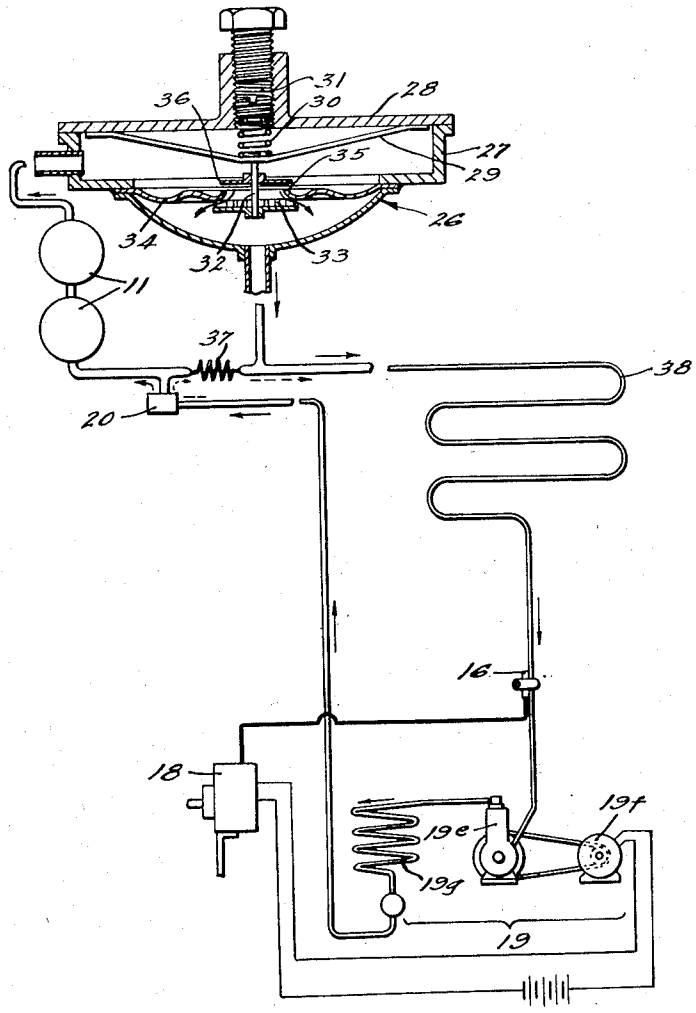
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TWO-TEMPERATURE REFRIGERATION CONTROL

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TWO-TEMPERATURE REFRIGERATION CONTROL

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Application January 23, 1939, Serial No. 252,291, now Patent No. 2,407,794, dated September 17, 1946, which is a division of application Serial No. 697,124, November 8, 1933, now Patent No. 2,145,773, dated January 31, 1939. Divided and this application November 15, 1945, Serial No. 628,887

11 Claims. (Cl. 62—4)

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This application is a division of co-pending application Serial No. 252,291 filed January 23, 1939, now Patent No. 2,407,794 issued September 17, 1946, which is a division of application Serial No. 697,124, filed November 8, 1933, now Patent No. 2,145,773 issued January 31, 1939.

This invention relates to mechanical refrigerators, and the claims of the original application are particularly directed to methods and apparatus for freezing ice, and more particularly to methods and apparatus for causing the ice to free itself from the surface upon which it has been frozen in order that more ice may be frozen upon the same surface while the first formed ice is stored for later use.

One of the objects of this invention is to selectively refrigerate one or more evaporators of a two temperature system.

Another object is the provision of diversion of the refrigerant path in response to temperature conditions.

The above being among the objects of the present invention, the same consists in certain novel features of construction, combinations of parts and steps of operation that will hereinafter be described with reference to the accompanying drawing, and then claimed, having the above and other objects in view.

In the accompanying drawing which illustrates one embodiment of the present invention, the valve mechanism is shown in section and other parts diagrammatically.

Any suitable type of refrigerating mechanism having suitable cyclic operation and having any suitable type of refrigerant flow controlling device may, of course, be adapted for use in connection with the present invention, the particular mechanism shown more or less diagrammatically at 19 including a compressor 19e driven by a suitable electric motor 19f and discharging refrigerant therefrom to a condensor 19g from which it is conveyed to an expansion valve 20 which discharges the refrigerant therefrom to one or both of the evaporators 11 and 38 after being gasified the refrigerant is returned to the suction side of the compressor 19e.

Any suitable or conventional type of control mechanism may be provided for controlling the operation of the motor 19f. The particular control indicated diagrammatically is of the thermostatic type including a control bulb 16 secured in contact with the tube 38 so as to prevent frosting of the suction line, a control switch indicated diagrammatically at 18 and controlled thereby and connected in series with

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the motor 19f and a suitable source of electrical energy.

A special thermostatic valve 26 in the passage leading from the evaporator 11 acts to stop and start refrigeration of evaporator 11 only without depending upon cyclic operation of the condensing unit. This valve includes a casing 27 having a cover 28. Intermediate the ends of the casing 27 a centrally apertured bowed diaphragm 34 is sealed at its edges to the casing 27 so as to divide its interior into two compartments. The diaphragm 34 is of metal and being bowed has the characteristic that when flexed over its central plane tends to snap into bowed position on the other side thereof. The marginal edges of the central aperture in the diaphragm 34 are bent upwardly to form a valve seat 35 and positioned above the valve seat 35 is a valve element 36 which is fixed and sealed to a pin 32 extending centrally through the central aperture in the diaphragm 34. Below the diaphragm the pin 32 has secured thereto a serrated crown stop 33 which will permit flow of refrigerant between it and the diaphragm 34 even though they are in contact with each other.

Although any suitable temperature responsive element such as a bellows, bi-metallic element or the like may be employed to operate the valve 35, as a matter of illustration only I have shown a strap 29 formed of a material having a high coefficient of expansion, such as zinc, secured at its opposite ends to the cover 28 and at its center to the pin 32. The cap 28 is provided with an upstanding central tubular boss in which is threadably received a plug 31 between which and the strap 29 adjacent the upper end of the pin 32 a coil spring 30 is maintained under compression, the force of which may be varied by adjusting the plug 31. With this construction the liquid refrigerant from the expansion valve 20 is divided, one part thereof passing through the evaporator 11 and discharging therefrom into the valve above the diaphragm 34, while the remainder of the refrigerant from the expansion valve may pass through a coil such as 37 to the tube 38. The interior of the valve 26 below the diaphragm 34 is connected to the suction tube 38 beyond the coil 37. The coil 37 is formed of a tube having a small capillary passage designed to restrict the flow of vapor, while allowing the desired amount of liquid refrigerant to pass through it. In addition there is some additional evaporator surface associated with the tube 38.

Assuming the valve to be in the position indicated and the refrigerating mechanism as be-

ing active, liquid refrigerant from the expansion valve 20 will flow through the evaporator 11 and into the upper end of the valve 26 and then between the valve 36 and the valve seat 35 into the lower part of the casing 27 and then to the tube 38, causing evaporators 11 and 38 to be refrigerated. Under such conditions as the refrigeration of 11 proceeds the refrigerant flowing into the valve 26 will become colder, causing the strap 29 to contract against the force of the spring 30 until such time as the pin 32 and consequently the stop member 33 will have been raised sufficiently to cause the diaphragm 34 to snap upwardly into contact with the valve 36 and thereby shut off the flow of refrigerant through the valve 26 and evaporator 11. As soon as this occurs all of the refrigerant flowing through the expansion valve 20 will be forced through the coil 37 to the tube 38 and, accordingly, the evaporation of refrigerant in 11 will stop. During this period the thermally responsive strap 29 will expand, due to the rise of temperature, and the valve 36 will push downwardly on its seat 35 under the force of spring 30. This force exerted upon the diaphragm 34 will increase gradually under the rising temperature within the space above the diaphragm 34 until the diaphragm snaps downwardly, opening the valve and reestablishing the process of refrigerating the evaporator 11.

The refrigerant has but one path back to the condensing unit while the valve 36 is closed, but when it is open the refrigerant flows through two paths that are connected in parallel.

Formal changes may be made in the specific embodiment of the invention described without departing from the spirit or substance of the broad invention, the scope of which is commensurate with the appended claims.

What I claim is:

1. In a refrigerating system, two evaporators, liquid flow means including a pressure reducing device of the vapor-lock type and another pressure reducing device, connecting means for series flow of refrigerant liquid through both said devices to one of said evaporators, connecting means for flow of refrigerant liquid to the other of said evaporators through one only of said devices, thereby producing less than the total pressure reducing effect of the two said devices, and a thermally actuated valve for regulating the flow of refrigerant to limit operation of one of said evaporators and to simultaneously cause an increased flow of liquid refrigerant to the other of said evaporators.

2. In a refrigerating system, a pair of evaporators connected in said system, first and second liquid flow control devices providing two steps of pressure reduction in series, conduits associated with said controlling devices to feed liquid refrigerant to one of said evaporators at a relatively high evaporating pressure through one of said devices and to the other at a relatively lower pressure through both of said devices, one of said devices comprising a vapor-lock restrictor, unitary flow-shifting device for shifting cooling effect from one of said evaporators to the other by reducing refrigerant evaporation in one and increasing refrigerant evaporation in the other, a thermostatic control device responsive to a temperature effect associated with one of said evaporators to actuate said flow-shifting device, and a control device responsive to a temperature change associated with the other evaporator for stopping said system.

3. In a refrigerating apparatus, a plurality of evaporators, first and second refrigerant liquid control devices providing two steps of pressure reduction, one of said steps being effected by a device forming a constantly open passage of restricted diameter in proportion to its length, and a flow-shifting device for diverting refrigerant liquid flow relative to the device providing one of said steps of pressure reduction, said shifting device being so constructed and arranged as to cause an evaporator already cooled by refrigerant flowing through only one of said steps to continue operation with refrigerant liquid flowing to it through both said steps of pressure reduction.

4. In a refrigerating system charged with a volatile refrigerant, two evaporators, refrigerant pressure reducing means including two sections, at least one of said sections comprising means forming a constantly open passage of small diameter, means connecting a first of said evaporators to receive liquid refrigerant through both said sections, means connecting a second of said evaporators to receive liquid refrigerant through one only of said sections, and a control device energized in response to changes of temperature to provide at one time for cooling of both said evaporators with refrigerant liquid flowing through one only of said pressure reducing sections and mostly evaporating in one of said evaporators and to provide at another time for cooling the other of said evaporators with refrigerant liquid flowing through the other of said pressure reducing sections and mostly evaporating in the last said other evaporator.

5. In a refrigerating system charged with a volatile refrigerant, refrigerant pressure reducing means including two sections, at least one of said sections comprising means forming a constantly open passage of small diameter, an evaporator connected to receive liquid refrigerant through both said sections, another evaporator connected to be supplied with liquid refrigerant through only one of said sections, means energized by a change of temperature for substantially stopping the evaporation of refrigerant in one of said evaporators and increasing the flow of liquid refrigerant to the other said evaporator, and means responsive to another change of temperature for controlling said system.

6. In a refrigerating system employing a volatile refrigerant, a condensing unit, an expansion device for reducing the pressure of said refrigerant liquid to allow it to evaporate, a second expansion device for reducing refrigerant pressure to a lower point for evaporation at a lower temperature, a first evaporator connected to receive liquid refrigerant from the first said device, a second evaporator connected to receive liquid refrigerant from the second said device and also connected in series with the first said evaporator, a control mechanism for substantially stopping the evaporative effect produced in the first said evaporator during operation of said condensing unit, and means for supplying energy to actuate said control mechanism in response to a change of temperature, said system and control mechanism being so constructed and arranged as to cause an increase in the flow of liquid refrigerant to the second of said evaporators simultaneously with the stopping of said evaporative effect in the first said evaporator and thereby cause the second said evaporator to become more active.

7. The method of cooling an evaporator by

selectively feeding a volatile refrigerant to it during one period of time with a considerable proportion of the refrigerant in its vapor phase, thus producing a limited cooling effect in the evaporator, and during another period of time modifying the path and thereby the restriction of refrigerant flow to said evaporator in response to a temperature change to increase the percentage of refrigerant entering the evaporator in its liquid phase and thereby the rate of evaporation and temperature of evaporation in the evaporator, employing the vapor-lock method to regulate refrigerant flow to the evaporator during at least one of said periods, withdrawing refrigerant vapor from said evaporator, condensing it and returning it to repeat the circuit, which circuit is confined to a pair of alternative paths of flow.

8. In a refrigerating system employing a volatile refrigerant, a pressure imposing element, a condenser, first and second pressure reducing devices connected in series, one of said devices being of the vapor-lock type, an evaporator connected to receive liquid refrigerant after flowing through both of said reducing devices, a branch outlet connection for refrigerant leading from the first of said pressure reducing devices, another evaporator connected to receive liquid refrigerant from said outlet after it has passed through the first one only of said pressure reducing devices, and means for controlling refrigerant flow through the last said evaporator, said pressure imposing element being connected to withdraw vaporized refrigerant from both said evaporators.

9. In a refrigerating system employing a volatile refrigerant, a pressure imposing element, a condenser, first and second pressure reducing devices connected in series, an evaporator connected to receive liquid refrigerant after flowing through both of said reducing devices, a branch outlet connection for refrigerant leading from the first of said pressure reducing devices, another evaporator connected to receive liquid refrigerant from said outlet after it has passed through the first one only of said pressure reducing devices, and means for controlling refrigerant flow through the last said evaporator.

10. In a refrigerating system charged with a volatile refrigerant, a pressure imposing element, a condenser, liquid refrigerant control apparatus providing two stages of pressure reduction, a pair of evaporators, refrigerant conduits for by-passing one of said evaporators and feeding the other evaporator with liquid refrigerant through both said stages of pressure reduction and alternatively for by-passing one of said stages of pressure reduction and feeding both of said evaporators through only one stage of pressure reduction, and a valve arranged to open and close a port in one of said conduits to control the operation of one of said evaporators in response to temperature changes.

11. In a refrigerating system employing a volatile refrigerant, two evaporators connected in series, a first pressure reducing device arranged to feed liquid refrigerant to the first of said evaporators at a moderate evaporating pressure, a conduit leading from the first said pressure reducing device and forming a by-pass around said first evaporator, a second pressure reducing device in said by-pass arranged to feed the second of said evaporators at a lower evaporating pressure, a valve arranged to stop flow through one of said evaporators while the other continues to operate, and thermally responsive means for supplying energy to actuate said valve.

GLENN MUFFLY.

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Certificate of Correction

Patent No. 2,565,145 August 21, 1951

GLENN MUFFLY

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 3, line 42, after "flow" insert *controlling*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of December, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.