet device controlled and operated by the opening and closing of the switch mechanism for periodically interposing additional resistance to the expansion of the switch operating bellows in order to cause the evaporator to attain a temperature above freezing so that the frost will melt from the sur-

faces of the evaporator. I have found, however, that this affects the sensitivity of the switch, particularly when the switch is small in dimension, since the control and operation of the ratchet device places an additional load or resistance upon the bellows which operates the switch mechanism. This affects the sensitivity of the switch since the operation of such a ratchet device increases the frictional load upon the bellows and also places an additional load which is not always uniform and therefore cannot well be compensated for. This objectionable feature becomes more objectionable when low pressures and low temperatures are required, particularly with a rather small differential.

In order to avoid this objectionable situation, in my device I do not depend upon the switch mechanism for controlling or operating the ratchet device but, on the other hand, I use an external source of power. As one structural embodiment for using an external source of power for controlling defrosting, I have provided a bimetal strip 50 which is anchored at one end of a block 51 extending from the casing 36. The opposite or free end of the bimetal strip is adapted to engage the teeth 52 of a ratchet wheel 53 which is rotatably mounted upon a pin 54 fixed to a vertically slidable rod 55 which slides within a guiding aperture in a boss 56. This rod is provided with a pawl 57 which cooperates with the teeth 52 of the ratchet wheel 53 and bimetal strip 50 in order to insure rotation of the ratchet wheel 53 in the proper direction.

The rod 55 is urged in a downward direction by the compression type coil spring 58 which at its upper end rests against a spring retainer 59 carried at the lower end of a defrosting mechanism regulating screw 60 which is threaded through a lever 61. The lever 61 is pivoted at its mid point upon a pivot pin 62 and at its opposite end is provided with a forked end portion 63 which is received within a groove 64 formed in the lower portion of the temperature regulating screw 40. This causes the tension of the spring 58 to be adjusted through the lever 61 by any adjustment of the temperature regulating screw 40 so as to compensate for the changes caused by the adjustment of the screw 40.

The ratchet wheel 53 is provided with a pin or arm 65 which is riveted thereto and which projects therefrom radially so as to cooperate with the projection 66 formed upon the main switch lever 34 whenever the arm 65 is in the position shown in Fig. 1. When the arm 65 is in this position and the bellows 32 expands during the off cycle this expansion of the bellows 32 will be resisted by the tension of the spring 39 as well as the tension of the defrosting spring 58. This will necessitate that the evaporator 24 attain a higher temperature than normal, preferably several degrees above freezing before sufficient pressure is obtained within the bellows 32 in order to overcome the tension of the springs 39 and 58 in order to close the switch contacts 38 and the electric circuit 30 in order to permit the motor 29 to start the refrigerating system.

When the electric circuit 30 is closed, electric current flows through the heater 67 which is in series with the electric circuit 30 and the switch contacts 38 and in close proximity to the bimetal strip 50. The current flowing through the heater 67 causes it to become heated and to heat the bimetal strip 50 thereby causing the free end of the bimetal strip 50 to curl upwardly and by its engagement with one of the teeth 52 of the

ratchet wheel 53 will rotate the ratchet wheel in a counterclockwise direction for the distance of about one tooth. This will cause the arm 65 to move out of the path of the projection 66 upon the main switch lever 34 and permit the switch mechanism and the refrigerating system to again resume normal operation. The rod 55 is provided with a pin 68 which limits its downward movement.

When it is desired to freeze water within the ice tray 27, it is usually undesirable to permit the evaporator to be defrosted. I therefore provide means for rendering the defrosting means inoperative. This is provided by a finger manipulator 70 pivoted to the casing by a pin 71. This finger manipulator 70 has an effective and an ineffective position which are determined by a leaf spring 72. The finger manipulator 70 is connected by a rod 73 and a lost motion connection to an extension 74 and extending from the rod 55. This lost motion connection is provided by extending the rod 73 through an aperture in the extension 74 and providing a nut and lock nut 75 upon the lower end of the rod 73. The connection between the finger manipulator 70 and the rod 73 are so proportioned that when the finger manipulator 70 is thrown to effective position to render the defrosting mechanism inoperative, the rod 73 is pulled upwardly to engage the extension 74 so that the arm 65 of the defrosting mechanism is prevented from engaging the projection 66 upon the switch lever 34, and at the same time the connection between the rod 73 and the finger manipulator 70 is thrown across the dead center position. By throwing the finger manipulator 70 from the dead center position, it is resiliently held in this position by the tension of the spring 58 until it is again returned manually to ineffective position.

By my mechanism I have relieved the bellows 32 from operating the ratchet device and used a bimetal strip and heater connected with the electric circuit supplied with electric energy from an external source in order to perform this operation. By this mechanism the ratchet wheel 53 is stepped around approximately one tooth every time the switch is closed so that the number of cycles and the number of teeth upon the ratchet wheel govern the frequency of the defrosting period.

In Fig. 2, I have shown a fragmentary view which illustrates a modified arrangement wherein the compressor motor 80 having an electric circuit 81 controlled by the opening and closing of the switch contacts 82 is provided with a high resistance electric heater 83 in parallel with the switch contacts 82 so that this heater has electric energy flowing through it only when the switch contacts 82 are open. This causes the bimetal strip 84 to be heated during the off cycle of the refrigerating system and this, of course, causes the ratchet wheel 53 to be moved in a counterclockwise direction during the off cycles of the refrigerating system instead of during the on cycles of the system as illustrated in the form shown in Fig. 1. This circuit arrangement eliminates the necessity of the entire motor current from passing through the heater of the bimetal strip.

While the form of embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. Refrigerating apparatus including refrigerant liquefying means and refrigerant evaporating means, means for cyclically controlling the liquefying means to normally maintain the evaporating means at a normal average temperature, and bimetal powered means for periodically affecting by physical force the operation of the controlling means to periodically cause the temperature of the evaporating means to be changed from normal.
2. Refrigerating apparatus including refrigerant liquefying means and refrigerant evaporating means, means for cyclically controlling the liquefying means to normally maintain the evaporating means at a normal average temperature, means for conducting electric energy to said liquefying means, and thermal means heated by electric energy flowing through said conducting means for periodically affecting by physical force the operation of said controlling means to periodically cause the temperature of the evaporating means to be changed from normal.
3. Refrigerating apparatus including refrigerant liquefying means and refrigerant evaporating means, means for cyclically controlling the liquefying means to normally maintain the evaporating means at a normal average temperature, a bimetal powered ratcheting means for affecting by physical force the operation of the cyclically controlling means to cause the temperature of the evaporating means to be changed from normal.
4. Refrigerating apparatus including refrigerant liquefying means and refrigerant evaporating means, means for conducting electric energy to said liquefying means, means for cyclically controlling the supply of electric energy to said liquefying means to normally maintain the evaporating means at a normal average temperature, a bimetal powered ratcheting device energized by the electric energy flowing through said conducting means for periodically causing the temperature of the evaporating means to be changed from normal.
5. Refrigerating apparatus including refrigerant liquefying means and refrigerant evaporating means, means for cyclically controlling the liquefying means to normally maintain the evaporating means at a normal average temperature, and a bimetal powered ratcheting device for periodically interposing a resistance to the operation of the controlling means to periodically cause the temperature of the evaporating means to be changed from normal.
6. Refrigerating apparatus including refrigerant liquefying means and refrigerant evaporating means, means for cyclically controlling the liquefying means to normally maintain the evaporating means at a normal average temperature, a ratcheting device provided with means for periodically mechanically affecting the normal operation of the control of the liquefying means to periodically cause the temperature of the evaporating means to be changed from normal, and means mechanically independent of the cyclical control means but responsive to the cycling of the liquefying means for ratcheting the ratcheting device.
7. Refrigerating apparatus including refrigerant liquefying means and refrigerant evaporating means, means for cyclically controlling the liquefying means to normally maintain the evaporating means at a normal average temperature, a ratcheting device provided with means for periodically mechanically affecting the normal operation of the control of the liquefying means to periodically cause the temperature of the evaporating means to be changed from normal, and electrical means energized once each cycle of the liquefying means for ratcheting the ratcheting device.
8. Refrigerating apparatus including a cooling unit adapted to contain a refrigerant medium, means for circulating the refrigerant medium through said cooling unit, means for cyclically controlling the circulation of the refrigerant medium to normally maintain the cooling unit at a normal average temperature, means powered mechanically independently of the cyclical control means but responsive to the cycles of circulation of the refrigerant medium for periodically mechanically affecting the normal action of the cyclical control means to periodically cause the temperature of the evaporating means to be changed from normal, and means operable at will for rendering said independently powered means ineffective to change the temperature of the cooling unit from normal.
9. Refrigerating apparatus including refrigerant liquefying means and refrigerant evaporating means, means for cyclically controlling the liquefying means to normally maintain the evaporating means at a normal average temperature, means for adjusting said cyclically controlled means to vary said normal average temperature, means powered mechanically independently of the cyclically controlled means for periodically affecting the control of the liquefying means to periodically cause the temperature of the evaporating means to be changed from normal, and means responsive to the movement of said adjusting means for varying the effect of said independently powered means.
10. Refrigerating apparatus including a cooling unit, means for circulating a refrigerant medium through the unit, control means responsive to the temperature of the cooling unit for controlling the starting and stopping of the circulation of the refrigerant medium through the unit, means for controlling the action of the control means to provide a normal relationship between the temperature of the cooling unit and the starting of the circulation, a cycle counting device powered mechanically independently of said control means for periodically changing the control of the action of the control means to periodically change the relationship between the temperature of the cooling unit and the starting of the circulation.
11. Refrigerating apparatus including a cooling unit, means for circulating a refrigerant medium through the cooling unit, control means for starting and stopping the circulation of refrigerant medium at definite high and low cooling unit temperature limits, a cycle counting device powered mechanically independently of said control means but responsive to the cycles of circulation for mechanically affecting the action of the control means to change one of the temperature limits of said control means.
12. Refrigerating apparatus including refrigerant liquefying means and refrigerant evaporating means, a control means for one of said means for normally maintaining said evaporating means at freezing temperatures, and a bimetal operated device for periodically disturbing the control of one of said means to permit the temperature of the evaporating means to rise above freezing temperatures.
13. Refrigerating apparatus including refrigerant

ant liquefying means and refrigerant evaporating means, a control means for one of said means for normally maintaining said evaporating means at freezing temperatures, and a bimetal operated ratcheting device for periodically disturbing the control of one of said means to permit the temperature of the evaporating means to rise above freezing temperatures.

14. Refrigerating apparatus including refrigerant liquefying means and refrigerant evaporating means, a control means for one of said means for normally maintaining said evaporating means at freezing temperatures, and an electrically heated bimetal operated device for periodically disturbing the control of one of said means to permit the temperature of the evaporating means to rise above freezing temperatures.

15. Refrigerating apparatus including electrically operated refrigerant liquefying means and refrigerant evaporating means, means for conducting electric energy to said liquefying means, means for cyclically controlling the supply of energy to said liquefying means to maintain said evaporating means at a normal average temperature, and means operated by the heating effect of electrical energy supplied by said conducting means for periodically disturbing the control of one of said means to vary the normal average temperature of the evaporating means.

16. Refrigerating apparatus including electrically operated refrigerant liquefying means and refrigerant evaporating means, means for conducting electric energy to said liquefying means, means for cyclically controlling the supply of energy to said liquefying means to maintain said evaporating means at a normal average temperature, and a ratcheting device having thermal operating means operated by the heating effect of electrical energy supplied by said conducting means for periodically disturbing the control of one of said means to vary the normal average temperature of the evaporating means.

17. Refrigerating apparatus including refrigerant liquefying means and refrigerant evaporating means, cyclical control means for cyclically controlling the liquefying means to normally maintain the evaporating means at a normal average temperature, and mechanically independently powered means responsive to the cycling of the liquefying means for periodically mechanically affecting the operation of the cyclical control means to periodically cause the temperature of the evaporating means to be changed from normal, said mechanically independently powered means being powered mechanically independently of the cyclical control means.

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