

June 16, 1936.

G. MUFFLY

2,044,482

REFRIGERATION APPARATUS

Filed Nov. 5, 1932

3 Sheets-Sheet 2

Fig. 2

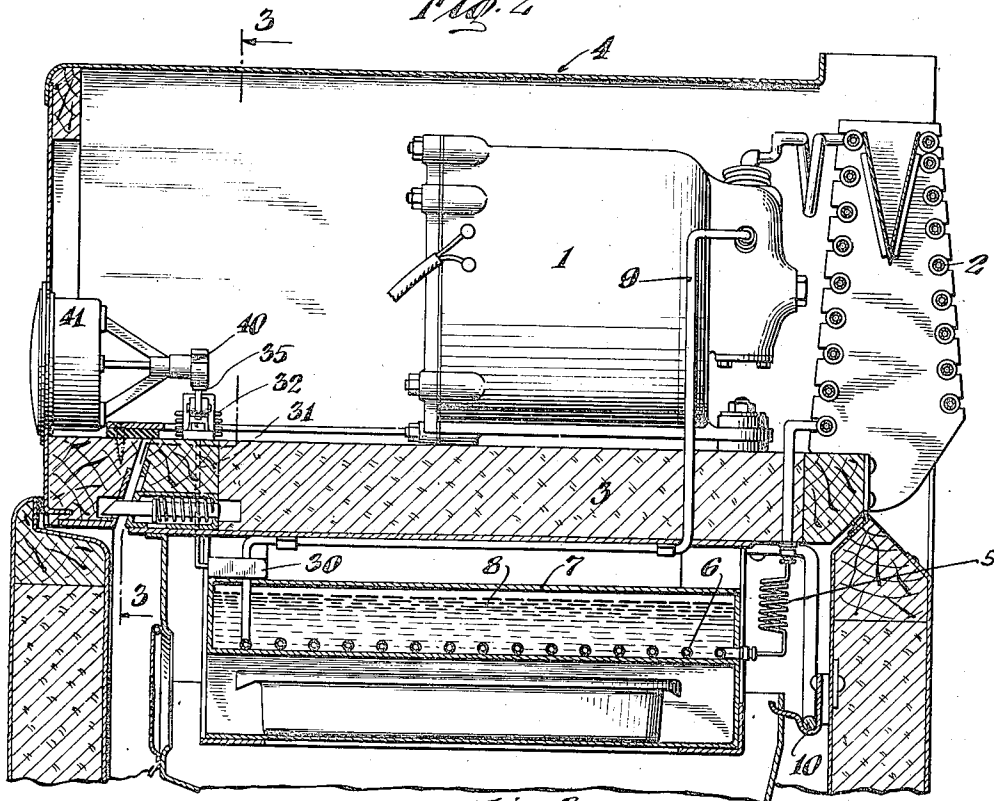
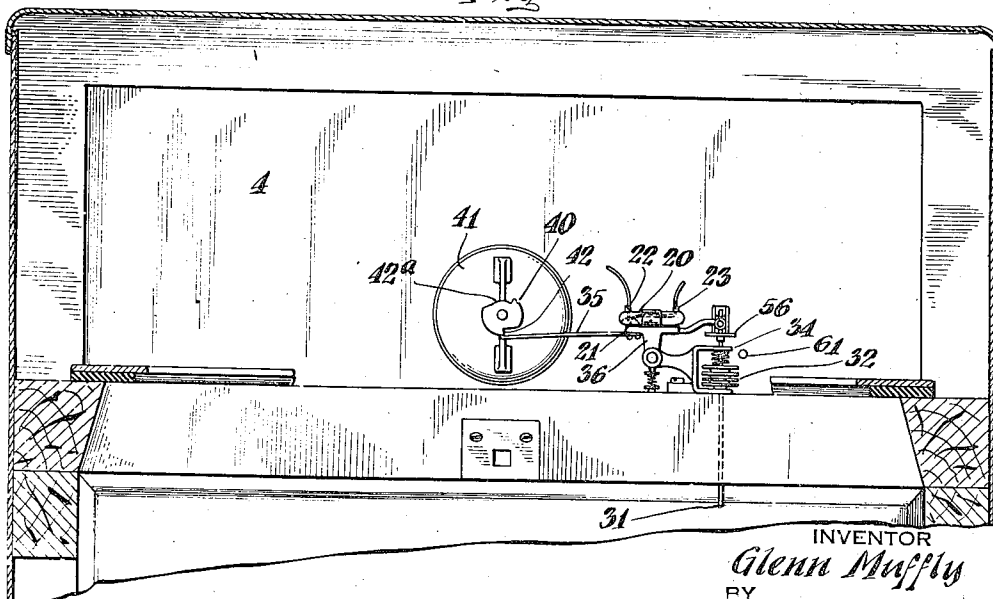


Fig. 3



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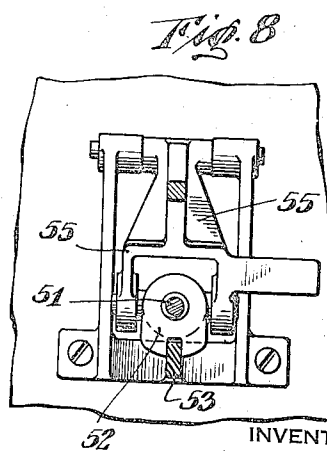
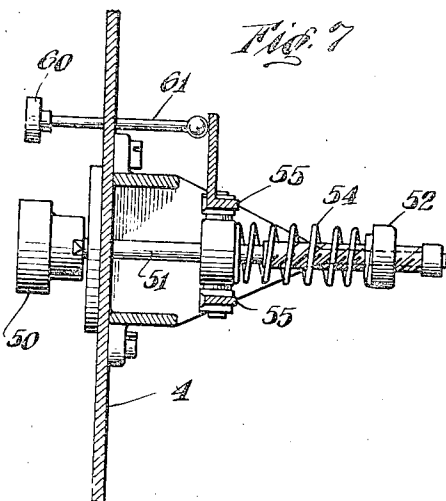
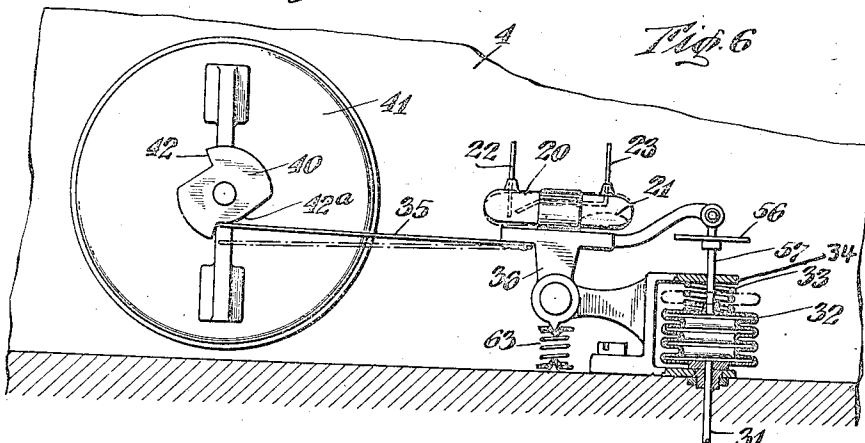
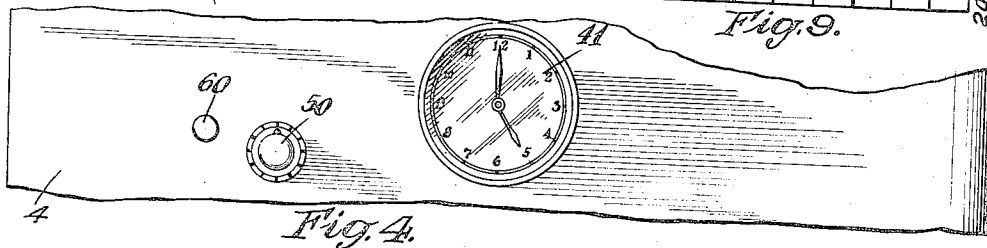
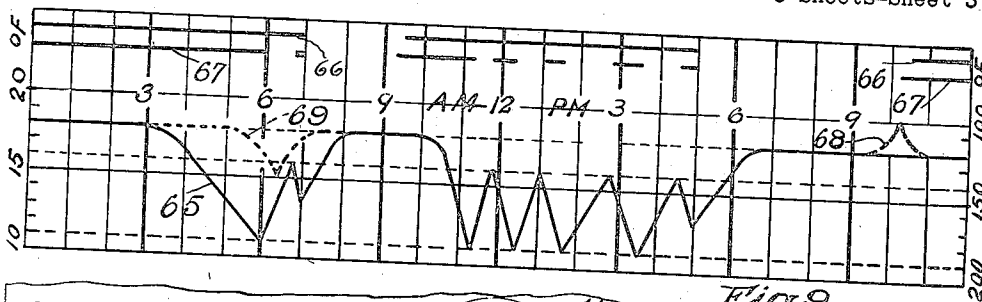
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3 Sheets-Sheet 3



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2,044,482

REFRIGERATION APPARATUS

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Application November 5, 1932, Serial No. 641,352

30 Claims. (Cl. 62-4)

This invention relates to apparatus for the exchange of heat, and relates more particularly to refrigeration systems.

An object of this invention is to provide an "off-peak" refrigerating system embodying certain improvements over the existing art as exemplified in my United States Patent No. 1,787,209, which provides time actuated starting means and thermostatic means for stopping the operation of the system.

This earlier invention of mine was designed to cause a refrigeration system to operate for one long running period each twenty-four hours, storing up refrigeration in the form of ice to last over the remaining major portion of the twenty-four hours.

The present invention is designed to accomplish certain additional desirable results such as provision for continuation of refrigeration at a somewhat higher temperature range in the event of the stoppage of the clock; to provide a definite stopping time just ahead of the desired "off" period so as to more surely escape the peak-load period of the central station; to provide a single adjusting means for the thermostatic control so arranged that the entire range of adjustment is available for manual setting without interior adjustments; and to provide for thermostatic cyclic operation at all times intermediate of the time controlled operation.

In addition, the present invention provides correlated means for insuring the starting of the system prior to the termination of a clock-controlled off period in the event of an unusual temperature rise that requires such earlier starting to insure against the spoilage of materials in storage. It further provides for manual starting of a running period when required to obtain quick freezing without disturbing the adjustment of the control means, thus insuring that after the freezing is finished, the system will automatically return to its normal cyclic operation without the necessity for re-setting the control.

A still further object of this invention is to utilize the greater latent heat absorbing qualities of a frozen eutectic solution in cooperation with the off-peak system and thus maintain a more uniform low temperature during the clock-controlled off periods.

With these and other objects in view I shall describe my invention with reference to the accompanying drawings, in which:

Figure 1 is a plan view of a refrigerator equipped with an electric driven compression type

refrigerating system embodying my new control method;

Fig. 2 is a side elevation of the same cabinet and system shown partially in section;

Fig. 3 is a sectional view of Fig. 2 on the line 3-3, showing a rear view of the control apparatus with the combined thermal, time and manual actuating means;

Fig. 4 is a front elevation of the upper portion of the cabinet;

Fig. 5 is an enlarged detail view of the adjusting mechanism for the control, partially in section, on line 5-5 of Fig. 1;

Fig. 6 is an enlarged detail view of the control mechanism, partially in section, as seen from the rear;

Fig. 7 is an enlarged detail, sectional view of the adjusting mechanism on the line 7-7 of Fig. 5, and

Fig. 8 is a view of the adjusting mechanism as seen from the rear.

Fig. 9 is a graphic representation of operating cycles typical of the operation of a system as illustrated by previous views.

Referring to Fig. 1, the high pressure side of the refrigerating system is seen mounted in a cabinet above the cold storage space. This portion of the system includes the motor-compressor unit 1, the condenser 2, and associated control means mounted on top of the unit base 3, which is removably installed in the cabinet 4, as later described herein.

The refrigerant vapor, such as methyl chloride, is compressed by the unit 1 and passes into the condenser 2 where it is liquefied, and it then passes in liquid form through the pressure reducing device shown in Figure 2 as the capillary tube 5. The liquid refrigerant then passes into the expansion coil 6 within the brine tank 7, where it vaporizes under the effect of heat picked up from the eutectic brine solution 8 contained in the tank 7. There are many eutectic solutions suitable for this use, one being a 23% solution of barium chloride in water.

The refrigerant vapor then returns through the suction tube 9 to the intake of the compressor of unit 1.

The operation of the motor-compressor unit 1 is controlled by the switch 20 which makes and breaks the circuit supplying electric current to it.

The switch 20 may be a mercury bulb, as shown, or any suitable type of switch. As shown in Fig. 3, the switch 20 is in the closed position with a mercury 21 contacting both of the terminals 22 and 23.

The circuit thus closed is normally opened by one of two methods, depending upon which of the activating causes occurs first. The two possibilities are as follows:

1. The bulb 30, which is partially filled with a volatile liquid, such as methyl chloride, is cooled by contact with the brine tank 7, thus causing the vapor pressure of the volatile liquid to fall. This reduces the vapor pressure in the bulb 30, the tube 31 and the metal bellows 32. This reduction of internal pressure allows the bellows 32 to contract under the action of the spring 33 (Fig. 6), which is under compression between the bellows 32 and the bracket 34, and is strong enough to flex the flat spring 35 to a limited degree.

The contraction of the bellows causes a clockwise tilting of the pivoted support 36 which carries the mercury switch 20, thus breaking the circuit and stopping the operation of the motor compressor 1.

2. The cam 40 is constantly driven in a clockwise direction as seen in Fig. 3, preferably at one revolution per twenty-four hours, by means of the clock mechanism 41, which is preferably a conventional electrically operated clock with an extra shaft driven at one-half the speed of the shaft carrying the hour hand. When the cam 40 turns slightly forward from the position shown in Fig. 3, the flat spring 35 will snap upward into the notch 42, thus relieving the flexure of spring 35 to a degree which will allow the spring 33 to compress the bellows 32 and tilt switch 20 to the "off" position, stopping the operation of the system.

The opposite of either of these two causes will start the operation of the system as follows:

1. The expansion of bellows 32 due to a rise of temperature of bulb 30 will compress spring 33 and tilt the switch 20 to the "on" position.
2. The further rotation of cam 40 in the same direction will again flex spring 35 and it will tilt the switch 20 to the "on" position.

It is evident from the above that the reclosing of switch 30 will usually occur under the combined effect of two causes at the end of a time-initiated off period. It is further evident that a proper balance between the two springs 33 and 35 will allow the system to start and stop under thermostatic control during the normal running hours of the day, while the spring 35 is riding on the maximum radius of the cam 40.

It is further evident that correct depths of the cam notches 42 and 42a, and a correct balance between the two springs, will allow the switch 20 to be closed by thermostatic action alone when the spring 35 is in one of the notches. This closing of the switch will occur at a higher temperature of bulb 30 than when the cam is in an "on" position, but this higher temperature starting point may, by proper design, be made to occur before the temperature of the brine tank 7 has risen to a point that endangers the preservation of food or other goods stored in the cabinet.

- The adjustment of this switch control mechanism is accomplished by means of the knob 50 located on the front of the cabinet. Manual turning of the knob rotates the shaft 51 and adjusts the position of nut 52 to which shaft 51 is threaded. Nut 52 is in notched engagement with bracket 53, relative to which it is free to slide but prevented from rotating. A movement of nut 52 toward knob 50 compresses spring 54, which, in turn, acts upon bell crank 55, tending to depress disc 56 on rod 57, which is connected

with the upper (movable) head of bellows 32, thus tending to retard the closing and hasten the opening of switch 20.

It is evident that the adjustment of knob 50 will thus serve to set the mechanism to start at any desired temperature within the range of the design. Former devices have two adjustments, one at the thermostat inside of the cabinet, this adjustment being more or less a fixed one, set at the factory or by the service man, and the other on the exterior of the cabinet, to be adjusted by the housewife to vary cooling rates; this second adjustment serving to vary the adjustment of the thermostat, already under adjustment restraint. According to this invention, one adjustment control on the exterior of the cabinet suffices for all adjustments. The service man makes the preliminary adjustments by turning knob 50, one or more times, to properly bias the thermostat. The housewife then turns the knob 20 additionally to vary the cooling rate.

The unit base 3 supports the brine tank 7 as well as the parts mounted on its upper side, hence the entire refrigerating system is removable from the cabinet by hinging downward about the pivot point 10.

This hinging of the system assembly carries the disc 56 and the spring 35 downward away from the bell crank 55 and the cam 40, thus automatically disconnecting the mechanical parts on the system assembly from the mechanical parts on the cabinet assembly. The disconnecting of the electrical circuit between the cabinet and the system may be accomplished with a plug and socket connection as indicated or by any suitable automatic means.

On the face of the cabinet, back of knob 50, is a dial plate 50c on which suitable graduations may be provided to indicate the position of knob 50. Fig. 5 shows the detail of attachment of knob 50 to shaft 51 by means of the set screw 50d, co-acting with the groove 50b in shaft 51. After a satisfactory adjustment of nut 52 on shaft 51 has been obtained, a convenient setting of knob 50 may be made by means of set screw 50d so that the graduations on plate 50c will thereafter have a definite significance.

An additional provision is made for the manual starting of the system when it is desired to cause it to start ahead of its normal thermal cycle without resorting to the adjustment of knob 50. An occasion for such starting would be when the housewife has filled an ice tray with material to be frozen and she desires the freezing operation to start at once, but she does not wish to alter the adjustment of the control for fear she might forget to set it back to its normal position. Under such conditions, she can start the operation of the system by pushing on button 60 which acts through rod 61 to move bell crank 55 counter-clockwise (Fig. 5), causing its lower fork 62 to push upward on disc 56 and tilt switch 20 to its closed position. If desired, a toggle spring 63, or its equivalent, may be added to the assembly, as shown in Fig. 6, to give the switch 20 a "snapover" action, which will insure that the switch will remain in the closed position for a time after the button 60 is depressed. Practice has shown that when a control switch is snapped on by an external force such as this, coincident with the placing of material to be frozen in the evaporator, the system usually continues to run until the material is frozen, after which there is no further need for an extra cold setting of the control.

A study of the foregoing description reveals the fact that this system will operate to stop at a definite time. The use of an eutectic freezing solution in the brine tank insures that the normal thermal cycles will be of considerable duration, both as to their "off" and their "on" portions. It is, therefore, obvious that when the system has been definitely stopped by the sudden change of spring tension, due to spring 35 dropping into notch 42 or 42a, it will remain stopped for a considerable period. This period is normally long enough to bridge over the peak-load period of any power plant supplying a residential district. The cam 40 is provided with one or more notches 42, 42a, etc., as required for a given location on a power line.

The regular clock actuated stopping of the system at one or more pre-selected times each day, provides a very desirable type of load from the power company's standpoint, yet the user is privileged, when occasion arises, to cause the system to operate during any normally off period.

In my Patent No. 1,787,209 covering off-peak types of refrigerating systems, I have provided for a clock-driven switch to insure the starting of a refrigerating system at definite times, but in this application I have added several improvements, among which is the means for insuring the automatic starting of the system during an off period of the clock mechanism whenever this automatic starting is made desirable by an unusual thermal condition.

A graphic representation of cycles of operating resulting from the use of the apparatus herein described will be seen in Fig. 9, where time is plotted horizontally and temperatures vertically. For temperatures applicable to refrigeration the scale at the left will serve to identify the temperatures represented by the horizontal lines while the time in hours of the day is marked at three hour intervals with a vertical line for each hour.

The curve made by solid line 65 shows temperature in that part of the system containing the freezing solution, or in other words the temperatures affecting the thermostatic control. The heavy horizontal line 66 is broken during two periods of time to represent the periods during which spring 35 is in one of the notches 42 and 42a. The heavy horizontal line 67 is broken to represent periods of time during which the switch 20 is actually open and the system idle. It will be noted that in general the line 65 is falling while the system is operating and is rising while the system is idle, but there are important exceptions to this rule which result from the previously described features in the construction of this type of system.

Starting at midnight at the left end of the chart we can follow the solid line 65 which stays on the 18 degree line for three hours and then breaks away gradually at three A. M. and then falls quite rapidly to the 11 degree line, which it reaches at six A. M. This indicates that the temperature is at first constant while the system is in operation as indicated by line 67. The refrigerating effect is being absorbed in the main by the freezing solution which is now being frozen. This line would be falling more or less rapidly if the material being frozen were other than a eutectic, but a peculiarity of eutectics is that they freeze and melt at substantially constant temperatures, a particular temperature or narrow range of temperatures for each eutectic solution. In this case we are assuming the use

of a eutectic solution such as the one mentioned earlier herein, which has a freezing and melting temperature (eutectic point) of 18 degrees F.

The pull-down of temperature after three A. M. is the result of refrigeration being continued after the eutectic freezing solution had finished freezing at three A. M. This drop of temperature affects the control bulb 30 (Fig. 2) and through it the switch 20, which opens at six A. M., as indicated by the break in the line 67 and by the fact that line 65 has stopped falling and starts up again.

This graph assumes that the standard temperature setting of the thermostat seen in Fig. 8 is to cut out at 11 degrees F. and in at 16 degrees F. We, therefore, see that the switch 20 was opened thermostatically at 11 degrees, which temperature is shown as having been reached at six A. M. The temperature of the freezing solution 8 and tank 7, being without artificial refrigeration, rises along the curve 65 until about 6:45 A. M., at which time the "cut-in" temperature of 16 degrees is attained and the switch recloses.

The running period thus initiated starts pulling the temperature down again, but this pull-down is arrested at seven A. M. when the spring 35 snaps into the notch 42 (the smaller notch on cam 40). The temperature now rises above the 16 degree line where the system was restarted for its last previous run, because the setting of the thermostat has been modified by the change in deflection of spring 35. This change is here assumed to be such that the switch will close at approximately 20 degrees and open at 15 degrees. The rise of temperature is, however, arrested by the cryohydrate (frozen eutectic solution) at the eutectic temperature of 18 degrees and the temperature will remain nearly constant at about this point for several hours if nothing interferes.

At about 9:25 A. M. the cam 40 will have moved the cut-in temperature of the control down to the 18 degree line and the switch will be closed, restarting the system as indicated by the line 67. The temperature indicated by line 65 does not begin to fall at once, as some of the eutectic solution has been melted and this must be refrozen before the temperature will drop appreciably. It does start to drop at about ten A. M., after the cam has restored the original adjustment of the thermostat, and hence it falls all of the way to the 11 degree line before cutting out thermostatically at about 11:15 A. M.

The cycles indicated by lines 65 and 67 between this time and 5 P. M. are normal thermostatic cycles such as are common to many types of refrigerating systems operating under thermostatic control, but it will be noted that these cycles occur in a range entirely below the 18 degree eutectic line. This means that none of the eutectic solution has melted.

At five P. M. the spring 35 snaps into notch 42a of cam 40 and since the temperature, as indicated by line 65, is at this moment below the 15 degree line (cut-out temperature of the modified setting of the thermostat) the thermostatic switch 20 opens at once and the system stops. The temperature rises to the 18 degree eutectic point and stays substantially constant for several hours while the machine is idle, restarting shortly after ten P. M., slightly ahead of the full restoration to normal setting as it did at 9:25 in the morning. As the machine has been idle for several hours it will now take sev-

eral hours to catch up and refreeze all of the eutectic solution, which it will do by about three A. M. as shown at the beginning of the chart.

In the event that a severe load were placed in the refrigerator between five and ten P. M. in the form of an extra amount of warm food, the requirement to freeze a dessert, leaving the door open, or a severe rise of room temperature, the eutectic solution might be fully melted before the cam restores the normal adjustment. In such an event the temperature will rise above the 18 degree eutectic point on a curve such as that indicated by the heavy dotted line 68. This rise will cause the thermostat to reclose at 20 degrees or slightly lower, depending upon how far the cam has moved in restoring the standard setting of the control.

In case the clock 41 accidentally stops immediately after the spring 35 has snapped into one of the notches the system will stand idle until all or practically all of the eutectic solution has melted and the temperature rises to 20 degrees, at which point the control will cut in and restart the system regardless of the idle clock. In this case and with no abnormal load on the refrigerator the upward curve 68 will start later than shown, but in time to save the materials stored in the refrigerator from spoilage.

In the event of a stopped clock with the spring 35 resting at the bottom of one of the notches in cam 40 the machine will run in long cycles, stopping at 15 degrees after a short pull-down as indicated by heavy dotted line 69, warming up to the eutectic line and following it for several idle hours, then warming up quickly to 20 degrees as shown by line 68, and then restarting to pull down quickly to 20 degrees for a long freezing period of the eutectic and another short pull-down to the 15 degree cut-out temperature. The emergency cycles just described are similar to those ordinarily experienced with a system employing a simple thermostatic control and a eutectic freezing solution for holdover. The cycles shown by line 65 from eleven A. M. to five P. M. are similar to those ordinarily experienced with a system employing a non-freezing brine for hold-over.

This system has two types of cycles, the compound cycle shown for twenty-four hours by line 65 and the emergency simple long cycle indicated by the dotted lines 68 and 69 as above described. This system of latent heat hold-over and automatic control may be described with reference to heating instead of to refrigeration by reference to the scale of temperatures shown at the right of Fig. 9 and taking the upwardly inclined portions of the curve 65 as the operating periods. The melting temperature of the material used for heat storage will in this case be about 120 degrees instead of 18 degrees and the reserve will be latent heat of the liquid instead of the latent heat absorbing capacity of the solid freezing solution.

While the invention has been illustrated in a heat exchange system for the withdrawal of heat, it is believed to be obvious that the principles apply equally to the addition of heat in a heat exchange system.

Whereas one or more embodiments of the invention have been described for the purpose of illustration, it should be understood that many modifications may be made by those skilled in the art without departing from the spirit of the invention.

What I claim is:

1. In a refrigerating system, an evaporator having associated therewith a quantity of eutectic solution, thermostatic means controlling the starting and stopping of said system at maximum and minimum temperatures falling respectively above and below the freezing point of said solution, time controlled means for stopping said system, and means acting under the combined influence of said thermostatic means and said time controlled means for restarting said system at the end of the idle period initiated by said time controlled means.

2. In a refrigerating system, temperature-responsive means for starting the operation of said system when a predetermined maximum temperature is reached, and time-controlled means for periodically effecting a substantial change upward of said maximum temperature as controlled by said temperature responsive means and for automatically restoring the original maximum temperature setting of said temperature-responsive means after the lapse of a fixed period of time.

3. In a refrigerating system, temperature-responsive means for starting the operation of said system when a predetermined maximum temperature is reached, and time-controlled means for periodically effecting a substantial change upward of the maximum temperature at which said temperature responsive means will start said operation and for gradually restoring the original maximum temperature setting of said temperature responsive means during the lapse of a fixed period of time.

4. In a refrigerating system, thermostatic means for controlling the starting and stopping of said system at definite maximum and minimum temperatures, and time-controlled means acting periodically over predetermined lengths of time to vary the temperatures of said system at which cyclic operations of said system are controlled by said thermostatic means.

5. In a refrigerating system, a condensing unit, an evaporator having associated therewith a quantity of freezing solution having its eutectic point within the operating range of temperatures of said system, thermostatic means for controlling the starting and stopping of said system at definite maximum and minimum temperatures, and time-controlled means acting periodically over predetermined lengths of time to modify the maximum and minimum temperatures at which the thermostatic cyclic operation of said system is controlled.

6. A refrigerating system comprising a condensing unit, an evaporating unit, and a thermostatic control for starting and stopping the operation of said system, said evaporating unit having associated therewith a quantity of eutectic freezing solution so arranged with respect to the evaporating unit that the freezing of said solution will occur progressively from the bottom upward, said thermostatic control being arranged to stop the operation of said system in response to a drop of temperature near the top of said eutectic freezing solution, time-controlled means for stopping said system, and means acting under the combined influence of said thermostatic means and said time-controlled means for re-starting said system at the end of the idle period initiated by said time-controlled means.

7. In a refrigerating system, a condensing unit, an evaporator having associated therewith a quantity of freezing solution having its eutectic point within the operating range of temperatures

of said evaporator and temperature-responsive means for starting the operation of said system when a predetermined maximum temperature is reached, and time-controlled means for periodically effecting a substantial change upward of said maximum temperature and for restoring the original maximum temperature setting of said temperature-responsive means after the lapse of a fixed period of time.

8. A refrigerating system, temperature-responsive means for starting the operation of said system when a predetermined maximum temperature is reached and for stopping said system when a predetermined minimum temperature is reached, and time-controlled means for periodically acting upon said temperature responsive means to effect a substantial change upward of said maximum and minimum temperatures controlled thereby and for restoring the original temperatures of operation of said temperature responsive means after the lapse of a fixed period of time.

9. In a refrigerating system, a condensing unit, an evaporator having associated therewith a quantity of freezing solution having its eutectic point within the operating range of temperatures of said evaporator, temperature-responsive means for starting the operation of said system when a predetermined maximum temperature is reached and for stopping said system when a predetermined minimum temperature is reached, and time-controlled means for periodically acting upon said temperature responsive means to effect a substantial change upward of said maximum and minimum temperatures controlled thereby and for establishing normal temperatures of operation of said temperature-responsive means after the lapse of a fixed period of time.

10. In a refrigerating system operated from a source of electrical energy, latent heat storage means comprising material which has a melting range substantially below that of water and arranged to cause said system to start and stop within temperature limits such that a substantial portion of said heat storage material will remain frozen, and other control means arranged to periodically cause said system to remain idle while a greater portion of said heat storage material than is normally melted during the thermostatically controlled cycles melts.

11. In a refrigerating system, latent heat storage means comprising material having a melting range substantially below that of water and arranged to be refrigerated by said system, control means arranged to cause said system to start and stop within temperature limits such that a substantial portion of said heat storage material will remain frozen during such cycling of said system, and secondary control means arranged to periodically effect a change in the cycling of said system and cause it to remain idle while a greater-than-normal portion of said heat storage material melts.

12. In a refrigerating system, in combination, an evaporator, a compressor, a motor for driving said compressor, thermostatic means responsive to variations of temperature in said system for controlling the starting and stopping of said motor, and means operable at predetermined intervals of time for alternately varying the maximum and minimum temperatures in said system at which said motor is started and stopped as induced by said evaporator and as otherwise controlled by said thermostatic means.

13. In a refrigerating system, in combination,

an evaporator, a compressor, a motor for driving said compressor, means operable at predetermined time intervals to alternately stop and start said motor for the purpose of normally maintaining the temperature of said system as induced by said evaporator between predetermined maximum and minimum values, and means responsive to temperature variations in said system for starting said motor regardless of the operative position of the first mentioned means when said predetermined maximum value is materially exceeded and for stopping said motor regardless of the operative position of said first mentioned means when said predetermined minimum value is materially lowered.

14. In a refrigerating system, a condensing unit, an evaporator having associated therewith a quantity of freezing solution having its eutectic point within the operating range of temperatures of said evaporator, time controlled means for automatically starting and stopping the operation of said system, and means responsive to operative conditions of said system for stopping and starting operation of said system independently of said time controlled means between the time controlled idle periods and within temperature limits below a temperature at which a major portion of said freezing solution will have melted.

15. In a refrigerating system, a condensing unit, a cooling unit, a quantity of freezable material contained in said cooling unit, thermostatic control means designed to stop said condensing unit when a large percentage of said freezable material is frozen and to restart said condensing unit in response to a relatively small rise of temperature, time controlled means for causing said condensing unit to stop at a predetermined time and to remain idle until a greater temperature rise has taken place, such greater temperature rise being sufficient to melt a greater portion of said freezable material than is melted during the above mentioned relatively small rise of temperature, and means for automatically starting said condensing after the same has been stopped by said time controlled means.

16. In a refrigerating system, a condensing unit, a cooling unit, a quantity of material having its freezing temperature range below 32 degrees F. permanently contained in said cooling unit, thermostatic control means designed to stop said condensing unit when substantially all of said freezable material is frozen and to restart said condensing unit in response to a relatively small rise of temperature, and time controlled means for causing said condensing unit to stop at a predetermined time and to remain idle until automatically started when a greater temperature rise has occurred, such greater temperature rise being sufficient to allow a substantial portion of said freezable material to melt but not so great as to allow said material to warm up to a temperature higher than ten degrees F. above its melting temperature.

17. In a refrigerating system, a condensing unit, a cooling unit, a quantity of material having its freezing temperature below 32 degrees F. contained in said cooling unit, thermostatic control means designed to stop said condensing unit when the said material is substantially all frozen and to restart the condensing unit in response to a relatively small rise of temperature of said material, and time controlled means for causing said condensing unit to stop at a substantially predetermined time regardless of how long it has been running and to prevent it from starting at

such time if it is idle and in either case to cause it to temporarily remain until a greater temperature rise than normal has taken place, such greater temperature rise being sufficient to melt a greater portion of said material than is melted during such an idle period as first described and being terminated by the combined action of said thermostatic means and said time controlled means.

18. In a refrigerating system, a condensing unit, a thermostat, and time controlled means for causing the condensing unit to remain idle from a predetermined time until it is started by said thermostat, the thermostat being capable of starting said unit in response to a maximum temperature rise in the event of failure of said time controlled means and of starting said unit at progressively lesser temperature rises as said time controlled means restores the original starting temperature adjustment of said thermostat.

19. In a refrigerating system, an evaporator, a condensing unit, a thermostat, a container of freezing material associated with said evaporator in a manner to be frozen thereby in a temperature range below 32 degrees F., and time controlled means interconnected with said thermostat for causing said system to remain idle during a period of time starting at a substantially definite predetermined time in the twenty-four hours of a day and ending when the said period of time has elapsed, the interconnection between said time controlled means and said thermostat being so constructed and arranged that in the event of a failure of said time controlled means or in the event of an abnormal rise of temperature during said period of time said thermostat will start the system at a temperature which is reached after substantially all of said freezing material has melted, said temperature being higher than the usual starting temperature at which said thermostat will normally start the system and said usual starting temperature being such that the start occurs when a substantial portion of said freezing material is still frozen.

20. In a refrigerating system, a condensing unit, an evaporator having associated therewith a quantity of material having its freezing temperature within the operating range of said evaporator and lower than 32 degrees F., thermostatic means for starting and stopping said system, and time controlled means for modifying the cycles produced by said thermostatic means so constructed and arranged that during a certain period of time the thermostatic means will be caused to operate within temperature limits that maintain said freezing material in a substantially frozen condition and during another period of time said thermostatic means will operate to allow said system to remain idle until a large part of said freezing material has melted.

21. In a refrigerating system, an evaporator, a condensing unit, automatic control means for starting and stopping said condensing unit, a quantity of material having a freezing range below 32 degrees F. associated with said evaporator in such manner that it will be substantially frozen at the lowest stopping point of said automatic control means, said control means comprising temperature responsive means and time controlled means for modifying the temperature range of the temperature responsive means, said control means being so constructed and arranged that during certain periods of time the system will operate on thermostatic cycles that

keep a substantial portion of said freezing material frozen and at other times the system will not be started until a considerable portion of said freezing material has melted.

22. In a refrigerating system, a condensing unit, an evaporator, a quantity of material associated with said evaporator and capable of being frozen by the operation of said system within a range of freezing temperatures below 32 degrees F., thermostatic means for starting said system at a maximum temperature attained when substantially all of said material is melted and stopping said system at a lower temperature, and time controlled means cooperating with said thermostatic means for modifying the action thereof so that the starting will occur at a temperature which insures that a substantial portion of said material is still frozen and the stopping will occur at a temperature below the last mentioned temperature.

23. In a refrigerating system, in combination, a condensing unit, an evaporator unit, a quantity of freezable material associated in heat exchange relation with said evaporator unit, thermostatic control means so constructed and arranged that it starts said condensing unit at a temperature above the freezing range of said freezable material and stops said condensing unit at a temperature below the freezing range of said freezable material and other means operatively connected with the said thermostatic control means so constructed and arranged as to periodically act upon said control means to change the temperature responsiveness of the thermostatic control means to cause it to start said condensing unit at a temperature below the freezing range of said freezable material and to stop it at a lower temperature.

24. In combination, a refrigerating system, control means for starting and stopping the operation of said system, and control actuating means operative to actuate said control means in response to a resultant of two forces, one of said forces being time-actuated and the other of said forces being dependent upon temperature changes.

25. A refrigerating system, a freezable material adapted to be frozen by said system, control means normally causing cyclic operation of said system between temperature limits which prevent the melting of any major portion of said freezable material, and means acting in conjunction with said control means to cause said system to operate cyclically during pre-selected periods of each day between temperature limits which allow a major portion of said freezable material to melt and freeze during each cycle.

26. In a refrigerating system, a condensing unit, an evaporating unit, a quantity of freezable material associated with said evaporating unit, thermostatic control means for said system, normally causing said system to operate between one set of temperature limits and time controlled means for modifying the cycles of said system as controlled by said thermostatic control means to cause said system to operate within different temperature limits during pre-selected periods of each day, one set of temperature limits having its upper limit above and its lower limit below a temperature range in which a major portion of said freezable material freezes and melts.

27. In a refrigerating system, latent heat storage means comprising material which has a melting range substantially below that of water, control means arranged to cause said system to

start and stop within temperature limits such that a substantial portion of said heat storage material remains frozen during such cycling of said system, and other control means arranged to cause said system to remain inoperative during certain periods of each day until a greater-than-normal portion of said heat storage material has melted and then to start.

28. In a refrigerating system, latent heat storage means, thermostatic means for starting and stopping said system within a temperature range outside of the temperature range in which said latent heat storage means absorbs or releases a major portion of its latent heat, and automatic means modifying a temperature adjustment of said thermostatic means during certain periods of each day.

29. In a refrigerating system, thermostatic means for starting and stopping said system, and automatically actuated means for effecting a temperature adjustment of said thermostatic means during pre-selected periods of each day.

30. In a refrigerating system, an evaporating unit, a condensing unit, a quantity of material freezable within a temperature range below 32 degrees F. associated with said evaporating unit so as to be capable of being frozen thereby, thermostatic means for controlling the operation of said system between pre-selected temperature limits, and means for changing one of said temperature limits during pre-selected periods of each day.

GLENN MUFFLY,