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2,532,816

AIR CIRCULATING ARRANGEMENT FOR REFRIGERATORS

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2 Sheets-Sheet 1

Fig. 1.

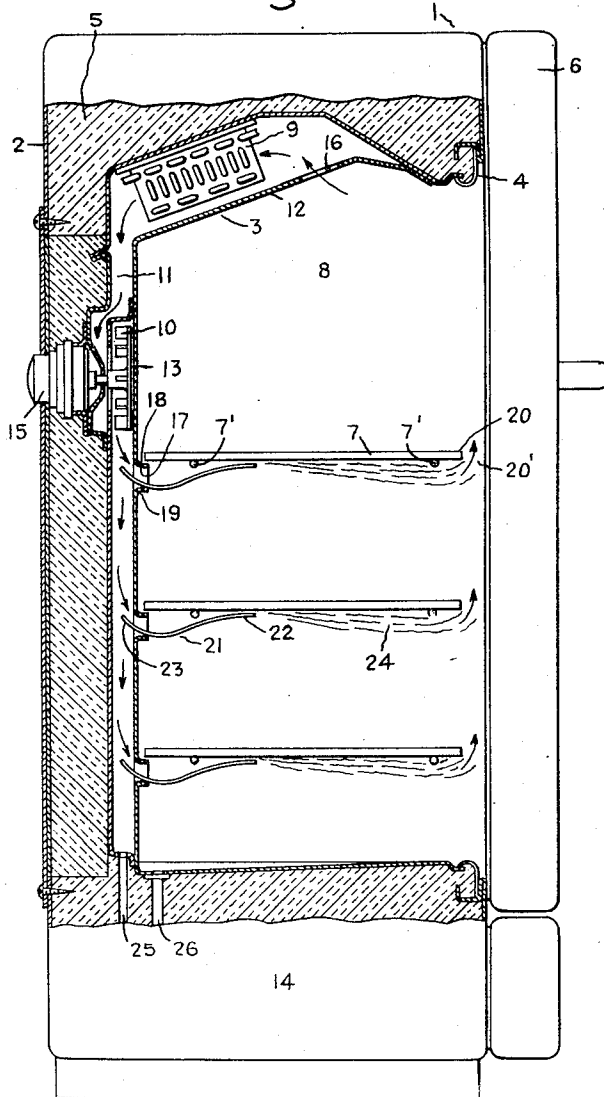
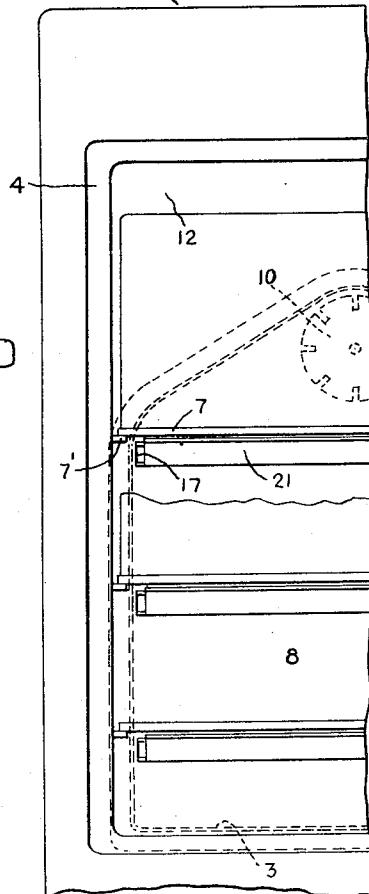


Fig. 2.



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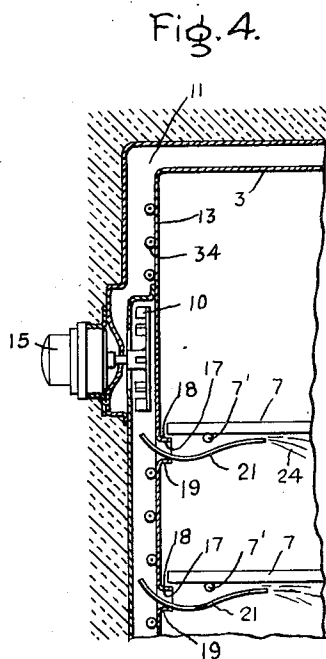
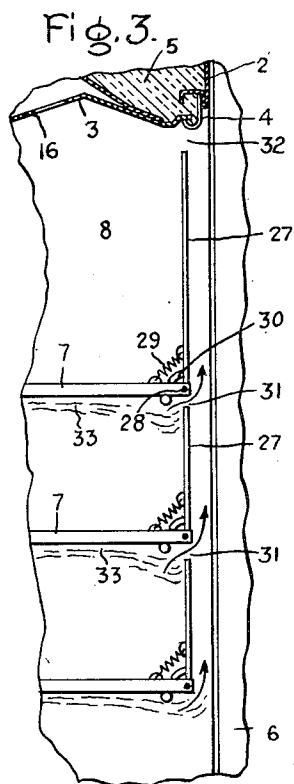
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2 Sheets-Sheet 2



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AIR CIRCULATING ARRANGEMENT FOR REFRIGERATORS

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12 Claims. (Cl. 62—102)

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My invention relates to refrigerator cabinets and more particularly to air circulating arrangements therefor.

It has been found difficult to obtain high humidity conditions in a refrigerator cabinet which minimize the drying out of food stored therein and at the same time to minimize the condensation of moisture and the dripping of this moisture onto the food. Circulating air through the refrigerator has been found satisfactory for minimizing the condensation of moisture on articles such as shelves from which it drips onto the food, but the circulation of a sufficient quantity of air to accomplish this purpose tends to dry out the food stored in the refrigerator. By my arrangement air is directed in such a manner that the dripping of moisture from the shelves onto the food stored below is minimized but at the same time the drying out of the food is also minimized.

Accordingly, it is an object of my invention to provide an improved air circulating arrangement for refrigerators in which the dripping of moisture onto the food is minimized and in which the drying out of food is also minimized.

Further objects and advantages of my invention will become apparent as the following description proceeds, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming part of my invention.

In carrying out the objects of my invention an air circulating arrangement is provided in which air is generally confined to an area near the undersurface of shelves in the refrigerator cabinet so that the moisture condensing thereon is rapidly removed before it has an opportunity to drip onto the food. Air circulation over the remainder of the area between shelves is minimized so that drying out of the food is also minimized.

For a better understanding of my invention reference may be had to the accompanying drawings in which Fig. 1 is a side sectional elevation view of a refrigerator incorporating an embodiment of my invention; Fig. 2 is a front elevation view of a portion of the refrigerator shown in Fig. 1; Fig. 3 is a side sectional elevation view of a portion of the refrigerator illustrating a modified form of my invention; and Fig. 4 is a side elevation view of a portion of the refrigerator illustrating another modification.

Referring now to Figs. 1 and 2, there is shown a refrigerator cabinet 1 including an outer wall 2 and an inner wall or liner 3 which defines a food storage compartment. The space between the inner and outer walls adjacent the access opening of the refrigerator is closed by a breaker strip 4 of a material of low heat conductivity, and the space between the inner and outer

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walls is filled with a suitable heat insulating material 5. The access opening of the refrigerator is closed by a door 6. A plurality of spaced shelves 7, resting on shelf supports 7', are provided within a food storage compartment 8 defined by the liner 3. These shelves are substantially imperforate so as to divide the compartment 8 into separate subcompartments.

In order to cool the air and to circulate the cold air through the food storage compartment 8 an evaporator 9 and a fan 10 are provided. The evaporator and fan are both arranged within a duct 11 which extends along the exterior of the top wall 12 and rear wall 13 of the liner 3. Refrigerant is supplied for cooling the evaporator 9 from any suitable refrigerating apparatus (not shown) disposed within a machinery compartment 14 located at the bottom of the refrigerator. The fan is driven by an electric motor 15. Air is withdrawn from the food storage compartment 8 through an opening 16 in the top wall 12 of the liner 3, is circulated by the fan through the duct 11 over the evaporator 9, and is discharged back to the food storage compartment through a plurality of openings 17 in the rear wall 13 of the liner. Each of the openings 17 is arranged in a particular manner immediately below a corresponding one of the shelves 7. These openings 17 extend substantially completely across the width of the rear wall 13 of the liner 3 and are formed by flanging inwardly portions of the rear wall to provide lips 18 and 19 adjacent each of the openings. The air entering the openings 17 from the duct 11 is directed by the lips 18 and 19 toward the front of the refrigerator adjacent the underside of each of the shelves 7. Because of the velocity of the air entering the compartment 8 through the openings 17 and because of the directing of this air by the lips 18, 19 in a direction forwardly adjacent the underside of each shelf 7 the moving strata of air deviates little in a vertical direction from the underside of the shelf 7. Hence, even at the forward edge 20 of each of the shelves the moving body of air still extends only a small distance below the underside of each shelf 7 and contact of the moving air with food stored on the shelf below is minimized. I have found that making the height of the openings 17 about $\frac{1}{2}$ inch confines moving air generally to the region beneath the corresponding shelf.

In order to still further direct the air into the desired region, guides or deflectors 21 are secured to the liner 3 adjacent the lower lips 19 of the openings. The forward edge 22 of each of the deflectors 21 is positioned quite close at the lower surface of the corresponding shelf 7. I have found that positioning this forward edge within $\frac{1}{8}$ inch of the lower surface of the corresponding shelf 7 causes the moving air to be confined even

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more closely to the region adjacent the lower surface of the shelf. The guides or deflectors 21 serve an additional function in that the rear ends 23 extend into the duct 11 so as to scoop the air positively from the duct and direct it into the food storage compartment 8. The deflectors are curved as indicated to provide a smoother change in the direction of the air. The deflectors 21 may be omitted, if desired, since the lips 18, 19 direct the air into the region adjacent the underside of the shelves. However, I prefer to employ these deflectors because of the additional air-directing effect and because of their function in scooping air from the duct. The forward edges 20 of the shelves 7 are spaced from the inner face of the door to provide elongated openings 20'. The air passes upwardly from the subcompartments between adjacent shelves 7 and between the lowest shelf and the bottom of the liner 3 through these openings 20'. The width of these openings, that is, the distance between the front edges of the shelves and the inner face of the door, is approximately one inch.

With the arrangement disclosed I have found that the moving air is substantially confined within an area indicated by the wavy lines 24 and hence contact between the moving body of air and articles stored on the shelf below the openings admitting the air is minimized. The air moving across the under surface of each of the shelves 7 takes up any moisture condensing thereon and this moisture is carried by the air stream through the opening 16 and is deposited on the cold surface of the evaporator 9. On the other hand, food stored on the shelves, not being subjected to the moving stream of air, is not caused to dry out. Hence, the advantages of a higher humidity refrigerator from a standpoint of food preservation are obtained without the disadvantage of water dripping onto the food. The direction of air movement in the cabinet is indicated by the arrows in Fig. 1.

The evaporator 9 may be defrosted at intervals and the defrost water flows through the duct 11 and is discharged through a drain 25 into any suitable receptacle (not shown) in the machinery compartment 14. A drain 26 is also provided from the food storage compartment 8 to the machinery compartment for discharging any defrost water which may flow into the food storage compartment.

In a modified form of my invention shown in Fig. 3 doors or barriers 27 are provided at the forward edges of the shelves 7. The same numerals have been used to designate corresponding parts in Figs. 1, 2 and 3. The doors 27 are hinged at 28 and are biased toward the vertical position shown by springs 29. Movement of the doors under the influence of the springs is limited by stops 30 secured to the doors 27 and engaging the shelves 7. Each of the doors is spaced from the shelf above by a small amount, as indicated at 31, corresponding generally to the spacing of the openings in the rear wall beneath the shelves, and the upper door 27 is spaced slightly from the top forward edge of the liner 3, as indicated at 32. I have found about one inch to be a desirable space between the top of each of the doors 27 and the bottom of its corresponding shelf 7. These doors limit the egress of the air from each of the subcompartments to the openings 31, between the upper edge of each of the doors 27 and the corresponding shelf 7. The air being admitted to each of the subcompartments through an opening positioned closely adjacent the under side of a shelf

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7 and being discharged from each subcompartment through openings 31 also adjacent the under side of shelves 7, the air is confined closely adjacent the under side of each of the shelves 7 with the exception of a small amount eddying near the forward edge of the shelves. The general distribution of the moving body of air beneath each of the shelves is indicated by the wavy lines 33, and the direction of air movement within the cabinet is indicated by the arrows. If desired, the upper door 27 may be omitted since the air will be drawn in the general direction of the opening 16, even in absence of this upper door, giving the same general air path.

In Fig. 4 there is shown another modified form of my invention in which the food storage compartment 8 is cooled by evaporator tubing secured to the exterior of the liner 3 in lieu of utilizing the form of evaporator shown at 9 in Fig. 1. The same numerals have been used to designate corresponding parts in Figs. 1 and 4. Referring to Fig. 4 evaporator tubing 34 is secured to the exterior of the rear wall 13 of the liner 3. The tubing 34 is arranged on the wall portion 13 in a conventional manner well-known in the art, and refrigerant is circulated through the tubing 34. Air is directed by the fan 10 over the evaporator tubing 34 and into the food storage compartment 8 in the same manner as in the form of invention shown in Figs. 1 and 2.

While I have shown and described specific embodiments of my invention I do not desire my invention to be limited to the particular constructions shown and described, and I intend by the appended claims to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The refrigerator cabinet including an outer wall, an inner wall spaced from said outer wall and defining a food storage compartment, a plurality of substantially imperforate shelves arranged in spaced relationship within said compartment and dividing said compartment into sub-compartments, said inner wall having a plurality of horizontal openings therein, each of said openings being arranged immediately below the lower rear edge of a corresponding one of said shelves, the forward portion of each of said sub-compartments being unobstructed at least in the region immediately below the forward edge of said shelves, means for circulating air through said openings into said compartment, and means adjacent each of said openings for directing air toward the forward portion of said compartment closely adjacent the under side of the corresponding shelf whereby the moving stream of air is confined to the region in the vicinity of the under side of each shelf and contact between the circulating air and food stored on the shelves is minimized.

2. The refrigerator cabinet including an outer wall, an inner wall spaced from said outer wall and defining a food storage compartment, a plurality of substantially imperforate shelves arranged in spaced relationship within said compartment and dividing said compartment into subcompartments, said inner wall having a plurality of horizontal openings therein, each of said openings being arranged immediately below the lower rear edge of a corresponding one of said shelves, the forward portion of each of said sub-compartments being unobstructed at least in the region immediately below the forward edge of said shelves, an evaporator for cooling said com-

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partment, means for circulating air over said evaporator and through said openings, and means adjacent said openings for directing air toward the forward portion of said compartment closely adjacent the under side of the corresponding shelf whereby the moving stream of air is confined to the region in the vicinity of the under side of each shelf and contact between the circulating air and food stored on the shelves is minimized.

3. A refrigerator cabinet including an outer wall, an inner wall spaced from said outer wall and defining a food storage compartment, a plurality of substantially imperforate shelves arranged in spaced relationship within said compartment and dividing said compartment into subcompartments, a duct extending along the exterior of the rear portion of said inner wall, an evaporator arranged within said duct, means for circulating air over said evaporator and through said duct and said compartment, said inner wall having a plurality of horizontal openings therein for providing access for air from said duct to said compartment, each of said openings being arranged immediately below the lower rear edge of a corresponding one of said shelves, the forward portion of each of said subcompartments being unobstructed at least in the region immediately below the forward edge of each of said shelves, and means adjacent each of said openings for directing air toward the forward portion of said compartment closely adjacent the under side of the corresponding shelf whereby the moving stream of air is confined to the region in the vicinity of the under side of each shelf and contact between the circulating air and food stored on the shelves is minimized.

4. A refrigerator cabinet including an outer wall, an inner wall spaced from said outer wall and defining a food storage compartment, a plurality of substantially imperforate shelves arranged in spaced relationship within said compartment and dividing said compartment into subcompartments, a duct extending along the exterior of the rear portion of said inner wall, an evaporator arranged within said duct, means for circulating air over said evaporator and through said duct and said compartment, said inner wall having a plurality of horizontal openings therein for providing access for air from said duct to said compartment, each of said openings being arranged immediately below the lower rear edge of a corresponding one of said shelves, the forward portion of each of said subcompartments being unobstructed, and means adjacent each of said openings for directing air toward the forward portion of said compartment closely adjacent the under side of the corresponding shelf whereby the moving stream of air is confined to the region in the vicinity of the under side of each shelf and contact between the circulating air and food stored on the shelves is minimized.

5. A refrigerator cabinet including an outer wall, an inner wall spaced from said outer wall and defining a food storage compartment, a plurality of substantially imperforate shelves arranged in spaced relationship within said compartment and dividing said compartment into subcompartments, a duct extending along the exterior of the rear portion of said inner wall, an evaporator arranged within said duct, and means for circulating air over said evaporator and through said duct and said compartment, said inner wall having a plurality of horizontal open-

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ings therein for providing access for air from said duct to said compartment, each of said openings being arranged immediately below the lower rear edge of a corresponding one of said shelves, the forward portion of each of said subcompartments being unobstructed at least in the region immediately below the forward edge of each of said shelves, said rear portion of said inner wall being flanged inwardly adjacent each of said openings to provide lips for directing air toward the forward portion of said compartment closely adjacent the under side of the corresponding shelf whereby the moving stream of air is confined to the region in the vicinity of the under side of each shelf and contact between the circulating air and food stored on the shelves is minimized.

6. A refrigerator cabinet including an outer wall, an inner wall spaced from said outer wall and defining a food storage compartment, a plurality of substantially imperforate shelves arranged in spaced relationship within said compartment and dividing said compartment into subcompartments, a duct extending along the exterior of the rear portion of said inner wall, an evaporator arranged within said duct, means for circulating air over said evaporator and through said duct and said compartment, said inner wall having a plurality of horizontal openings therein for providing access for air from said duct to said compartment, each of said openings being arranged immediately below the lower edge of a corresponding one of said shelves, the forward portion of each of said subcompartments being unobstructed at least in the region immediately below the forward edge of each of said shelves, a deflector extending through each of said openings for directing air toward the forward portion of said compartment, each of said deflectors having a portion extending into said duct for diverting air from said duct and a second portion extending upwardly and forwardly from said portion of said inner wall, the forward edge of said deflector being spaced slightly from the under side of its corresponding shelf to provide a narrow horizontal opening whereby the moving stream of air is confined to the region in the vicinity of the under side of each shelf and contact between the circulating air and the food stored on the shelves is minimized.

7. A refrigerator cabinet including an outer wall, an inner wall spaced from said outer wall and defining a food storage compartment, a plurality of substantially imperforate shelves arranged in spaced relationship within said compartment and dividing said compartment into subcompartments, a duct extending along the exterior of the rear portion of said inner wall, an evaporator arranged within said duct, means for circulating air over said evaporator and through said duct and said compartment, said inner wall having a plurality of horizontal openings therein for providing access for air from said duct to said compartment, each of said openings being arranged immediately below the lower rear edge of a corresponding one of said shelves, a door hinged to each of said shelves at the forward edge thereof and extending upwardly therefrom, each of said doors being spaced from the under side of the next shelf above to provide a narrow horizontal opening adjacent the under side of said shelf for the discharge of air from the corresponding subcompartment, and means adjacent each of said first-named openings for directing air toward the forward portion of said compart-

ment closely adjacent the under side of the corresponding shelf whereby the moving stream of air is confined to the region in the vicinity of the under side of each shelf and contact between the circulating air and food stored on the shelves is minimized.

8. A refrigerator cabinet including an outer wall, an inner wall spaced from said outer wall and defining a food storage compartment, a plurality of substantially imperforate shelves arranged in spaced relationship within said compartment and dividing the compartment into subcompartments, a duct extending along the exterior of the rear portion of said inner wall, an evaporator arranged within said duct, means for circulating air over said evaporator and through said duct and said compartment, said inner wall having a plurality of horizontal openings therein for providing access for air from said duct to said compartment, each of said openings being arranged immediately below the lower rear edge of a corresponding one of said shelves, a door hinged to each of said shelves at the forward edge thereof and extending upwardly therefrom, the upper of said doors being spaced from the top of said liner to provide a passage for egress of air from said compartment to said duct, each of the remaining of said doors being spaced from the under side of the next shelf above to provide a narrow horizontal opening adjacent the under side of said shelf for the discharge of air from the corresponding subcompartment, and means adjacent said first-named openings for directing air toward the forward portion of said compartment closely adjacent the under side of the corresponding shelf whereby the moving stream of air is confined to the region in the vicinity of the under side of each shelf and contact between the circulating air and food stored on the shelves is minimized.

9. A refrigerator cabinet including an outer wall, an inner wall spaced from said outer wall and defining a food storage compartment, a plurality of substantially imperforate shelves arranged in spaced relationship within said compartment and dividing the compartment into subcompartments, a duct extending along the exterior of the rear portion of said inner wall, an evaporator arranged within said duct, means for circulating air over said evaporator and through said duct and said compartment, said inner wall having a plurality of horizontal openings therein for providing access for air from said duct to said compartment, each of said openings being arranged immediately below the lower rear edge of a corresponding one of said shelves, the forward portion of each of said subcompartments being unobstructed at least in the region immediately below the forward edge of each of said shelves, means adjacent said openings for directing air toward the forward portion of said compartment closely adjacent the under side of the corresponding shelf whereby the moving stream of air is confined to the region in the vicinity of the under side of each shelf and contact between the circulating air and food stored on the shelves is minimized, and a drain at the bottom of said duct for discharging defrost water from said duct.

10. A refrigerator cabinet including an outer wall, an inner wall spaced from said outer wall and defining a food storage compartment, a plurality of substantially imperforate shelves arranged in spaced relationship within said compartment and dividing said compartment into

subcompartments, a duct extending along the exterior of the rear portion of said inner wall, an evaporator arranged within said duct, and means for circulating air over said evaporator and through said duct and said compartment, said inner wall having a plurality of horizontal openings therein for providing access for air from said duct to said compartment, each of said openings being arranged immediately below the lower rear edge of a corresponding one of said shelves, the forward portion of each of said subcompartments being unobstructed at least in the region immediately below the forward edge of each of said shelves, said rear portion of said inner wall being flanged inwardly adjacent said openings to provide upper and lower lips, the lower one of said lips being spaced about $\frac{1}{4}$ " below the under side of its corresponding shelf for directing air toward the forward portion of said compartment closely adjacent the under side of its corresponding shelf whereby the moving stream of air is confined to the region in the vicinity of the under side of each shelf and contact between the circulating air and food stored on the shelves is minimized.

11. A refrigerator cabinet including an outer wall, an inner wall spaced from said outer wall and defining a food storage compartment, a plurality of substantially imperforate shelves arranged in spaced relationship within said compartment and dividing said compartment into subcompartments, a duct extending along the exterior of the rear portion of said inner wall, an evaporator arranged within said duct, means for circulating air over said evaporator and through said duct and said compartment, said inner wall having a plurality of horizontal openings therein for providing access for air from said duct to said compartment, each of said openings being arranged immediately below the lower edge of a corresponding one of said shelves, the forward portion of each of said subcompartments being unobstructed at least in the region immediately below the forward edge of each of said shelves, a deflector extending through each of said openings for directing air toward the forward portion of said compartment, each of said deflectors having a portion extending into said duct for diverting air from said duct and a second portion extending upwardly and forwardly from said rear portion of said inner wall, the forward edge of said deflector being spaced about $\frac{1}{8}$ " from the under side of its corresponding shelf to provide a narrow horizontal opening whereby the moving stream of air is confined to the region in the vicinity of the under side of each shelf and contact between the circulating air and the food stored on the shelves is minimized.

12. A refrigerator cabinet including an outer wall, an inner wall spaced from said outer wall and defining a food storage compartment, a plurality of substantially imperforate shelves arranged in spaced relationship within said compartment and dividing said compartment into subcompartments, a duct extending along the exterior of the rear portion of said inner wall, an evaporator arranged within said duct, means for circulating air over said evaporator and through said duct and said compartment, said inner wall having a plurality of horizontal openings therein for providing access for air from said duct to said compartment, each of said openings being arranged immediately below the lower rear edge of a corresponding one of

said shelves, a door hinged to each of said shelves at the forward edge thereof and extending upwardly therefrom, each of said doors being spaced about 1" from the under side of the next shelf above to provide a narrow horizontal opening adjacent the under side of said shelf for the discharge of air from the corresponding sub-compartment, and means adjacent said first-named openings for directing air toward the forward portion of said compartment closely adjacent the under side of the corresponding shelf whereby the moving stream of air is confined to the region in the vicinity of the under side of each shelf and contact between the circulating air and food stored on the shelves is minimized. 15

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