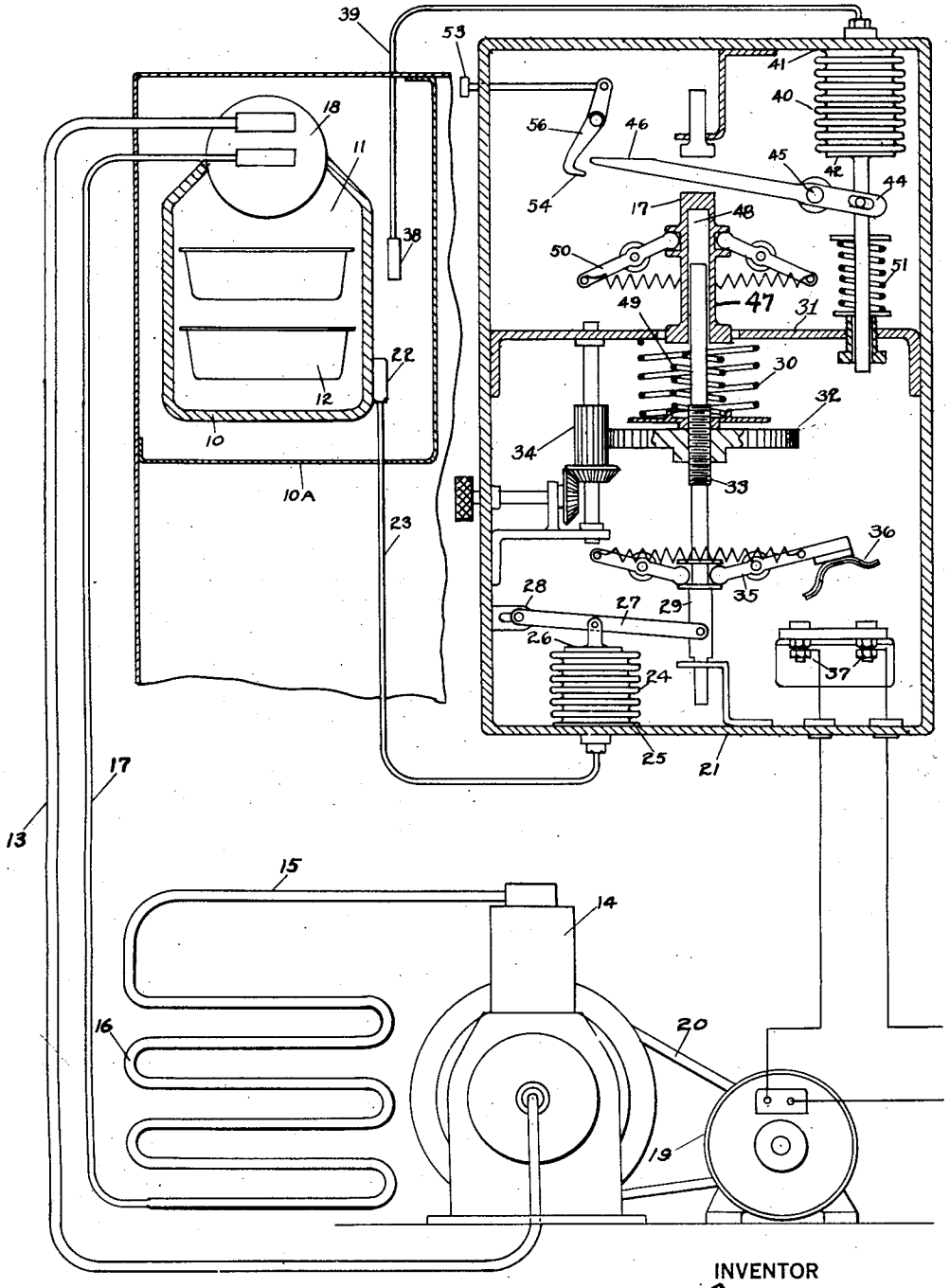
April 19, 1938. L. A. PHILIPP 2,114,768

REFRIGERATING APPARATUS

Filed Dec. 8, 1932



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Patented Apr. 19, 1938 2,114,768

UNITED STATES PATENT OFFICE

2,114,768

REFRIGERATING APPARATUS

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Application December 8, 1932, Serial No. 646,261

4 Claims. (Cl. 62—4)

This invention relates to refrigerating apparatus and particularly to the control mechanism for such apparatus.

One of the objects of the invention is to provide a refrigerating system in which the cooling unit normally operates between predetermined temperatures and in which is provided a means responsive to the condition of the cooling unit to raise the temperature of the cooling unit to a point at which the accumulated frost melts and thereafter the system is returned to normal operation.

Another object of the invention is to provide a system so constructed and arranged that the accumulation of frost to any predetermined thickness on a cooling unit will cause the operation of the control mechanism to be temporarily modified and produce a single defrosting cycle during which cycle substantially all of the accumulated frost melts.

A further object of the invention is the provision of mechanism operable at the will of the user of the machine to render the automatic defrosting mechanism inoperative, so that the machine will operate solely under the control of the normal temperature-responsive mechanism. Such a construction is particularly desirable for use in household refrigerators in which at times it is necessary to keep the machine in normal operation for the purpose of freezing ice or dessert.

Other objects and advantages of the invention will be apparent from the following description and accompanying drawing wherein the single figure is a diagrammatic representation of a refrigerating apparatus embodying one form of my improved control mechanism partly in elevation and partly broken away.

In general my invention, which may be applied to any automatically controlled refrigerating apparatus, comprises a mechanism responsive to the temperature of the cooling unit for opening and closing the circuit to a source of power for the compression mechanism, together with a temperature-responsive device located adjacent to but spaced from the cooling unit and operatively associated with a mechanism arranged to temporarily modify the action of the first named temperature-responsive mechanism.

In the embodiment of the invention herein illustrated there is shown a cooling unit or evaporator 10 located within an insulated compartment 10a, and which is provided with a freezing compartment 11 for the reception of ice trays 12. Evaporated refrigerant is withdrawn from the cooling unit 10 through a conduit 13 by means of a compressor 14 wherein the expanded gas is compressed and discharged through a conduit 15 to a condenser 16. The condensed refrigerant passes through a conduit 17 to the header 18 of the aforementioned cooling unit 10 and within this header 18 may be located any suitable pressure reducing valve such as a float valve (not shown). The compressor is driven by an electric motor 19 through a belt 20.

The operation of the motor and compressor is controlled by a temperature-responsive device 21 comprising a thermostatic bulb 22 located in immediate contact with a wall of the cooling unit 10 and connected by a flexible conduit 23 to a hermetically sealed sylphon bellows 24. The bulb 22, conduit 23 and bellows 24 contain expansible fluid which may be sulphur dioxide, methyl chloride or any other similar and well known medium. One end of the bellows is fixed as indicated at 25, and its outer end 26 moves in response to variations in the pressure of the medium contained within the bellows. The outer end of the bellows is secured to a lever 27, which lever has one of its ends mounted on a fixed pivot 28 and its other end movably secured to a switch operating rod 29. Movement of the rod upwardly is opposed by coil spring 30 secured between the fixed stop 31 and a collar or disc 32. The collar 32 may be mounted in screw threaded relation with the shaft 29 as indicated at 33, so that it may be rotated relatively to the shaft 29 as by means of a pinion gear 34 associated with its peripheral edge, thereby varying the tension on the spring 30.

A conventional toggle mechanism 35 carrying at one end thereof a movable contact member 36 is also associated with and operated by the shaft 29. A pair of fixed contact members 37 is provided to cooperate with the movable contact member 36.

In the operation of the control mechanism as hereto described, with the parts in the position shown in the figure in the drawing, the circuit through the contact members 36 and 37 is broken and the compressor and its driving motor are at rest. When the temperature of the evaporator has increased to a predetermined degree the fluid contained in the thermostat bulb 22 and the bellows 24 will expand sufficiently to cause the bellows to move the lever 27 and the rod 29 upwardly against the tension of the spring 30, and when the pressure exerted within the bellows becomes sufficient to overcome the downward force of the spring 30, the rod 29 will move upwardly far

enough to cause the toggle mechanism **35** to snap to its downward position and thereby close the circuit to the motor **19** through the contact members **36** and **37**. The motor and compressor will continue to operate until the cooling unit temperature has been lowered to such an extent that the pressure with the bellows **24** and its associated bulb **22** has been reduced to a point where the force of the spring **30** overcomes the pressure exerted by the bellows, whereupon the rod **29** will be moved downwardly to the point where the toggle mechanism will be operated to separate contact members **36** and **37**. The adjustment of the collar **32** relative to the shaft **29** to increase or decrease the tension on the spring **30** obviously serves to vary the effective operating temperature of the switch mechanism.

In order to temporarily modify the operation of the control mechanism which has just been described, so that the cooling unit may be periodically automatically defrosted, I have provided a means responsive to the accumulation of a substantial quantity of frost on the unit for modifying the operation of the compressor. In the embodiment herein shown and described, this means comprises a bulb **38** disposed adjacent to, but spaced a short distance from, the cooling unit. This bulb, which should be relatively long, is spaced from the cooling unit at a distance at which the accumulation of frost on the unit begins to materially retard the rate of heat transfer from the air to be cooled to the cooling unit, and in tests I have already conducted I have found that a satisfactory operation is obtained by placing the bulb about one-quarter inch from the outer wall of the cooling unit. The bulb **38** is connected by means of a flexible conduit **39** to a sylphon bellows **40**, and a suitable expansible fluid is confined within the bulb **38**, the conduit **39** and the bellows.

One end of the bellows is rigidly fastened as indicated at **41**, while the other end **42** is free to contract and expand in accordance with variations in the pressure of the confined expansible fluid. The movable end of the bellows operates against one end **44** of a lever which is pivoted intermediate its ends as indicated at **45**. The outer end **46** of this lever bears against an operating rod **47** which is recessed at its lower end as indicated at **48** so as to telescope over the outer end of the rod **29**. A coil spring **49** is interposed between the lower end of rod **47** and the collar which is attached to the gear member **32**. The rod **47** is provided with a toggle mechanism **50** whereby the rod will move either up or down with a snap action. The movement of the bellows **40** is opposed by an adjustable coil spring **51**.

In the operation of the complete control mechanism herein described the refrigerating apparatus remains under the normal control of the thermostatic bellows **24** and the switch mechanism until the frost on the cooling unit has accumulated to such a thickness that it contacts with and begins to surround the bulb **38**. As the frost begins to collect around the bulb it lowers the temperature and consequently the pressure of the expansible medium within this bulb and its associated bellows **40** to a point where the force exerted by the bellows is insufficient to overcome the force of the spring **51**, whereupon the spring **51** moves the operating lever counterclockwise, causing the end **46** thereof to bear against the upper end of the rod **47** with sufficient force to deflect the toggle mechanism **50** and thereby cause the rod **47** to move downwardly with a snap action until the lower end of the rod engages the spring **49** and compresses it against the collar **32**. It will be obvious that when the rod **47** and the associated spring **49** are bearing against the member **32**, the bellows **24** must exert a pressure sufficient to overcome the force of the spring **30**, the spring **49** and the two toggle members **35** and **50** in order to permit the closing of the contact members **36** and **37**. In other words in order to obtain the necessary pressure within the bellows **24** the cooling unit **10** must heat up to a temperature higher than that at which it normally operates, and it will be apparent that, by properly determining the effective pressure exerted by the rod **47**, the toggle **50** and the spring **49**, this temperature may be set sufficiently high to permit the complete defrosting of the cooling unit before the switch contact members **36** and **37** are again closed. When this predetermined high pressure and correspondingly high temperature is reached, the bellows **24** will move the rod **29** upwardly against the force of the spring **30**, the spring **49**, and the two toggle members and will eventually force the rod **47** up to a point where the toggle mechanism **50** will throw over, and completely remove the rod **47** from contact with the spring **49**. While the cooling unit has been warming to this predetermined defrosting temperature, the expansible fluid within the bulb **38** and the bellows **40** will also become warmer and thus will oppose the force of the spring **51** sufficiently to rock the arm **44** of its operating lever in a clockwise direction and thereby relieve the rod **47** from the force of the spring **51**.

Movement of the member **32** upwardly on the rod **29** to obtain varying temperature conditions within the evaporator, with the resultant compression of the spring **30**, has the effect of shortening the distance through which the rod **47** must move to bring it in contact with spring **49** so that less pressure will be exerted by the spring **49**, the rod **47** and its attached toggle member, thereby providing a compensating effect for the increased tension on the spring **30** with the result that the defrosting cut out temperature will be substantially constant regardless of the position of the member **32** relative to the shaft **29**.

In the actual operation of my device I have found that if the main thermostatic control mechanism **21** is set to cut in the compressor at a cooling unit temperature of 28 degrees Fahrenheit and to cut out the compressor at a cooling unit temperature of 19 degrees Fahrenheit, and that if the thermostatic bulb **38** is spaced approximately one-quarter inch from the cooling unit and is set to operate so as to permit the arm **47** to be forced down by the spring **51** when the temperature of the bulb has been reduced by the accumulated frost to approximately 27 degrees Fahrenheit, complete defrosting of the cooling unit is obtained in a single cycle. The bulb **38** may be moved to or from the cooling unit wall so as to vary the amount of frost which may be permitted to collect, and the operating temperature of the defrosting thermostat may be regulated by varying the tension on the spring **51**.

In order that the automatic defrosting mechanism may be rendered ineffective at the will of the user of the machine, as for example when it is desired that ice or desserts be frozen without any unforeseen interruption, I have provided a pivoted lever member **52** having a handle or knob **53** and so arranged that a projection **54** provided thereon may be interposed in the path of movement of the end **46** of the operating lever and

thereby prevent any movement of this lever in a counterclockwise direction even though the temperature of the bulb 38 should be reduced by the collection of frost thereon to a point where the spring 51 normally tends to force the rod 47 in a downward direction.

It will be apparent from the foregoing description that I have shown only a diagrammatic embodiment of the invention, and that various structural modifications may be made and other forms adopted all coming within the scope of the appended claims.

I claim:

1. Refrigerating apparatus comprising a cooling unit, means for circulating a refrigerant medium through said unit, pressure operated apparatus responsive to the temperature of said unit for controlling the flow of said refrigerant medium to maintain normal operating temperatures for the unit, manually operated means for adjusting the pressure operated means to vary the operating temperature of said unit, automatic means responsive to a predetermined condition of said unit for temporarily obtaining a predetermined higher temperature in said unit, and means associated with said automatic means for insuring the attainment of said predetermined higher temperature regardless of the setting of said manually operable means.

2. Refrigerating apparatus comprising a cooling unit, means for circulating a refrigerant medium through said unit, pressure operated apparatus responsive to the temperature of said unit for controlling the flow of said refrigerant medium to maintain normal operating temperatures for the unit, manually operated means for adjusting the pressure operated means to vary the operating temperature of said unit, automatic means responsive to the accumulation of a predetermined amount of frost on said unit for temporarily obtaining a predetermined higher temperature in said unit, and means associated with said automatic means for insuring the attainment of said predetermined higher temperature regardless of the setting of said manually operable means.

3. Refrigeration apparatus including a cooling element, an energy supply control device, pressure operated means automatically operative to normally regulate said device to maintain said cooling element within a substantially constant temperature range, additional pressure operated means also operative to operate said device to cause an increase in temperature of said cooling element above said range irrespective of the regulation effort of said first means, said additional means being constructed and arranged so that operation thereof is instigated upon accumulation of a predetermined amount of frost on said cooling element and operation thereof is terminated upon predetermined abnormal increase in temperature of said cooling element and manually operable means positioned for controlling said additional pressure operated means.

4. Refrigeration apparatus including a cooling unit, and apparatus for controlling flow of refrigerant in said unit comprising a primary energy control device, means for normally actuating said device including a bellows and a bulb responsive to temperature of said cooling element connected to said bellows, a second bellows, a second bulb spaced from said cooling unit and connected to said second bellows, said first and second bellows acting through common mechanism on said control device, means whereby said second bellows is normally ineffective and is caused to take over actuation of said control device on attaining a low temperature due to accumulation of frost, snap action mechanism associated with said second bellows and a manually controllable locking device associated with said second bellows.

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