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REFRIGERATING APPARATUS

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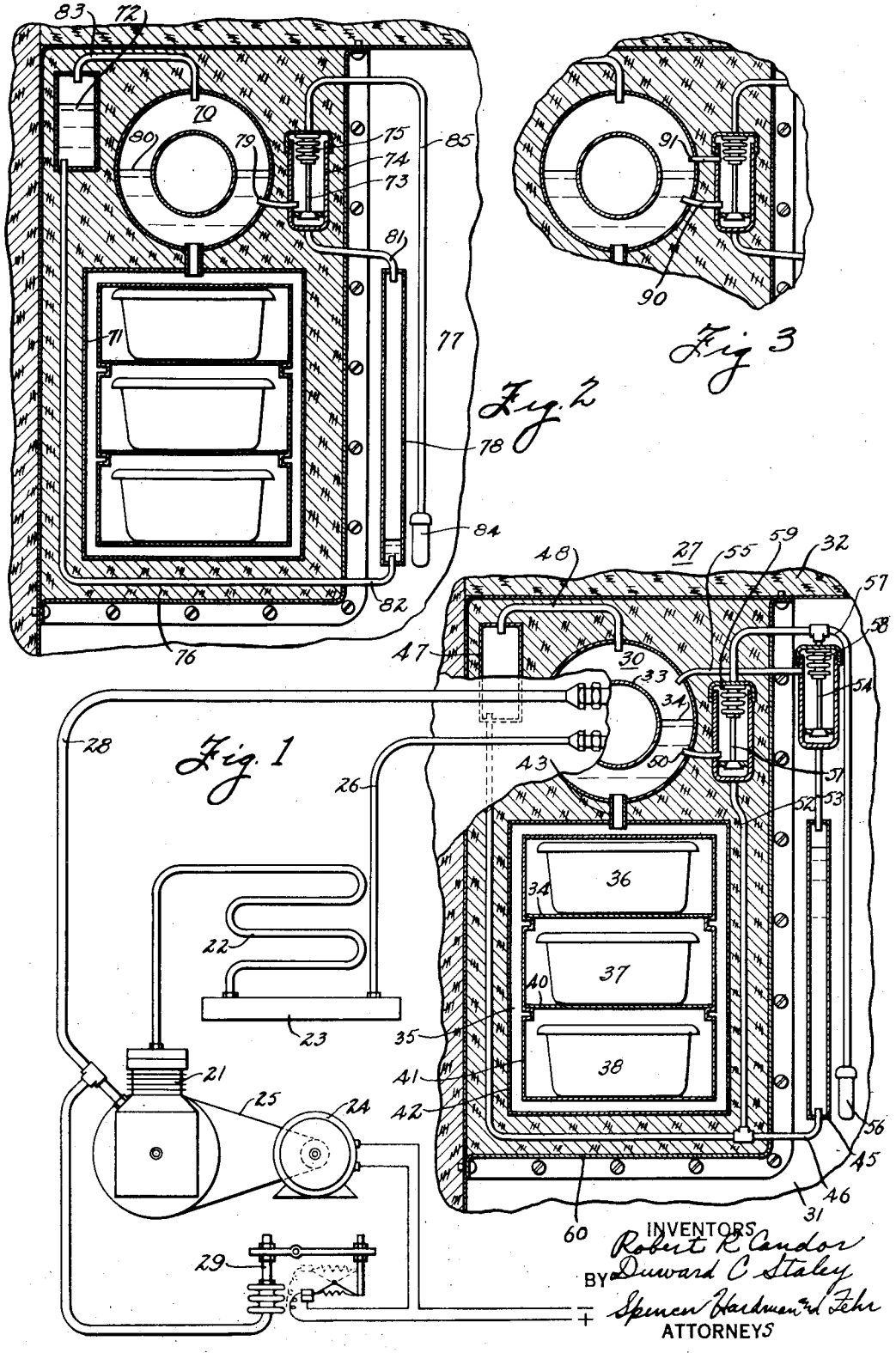

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REFRIGERATING APPARATUS

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This invention relates to refrigerating apparatus and more particularly to cooling units for household refrigerator cabinets.

Household refrigerator cabinets are ordinarily provided with a freezing chamber for freezing ice cubes. In order to freeze the ice cubes rapidly, a comparatively cold temperature is necessary. However, for cooling food stuffs and vegetables which are ordinarily stored within refrigerator cabinets such comparatively cold temperature is undesirable. Consequently one of the objects of the invention is to provide an improved cooling unit wherein an extremely cold temperature is obtained within the freezing chamber and a comparatively higher temperature is obtained within the food storage compartment of the refrigerator.

Another object of the invention is to regulate the temperature of the freezing chamber and the food storage compartment independently of each other.

A still further object of the invention is to provide an improved cooling unit having an additional reservoir for preventing fluctuation of the level of liquid refrigerant within the float chamber.

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

In the drawing:

Fig. 1 is a sectional view of one embodiment of the improved cooling unit together with a diagrammatic representation of the remaining elements of a refrigerating system;

Fig. 2 is a sectional view of another embodiment of the improved cooling unit shown installed within the refrigerator cabinet; and

Fig. 3 is a fragmentary sectional view of another embodiment of the cooling unit.

Referring to the drawing, there is shown diagrammatically for illustrative purposes a refrigerating system of the compressor-condenser-expander type including a compressor 21 for compressing the refrigerant, preferably sulphur-dioxide, and for forwarding it to the condenser 22 where it is liquefied and collected in the receiver 23. A supply conduit 26 supplies liquid refrigerant to the float chamber 30 of the evaporator or cooling unit 27 where the liquid refrigerant vaporizes because of the absorption of heat and is returned to the compressor through the return conduit 28. The actuating means for the compressor comprises a motor 24 connected by pulley and belt means 25 to the compressor. A pressure responsive switch means 29 is preferably connected to the return conduit 28 for controlling the motor 24 to provide alternating operating and idle periods of the compressor according to the pressure and consequently the temperature of the evaporator.

The cooling unit shown in Fig. 1 is positioned within the upper corner of the food storage compartment 31 of a refrigerator cabinet 32 of which only a portion is shown. The cooling unit 27 has a supply reservoir or float chamber 30 containing a float ball 33 for regulating the level 34 of liquid refrigerant within the float chamber by controlling the supply of liquid refrigerant entering the float chamber from the supply conduit 26. The freezing compartment 35 is positioned below the float chamber. Within the freezing compartment a plurality of trays 36, 37 and 38 are supported upon shelves 39 and 40 as well as in the bottom of the compartment. The freezing compartment is provided with an inner wall 41 and and outer wall 42 between which liquid refrigerant is maintained. The liquid refrigerant is supplied to this space between the walls from the float chamber through the conduit 43. The temperature within the supply reservoir or float chamber and the freezing compartment is controlled by the control mechanism 29.

The food storage compartment 31 is cooled by a vertical plate type cooling member 45 which is provided with a pair of spaced plates for containing liquid refrigerant. A conduit 46 for liquid refrigerant connects into the bottom of the plate type cooling member 45 and extends horizontally and then upwardly around the freezing chamber and finally enters the bottom of the reservoir 47 positioned adjacent the float chamber. The top of the reservoir is connected to the top of the float chamber by conduit 48 for allowing the escape of gaseous refrigerant from the reservoir. The use of the reservoir prevents fluctuation in the level of liquid refrigerant in the float chamber which would otherwise occur. Liquid refrigerant is supplied to the cooling member 45 through a conduit 50 connecting the lower portion of the float chamber 30 below the liquid level and a valve 51, preferably of the snap-acting type, which controls the flow of refrigerant down the conduit 52 which connects into the lower portion of the conduit 46.

According to the present invention, thermostatic means are provided for varying the level of liquid refrigerant within the cooling member 45. To this end a conduit 53 extends upwardly from the cooling member and connects into the bottom of a valve 54, preferably of the snap-

acting type, which controls the escape of vaporized refrigerant from the cooling member. A conduit 55 is provided for returning the vaporized refrigerant to the float chamber. The valves 51 and 54 are opened and closed by a thermostatic bulb 56 positioned within the food storage compartment 31 of the refrigerator. The thermostatic bulb which contains a selected volatile fluid which vaporizes or boils at the selected refrigerating temperature, is connected by a fluid conduit 57 to the bellows 58 and 59 which are enclosed within the valve chamber of each of the valves 54 and 51. Means of any suitable type are provided for adjusting the bellows 58 and 59 and the valves 51 and 54 to operate at any desired temperature within a limited range. In practice the valve 51 is set to operate at a slightly higher temperature than the valve 54 so that the valve 51 always opens last and closes first. The float chamber 30, the freezing chamber, the valves 51 and 54, reservoir 47 and connecting conduits are surrounded by insulation and positioned within the casing 60 which encloses the insulation which may be granulated cork or other suitable material. The casing 60 is preferably fastened within an upper corner of the food storage compartment 31.

The operation of this embodiment is as follows: When the food storage compartment 31 is warmer than the desired selected temperature, the volatile fluid within the thermostatic bulb 56 will expand the bellows 58 and 59 within the valve chambers of the snap-acting valves 51 and 54 to open first the valve 54 to allow gaseous refrigerant to escape from the top of the cooling member 45 through conduit 53 past the valve 54 and through the conduit 55 into the float chamber and then to open the valve 51 to allow liquid refrigerant to flow from the float chamber through the conduit 50 past valve 51 through conduits 52 and 46 into the cooling member 45 to fill it with liquid refrigerant. With the cooling member 45 filled with liquid refrigerant, the increased amount of surface having contact with the liquid refrigerant provides an increased amount of cooling which eventually brings the temperature below the selected point. When the food storage compartment 31 has become cooler than the desired temperature, the volatile fluid within the thermostatic bulb 56 will contract to close first the valve 51 and then the valve 54, which will stop first the flow of liquid refrigerant to the cooling member and then stop the escape of the gaseous refrigerant from the top of the cooling member 45. The heat absorbed from the food storage compartment 31 will cause gaseous refrigerant to collect in the top of the cooling member 45 above the surface of the liquid refrigerant in increasing amounts. The pressure of this gas will force liquid refrigerant out of the cooling member 45 through the conduit 46 into the reservoir 47, as long as the valves 51 and 54 remain closed. When the food storage compartment has warmed sufficiently, the valves 51 and 54 will again snap open in the same order as above described and liquid refrigerant will again be allowed to flow into the cooling member 45.

In Fig. 2 there is shown an embodiment of the invention which is somewhat simpler than in Fig. 1 but it does not have the advantage of providing separate passages for gaseous and liquid refrigerant. This embodiment is in the greater part similar to Fig. 1 and has a float chamber 70 with a freezing compartment 71 containing ice trays positioned below the float chamber and connected to it. The reservoir 72 is positioned at one side of the float chamber and a snap-acting valve 73 enclosed by a casing 74 and operated by a bellows 75 is positioned at the other side of the float chamber 70. The float chamber 70, freezing chamber 71, reservoir 72 and the valve chamber 74 are all surrounded by insulation and enclosed by a metal casing 76 which is positioned within a corner of the food storage compartment 77 of the refrigerator cabinet. On the outside of the casing 76 there is a plate-like cooling member 78 adapted to contain refrigerant. A conduit 79 connects the portion of the float chamber 70 which is below the liquid level 80 and the upper part of the valve chamber 74 while the conduit 81 connects the bottom of the valve chamber 74 and at the top a cooling member 78. Another conduit 82 connects the bottom of the cooling member 78 with the bottom of the reservoir 72, while another conduit 83 connects the top of the reservoir 72 with the top of the float chamber 70. A thermostatic bulb 84 is positioned within the food storage compartment 77 and is connected through a fluid conduit 85 to the bellows 75 to open and close the valve 73 in response to temperature within the food storage compartment 77.

In a manner somewhat similar to that described for the embodiment shown in Fig. 1, the opening of the valve 73 will allow liquid refrigerant to flow into the cooling member 78 to cool the food storage compartment and this valve will also allow the gaseous refrigerant, formed by the evaporation of the liquid refrigerant, to escape. When the food storage compartment has been cooled sufficiently, the valve 73 will close and the gaseous refrigerant which collects in the top of the cooling member 78 will force liquid refrigerant out of the cooling member 78 through the conduit 82 into the reservoir 72. It is apparent of course that conduit 82 must be connected to the cooling member 78 somewhere below the liquid level, preferably at the bottom, in order to accomplish this result. When the food storage compartment 77 has become warmer than the desired temperature, the expansion of the volatile fluid within the thermostatic bulb 84 will cause the valve 73 to open, which opening will allow some of the gaseous refrigerant to escape from the top of the cooling member 78 into the float chamber, and will also allow some liquid refrigerant to flow from the float chamber to the cooling member. In this manner the level of liquid refrigerant within the cooling member 78 is thermostatically controlled to maintain the proper amount of liquid refrigerant within the cooling member 78 to keep the food storage compartment 77 at the temperature desired.

The modification shown in Fig. 3 differs only from the modification in Fig. 2 in that it provides a pair of conduits connecting the float chamber and the valve chamber, the lower conduit 90 being connected into the float chamber below the liquid level for the purpose of carrying liquid refrigerant from the float chamber to the valve chamber, while the upward conduit 91 is connected above the liquid level on the float and valve chambers so that a separate passage for gaseous refrigerant is provided between the valve chamber and the float chamber, thus avoiding the forcing of a column of liquid refrigerant ahead of and along with the gaseous refrigerant into the float chamber from the valve 73.

From the above description it will be seen that means are provided for independently controlling the freezing chamber and the cooling member so

as to regulate the temperatures within the freezing chamber and the food storage compartment of the refrigerator independently of each other.

While the form of embodiment of the present 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 flooded type cooling unit including a supply reservoir, a cooling member adapted to contain liquid refrigerant, and a second reservoir, conduits connecting the supply reservoir, the cooling member and the second reservoir, and a thermostatically controlled valve in the conduit connecting the supply reservoir and the cooling member for controlling the accumulation of gaseous refrigerant in the cooling member for varying the cooling action of the cooling member, by forcing liquid refrigerant into the second reservoir.

2. A cooling unit including a float chamber, a cooling member and a reservoir, all adapted to contain liquid refrigerant, a conduit connecting the lower portion of the float chamber and the upper portion of the cooling member, a conduit connecting the lower portion of the cooling member and the lower portion of the reservoir, a conduit connecting the upper portion of the reservoir and the upper portion of the float chamber and a valve in the first mentioned conduit.

3. Refrigerating apparatus including a refrigerator cabinet having a food storage compartment therein, a cooling unit positioned within said food storage compartment, said cooling unit including a supply reservoir, a cooling member and a second reservoir, means for maintaining liquid refrigerant within the supply reservoir, means for supplying liquid refrigerant to the cooling member from the supply reservoir, means for insulating the supply reservoir and the second reservoir, and means responsive to the temperature within the food storage compartment for forcing liquid refrigerant from the cooling member into the second reservoir to vary the cooling action of the cooling member.

4. Refrigerating apparatus including a refrigerator cabinet having a food storage compartment therein, a cooling unit within the food storage compartment, said cooling unit including a float chamber, a cooling member and a reservoir all adapted to contain liquid refrigerant, a freezing chamber, refrigerant passages connected to the float chamber for cooling the freezing chamber, means for insulating the float chamber, the freezing chamber, and the reservoir and means responsive to the temperature within the food storage compartment for forcing liquid refrigerant from the cooling member into the reservoir to vary the cooling action of said cooling member independent of the freezing chamber.

5. An evaporator including a supply reservoir, a freezing chamber, means for maintaining refrigerant in contact with the freezing chamber, means for insulating the supply reservoir and the freezing chamber, a box cooling member, supply means for supplying liquid refrigerant to the box cooling member, a second reservoir for liquid refrigerant, a conduit connecting the lower part of the box cooling member with the second reservoir, and a thermostatically controlled valve in said supply means for controlling the level of liquid refrigerant in the box cooling member according to refrigerating requirements independent of the freezing chamber.

6. Refrigerating apparatus including a refrigerator cabinet having a food storage compartment therein, a reservoir for liquid refrigerant, a second reservoir for liquid refrigerant, a box cooling member positioned within the food storage compartment and adapted to contain liquid refrigerant, conduits connecting the first mentioned reservoir, the box cooling member, and the second reservoir, means for insulating the first mentioned reservoir and the second reservoir from the food storage compartment, and means responsive to the temperature within the food storage compartment for regulating the level of liquid refrigerant within the box cooling member.

7. Refrigerating apparatus including a refrigerator cabinet having a food storage compartment therein, a reservoir for liquid refrigerant, a second reservoir for liquid refrigerant, a box cooling member positioned within the food storage compartment and adapted to contain liquid refrigerant, conduits connecting the first mentioned reservoir, the box cooling member, and the second reservoir, and means for regulating the level of liquid refrigerant in the box cooling member according to the temperature within the food storage compartment.

8. In a cooling unit for refrigerating apparatus, the combination of a cooling member adapted to contain liquid refrigerant, a supply reservoir adapted to contain liquid refrigerant, a second reservoir, means for conducting refrigerant from the supply reservoir to the cooling member, and means for forcing liquid refrigerant from the cooling member into the second reservoir for regulating the cooling action of the cooling member.

9. In a cooling unit for refrigerating apparatus, the combination of a cooling member adapted to contain liquid refrigerant, a supply reservoir adapted to contain liquid refrigerant, a second reservoir, means for conducting refrigerant from the supply reservoir to the cooling member, means for conducting refrigerant from the cooling member to the second reservoir and from the reservoir to the supply reservoir, and thermostatically controlled means for forcing liquid refrigerant from the cooling member into the second reservoir.

10. Refrigerating apparatus including a cabinet containing a fluid chamber to be cooled, a cooling member exposed within said chamber to be cooled, a supply reservoir for supplying liquid refrigerant to said cooling member, a second reservoir connected to said cooling member, said supply reservoir and said second reservoir being isolated from said chamber to be cooled, and thermostatic means for controlling the withdrawal of gaseous refrigerant from said cooling member to force liquid refrigerant from said cooling member to said second reservoir for varying the level of liquid refrigerant in said cooling member in accordance with the cooling requirements.

11. A cooling unit including a freezing member containing liquid refrigerant, means for controlling the level of liquid refrigerant in said freezing member, an air cooling member below the level of liquid refrigerant in said freezing member, means for conducting liquid refrigerant to said air cooling member from said freezing member and for conducting gaseous refrigerant from said air cooling member, a reservoir having at least a portion located above the liquid level in the freezing member, conduit means for conducting liquid refrigerant from said cooling mem-

ber to said reservoir, and means automatically responsive to air temperature conditions for controlling the discharge of gaseous refrigerant from said cooling member to force liquid refrigerant into the reservoir.

12. A refrigerating apparatus comprising means forming a freezing zone to be maintained below 32° F., means forming a cool air zone to be maintained above 32° F., an evaporator comprising a liquid refrigerant freezing pool thermally connected to said freezing zone, and a liquid refrigerant air cooling pool thermally connected to said cool air zone, a storage chamber connected to said air cooling pool, a refrigerant liquefying apparatus connected to said evaporator for supplying liquid refrigerant thereto and for withdrawing liquid refrigerant therefrom, automatic means for regulating the level of liquid refrigerant in said freezing pool, automatic means for controlling the refrigerant liquefying apparatus for regulating the liquid temperature of said freezing pool, and automatic means responsive to temperatures within said cool air zone for transferring liquid refrigerant from said air cooling pool to said storage chamber for regulating the liquid level and cooling effect of said air cooling pool.

13. A cooling unit including a flooded freezing chamber, a cooling member, and a reservoir all adapted to contain liquid refrigerant, a conduit connecting the flooded freezing chamber and the cooling member, a conduit connecting the cooling member and the reservoir, a conduit connecting the reservoir and the flooded freezing chamber, and a thermostatically controlled valve in the first mentioned conduit.

14. A cooling unit including a flooded freezing chamber, a cooling member, and a reservoir all adapted to contain liquid refrigerant, a conduit connecting the flooded freezing chamber and the cooling member, a conduit connecting the cooling member and the reservoir, a conduit connecting the reservoir and the flooded freezing chamber, and a thermostatically controlled valve in the first mentioned conduit, said freezing chamber and said reservoir being insulated from said cooling member.

15. A mechanical refrigerator of the household type comprising walls enclosing an ice-making compartment and a food storage compartment, an evaporator for cooling said refrigerator, said evaporator having a portion in heat exchange relation with said ice-making compartment and a portion in heat exchange relation with said food storage compartment, and a valve for controlling the flow of refrigerant to and a second valve for controlling the evaporation of refrigerant from that portion of said evaporator which is in heat exchange relation with said food storage compartment, said valves being actuated in response to the temperature within said food storage compartment.

16. In a cooling unit for refrigerating apparatus, the combination of a cooling member adapted to contain liquid refrigerant, a supply reservoir adapted to contain liquid refrigerant, a second reservoir, means for conducting refrigerant from the supply reservoir to the cooling member, and means for forcing liquid refrigerant from the cooling member into the second reservoir for regulating the cooling action of the cooling member without affecting the level of liquid refrigerant in said first named reservoir.

17. In a cooling unit for refrigerating apparatus, the combination of a cooling member adapted to contain liquid refrigerant, a supply reservoir adapted to contain liquid refrigerant, a second reservoir, means for conducting refrigerant from the supply reservoir to the cooling member, and temperature responsive means for forcing liquid refrigerant from the cooling member into the second reservoir for regulating the cooling action of the cooling member without affecting the level of liquid refrigerant in said first named reservoir.

18. In a cooling unit for refrigerating apparatus, the combination of a cooling member adapted to contain liquid refrigerant, a supply reservoir adapted to contain liquid refrigerant, a second reservoir, means for conducting refrigerant from the supply reservoir to the cooling member, means for forcing liquid refrigerant from the cooling member into the second reservoir for regulating the cooling action of the cooling member, and means for preventing pressure from building up in the second reservoir when liquid refrigerant is forced into the second reservoir.

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