Dec. 29, 1936. R. K. MILLER 2,065,604

REFRIGERATING APPARATUS

Filed March 26, 1934 2 Sheets-Sheet 1

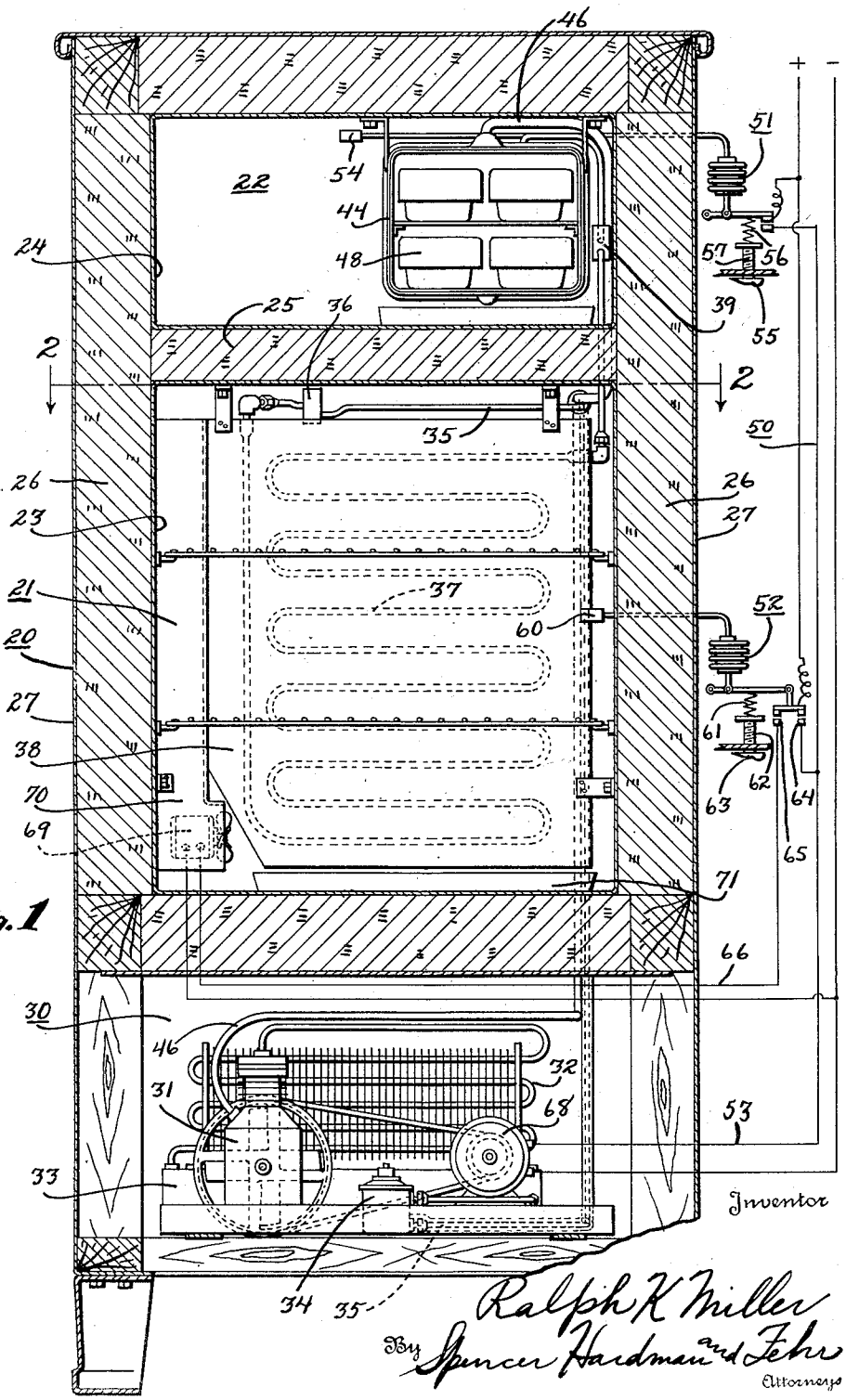

Fig. 1

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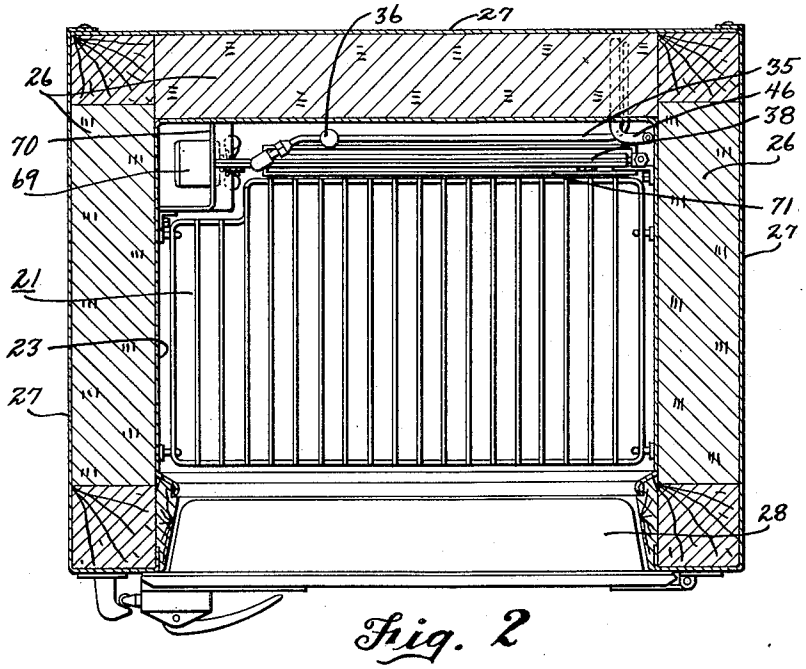

Fig. 2

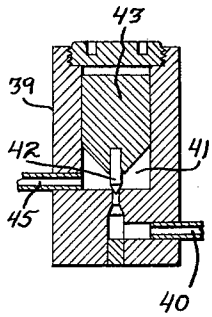

Fig. 3

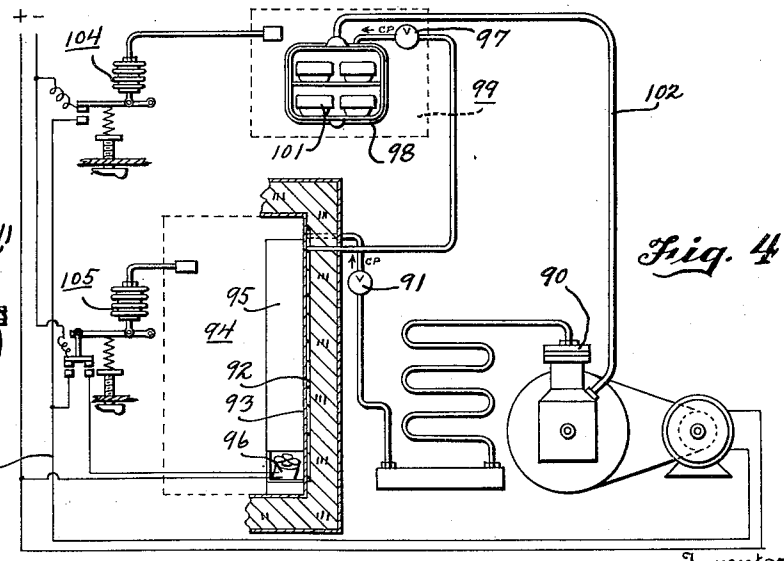

Fig. 4

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UNITED STATES PATENT OFFICE

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REFRIGERATING APPARATUS

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3 Claims. (Cl. 62—116)

This invention relates to refrigerating apparatus and more particularly to two temperature refrigerators having separate compartments for freezing and food storage.

At present practically all refrigerators manufactured have a single cooling unit having all of its cooling surfaces at substantially the same temperature for freezing purposes for the dual function of freezing water and comestibles as well as cooling the air or atmosphere within the food compartment. This scheme has the objection that it unduly dries the food compartment air and causes frost to collect upon the surfaces of the evaporator. Practically the only exceptions are those manufacturers which employ a serially arranged expansion coil having the first portion of the coil for freezing and the remaining portions for cooling the food compartment. In such a system, however, there is difficulty as to the control of the different temperatures throughout the portion of the coil within the food compartment.

It is an object of my invention to provide an improved two temperature refrigerator wherein relatively high evaporating pressures and temperatures are maintained throughout the evaporating portion for the food compartment and considerably lower evaporating pressures and temperatures are maintained throughout another portion of the evaporating means for freezing purposes.

It is another object of my invention to provide an improved control system for two temperature refrigerators.

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

In the drawings:

Fig. 1 is a vertical sectional view through a two temperature refrigerator embodying my invention;

Fig. 2 is a sectional view along the line 2—2 of Fig. 1;

Fig. 3 is a sectional view through one of the weight type of restriction valves shown in Figs. 1 and 2; and

Fig. 4 is a modified form of my improved two temperature refrigerating system.

Referring to the drawings and more particularly to Fig. 1, there is shown a two temperature refrigerator including a cabinet 20, a food or high temperature compartment 21 within the middle portion of the cabinet and the separate freezing compartment 22 located directly above the food compartment 21 but insulated therefrom. The food compartment 21 and the freezing compartment 22 are enclosed by sheet metal inner walls 23 and 24. Between the top sheet metal wall of the food compartment and the bottom sheet metal wall of the freezing compartment, there is provided insulating means 25 for preventing transfer of heat from the high temperature food compartment 21 to the freezing compartment 22. Insulating means 26 surrounds both the inner walls of the food compartment 21 and the freezing compartment 22.

Surrounding the insulating means 26 are the outer sheet metal walls 27. Separate doors and door openings are provided for the food compartment 21 and the freezing compartment 22, the door for the food compartment being shown in Fig. 2 and designated by the reference character 28. If desired, however, a single door may be used together with some suitable means for sealing and insulating one compartment from the other.

Directly beneath the insulated food compartment 21 is a machinery compartment 30 containing a refrigerant liquefying means including a compressor 31 driven by the electric motor 68 for compressing the refrigerant and for forwarding the compressed refrigerant to a condenser 32 where the compressed refrigerant is liquefied and collected in a receiver 33. From the receiver 33 the liquid refrigerant flows to a high side float type of valve mechanism 34 which controls the flow of liquid refrigerant through a supply conduit 35 to a weight type restrictor 36 located at the top of the food compartment 21. This weight type restrictor 36 maintains a pressure within the conduit 35 and prevents the evaporation of the liquid refrigerant before it enters the food compartment 21.

After the liquid refrigerant passes through the restrictor 36 which may be of the type shown in Fig. 3, the liquid refrigerant passes into an evaporating means including a serpentine coil portion 37 which is soldered or otherwise suitably fastened in heat exchange relation to a vertical metal plate 38 which is spaced from, but parallel to, the rear wall of the food compartment 21. After passing through the serpentine coil portion 37, the liquid refrigerant is conducted into the freezing compartment 22.

Within the freezing compartment 22 is a weight restricting valve 39 better shown in Fig. 3, which weight restricting valve 39 has an entrance 40 where the refrigerant from the ser-

pentine coil 37 enters the valve body and a valve chamber 41 containing the valve 42 formed on the lower end of a weight 43. The weighted valve 42 restricts the flow of refrigerant from the serpentine coil 37 to the evaporating means 44 within the freezing compartment and maintains a pressure differential between these two evaporating portions 37 and 44. The liquid refrigerant which passes through the weight restricting valve 39 leaves the valve body through the refrigerant conduit 45 which connects to the evaporating portion 44. From the evaporating portion 44 the evaporated refrigerant is returned to the compressor through the return conduit 46.

By the use of this particular system a higher evaporating pressure and temperature is maintained within the serpentine refrigerant coil portion 37 within the food compartment 21 than in the evaporator portion 44 in the freezing compartment 22. The pressure and temperature difference between these two evaporating portions is preferably sufficient to maintain the entire serpentine coil portion 37 at temperatures above freezing while the entire freezing evaporator portion is maintained at temperatures considerably below freezing. The evaporating portion 44 is provided with means for supporting a plurality of ice trays 48 for freezing ice cubes, desserts, and other comestibles therein.

In order to control the operation of the refrigerant liquefying means and to maintain proper temperatures within the freezing compartment 22 and the food compartment 21, I have provided an improved electrical control means including an electrical circuit 50 having a single contact switch means 51 and a doube contact switch means 52 located in parallel electrical circuit relation to each other but in series with the electric motor circuit 53. These switches, shown diagrammatically, preferably are of the snap acting type. The single contact switch means 51 is operated by and responsive to a thermostatic bulb 54 which is located within the freezing compartment 22. The switch 51 is also provided with a manually operable temperature regulating means 55 which regulates the opening and closing of the single contact switch 51 and by means of the temperature regulating spring 56 and the temperature regulating screw 57 provided with a finger manipulator for varying the tension of the spring 56 so as to cause the opening and closing of the switch 51 according to different pressures and temperatures within the freezing compartment 22.

The switch 52 is operated by and responsive to the temperature of the thermostatic bulb 60 located within the food compartment 21. The switch 52 is provided with a manually adjustable temperature regulating means including the temperature regulating spring 61 and a temperature regulating screw 62 provided with a finger manipulator 63 for regulating the opening and closing temperatures of the switch 52. The switch 52 is provided with two sets of contacts. One set of contacts 64 controls the flow of electric energy through one portion of the electric motor circuit 53 which is in parallel with the switch 51 and the other set 65 controls the flow of electric energy through the fan motor electric circuit 66 arranged in parallel with the electric motor which drives the compressor 31. Connected in the electric circuit 66 is an electric motor driven fan 69 which draws warm air from the top of the food compartment down through the duct means 70 located upon the left side of the food compartment 21 and circulates the air over the surfaces of the serpentine evaporating portion 37 and the plate 38.

By this control means whenever the temperature within the food compartment 22 reaches its high limit for which the switch 51 is set, the switch 51 will close and cause operation of the electric motor 68 and the refrigerant liquefying means. If the temperature within the food compartment has not reached the high limit for which the switch 52 is set, the switch 52 will remain in the open position and the motor driven fan 69 will not operate. The refrigerant will circulate through the serpentine coil portion 37 but because the motor driven fan is not operated little heat will be absorbed from the air within the food compartment. After passing through the weight restrictor valve 39 the refrigerant is at a lower pressure and will evaporate and cool the freezing compartment 22.

During the time the switch 51 is closed, if the food compartment should reach the high limit for which the switch 52 is set, the switch 52 will also close and remain closed until the temperature within the food compartment reaches the low limit for which the switch 52 is set to open. The closing of the switch 52 will cause the motor driven fan 69 to operate and withdraw warm air from the top of the food compartment and circulate it over the surfaces of the serpentine portion 37 and the plate 38 to cool the air within the food compartment. The electric motor 68 and the refrigerant liquefying means will continue to operate as long as any one of the switches remain closed. When both of the switches open the refrigerant liquefying means will cease operation. This will take place only when the freezing compartment and the food compartment have reached the low limits for which the switches 51 and 52 are set.

The switches 51 and 52 thus operate independently of each other and thereby control the operation of the refrigerant liquefying means to maintain proper temperatures within the food compartment 21 and the freezing compartment 22. By the use of the weight restricting valve 39 between the two evaporating portions, the serpentine coil 37 is maintained at evaporating pressures corresponding to temperatures above freezing so that no frost will form thereon. This avoids excessive drying of foodstuffs within the food compartment. Any moisture condensing thereon will flow down the surfaces of the plate 68 and be collected in drip pan 71. By maintaining the evaporating temperature and pressure within the serpentine portion 37 above freezing, the temperature of the food compartment 21 is positively prevented from going below freezing and freezing foodstuff stored therein. This avoids the danger of freezing the foodstuffs common to systems wherein the evaporator is located entirely within the food compartment and which may be set at extremely low temperatures occasionally to secure quick freezing. By forcibly circulating the food compartment air over the moist evaporator surfaces, a relatively high humidity is maintained within the food compartment.

In Fig. 4 I have shown a modified form of my system, partially diagrammatic, in which a similar refrigerant liquefying apparatus 90 is provided which supplies liquid refrigerant to an automatic expansion valve 91 controlled by pressure on the outlet side. The expansion valve 91 controls the flow of liquid refrigerant to a ser-

pentine evaporating coil portion 92 which is located outside of but in heat exchange relation with the sheet metal inner walls 93 of an insulated food compartment 94. This food compartment 94 is provided with duct means 95 along one of its side walls a and motor driven fan 96 for circulating air over the portion of the inner wall 93 to which the serpentine coil 92 is fastened. From the serpentine coil portion 92 the refrigerant is forwarded to a second expansion valve 97 also controlled by the pressure on its outlet side. The expansion valve 97 controls the flow of refrigerant through the low pressure evaporating portion 98 located within the freezing compartment 99. The low pressure evaporating portion 98 is provided with shelves for supporting the ice trays 101. The liquid refrigerant evaporates within the serpentine coil portion 92 and the low pressure portion 98 of the evaporating means and is returned to the liquefying means through a return conduit 102. The operation of the refrigerant liquefying means and the motor driven fan 96 is controlled by an electric circuit 103 which is similar to the control circuit shown in Fig. 1 and is similarly provided with switches 104 and 105 responsive to the temperature of the freezing compartment 99 and the food compartment 94.

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

What is claimed is as follows:

1. A refrigerator including a cabinet containing separate freezing and food compartments, a refrigerating system including an evaporating means having an evaporating portion in heat exchange relation with the food compartment and an evaporating portion in heat exchange relation with the freezing compartment, said evaporating portions being connected in series, means for creating a forced circulation of the food compartment air over the evaporating portion disposed therein, a refrigerant liquefying and condensing means for supplying refrigerant to the evaporating portion in heat exchange relation with the food compartment and for withdrawing refrigerant from the evaporating portion in heat exchange relation with the freezing compartment, means for maintaining a higher pressure within the evaporating portion in heat exchange relation with the food compartment than in the evaporating portion in heat exchange relation with the freezing compartment, means for controlling said refrigerant liquefying and condensing means, said last named means including means responsive to the temperature within said freezing compartment and another means responsive to the temperature within said food compartment, said temperature responsive means being arranged to be actuated independently of one another to start and/or stop operation of said refrigerant liquefying and condensing means, and one of said temperature responsive means being arranged to cause operation of said air circulating means simultaneously with the causing of operation of the refrigerant liquefying and condensing means thereby.

2. A refrigerator including a cabinet containing separate freezing and food compartments, a refrigerating system including an evaporating means having an evaporating portion in heat exchange relation with the food compartment and an evaporating portion in heat exchange relation with the freezing compartment, said evaporating portions being connected in series, means for creating a forced circulation of the food compartment air over the evaporating portion disposed therein, a refrigerant liquefying and condensing means for supplying refrigerant to the evaporating portion in heat exchange relation with the food compartment and for withdrawing refrigerant from the evaporating portion in heat exchange relation with the freezing compartment, means for maintaining a higher pressure within the evaporating portion in heat exchange relation with the food compartment than in the evaporating portion in heat exchange relation with the freezing compartment, means for controlling said refrigerant liquefying and condensing means, said last named means including means responsive to the temperature within said freezing compartment and another means responsive to the temperature within said food compartment, said temperature responsive means being arranged to be actuated independently of one another to start and/or stop operation of said refrigerant liquefying and condensing means, and the means responsive to the temperature of said food compartment being arranged to cause operation of said air circulating means simultaneously with the causing of operation of the refrigerant liquefying and condensing means thereby.

3. A refrigerating apparatus including separate compartments to be cooled, a closed refrigerant system including a cooling element in heat exchange relation with one of said separate compartments and another cooling element in heat exchange relation with the other of said separate compartments, means for creating a forced circulation of air in one of the said compartments, said closed refrigerant system also including a refrigerant circulating means for supplying refrigerant to said cooling elements, means for controlling said refrigerant circulating means, said last named means including means responsive to the temperature within one of said separate compartments and another means responsive to the temperature within the other of said separate compartments, said temperature responsive means being arranged to be actuated independently of one another to start and/or stop operation of said refrigerant circulating means, and one of said temperature responsive means being arranged to cause operation of said air circulating means simultaneously with the causing of operation of the refrigerant circulating means thereby.

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