

June 19, 1956

T. E. HOYE ET AL

2,750,758

AUTOMATIC DEFROSTING REFRIGERATOR CABINET

Filed July 12, 1954

3 Sheets-Sheet 1

FIG. 1.

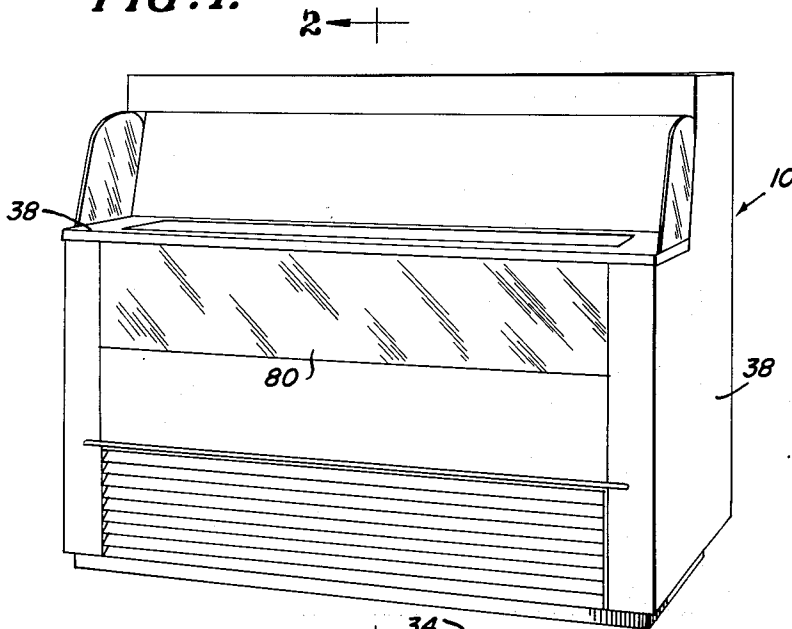
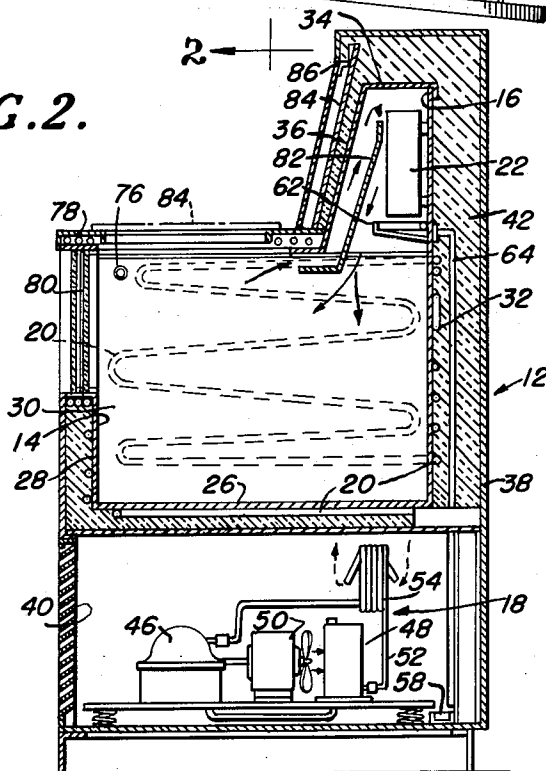


FIG. 2.



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FIG. 3.

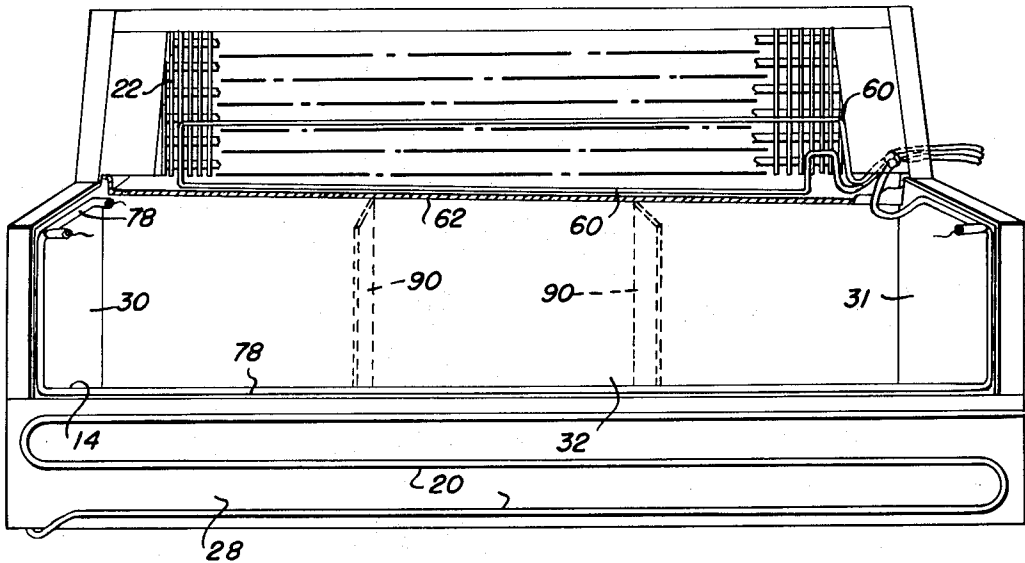
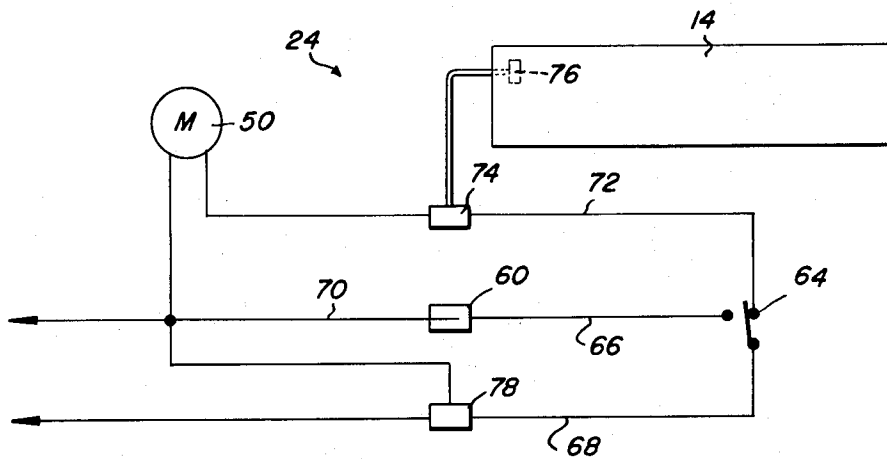


FIG. 6.



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3 Sheets-Sheet 3

FIG. 4.

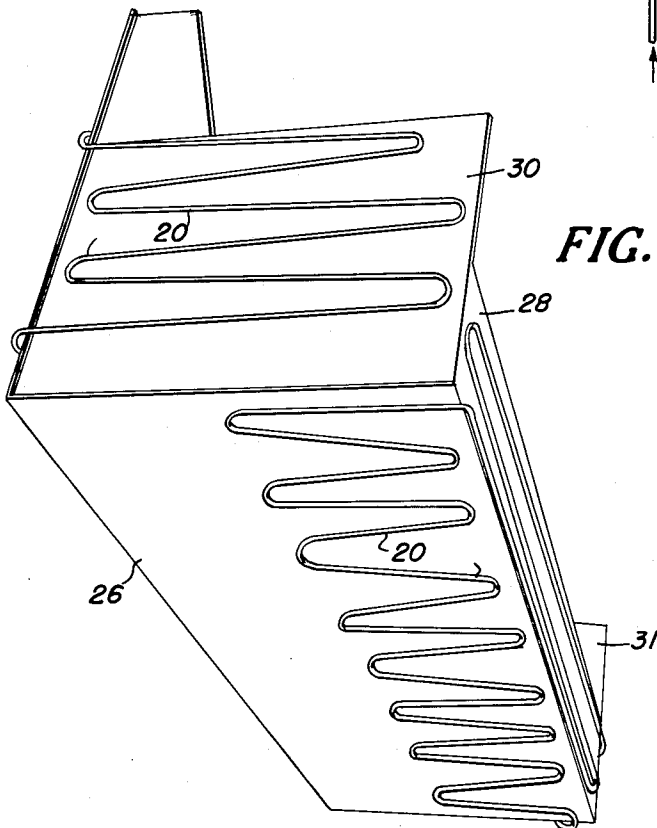
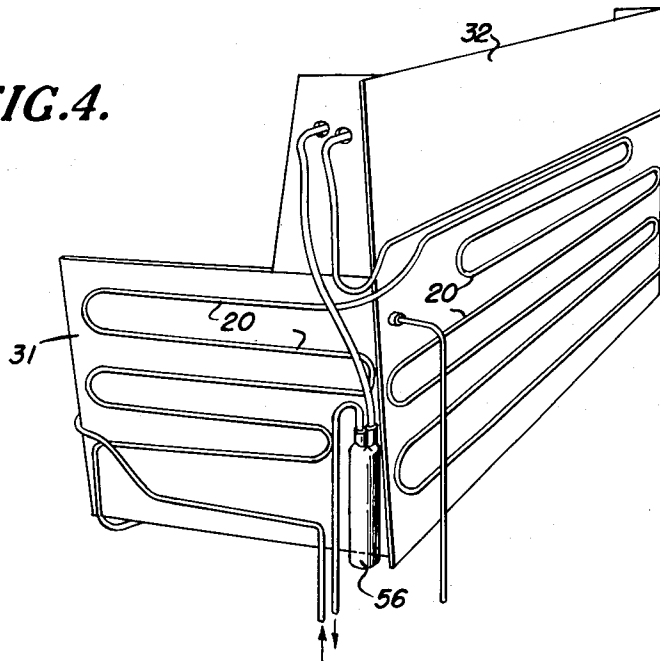


FIG. 5.

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AUTOMATIC DEFROSTING REFRIGERATOR CABINET

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8 Claims. (Cl. 62—4)

This invention relates to refrigerated display cabinets and more particularly to an automatically defrosted refrigerated display cabinet having an open chamber for displaying ice cream and other products which must be maintained at sub-zero temperatures.

In the well known open top low-temperature refrigerated display cabinets a plurality of evaporator plates are provided within the product display chamber which also serve as partitions to divide the chamber into bins for receiving the products. With this type of cabinet, the evaporator plates are utilized to refrigerate the products and it is therefore necessary that they be in close proximity thereto in order that the products may be maintained at a sufficiently low temperature. Since deposits of frost act as an insulator on the plates, it is highly important that these plates be maintained frost free. However, since the plates constitute the primary refrigerating means it is not possible to defrost the same by any well known automatic means because of the close proximity of the product and the danger of injuring the same. This is particularly true in refrigerating ice cream products, since if they are allowed to soften and are then refrozen they tend to become icy. Consequently, it is the usual practice to operate such cabinets continuously and to remove frost deposits by scraping the plates periodically. Where a large number of display cabinets are maintained, such as by an ice cream dealer, it has been the practice heretofore to maintain a servicing crew whose sole purpose it is to scrape the evaporated plates so as to maintain the display cabinets in efficient working operation. The formation of frost within the display chamber, in addition to constituting a major source of added expense to the dealer, is particularly undesirable in self-service cabinets since the product is often presented to the customer in an unattractive condition. It has been proposed to provide an upper chamber in communication with the display chamber and to provide an upper evaporator coil in the upper chamber so that the majority of the frost will be deposited thereon. Thus, with this type of cabinet it is possible to defrost the upper coil automatically since it is not in proximity to the product and since the display chamber evaporator plates are the primary refrigerating means for the product. While this arrangement retards the formation of frost on the display chamber evaporator plates, it is still necessary to periodically scrape the plates to remove frost formation.

With the present invention, the primary refrigerating means is remote from the product thereby eliminating the necessity of evaporator plates inside the display chamber and the need to defrost the same with its attendant disadvantages. The invention contemplates the provision of a cabinet having an evaporator coil, constituting the primary refrigerating means, disposed within an upper chamber in communication with the display chamber which cooperates therewith to circulate cold air therein sufficient to maintain the product at sub-zero temperatures. Defrosting of the upper evaporator coil is accomplished automatically at a predetermined interval preferably dur-

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ing a time when the product is not on display so that the cabinet can be closed. In this manner, the warming of the primary refrigerating coils sufficient to defrost the same does not adversely affect the air temperature maintained around the product.

Accordingly, an object of the present invention is the provision of a refrigerated display cabinet having an open display chamber for receiving ice cream and other products which is completely unobstructed by evaporation plates so that the display chamber and products can be maintained free from frost deposits.

Another object of the present invention is the provision of a refrigerated display cabinet having improved means for effecting refrigerated air circulation therein so as to eliminate the necessity of blowers or fans such as are necessary in conventional cabinets.

A further object of the present invention is the provision of a refrigerated display cabinet having improved automatic defrosting means which effectively eliminates the necessity of scraping frost from the evaporator plates or coils.

A still further object of the present invention is the provision of a refrigerated display cabinet having a lower open display chamber and an upper chamber in communication therewith which has an evaporator coil therein, constituting the primary refrigerating means, for cooling any moist air which might enter through the open top so that the moisture in the air will deposit on the coil and be removed therefrom during the defrosting cycle.

A still further object of the present invention is the provision of an open top refrigerated display cabinet having improved means for reducing the circulation of air in and out of the open top.

Still another object of the present invention is the provision of a refrigerating display cabinet having an opened display chamber for receiving products therein which is provided with an improved cover for use during periods when the products are not on display.

Further objects of the invention are simplicity of design and ease and economy of manufacture and maintenance.

These and other objects of the present invention will become more apparent during the course of the following detailed description and appended claims.

The invention may best be understood with reference to the attached drawings wherein an illustrative embodiment is shown.

In the drawings:

Figure 1 is a perspective view of a refrigerated display cabinet constructed in accordance with the principles of the present invention;

Figure 2 is a cross-sectional view taken along the line 2—2 of Figure 1;

Figure 3 is a front perspective view showing the inner walls of the display cabinet and the manner in which the various heater elements are disposed therein;

Figure 4 is a rear perspective view showing the inner walls of the cabinet and the manner in which the evaporating coils are attached thereto;

Figure 5 is a bottom perspective view similar to Figure 4, and

Figure 6 is a schematic view showing the electrical system of the cabinet.

Referring now more particularly to the drawings, there is shown in Figure 1 a refrigerated display cabinet 10 embodying the principles of the present invention.

Cabinet 10 comprises in general a frame 12 defining a product receiving display chamber 14 and an upper chamber 16 communicating therewith, a refrigerating circuit 18 of the compressor-condenser-expander type, including lower evaporator coils 20 surrounding chamber 14 and upper evaporator coil 22 within upper chamber 16

and an electrical circuit 24 for automatically controlling the circuit 18, defrosting the evaporator coils 22 and for energizing resistance wires for a purpose hereinafter to be described.

The product receiving display chamber 14 of frame 12 is provided by an inner base or bottom wall 26, a low inner front wall 28 extending upwardly from the forward end thereof, inner end walls 30 and 31 connected with the bottom wall and front wall and an inner rear wall 32 extending upwardly from the bottom wall between the end walls and above the upper edges thereof. A short inner top wall 34 extends forwardly from the upper end of the inner rear wall 32 and an inner curtain wall 36 extends downwardly and forwardly from the inner top wall 34 to the upper edges of the end walls so as to provide the upper chamber 16. The frame also includes suitable outside frame walls 38 within which the inner walls are positioned and which provide a lower housing 40 for receiving the operating elements of the refrigerating circuit. Suitable insulation 42 may be provided between the outside walls 38 and the inner walls as shown in Figure 2.

The lower evaporator coils 20 of the refrigerating circuit 18 are preferably secured, as by soldering or the like, to the outer surface of the inner walls defining the product receiving display chamber 14 and, as shown in the drawings, may include a continuous pipe coiled so as to cover substantially the entire outer surface of the inner walls. As shown in Figures 4 and 5, the pipe extends upwardly into engagement with the inner end wall 30 from where it extends to the front inner wall 28, the bottom wall 26, the end wall 30, the rear wall 32, the opposite end wall 31 and then back across the rear wall from where the pipe leads into the upper evaporator coil 22. The upper evaporator coil 22 is preferably of the plate type and is disposed within the upper chamber as shown in Figure 2.

The refrigerating circuit 18 further includes the usual compressor 46, condenser 48, electric motor 50, capillary tube 52, heat exchanger 54 and accumulator or dryer 56. The circuit operates in the usual manner whereby refrigerant flows from the condenser 48 through capillary tube 52, heat exchanger 54 into lower evaporator coils 20 from where it passes into the upper evaporator coil 22. From the coil 22 the refrigerant then passes into the accumulator or dryer 56, then back through the heat exchanger 54 and into the compressor 46.

The electrical circuit 24 preferably includes resistance wires 60 which are secured adjacent the upper evaporator coil 22 so as to defrost the same. A drip pan 62 is preferably disposed below the evaporator coil 22 so that water coming from the coil during defrosting will be received therein and directed through a suitable discharge pipe 64 leading to the housing 40. Suitable means, such as pan 58, may be provided for catching the water as it proceeds from the discharge pipe 64. The resistance wires 60 are also preferably disposed on the upper surface of the drip pan 62 so that the water from the expansion coil 22 will be maintained in a liquid state to assure proper discharge through the pipe 64. As shown in Figure 6, the resistance wires 60 are adapted to be operated by a suitable timing switch of a well known construction, illustrated schematically at 64, so that during a given period or periods of time in each day the resistance wires will be connected to a source of electrical power through suitable lead wires 66, 68 and 70. When the time switch 64 is actuated, it completes a circuit through the resistance wires 60 and breaks a circuit through lead wire 72 to the motor 50 to render the refrigerating circuit inoperable. The normal operation of the refrigerating circuit is controlled by a thermostatic switch 74, connected with lead wire 72, which is operated by a suitable feeler bulb 76 preferably mounted in the upper corner of the display chamber 14. The electrical circuit also includes suitable resistance wires 78 which surround the opening of the chamber 14 and a display window 80 provided in the front wall of the cabinet. The wires 78 may be connected in the circuit as shown

or may be connected with a separate circuit which likewise provides for continuous heating thereof.

The upper evaporator coil 22 is maintained at a lower temperature than the evaporating coils 20 (approximately 16° to 20° F. differential) so as to establish a convectional circulation of air between the chambers 14 and 16. Thus, as the air within the chamber 14 is warmed by the products therein, it will become lighter and rise into the upper chamber 16 where it is immediately cooled by the evaporator coil 22, so that, as heavier cooled air, it will circulate downwardly into the chamber 14, thus completing the cycle. In order to positively direct the circulation of air, a suitable baffle plate 82 may be provided between the two chambers. The baffle plate 82 preferably includes a first portion extending downwardly and forwardly of the coil 22 and a second portion extending forwardly therefrom within the upper portion of the chamber 14. As shown in Figure 2, the air within the chambers will circulate, as indicated by the directional arrows, upwardly in front of the baffle plate 82 and downwardly past the evaporator coil 22 behind the baffle plate 82 into the lower chamber.

Since the cabinet is adapted to be used for displaying products with the product receiving chamber open at its top, the resistance wires 78 surrounding the same will warm the air adjacent the open top so as to provide a blanket of warm air therein which tends to reduce air circulation in and out of the chamber 14. In addition, the wires will maintain the portion adjacent the open top comfortable to the touch and prevent condensation on the window 80.

When the cabinet is not being used for display purposes, as for example, during the early morning hours and the like, the open top may be closed by a suitable cover 84 as shown in phantom lines in Figure 2. The cover 84 may be conveniently stored when not in use adjacent the front of the curtain wall 36 and for this purpose, the outer wall thereof is pivoted, as at 86, to permit the cover 84 to be moved thereunder.

When it is desired to partition off the open display chamber 14, suitable divider plates 90 (Figure 3) may be provided therein. The plates 90 are preferably adjustably mounted within the chamber so that they may be removed entirely or utilized to divide the chamber into partitions of varying sizes.

In operation, the refrigerating circuit is maintained at sub-zero operating temperatures by actuation of feeler bulb 76 and thermostating switch 74 of the electrical circuit which in turn controls the operation of the motor 50. Thus, actuation of the motor 50 will operate the compressor 46 so that liquid refrigerant will flow therefrom through the condenser and into the capillary tube 52 and heat exchanger 56 leading to the evaporator coils 20. As the liquid refrigerant passes through the capillary tube, it is partially expanded into gaseous state within the coils 20 from where it passes into the larger evaporator coil 22 where a further expansion takes place. The refrigerant then flows out of the evaporator coil 22 into accumulator or dryer 56 and then back through the heat exchanger into the compressor. When the air temperature within the upper portion of the chamber 14 has reached a predetermined low temperature, such as -10° F., the thermostatic switch 74 acts to break the circuit 72, thereby shutting off the motor 50. When a predetermined upper temperature, such as -6° F. is reached, the thermostatic switch 74 will be actuated to complete the motor circuit so that the refrigerating circuit will again be operated to cool the air.

When the time switch 64 is operated, such as in the early morning hours, the circuit 72 is broken, thus rendering the refrigerating circuit inoperative and the defrosting resistance wires 60 are energized through lead wires 66 and 70. The time switch is preferably set so that the wires 60 will be energized for a predetermined time, as for example, 30 minutes during the early morning hours

of each day. During this time interval, the frost which has accumulated on the upper coil 22 will melt and run off through the drip pan 62 and out the drain pipe 64 into pan 58 in the housing 40. It has been found that approximately ½ cup of water per day is all that will be accumulated in the normal operation of the defrosting cycle so that it will evaporate into the atmosphere from the receiving pan. It is also to be noted that when the defrosting wires 60 are energized, the coils 22 will be heated to a temperature above that maintained in the coils 20 thereby increasing the pressure of the refrigerant contained therein. Accordingly, since the defrosting period may be predetermined to take place at a time when the products are not being displayed to the customers, the chambers may be closed during defrosting by means of the cover 84. During the defrosting cycle the refrigerating circuit is rendered inoperative and the upper coils are warmed sufficiently to melt any frost that has accumulated thereon. Without the cooling effect of the upper coils the normal convectional circulation of air is interrupted and therefore the primary refrigerating means is temporarily ineffective to maintain the necessary sub-zero display chamber air temperatures necessary. To aid in maintaining the necessary air temperature during the defrosting cycle, the cover 84 acts to entrap the cold air in the chambers. Finally, since the defrosted coil is remote from the product and in the upper part of the enclosed cabinet, the warmed air adjacent the upper coil tends to remain in the upper chamber. In this manner the air temperature surrounding the product is not materially raised, thus protecting the product from damage and permitting a substantially complete automatic frost removal.

It is significant to note that the primary refrigerating means which maintains the products cold is provided by the upper coil 22. For example, it will be noted that when ice cream packages are placed within the chamber 14, the majority of the packages will not be in contact with any of the inner walls so as to be cooled directly thereby. Note particularly that a large number of packages will be disposed in the upper middle portion of the chamber. The air temperature in this portion of the cabinet must therefore be maintained at a sub-zero temperature to provide effective cooling to preserve the product. The cooling of the air is accomplished through the convectional circulation of the air past the upper evaporator coil 22. While, as mentioned above, the resistance wires 78 surrounding the opening to the chamber 14 provide an effective blanket of warm air which tends to reduce air circulation in and out of the opening, it will be seen that where moist, relatively warm air is introduced into the chamber 14, as when a customer reaches therein, the current of air circulating between the two chambers will carry the moist warm air upwardly directly into the upper chamber 16. As the air is cooled by the upper coil, the moisture therein will condense and deposit on the coil as frost. In this manner, any outside air which may enter the cabinet is immediately carried to the upper coil where substantially all of the moisture is removed so that as the air is cooled and circulated into the product display chamber there will be substantially no moisture therein to form frost either on the inner walls or the product itself.

It can thus be seen that there has been provided a refrigerated display cabinet having an open product receiving display chamber which is free from any obstructing evaporator plates and an upper chamber in communication therewith. The upper chamber includes an evaporator coil disposed therein which is maintained at a relatively low temperature so as to establish a convectional circulation of refrigerated air between the two chambers whereby the air warmed by the product circulates upwardly past the upper coil, is cooled and circulates downwardly into the display chamber. The cabinet also includes a continuously heated resistance wire which provides a blanket of warm air in the cabinet opening to reduce air circulation in and out of the chambers. In this manner,

any outside air which may enter the opening of the cabinet is immediately carried to the upper coil where it is cooled and the moisture therein is condensed and deposited on the upper coil. Thus, the lower chamber is continuously supplied with a circulation of cooled dry air which effectively refrigerates products carried therein and minimizes frost deposit thereon. This makes possible the further provision of an automatic defrosting means which maintains the primary refrigerating coil free from excessive frost deposits so that the same may operate most effectively. Moreover, defrosting may be carried on while the product is maintained at a safe low temperature.

It is to be understood, however, that the form of the invention herewith shown and described is to be taken as the preferred embodiment of the same and that various changes may be made without departing from the spirit of the invention or the scope of the appended claims.

We claim:

1. An automatically defrosting display cabinet for ice cream and the like comprising a frame including lower inner walls defining a product receiving chamber having an open top and upper walls defining an upper chamber having an open bottom communicating with a portion of said open top, a refrigerating apparatus including lower expansion coils carried by said frame adjacent to and entirely outside of said lower inner walls, an upper expansion coil in said upper chamber connected to said lower expansion coils, the relative cooling capacities of said upper and lower expansion coils being such as to cool the air in the upper chamber to a lower temperature than the temperature of the air in the product receiving chamber so as to establish a circulation of warmed air upwardly from said product receiving chamber into said upper chamber and cooled air downwardly therefrom into said product receiving chamber, means for controlling the operation of said refrigerating apparatus, means for automatically defrosting said upper coil, and heater means carried by said frame adjacent the open top thereof for creating a blanket of warm air therein so as to reduce air circulation in and out of said open top.

2. An automatically defrosting display cabinet as defined in claim 1 wherein said lower expansion coils include a coil secured to the outer surface of each of said lower inner walls.

3. An automatically defrosting display cabinet as defined in claim 1 including a member pivoted to the upper portion of said frame and a cover for said open top movable to a position behind its pivoted member.

4. An automatically defrosting display cabinet as defined in claim 1 including a plurality of divider elements removably mounted within said product receiving chamber.

5. An automatically defrosting display cabinet for ice cream and the like comprising a frame including an inner bottom wall, an inner front wall extending upwardly therefrom, inner end walls secured to said bottom and front walls, and an inner rear wall secured to said bottom wall and said end walls and extending above the latter, said inner walls defining a product receiving chamber having an open top, said frame further including walls cooperating with the upper portion of said inner rear wall defining an upper chamber having an open bottom communicating with the rear portion of the open top of said product receiving chamber, a refrigerating apparatus including inter-connected expansion coils secured to the outer surface of each of said inner walls and an upper expansion coil of larger internal cross sectional area than said interconnected expansion coils disposed within said upper chamber adapted to receive refrigerant from said interconnected expansion coils whereby said refrigerant expands and is under a lower pressure in said upper coil thus maintaining said upper coil colder than said lower coils so as to establish a circulation of warmed air upwardly from said product receiving chamber into said upper chamber and cooled air downwardly therefrom into said

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product receiving chamber, means in the upper portion of said product receiving chamber for controlling the operation of said refrigerating apparatus, means operable at a predetermined time for automatically defrosting said upper coil and heater means carried by said frame adjacent the open top thereof for creating a blanket of warm air therein so as to reduce air circulation in and out of said open top.

6. An automatically defrosting display cabinet as defined in claim 5 including an angular baffle having a first portion disposed in said upper chamber forward of said upper coil and a second portion extending forwardly therefrom disposed below the upper edge of said inner end walls, the warmed air from said product receiving chamber being directed upwardly in front of said baffle where it is cooled by said upper expansion coil and then downwardly behind said baffle.

7. An automatically defrosting display cabinet as defined in claim 5 including a drip pan disposed below said upper expansion coil and wherein said defrosting means

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includes electrical wires secured to said upper coil and to said drip pan.

8. An automatically defrosting display cabinet as defined in claim 1 including a drip pan disposed below said upper expansion coil and wherein said defrosting means includes electrical wires secured to said upper coil and to said drip pan.

References Cited in the file of this patent

UNITED STATES PATENTS

2,287,681	Hazard	June 23, 1942
2,302,051	Philipp	Nov. 17, 1942
2,313,390	Newton	Mar. 9, 1943
2,430,329	Davis	Nov. 4, 1947
2,460,469	Rifkin	Feb. 1, 1949
2,483,804	Brinkoeter	Oct. 4, 1949
2,494,481	Macmaster	Jan. 10, 1950
2,683,355	Schmidt	July 13, 1954