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REFRIGERATOR WITH WATER REPELLENT WALL

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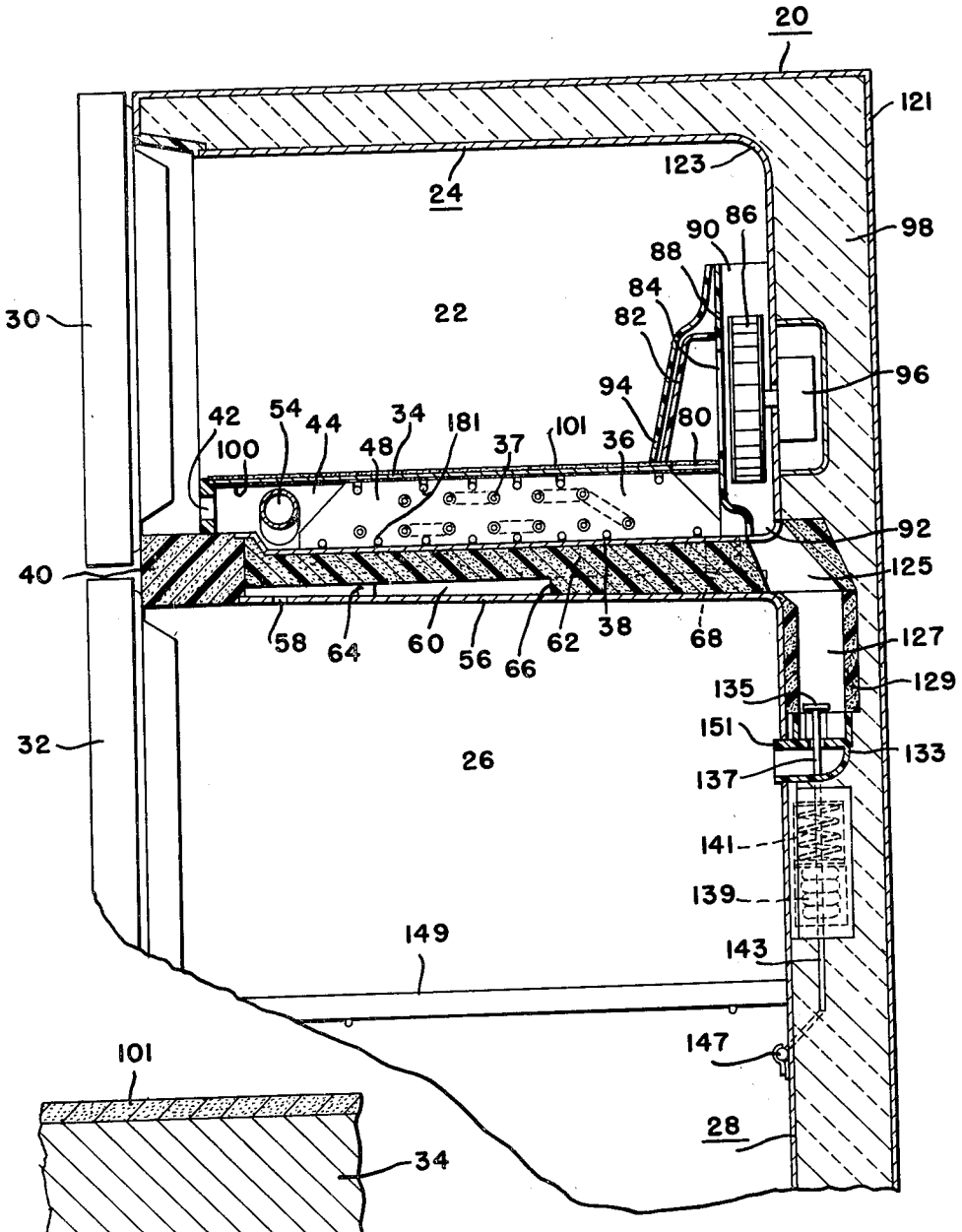


Fig. 1

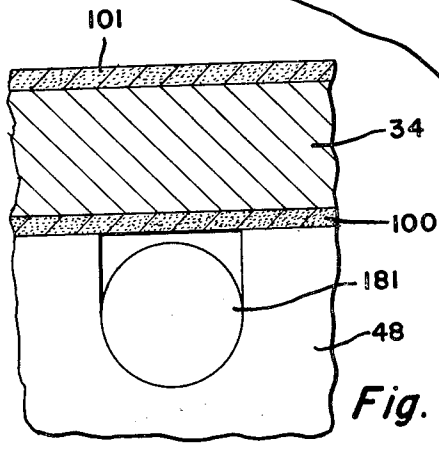


Fig. 2

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REFRIGERATOR WITH WATER REPELLENT WALL

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This invention pertains to refrigerating apparatus and more particularly to refrigerated walls having surfaces exposed to water vapor.

Where refrigerated walls have surfaces exposed to water vapor, condensation ordinarily is not uniform over the surface. Consequently, condensation may be concentrated at various undesirable points. This is more objectionable when the walls have exposed bottom surfaces refrigerated to below freezing temperatures. Under such conditions, long icicles gradually form and obstruct air flow. This obstruction to the air flow is serious regardless of whether forced or natural air circulation is employed.

Where finned evaporators operating at below freezing temperatures are in contact with the bottom surface, the icicles form between and in front of the fins to obstruct the flow of air. When such finned evaporators are defrosted, the icicles are sufficiently isolated from the evaporators to remain after the defrosting is completed. As a result, the defrosting must be continued and prolonged until the heat is transmitted through the wall which is in contact with the finned evaporator until the icicle is melted. This is objectionable since it unnecessarily raises the temperature of the wall and also prolongs the defrosting period promoting a rise in temperature of the refrigerated compartments.

It is an object of this invention to prevent the concentration of condensation of water vapor and the formation and accumulation of icicles upon the bottom surface of refrigerated walls exposed to water vapor.

It is another object of this invention to prevent the formation of icicles upon the bottom surface of a wall between the fins of an evaporator in contact with such a wall.

These and other objects are attained in the form of the invention shown in the drawings in which the top as well as the bottom surface of the wall which rests upon the top of the fins of the evaporator is provided with a water repellent coating. This prevents the concentration of the condensation upon the bottom surface and particularly prevents the formation of icicles. The condensation of water vapor is thereby caused to be concentrated upon the evaporator and the fins of the evaporator upon which the frost will form. Consequently, no icicles will form between the fins of the evaporator and the evaporator can be readily defrosted within a relatively short time. The water repellent coating upon the top of the wall prevents the sticking of wet trays and packages placed thereon.

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 embodiment of the present invention is clearly shown.

In the drawings:

FIGURE 1 is a transverse vertical sectional view through a two-compartment refrigerator embodying one form of my invention; and

FIGURE 2 is a fragmentary enlargement of a portion of the wall and evaporator as shown in FIGURE 1.

Referring now to the drawing, there is shown a refrigerator cabinet 20 provided with an upper below-freezing compartment 22 enclosed within an inner liner 24 and a lower above-freezing compartment 26 enclosed within an inner liner 28. The compartment 22 is closed by an insulated door 30. The compartment 26 is closed by an insulated door 32. The below-freezing compartment 22 is provided with a false sheet metal bottom wall 34 which rests on the tops of the vertical fins of the evaporator 36. The bottoms of the vertical fins of the evaporator 36 rest upon the bottom 38 of the liner 24. The front of the false bottom wall 34 is spaced from the door 30 and the bottom 38 as well as the door jamb 40 to provide a centrally located entrance 42 for the cold air from the below-freezing compartment 22. This entrance 42 leads to the central portion of the evaporator compartment 44 which is located between the false bottom wall 34 and the bottom 38 of the liner 24.

The evaporator 36 includes serpentine refrigerant tubing 37 extending horizontally from side to side within the evaporator compartment 44 provided with vertical, closely spaced fins 48. The front and rear edges of the fins are preferably all bevelled substantially from the top to the bottom as shown in FIGURE 1. The outlet of the evaporator 36 is connected to an accumulator 54 extending from side to side at a slight angle across the front of the evaporator compartment 44 in front of the evaporator 36.

The top wall 56 of the inner liner 28 of the above-freezing compartment 26 is provided with slots 58 just behind the door jamb 40. Air from the above-freezing compartment is drawn through the slots 58 into a thin, wide, divided passage 60 located between the top wall 56 and a cast insulating member 62 located between the top wall 56 of the liner 28 and the bottom wall 38 of the liner 24. The spacing of the top wall 56 from the insulation slab 62 is maintained by the round projection 64 and the V-shaped projection 66 which divides the flow of air at the rear of the space 60 so as to guide it through the upwardly-extending passages 68 at the rear corners to the sides of the evaporator compartment 44. This air which is humid, coming from the above-freezing compartment 26, is cooled and dried as it passes forwardly along the sides of the evaporator compartment 44 and then mixes at the front of the evaporator compartment 44 with the cold dry air entering through the front opening 42. The air from both compartments 22 and 26 therefore is mixed at the front of the evaporator compartment 44 and flows through the evaporator 36 between the fins thereof to the rear between the false bottom wall 34 and the bottom wall 38 of the liner 24.

The rear edge of the false bottom wall 34 is provided with a large centrally located notch 80 forming the outlet to the evaporator compartment 44. It is covered by an inlet shroud 82 which also encloses the inlet opening 84 of a centrifugal fan 86 located just in front of the rear wall of the below-freezing compartment liner 24. The centrifugal fan 86 is enclosed in a scroll 88 of plastic resin having an upwardly-extending discharge outlet 90 and a diagonally downwardly-extending discharge outlet 92. The inlet shroud 82 and the scroll 88 as well as the discharge outlet 90 are enclosed in an ornamental cover 94 of plastic resin which serves to prevent the air from gaining access to these members so as to prevent the deposit of frost thereon. The centrifugal fan 86 is driven by an electric motor 96 mounted in the recess in the insulation 98 located between the inner liner 24 and the outer sheet metal wall 121 of the cabinet 20. The centrifugal fan 86 creates the rearward circulation of the mixed air through the evaporator compartment 44 and the evaporator 36 by drawing the air through the openings 80 and 84 and discharging the air through the discharge outlets 90 and 92.

The air discharge from the outlet 90 impinges against the large fillet 123 at the meeting edges of the top and rear walls of the inner liner 24 directly above the outlet

90. This distributes the air substantially uniformly throughout the compartment 22 so that all parts of this compartment 22 are maintained substantially at the same temperature. The second downwardly directed discharge outlet 92 connects with the passage 125 extending downwardly through the rear of the insulation slab 62 and connecting with the passage 127 in the insulation piece 129. These insulation pieces 62 and 129 are preferably molded of polyurethane foam or foamed polystyrene.

Positioned beneath the insulation piece 129 is a plastic valve housing 133 of polymerized resin provided with a valve 135 connected to an operating rod 137 operated by the bellows 139 under the control of a spring 141. The bellows 139 is operably connected through the capillary tube 143 which extends through a passage in the insulation 98 and an aperture in the rear wall of the liner 28 and connects with the thermostat bulb 147 fastened beneath the shelf 149 to the rear wall. This valve structure is calibrated to close the valve 135 when the bulb is cooled to 33° F. and to fully open the valve 135 when the bulb 147 reaches 37° F. The valve housing 133 has a discharge nozzle 151 discharging directly into the above-freezing compartment 26. This air circulating from the discharge opening 151 through the compartment 26 to the openings 53 maintains the atmosphere in the compartment 26 suited to provide adequate refrigeration at above-freezing temperatures. The evaporator 36 is controlled to maintain the temperature in the compartment 22 between the temperatures of −2° F. and +11° F. This causes the evaporator 36 to be maintained below these temperatures by a motor-compressor-condenser unit which is connected to the evaporator 36 and controlled in accordance with the temperatures of the compartment 22. Since this is conventional, this is not shown.

The bottom surfaces of the false bottom wall 34 are maintained at temperatures well below freezing by the evaporator 36 having its fins in contact with it and by the air in the below-freezing compartment 22 above the false bottom wall 34. In the past, there has been a tendency to form on the bottom surface of the false bottom wall 34 icicles which grow in between the fins 48 of the evaporator 36 and also in front of the evaporator 36. These icicles seriously affect and diminish the flow of air through the evaporator 36 and through the compartment 44 and thereby diminish the efficiency and capacity of the system. The fins 48 of the evaporator 36 are provided with deep notches in their upper edges containing a sheathed tubular electric defrost heater 181. This defrost heater also extends through notches in the bottom of these fins which, however, are not as deep. The bottom section of the heater 181 is arranged so that its bottom surface rests upon the bottom wall 38 of the inner liner 24 so as to melt any frost from this bottom wall during any defrost period. When the evaporator 36 becomes coated with a sufficient amount of frost to impair the proper maintenance of refrigeration temperatures in the compartments 22 and 26, refrigeration is stopped and the electric heater 181 is energized to melt the frost therefrom. However, since the icicles form on the bottom surface of the false bottom wall 34 between and in front of the fins 48 of the evaporator 36, these icicles are not readily removed by the heater 181. Therefore, it is necessary either to allow the icicles to remain after the defrost period or to prolong the defrost period until the false bottom wall 34 is heated sufficiently to cause the icicles to drop therefrom. This, however, is highly objectionable since it warms the bottoms of any packages stored on the false bottom wall 34 and also allows the temperature within the compartments 22 and 26 to rise further during the extension of the defrost period.

According to our invention, in order to eliminate the formation of these icicles and the concentration of the condensation of water vapor upon the bottom of the false bottom wall 34, we provide a water repellent coating 100 extending throughout the entire bottom surface of the false bottom wall 34. This water repellent coating tends to prevent the condensation of the water vapor upon the bottom surface of the false bottom wall 34 excepting at the areas immediately in contact with the fins 48 of the evaporator 36. As an incident to this coating 100, the top surface is provided with a similar coating 101 which has the function of preventing the sticking of wet trays and packages resting thereon.

Examples of satisfactory water repellent coatings which may be applied to false bottom wall 34 may be found in the Canter and Geyer Patent 2,404,431, issued July 23, 1946. The wall 34 may be dipped into the coating material as explained in said patent. A more recently developed water repellent coating which is also suitable for coating the false bottom wall 34 is a mixture of an epoxy resin with a formaldehyde base resin together with carnauba wax and a microcrystalline hydrocarbon wax. These ingredients in the proper proportions and dissolved in a suitable solvent may be applied to the wall 34 by dipping the parts therein, air drying and then baking to polymerize the resins and form a tough, adherent coating on the article being coated.

A preferred formula for the coating material is as follows:

Example I

	Parts by weight
Epoxy resin	39 to 41
Melamine formaldehyde resin	9 to 11
Carnauba wax	1 to 3
Microcrystalline wax	5 to 7
Butyl acetate	200 to 220
Butyl alcohol	200 to 220
Xylol	360 to 400

The solids content of this solution is maintained at 6% to 7%. The coating is preferably formed by mixing equal quantities of butyl acetate, xylol and butyl alcohol with the epoxy resin to dissolve the resin wherein the mixture includes about 50% by weight of resin. The melamine formaldehyde component is dissolved in a mixture of equal parts of butyl alcohol and xylol wherein the melamine formaldehyde resin component, in dissolved form, comprises about 60% by weight of the mixture.

The carnauba wax and microcrystalline wax are melted in a steam-jacketed tank maintained at 150° F. or below and the remaining xylol is added thereto. Finally, the two resins in solution, the dissolved waxes together with the remaining butyl acetate and butyl alcohol solvents are mixed together to form the coating material.

It is apparent that all of the solid ingredients may be added to all of the solvents but, in this instance, the mixing problems are accentuated whereas by dissolving the several solid ingredients separately and then mixing the solutions, the problems are greatly reduced. When all ingredients are dissolved at once, the temperature of the mixture should not exceed 150° F.

The epoxy resin is a polymer of epichlorohydrin and bisphenol A having an epoxide equivalent of 450 to 2000. The epoxy resin and the melamine formaldehyde resin, both being reactable in their mixed condition, are copolymerizable during subsequent steps and, in this connection, the melamine formaldehyde resin triggers the reaction of the epoxy resin. For this reason, only sufficient melamine formaldehyde is used to complete the reaction of the epoxy resin since any great surplus of melamine formaldehyde resin will make the coating brittle which is not usually desirable if any flexing occurs in the wall 34 to which the coating is subsequently applied. On the other hand, the epoxy resin, when fully polymerized, though generally hard, is, nevertheless, pliable and is not brittle which is one of the major factors contributing to the long life and rugged character of the coating.

The microcrystalline hydrocarbon wax is any of the high melting point waxes of the methane series having an empirical formula of from $C_{30}H_{62}$ and $C_{35}H_{72}$. Waxes in

this range have melting points above 170° F. as differentiated from commercial grades of paraffin which has an empirical formula of $C_{24}H_{50}$ and a melting point of about 128° F. This high melting point wax is generally preferred although paraffin ($C_{24}H_{50}$) may be used in the coating and still provide considerably more effective ice shedding properties than any known prior art coating. In general, the wax component comprising the carnauba wax and the paraffin series wax should make up between 10% and 20% by weight of the total resin ingredient.

Thus, by the simple action of providing a water repellent coating for the bottom surface of this false bottom wall 34, the objectionable formation of icicles is effectively prevented.

While the embodiment of the present invention, as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. Refrigerating apparatus including a cabinet having insulated walls and an insulated door enclosing a compartment to be refrigerated, means associated with said insulated walls including a metal wall forming an evaporator compartment separate from said compartment to be refrigerated, a refrigerant evaporating means in said evaporator compartment, means for circulating humid air from said compartment to be refrigerated through said evaporator compartment back to said compartment to be refrigerated, said metal wall having a downwardly turned face exposed to said evaporator compartment provided with a surface of water repelling material to prevent the formation from the humid air of icicles depending from said downwardly turned face.

2. Refrigerating apparatus including a cabinet having insulated walls and an insulated door enclosing a compartment, an evaporating means provided with a plurality

of transverse fins located in said compartment, a metal wall in said compartment dividing said compartment into a first subcompartment to be refrigerated and a second subcompartment containing said evaporating means and transverse fins, said metal wall on the face exposed to said second subcompartment facing downwardly and being provided with a surface of water repelling material, means for circulating humid air from said first subcompartment through said second subcompartment in heat transfer with said evaporating means and said fins back to said first subcompartment, said surface of water repelling material extending into contact with edge portions of the fins, the surface of water repelling material preventing the formation from the humid air of icicles depending from said face between said fins.

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