

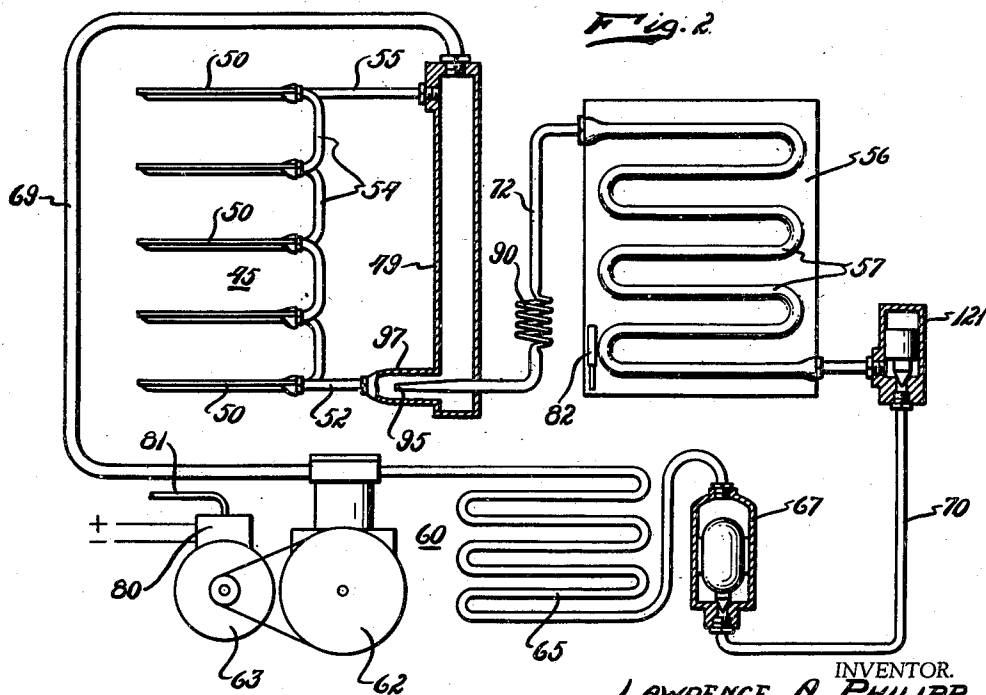
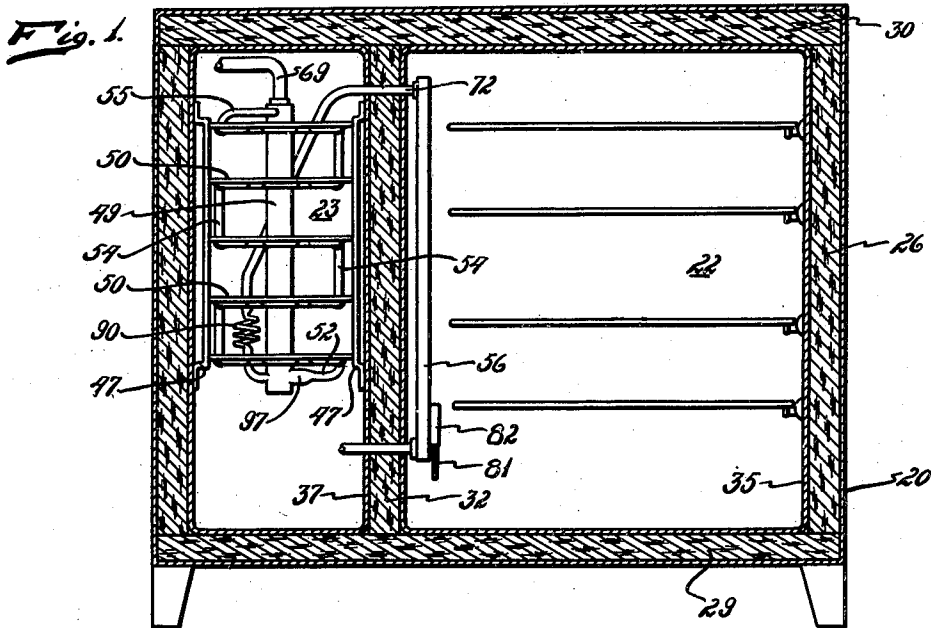
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L. A. PHILIPP

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REFRIGERATING APPARATUS

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INVENTOR.
LAWRENCE A. PHILIPP

BY
Ralph E. Baker
ATTORNEY.

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REFRIGERATING APPARATUS

Lawrence A. Philipp, Detroit, Mich., assignor, by
mesne assignments, to Nash-Kelvinator Cor-
poration, Detroit, Mich., a corporation of Mary-
land

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3 Claims. (Cl. 62—126)

This invention relates to refrigerating apparatus, and more particularly to refrigerating apparatus of the multiple temperature type.

One of the objects of my invention is to provide a new and improved arrangement for freezing substances and for cooling circulating air in a refrigerator cabinet.

Another object of my invention is to provide an improved and simplified arrangement for obtaining a temperature differential between a number of different refrigerant evaporators.

Another object of my invention is to provide for maintaining a substantially constant temperature differential between a number of different refrigerant evaporators without the necessity of making adjustments although various average mean temperatures are sought to be attained in the different evaporators.

Another object of my invention is to provide an improved unitary refrigerating system in a refrigerator cabinet, which system includes a refrigerant condensing element, a low temperature refrigerant evaporator for freezing large quantities of ice cubes and the like, and a relatively high temperature refrigerant evaporator for cooling circulating air in the food compartment of the cabinet, and to provide for controlling the operation of the condensing element in response to changes in temperatures in the relatively high temperature evaporator, and also to provide an improved arrangement for maintaining a substantially constant temperature differential between said evaporators, which permits a large quantity of substances to be frozen to be applied to the low temperature evaporator without effecting the average temperatures maintained in the air cooling evaporator, while at the same time the operation of the condensing element continues until the heat of the substances to be frozen is substantially or entirely absorbed by the low temperature evaporator.

Another object of my invention is to provide within a refrigerator cabinet an improved arrangement of and control for refrigerant evaporating means, which is arranged and operated without the collection of frost thereon or a slight film of frost is allowed to collect thereon during the on-phase of the refrigerating cycle and is melted off during the off-phase of the refrigerating cycle, while at the same time provisions are made for freezing substances, such as ice cubes and the like, and for cooling circulating air in the food storage compartment whereby continuous refrigeration at substantially constant, predetermined temperatures is assured and the

necessity of periodic inoperative conditions of the system for defrosting is avoided.

Another object of my invention is to provide for initiating ebullition in a refrigerant evaporator by injecting expanded refrigerant into the liquid refrigerant contained in said evaporator at pressures greater than those normally existing therein to increase the heat transfer from the medium surrounding the evaporator to the refrigerant contained therein.

Another object of the invention is to provide uniform temperatures throughout various portions of a heat absorber by positively circulating and initiating the ebullition of refrigerant contained therein.

Another object of my invention is to provide a new method of refrigeration which consists in evaporating liquid refrigerant in a liquid refrigerant evaporating zone and conducting the evaporated refrigerant and liquid refrigerant through a continuously open passageway to a second liquid refrigerant evaporating zone and controlling the flow of such liquid and gaseous refrigerant through said continuously open passageway in accordance with the difference in pressures in said two evaporating zones.

Other objects and advantages will be apparent from the following description, reference being had to the accompanying drawing.

In the drawing:

Fig. 1 is a vertical view, partly in section, of a refrigerating apparatus embodying features of my invention;

Fig. 2 is a schematic view of the refrigerating system embodying features of my invention.

Referring to the drawing, the numeral 20 designates, in general, a cabinet having a compartment 22 for the storage of foods to be refrigerated, and a freezing compartment 23. The cabinet is constructed of insulating walls, including side walls 26, bottom wall 29 and top wall 30. The cabinet also includes a fixed, vertical insulating wall 32 which extends from the rear to the front of the cabinet and from the top wall 30 to the bottom wall 29, separating the food compartment from the freezing compartment. An inner metallic lining member 35 forms the inner walls of the food compartment and is, preferably, provided with a coating of vitreous enamel, such as porcelain, to provide a neat appearing compartment and one which may be easily cleaned. A similar inner metallic lining member 37 forms the inner walls of the compartment 23. The liner 37 may be coated the same as liner 35.

Within the freezing compartment 23 is dis-

posed a refrigerant evaporator 45, which is supported by brackets 47. The evaporator 45 comprises, in general, a vertically disposed elongated accumulator, or header, 49 which has a space within its interior for both liquid and gaseous refrigerants. Associated with the header 49 are a plurality of refrigerated shelves 50. The shelves 50 are provided for supporting ice making receptacles (not shown). Liquid refrigerant is delivered to the shelves 50 through conduit 52, which is in open communication with the header 49 and interconnecting conduits 54. The uppermost shelf is connected to the upper part of header 49 by outlet conduit 55. Preferably, the shelves are constructed of sheet metal plates suitably secured together by welding but spaced apart between the sheets of metal to provide spaces for refrigerant. By operating the evaporator 45 at sufficiently low enough temperatures and by supporting the ice making receptacles on the upper surfaces of the refrigerant containing plates, the water in the receptacles will be rapidly frozen. If desired, desserts and the like may be placed in the receptacles stored on the shelves 50. Also, if desired, the frozen desserts and the like may be removed when frozen from the shelves and placed on the top of the wall 29 in compartment 23 immediately below the evaporator 45, where the substances will be retained in a frozen condition.

Within the food compartment 22 there is disposed a refrigerant evaporator 56. Evaporator 56 is of the plate type and is secured to the wall 32. As will be noted in the drawings, the evaporator 56 extends over the major portion of wall 32 within compartment 22. By providing an evaporator of this size and by so locating it in compartment 22, it is possible to substitute for the insulated wall 32 a thin metallic wall, since the evaporator is arranged to prevent the transfer of heat from the compartment 22 into the compartment 23. Preferably, the evaporator 56 is constructed of sheet metal plates which are secured together about their peripheries thereof by seam welding and welded at various points intermediate their edges but spaced apart between the welded points to provide a space 57 for refrigerant. Preferably, the space 57 is in the form of a serpentine coil for the passage of refrigerant.

A refrigerant condensing element 60 is provided for circulating refrigerant through evaporators 45 and 56. The element includes a compressor 62, motor 63 for operating the compressor, condenser 65 and high side float mechanism 67. The compressor 62 withdraws evaporated refrigerant from the evaporators 45 and 56 through a vapor conduit 69, which is connected to header 49 above the level of liquid refrigerant, compresses the evaporated refrigerant and delivers it to the condenser, wherein it is liquefied and from which it is delivered to the high side float mechanism 67. Liquid refrigerant is delivered to the evaporators through liquid supply conduit 70 under the control of float mechanism 67.

Liquid refrigerant is first delivered to evaporator 56 through the conduit 70, and from the evaporator 56 liquid and gaseous refrigerant is delivered to the evaporator 45 through conduit 72. Evaporated refrigerant is withdrawn from the evaporator 45 and header 49 through the vapor conduit 69.

Preferably, the condensing element is intermittently operated. In order to control the operation of the condensing element, I have provided a

thermostatically controlled switch 80 to which is connected, by pipe 81, a thermostat fluid containing bulb 82, which is disposed in thermal contact with the evaporating element 56 so that the switch operates in response to changes in temperature within the evaporating element 56. The switch 80 is adapted to open and close the circuit to the motor of unit 60 in response to predetermined changes in temperature within the evaporating element 56. In view of the fact that the evaporating elements 45 and 56 are of the so-called flooded type, the temperature therein will bear a direct relation to the pressures existing therein. Preferably, the switch 80 is adjustable, of the type well known in the art, and may be the same, for example, as the thermostatic switch disclosed in my co-pending application, Serial No. 661,033, filed March 16, 1933, for Refrigerating apparatus.

In order to maintain a predetermined temperature differential between the evaporating element 45 and the evaporating element 56, I have provided a restriction 90, which is interposed in the conduit 72, for controlling the flow of liquid and gaseous refrigerant from the evaporating element 56 to the evaporating element 45. The restriction 90 may be in the form of a capillary tube having a fixed internal diameter and is adapted to maintain at least a predetermined minimum pressure differential between the evaporating element 45 and the evaporating element 56, to thus maintain a temperature differential between said evaporating elements. When the pressure of the refrigerant in the evaporating element 56 reaches a predetermined point, for example, greater than the pressure within the evaporating element 45, and is of sufficient force to overcome the resistance offered by the restriction 90, the liquid and gaseous refrigerant will pass into the evaporating element 45. In other words, before refrigerant may pass from the evaporator 56 to the evaporating element 45, the pressure within the evaporating element 56 must be greater than the pressure in the evaporating element 45, plus an amount equal to overcome the resistance offered by the restriction 90. This predetermined pressure differential is maintained irrespective of the temperatures maintained in the evaporating elements 45 and 56.

Preferably, the thermostat is set so that the evaporating element 45 will be operated at temperatures which causes rapid freezing, and the evaporating element 56 at temperatures which are slightly above that which would be likely to cause the collection of frost or ice thereon due to the deposit of moisture from the circulating air in the food compartment. If desired, the thermostat may be set to operate evaporating element 56 at a temperature which would allow a slight film of ice to collect thereon during the on-phase of the refrigerating cycle and melted off during the off-phase of the refrigerating cycle. In view of the fact that the refrigerant condensing element 60 is operated in response to changes in temperature within the evaporating element 56, the adjustable thermostat 80 may be set so as to provide for operating the evaporating element 56 at either of the desired temperatures.

In the refrigerating system herein described, I prefer to use sulphur dioxide as a refrigerant. When sulphur dioxide is used as the refrigerant and when a predetermined setting of the switch 80 is made, I have found that the cyclic operation of the system is between an upper and lower pressure range limit in the evaporator 56, which

limits may be fourteen pounds pressure when the motor cuts in and four pounds pressure of the refrigerant when the motor cuts out. By the use of the restriction 90 and by determining the size of its internal diameter, so that at least a seven pound pressure differential is maintained between the two evaporators during the operating of the condensing element, I have found that when the aforementioned pressure range limits exist in the evaporator 56 that the upper and lower pressure range limits existing in the evaporator 45 extend between an upper limit of four pounds pressure of the refrigerant and lower limit of six inches of vacuum. With such pressure range limits existing in evaporator 45, it will be noted that the substances may be frozen rapidly.

Assuming now a large quantity of substances to be frozen is applied to the ice freezing plate, or evaporating element 45, the pressure of the refrigerant in element 45 is increased by the heat of the substances. When this occurs, the pressure of the refrigerant also increases in evaporating element 56 after the unit 60 begins operation, owing to the fact that liquid is then supplied to element 56 at a pressure higher than that already in said element, and as a result of the pressure in element 45 being increased above normal cycling limits, the pressures in element 56 are increased until the pressure differential maintained by restriction 90 is attained. As will be noted, the minimum pressure differential maintained by the restriction 90 during operation of the condensing element is seven pounds, since the lower pressure limit of element 45 is six inches of vacuum, and the lower pressure limit of element 56 is four pounds pressure of the refrigerant when the unit 60 ceases operation. At this time, the pressure range in element 56 is varied with the upper limit being at, for example, above fourteen pounds pressure, and the lower limit is four pounds pressure of the refrigerant. Thus, it will be noted that as the temperature in element 56 rises to a temperature corresponding to fourteen pounds pressure, the thermostatic switch 80 cuts in the motor-compressor unit 60 to reduce the pressures in the elements 45 and 56, which gradually takes place as the heat of the substances to be frozen is gradually dissipated by being absorbed in the refrigerant and withdrawn from elements 45 and 56 by the motor-compressor unit. Thus, the placing of a large quantity of substances to be frozen on element 45 will, after operation of the motor-compressor unit has started, cause it to continue to operate until the substances are either entirely or substantially frozen, even though the operation of the motor-compressor unit is controlled in response to changes in temperatures in the evaporating element 56. This is due to the pressure differential maintained by restriction 90, which prevents the pressure in element 56 to be lowered to four pounds until the pressure in element 45 is lowered to six inches of vacuum, at which time the substances are frozen. In the event an abnormal large quantity of warm foods should be placed in the food compartment, the pressures in each evaporating element is similarly increased until lowered by the action of the condensing element 60.

Although I have disclosed my pressure differential restriction 90 in connection with an intermittently operated refrigerating system, it will be readily apparent from the foregoing that in a continuously operated system, the restriction 90 would maintain a predetermined pressure dif-

ferential between the elements 45 and 56 at all times.

From the foregoing, it will be noted that I have provided an improved and simple arrangement for maintaining a pressure differential between a number of different evaporating elements for maintaining a temperature differential therebetween. It will also be noted that the pressure differential is obtained automatically throughout variations in pressure range limits existing in the different evaporating elements. In addition, it is to be noted that the pressure range limits may be set at any desired operating limits by simply adjusting a thermostatic switch without in any way affecting the temperature differential maintained between the different evaporating elements by the provision of the restriction 90. Furthermore, it will be noted that in maintaining a predetermined pressure differential, rapid ice freezing is promoted, since the condensing element, when once started, continues to operate until the ice is frozen.

In order to prevent refrigeration taking place immediately upon entrance of the liquid refrigerant into the supply conduit 70, after leaving the high side float mechanism 67, I have provided a pressure responsive valve, designated by the numeral 121. This valve is interposed in the conduit 70 adjacent the inlet of the evaporator 56. This valve maintains the pressures in the supply conduit 70 sufficient high enough so as to prevent refrigeration taking place in said conduit so that no refrigeration takes place before entering the evaporator 56. This prevents loss of refrigeration, increases the capacity of the apparatus and prevents the collection of moisture in the insulated portions of the food storage compartment through which the liquid supply conduit 70 extends.

In order to promote and to initiate the ebullition, as well as the circulation, of liquid refrigerant through the refrigerated shelves 50, I have provided an injector 95. This prevents the superheating of the liquid refrigerant in the shelves 50 and tends to keep uniform temperatures throughout the entire evaporator. The injector 95 is formed by restricting the outlet end of the conduit 72. The restricted end is disposed part way into a laterally extending fitting 97 to which the inlet conduit 52 is connected. The injector is adapted to inject expanded refrigerant into the conduit 52. During period when the float valve is open, the refrigerant leaving the high pressure side of the system and entering the low pressure side through the orificed valve seat becomes expanded (partly liquid and partly gas). The expanded refrigerant is received in the conduit 70 at pressures somewhat greater than those normally existing in the conduit 52. This high pressure expanded refrigerant passes through valve 121, evaporator 56, restriction 90, and leaves the injector and enters the liquid refrigerant in the conduit 52 where the pressure is lower. Consequently, the injector provides a means of positively circulating liquid refrigerant in the cooling element. It will also be noted that the gaseous part of the injected refrigerant immediately initiates the ebullition of refrigerant in the conduit 52 upon its admission thereto. Also, the gaseous part of the injected refrigerant, in addition to starting ebullition in the expansion conduit, promotes ebullition throughout its passages there-through.

By positively circulating, initiating and promoting ebullition in the cooling element, the oil 75

pumped therein by the compressor is readily returned to the compressor through the vapor conduit, by reason of its entrainment with the evaporated refrigerant.

5 Although only a preferred form of the invention has been illustrated, and that form described in detail, it will be apparent to those skilled in the part that various modifications may be made therein without departing from the spirit of the invention or from the scope of the appended
10 claims.

What I claim is:

1. A refrigerating system comprising a refrigerant evaporating element, a second refrigerant
15 evaporating element, means associated with said elements for reducing the pressures of the refrigerant in said elements, means for maintaining a substantially constant minimum pressure differential between said elements as the pressures are being reduced therein, and means between said
20 elements for injecting refrigerant into said second evaporating element.

2. A refrigerating system comprising a refrigerant evaporating element, a second refrigerant evaporating element, means associated with said elements for reducing the pressures of the refrigerant in said elements, a fixed restriction for
5 maintaining a substantially constant minimum pressure differential between said elements as the pressures are being reduced therein, and means between said elements for injecting refrigerant into said second evaporating element. 10

3. A refrigerating system comprising a refrigerant evaporating element, a second refrigerant evaporating element, means associated with said elements for reducing the pressures of the refrigerant in said elements, a capillary tube for
15 maintaining a substantially constant minimum pressure differential between said elements as the pressures are being reduced therein, and means between said element for injecting refrigerant into said second evaporating element. 20

LAWRENCE A. PHILIPP.