

Aug. 1, 1961

L. J. MANN ET AL
FROSTLESS REFRIGERATOR

2,994,209

Filed Feb. 26, 1959

4 Sheets-Sheet 1

Fig. 3

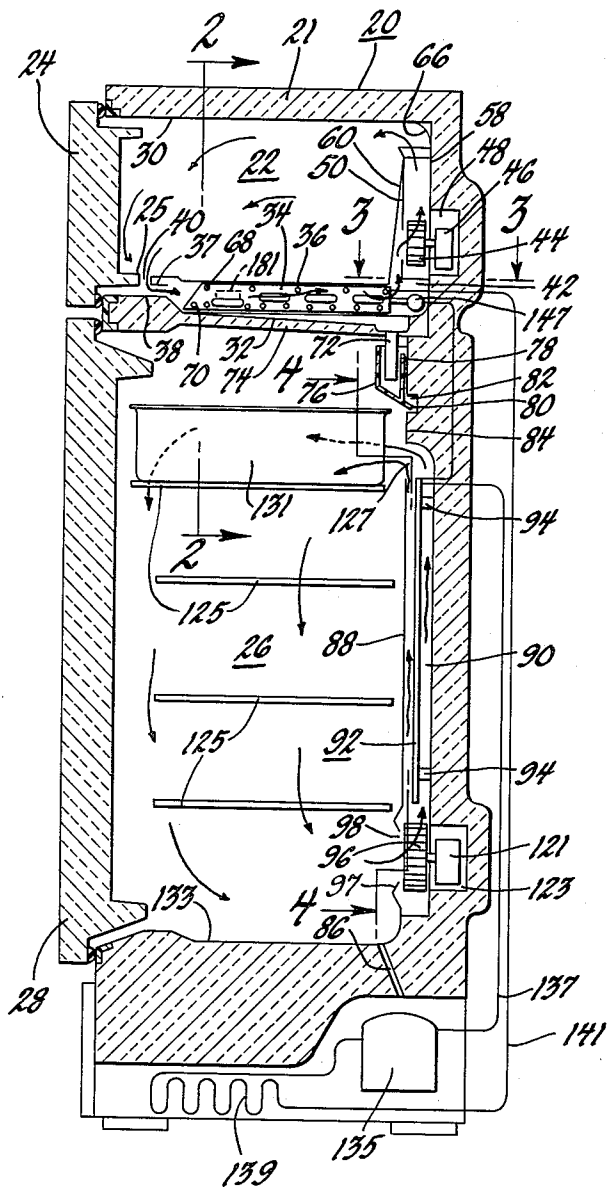
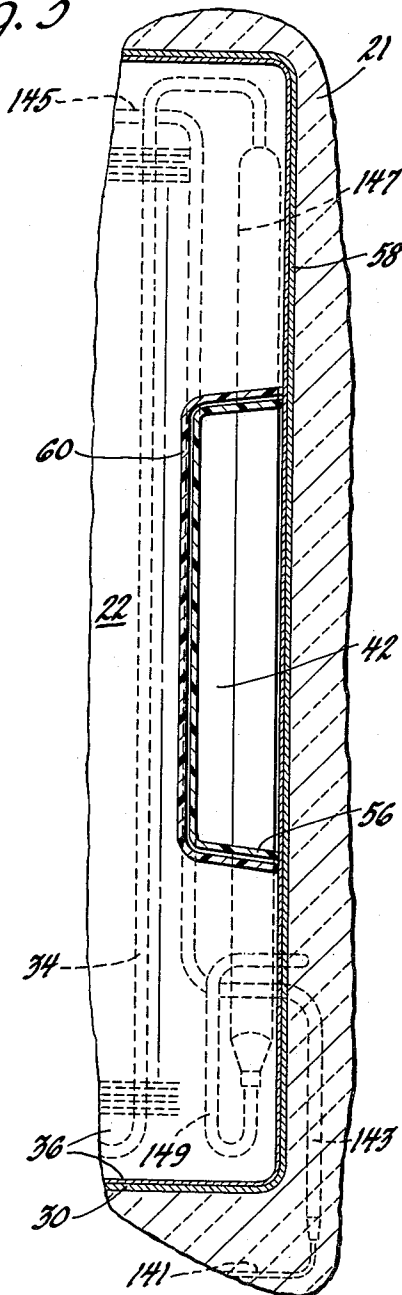


Fig. 1



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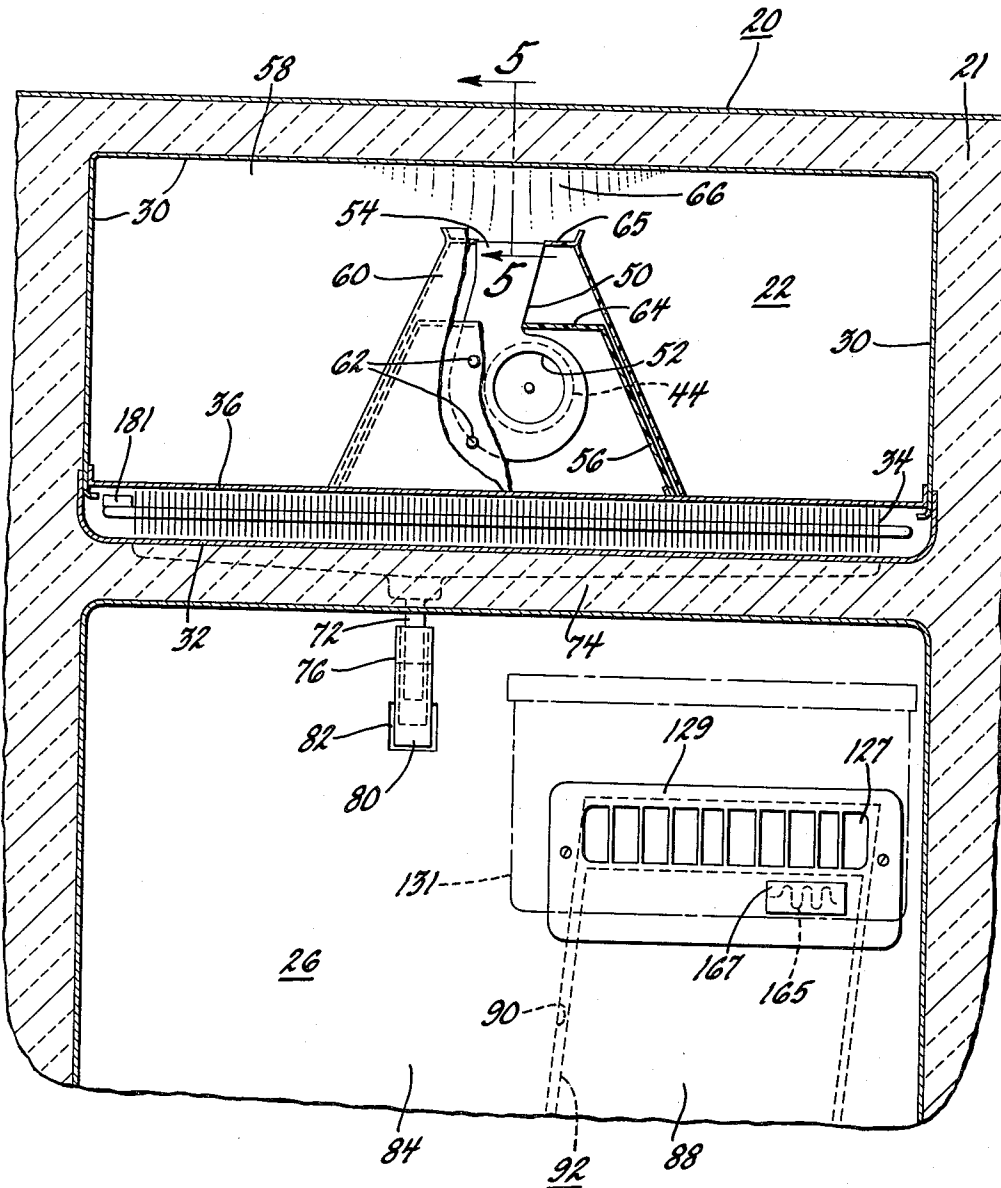


Fig. 2

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4 Sheets-Sheet 3

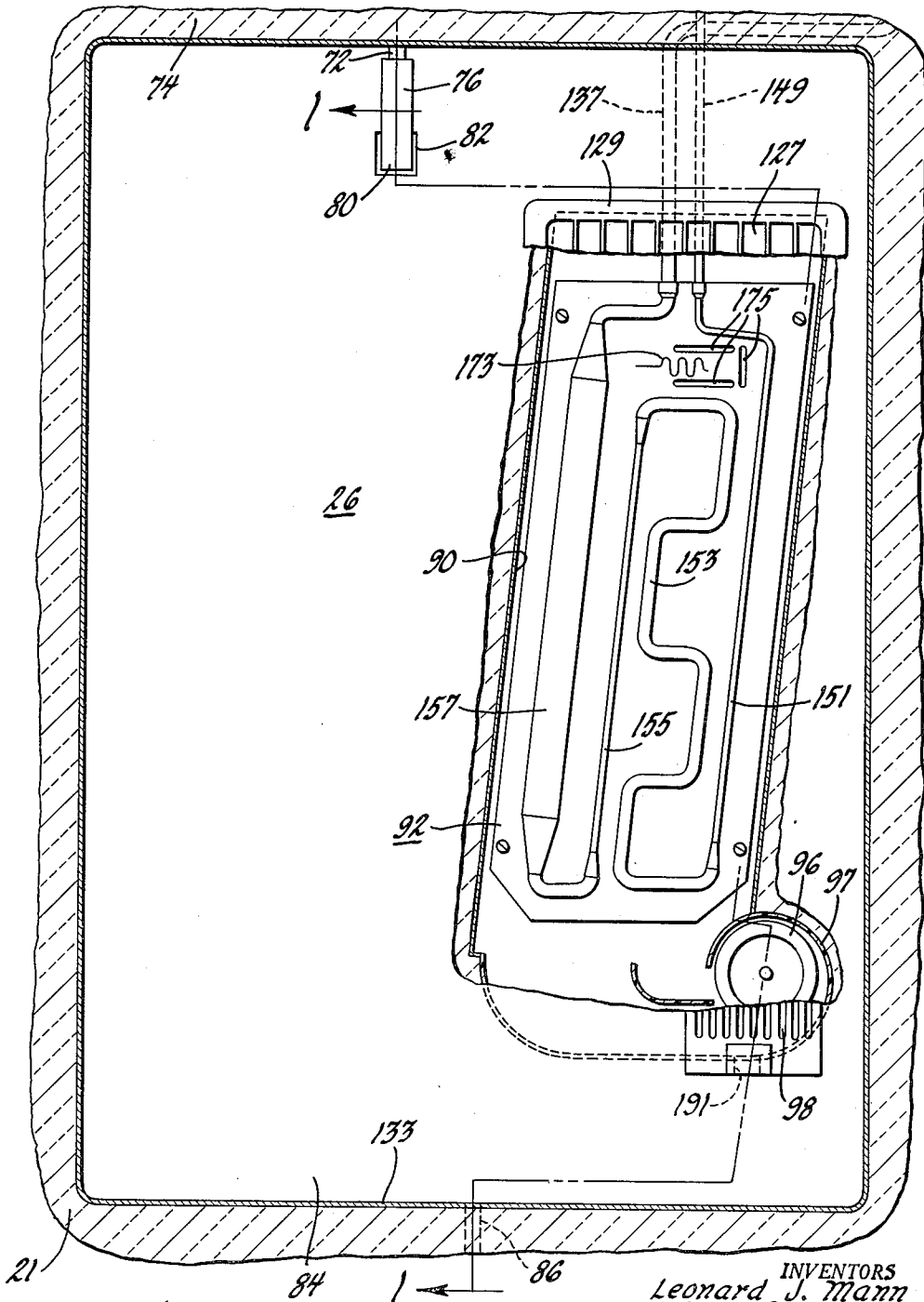


Fig. 4

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4 Sheets-Sheet 4

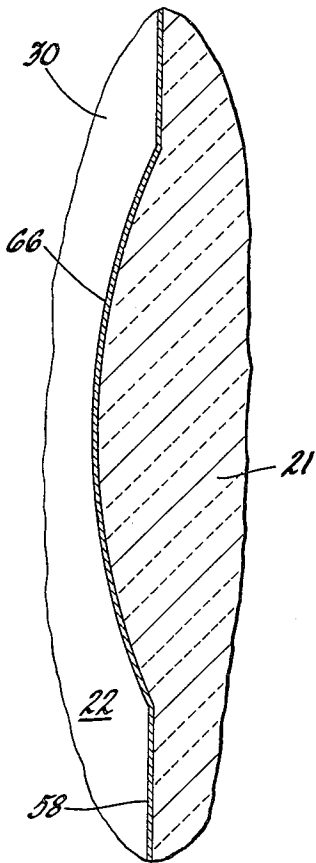


Fig. 6

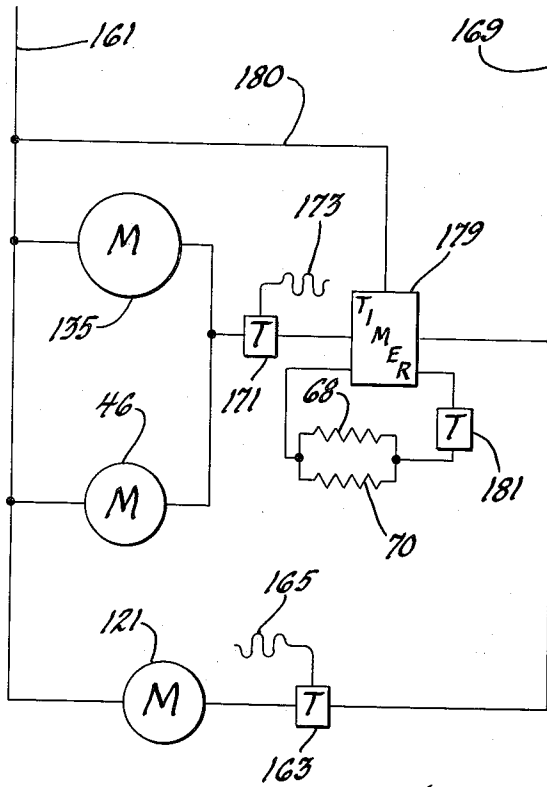


Fig. 7

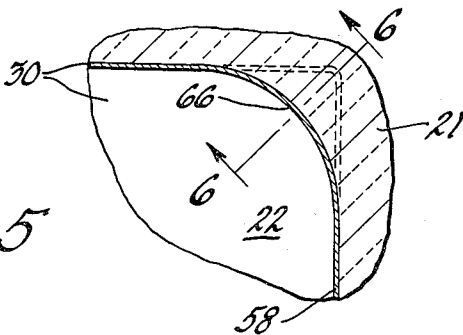


Fig. 5

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FROSTLESS REFRIGERATOR

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Filed Feb. 26, 1959, Ser. No. 795,789

4 Claims. (Cl. 62-215)

This invention relates to refrigerating apparatus and more particularly to a refrigerator which will not frost in either the below or above freezing compartments.

Refrigerators in which no frost forms in either the below or above freezing compartments achieved popularity within a short time after their introduction. However, the higher price of the initial models has prevented the attainment of large sales volumes.

An object of this invention is to provide a lower cost refrigerator in which neither the below nor the above freezing compartments accumulate any frost.

It is another object of this invention to provide a simpler, lower cost, air circulation arrangement for the below freezing compartment which will provide substantially uniform temperatures and rapid ice freezing without the formation or accumulation of frost therein.

It is another object of this invention to provide a simpler, lower cost arrangement for the disposal of defrost water from concealed refrigerant coils of two temperature refrigerators.

These and other objects are attained in the form shown in the drawings in which the evaporating means for the freezing compartment is provided beneath and in heat transfer relation with a false bottom wall spaced above the door opening at the front to provide an air entrance from the below freezing compartment. Fan and duct means are provided within the compartment at the rear for drawing air beneath the false bottom wall through the evaporator and discharging the cooled and dried air against an air distributing and deflecting surface which spreads the air evenly over the top of the compartment to provide uniform air distribution. The drip pan beneath the evaporator has an outlet which during defrosting drains into a trap located in the above freezing compartment beneath. This trap overflows onto the rear wall for disposal.

An accumulator is provided between the outlet of the evaporator beneath the false bottom wall and the plate type of evaporator provided behind the false rear wall of the above freezing compartment. This plate evaporator is provided with restricted passages on opposite sides of the serpentine passages to return liquid refrigerant from the serpentine passages to the accumulator during the off cycles to hasten defrosting of this plate. A fan is provided for discharging air upwardly on either side of the plate which discharges onto a meat tender located in the above freezing compartment for keeping the meat tender adequately cooled at a temperature of about 30° F. while the remainder of the above freezing compartment is maintained at about 36° F.

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 vertical sectional view taken on the line 1-1 of FIGURE 4 through a refrigerator embodying one form of my invention;

FIGURE 2 is a fragmentary vertical sectional view taken along the lines 2-2 of FIGURE 1;

FIGURE 3 is a fragmentary horizontal sectional view taken along the lines 3-3 of FIGURE 1;

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FIGURE 4 is a fragmentary irregular vertical sectional view taken along the lines 4-4 of FIGURE 1;

FIGURE 5 is a fragmentary vertical sectional view taken along the lines 5-5 of FIGURE 2;

FIGURE 6 is a fragmentary inclined sectional view taken along the line 6-6 of FIGURE 5; and

FIGURE 7 is a wiring diagram of the electrical system.

Referring now to the drawings and more particularly to FIGURE 1, the refrigerator cabinet includes an outer metal shell 20 containing at the top the below freezing compartment 22 provided with an insulated door 24 and beneath it the above freezing food compartment 26 provided with its own insulated door 28. A sheet metal member 30 forms the inner top and sides of the below freezing compartment 22. The bottom of this below freezing compartment 22 is provided by a sheet metal drip pan 32 upon which rests the transverse finned refrigerant evaporator 34 having vertical fins extending from front to rear. This evaporator 34 may be maintained at 0° F. to -10° F. Resting on top of the fins of the evaporator 34 is a false bottom wall 36 having its front edge 37 turned downwardly and rearwardly and spaced from the adjacent projection 25 of the door 24 as well as from the adjacent mullion 38 to provide a front air exit 40 from the freezing compartment 22 as well as an air entrance to the space beneath the false bottom wall 36 containing the evaporator 34.

The false bottom wall 36 has an opening 42 at the rear. Above this opening 42 is a centrifugal fan 44 driven by a small electric motor 46 located in a recess 48 in the rear wall between the back of the compartment 22 and the outer shell 20. The centrifugal fan 44 is enclosed in a suitable scroll 50 as shown in FIGURE 2 having an axial inlet opening 52 and an upper discharge opening 54. The inlet 52 of the scroll 50 is connected by the inner truncated duct member 56 to the opening 42 in the false bottom wall 36. The inner duct 56 has a horizontal web 64 at the top making sealing engagement with the fan scroll 50. This truncated inner duct member 56 fits the upwardly extending flanges extending around the opening 42 on the false bottom wall 36 and abuts the rear wall 58 and the discharge portion of the scroll 50 to provide a sealed enclosure connecting the opening 42 with the opening 52 so as to insure the drawing of the air from the compartment 22 through entrance 40, the evaporator 34, the opening 42, the inner duct 56 and the opening 52 for discharge by the fan 44 through the discharge opening 54 of the scroll 50. A sealing plastic material is preferably used to insure the airtightness of these joints to prevent leakage.

Surrounding the inner duct 56 and the scroll 50 is an outer tapered truncated cover duct 60 which is spaced from the inner duct 56 by spacing projections 62 formed on the outer face of the inner duct 56. These spacing projections insure that a substantially dead air space is provided between the inner duct 56 and the outer cover duct 60 to prevent the transfer of heat from the inner duct 56 to the outer cover duct 60 to prevent the formation of frost on the surfaces of the duct 60. The top of the scroll 50 adjacent the outlet 54 is provided with an outward flange which abuts against a web 65 in the top of the tapered truncated external cover duct 60 having an aperture registering with the outlets of the scroll 50. This substantially seals the space between the inner duct 56, the scroll 50 and the outer cover 60, all of which seal against the rear wall 58. All of these members may be made of a suitable plastic material such as polystyrene.

To assure good distribution of the cold air issuing from the outlet 54, there is provided a suitable air deflector and distributor 66 in the form of an arcuate fillet at the center of the upper rear corner where the top wall 30 and the

rear wall 58 merge as illustrated in the enlarged views, FIGURES 5 and 6. In this deflector 66, the fillet is the greatest in size at the middle and diminishes as illustrated in FIGURE 6 as the distance from the center increases. This deflector 66 spreads the air laterally over the top of the compartment 22 so that it is evenly distributed laterally as it moves forwardly and downwardly to the exit 40 from the compartment 22. Through this, all of the packages in the compartment 22 are maintained at a substantially uniform temperature of between 0° and 5° F.

Periodically the fan motor 46 is stopped, and the evaporator 34 and the drain pan 32 are heated by the upper and lower electric heaters 68 and 70. The defrost water collects on the drain pan 32 and flows through the down pipe 72 through the insulated wall 74 beneath the drain pan 32 into the overflow trap 76 which is made of a suitable plastic. This overflow trap 76 has an overflow wall 78 at the rear over which the defrost water flows onto the lip 80 extending into the notch 82 in the rear wall 84 of the above freezing compartment 26. The defrost water flows down the rear wall 84 and is drained from the bottom of the above freezing compartment 26 through a suitable drain tube 86.

The above freezing compartment 26 is provided with a false rear wall 88 and a long vertical recess 90 behind the false rear wall 88 containing an upright plate type refrigerant evaporator 92 which is slightly skewed as shown in FIGURE 4. This evaporator 92 is mounted in spaced relation to the false rear wall 88 and the recess 90 by spacing supports 94 so as to provide a passage on both faces of the evaporator 92. A centrifugal fan 96 enclosed in the scroll 97 is mounted behind the lower opening 98 in the false rear wall 88. It is driven by an electric motor 121 located in a recess 123 in the rear wall 84 of the above freezing compartment 26. Any water collecting in the bottom of the recess 90 will drain through the concealed outlet 191. The fan 96 and the motor 121 as well as the recess 123 may be identical to the fan 44, the motor 46 and the recess 48. Between the walls of the compartments 22 and 26 and the outer shell 20, there is preferably provided insulating material 21 of any suitable type, such as a foamed plastic material containing a gas having good insulating properties.

The operation of the fan 96 draws air from the above freezing compartment 26 through openings in and around the shelves 125 through the opening 98 and discharges the air upwardly along opposite faces of the evaporator 92 to the upper outlet opening 127 at the top of the false rear wall 88 which is provided with a suitable grille 129 diverting the air discharged from the recess 90 laterally. The meat tender 131 is placed directly in front of the discharge outlet opening 127 so that it receives the direct blast of air to keep it at excellent meat storage temperatures, such as about 30° F. The air is circulated at a rate through the above freezing compartment 26 sufficient to keep it at about 36° F.

Beneath the bottom wall 133 of the above freezing compartment 26 is the motor-compressor unit 135 which condenses the evaporated refrigerant drawn through the suction conduit 137 and forces this compressed refrigerant into the condenser 139 where it is liquefied and conducted through a capillary tube 141 to a transverse section of tubing 143 at the rear of the evaporator 34 connecting to a forwardly extending portion 145 at the opposite side of the evaporator which in turn connects to the first pass of evaporator tubing extending across the front of the evaporator 34. The evaporator tubing extends horizontally in serpentine fashion through the upright transverse fins of the evaporator 34, and the last pass at the rear thereof connects to a horizontal accumulator chamber 147 located behind the evaporator 34.

The opposite end of this accumulator chamber 147 is connected to tubing 149 extending back over the top of the accumulator 147 so as to form a liquid trap and extends downwardly and connects to the top of a down-

wardly extending restricted passage 151 in the evaporator 92. The bottom of this restricted passage 151 connects to the bottom of a larger upwardly extending serpentine passage 153 in the center of the evaporator 92. The top of the serpentine passage 153 connects to a second downwardly extending restricted passage 155 substantially like the restricted passage 151. This passage 155 connects to the bottom of an enlarged accumulator passage 157 in the evaporator 92. The passages 151, 155 and 157 are parallel and substantially upright. These passages together with the recess 90 and the evaporator 92 are skewed at an angle of about 6° so as to place the grille 129 off to one side behind the meat tender 131 and away from the trap 76. The top of the accumulator chamber 157 in the evaporator 92 is connected to the suction conduit 137 connecting with the sealed motor-compressor unit 135.

As shown in the wiring diagram, FIGURE 7, the supply conductor 161 connects to one terminal of the compressor motor 135 and each of the fan motors 46 and 121. The second terminal of the fan motor 121 connects to a cycling snap acting thermostat switch 163 controlled by a thermostat bulb 165 mounted behind a plastic cover 167 on the grille 129 as shown in FIGURE 2 so that it is responsive slowly to the temperature of the air in the above freezing compartment 26. The thermostat switch 163 cycles the fan motor 121 so as to keep the compartment 26 at a temperature of about 36° F. This control of the fan motor also keeps the meat tender 131 at a temperature of about 30° F. The second terminal of the thermostat 163 connects to the second supply conductor 169.

The second terminal of the compressor motor 135 and the upper fan motor 46 are connected to the same side of the cycling snap acting thermostat switch 171 controlled by the thermosensitive bulb 173 mounted in the upper portion of the evaporator 92 above the serpentine passage 153. The bulb 173 is shielded from the inflowing refrigerant in the restricted passage 151 by the three barrier slots 175 located to the right, above and below the bulb 173 as shown in FIGURE 4. This thermostat switch 171 is preferably set to open at a temperature of -10° F. and to close at a temperature of about 36° F. assuring the defrosting of the evaporator 92 during each cycle. The defrosting of the evaporator 92 is accelerated by the restricted passages 151 and 155 which are sufficiently narrow so that liquid and gas may be entrained to provide a percolator action. These restricted passages 151 and 155 therefore form vapor lift passages. The restricted passage 155 percolates liquid refrigerant out of the bottom of the accumulator 157 up to the top of the serpentine passageway 153. Liquid refrigerant from the bottom of the passageway 153 is percolated by the vapor lift action up through the restricted passageway 151 and the tubing 149 into the accumulator chamber 147 during the early part of each off cycle. The percolating of the liquid refrigerant in the evaporator 92 back into the accumulator after the opening of the thermostat switch 171 makes it possible for this evaporator 92 to defrost more quickly and to reduce the length of the off periods so that refrigeration of the below freezing compartment 22 may be resumed before there is any appreciable rise in temperature in that compartment. The defrost water from the evaporator 92 flows to the outlet 86.

The second terminal of the thermostat switch 171 connects to a defrost timer 179. The defrost timer 179 has an additional supply connection by the conductor 180 which during a defrost period connects the supply conductor 161 to the upper and lower defrost heaters 68 and 70. These two heaters 68 and 70 connect through a limiter switch 181 located at the opposite end of the first two passes of the evaporator 34 as shown in FIGURE 1. The defrost timer 179 periodically, such as once a day, deenergizes the sealed motor compressor unit 135 and the fan motor 46 and energizes the heaters 68 and 70 to melt the frost from the evaporator 34. This frost is entirely outside the compartment 22 and accumulates on the

evaporator 34 because the evaporator, in cooling the air, cools the air below the dew point and the frost point. The heating of the evaporator 34 is sufficiently rapid that packages within the compartment 22 will not be materially heated. The defrost limiter switch 181 opens at about 45° F. and terminates the energization of the heaters 68 and 70 after which the timer 179 resumes the refrigeration.

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. A refrigerator including an insulated cabinet having a storage compartment, said compartment having a door and door opening on one upright wall and top and side and rear upright walls, upwardly extending duct means on one of said upright walls provided with an upwardly directed outlet, means for cooling air and circulating the cooled air through said duct means into said compartment and discharging the cooled air from said outlet, the intersection of the top wall and one of said upright walls being provided with an air distributing surface located above said outlet and impinged upon by the air discharged from the outlet of said duct means, said distributing surface being spaced from said outlet and in direct alignment with said outlet in the direct blast of air issuing from said outlet, said distributing surface being in the form of a fillet having an enlarged center portion with gradually diminishing portions on opposite sides of the center portion.

2. A refrigerator including an insulated cabinet having an upper below freezing compartment and a lower above freezing compartment, a first evaporator for cooling said below freezing compartment, a second evaporator in the form of an upright plate having a principal passage arrangement with upright restricted passages connected to opposite ends of said principal passage arrangement, an accumulator chamber located adjacent said below freezing compartment connected to the outlet of said first evaporator and the upper end of one of said upright passages of said plate, a second accumulator chamber connected to the other upright passage, and a cycling refrigerant liquefying means having its outlet connected to the inlet of said first evaporator and having its inlet connected to the second accumulator chamber.

3. A refrigerator including an insulated cabinet having an upper below freezing compartment and a lower above freezing compartment, a first evaporator for cooling said below freezing compartment, a second evaporator in the form of an upright plate having a principal passage ar-

range ment with upright restricted passages connected to opposite ends of said principal passage arrangement, an accumulator chamber located adjacent said below freezing compartment connected to the outlet of said first evaporator and the upper end of one of said upright passages of said plate, a second accumulator chamber connected to the other upright passage, refrigerant liquefying means having its outlet connected to the inlet of said first evaporator and having its inlet connected to the second accumulator chamber, thermostatic cycling snap acting switch means having a thermosensitive controlling element mounted in thermal exchange with said plate above said principal passage, said plate being provided with slots between said thermosensitive element and said one upright passage to reduce the effect of the refrigerant in said passage upon said thermosensitive element.

4. A refrigerator including an insulated cabinet having a below freezing compartment provided with a bottom and a rear wall, a generally horizontal refrigerant evaporator immediately above and throughout a major portion of said bottom, a horizontal false bottom wall having its major portion resting in heat transfer relationship upon said evaporator, said false bottom wall being spaced from the bottom of said compartment at the front to provide an air entrance and spaced from the bottom rearwardly from said air entrance to provide an air passage extending with said evaporator to cool the air, said false bottom wall having a notch on its rear edge to provide an open area at the rear, fan means located above said open area of said false bottom wall discharging into said below freezing compartment, said fan means including a motor recessed into said rear wall and a forwardly projecting fan, and duct means within said below freezing compartment surrounding said fan and connecting the inlet side of said fan means with said open area at the rear of said false bottom wall.

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