

June 14, 1955

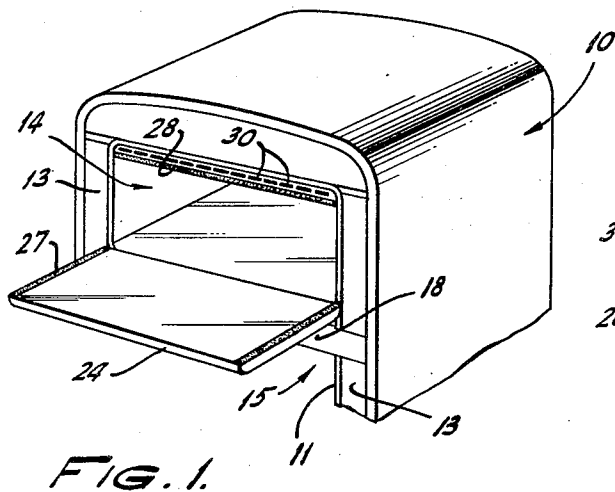
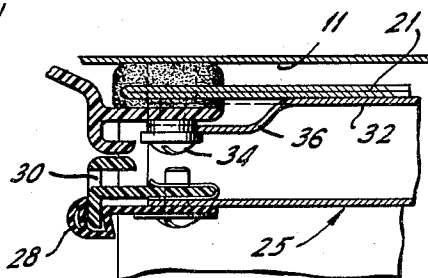
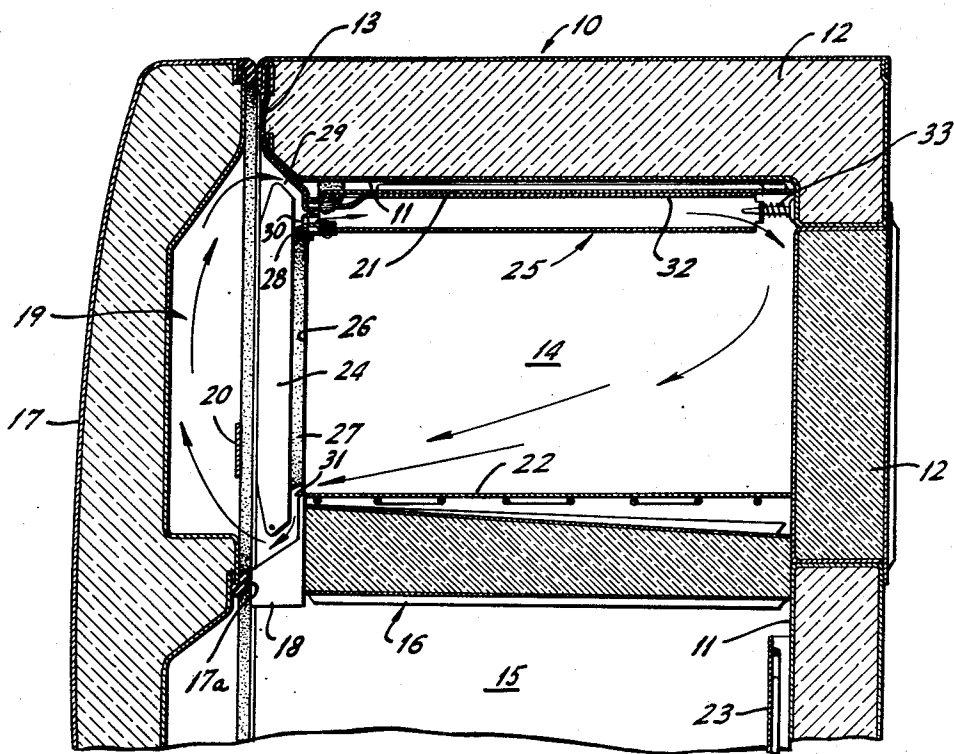
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2,710,508

AIR FLOW IN REFRIGERATED COMPARTMENT

Filed Feb. 3, 1953

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

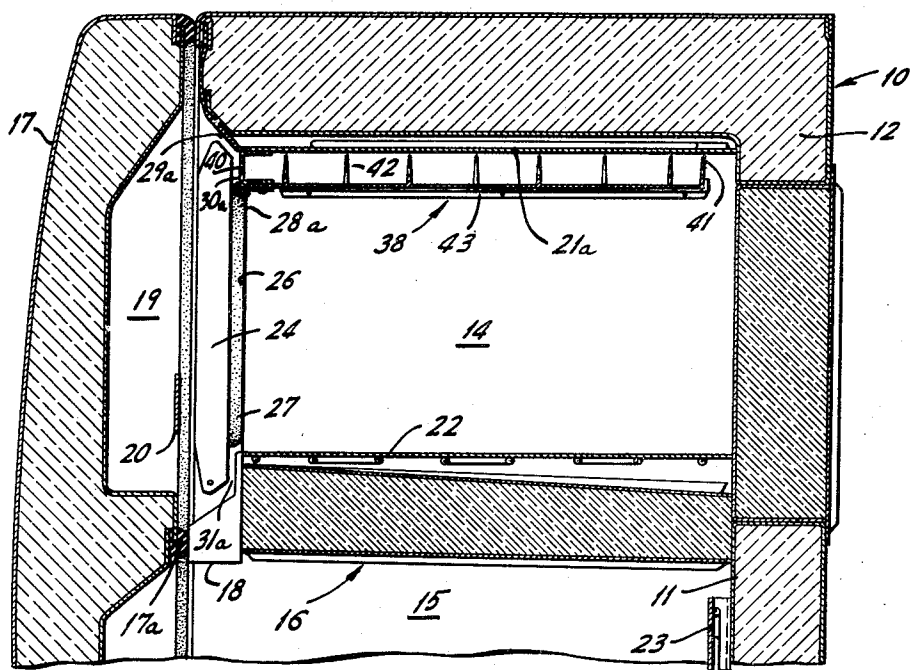


FIG. 5.

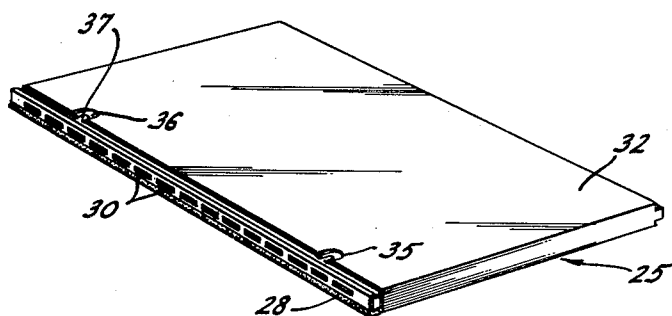


FIG. 4.

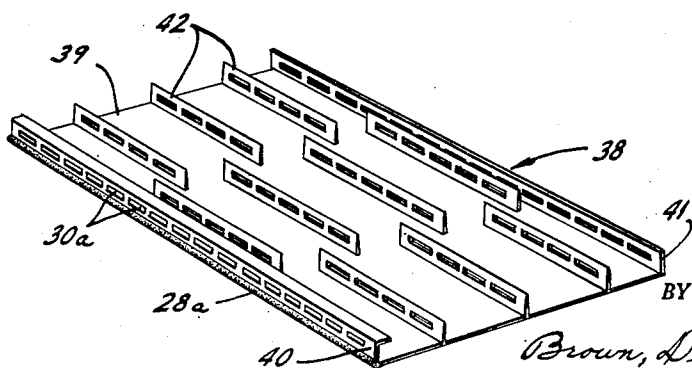


FIG. 6.

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AIR FLOW IN REFRIGERATED COMPARTMENT

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10 Claims. (Cl. 62—89)

Our invention relates to refrigeration apparatus, being particularly concerned with household refrigerators of the type which are provided with both freezing and food storage compartments. Commonly, in refrigerators of this kind, the freezing compartment is defined by a generally box-like evaporator which is provided with a small door individual thereto. Broadly, it is the objective of the invention to obviate certain frost collection problems to which such refrigerators have, theretofore, been susceptible.

In refrigerators of this so-called "single door" type, a single main door closes the cabinet, and opening of this door is necessary when access is had to either the food storage compartment or to the freezing compartment. Since the main door spans both compartments, opening thereof results in inflow of moisture-laden air into the region of the freezing compartment and, as a result, moisture and frost-collection problems are encountered. If, for example, the small door to the freezing compartment is tightly sealed against the forward edges of the evaporator which defines said compartment, the aforesaid moisture-laden air does not gain access to the interior of the freezing compartment, but remains in contact with, and is deposited upon, the outer surface of the cool evaporator, as well as upon other surfaces in adjacency thereto. As will be understood by those familiar with the field of refrigeration, such moisture deposition can constitute a substantial problem.

Efforts have been made to meet this problem by making a less than complete seal between the evaporator and its door, with the result that the moisture introduced when the main cabinet door is opened, is free to "migrate" to the cold interior surfaces of the evaporator upon which it is deposited. When resort is had to this latter arrangement, it is possible to maintain the exterior surfaces of the evaporator door, and the adjacent areas, in a reasonably dry condition, but this advantage is gained at the expense of collection of considerable quantities of frost throughout the evaporator, and attendant defrosting problems.

By our invention there is provided a refrigerator in which such moisture and frost collection problems are virtually eliminated and, specifically, it is an object of the invention to provide a refrigerator of the stated type, in which condensation on and dripping from the surfaces of the evaporator door are prevented.

It is a further object of the invention to provide refrigeration apparatus in which frost collection upon surfaces within the evaporator is minimized, the bulk of the frost being collected in one localized area from which it may readily be removed without the necessity of a defrosting "shut-down."

To achieve the foregoing general objectives and advantages, we have provided apparatus in which moisture present in the area adjacent the evaporator door passes into the evaporator and through a restricted duct or channel of considerable length, the moisture collecting upon the interior surfaces of said channel in the

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form of frost. Means is provided to facilitate removal of the collected frost, and in a preferred embodiment this is accomplished by removing the member which defines the channel and heating it, as for example by the use of warm water. In another embodiment of the invention the frost may conveniently be removed by a scraping operation.

The manner in which the foregoing objects and advantages may best be achieved, will be fully understood by a consideration of the following detailed description, taken together with the accompanying drawings, in which:

Figure 1 is a fragmentary perspective illustration of a household refrigerator embodying apparatus in accordance with the present invention;

Figure 2 is a fragmentary sectional view, on an enlarged scale, illustrating in greater detail apparatus of the kind shown in Figure 1;

Figure 3 is a detailed sectional showing of a portion of the apparatus shown in Figure 2;

Figure 4 is a perspective view showing—disassociated from the refrigerator—a duct-like member or device used in the embodiment of the invention illustrated in Figures 1 to 3;

Figure 5 is a sectional view, similar to Figure 2, and illustrating a modified embodiment of the invention; and,

Figure 6 is a perspective illustration of baffle structure used in said modified embodiment.

Now referring in detail to the drawings, and with initial reference to the embodiment of the invention illustrated in Figures 1 to 4, it will be seen that the invention is therein illustrated as embodied in a household or domestic refrigerator comprising an outer shell 10 and an inner shell or liner member 11, spaced and insulated from the outer shell 10 by means of any suitable insulation, shown at 12. As is customary, breaker strip means 13 of low thermal conductivity extends about the forward face, or throat area, of the cabinet and bridges the gap between the said outer shell 10 and inner liner 11. It will be understood that the cabinet also includes a compartment housing a condenser-compressor unit of any desired type, but illustration of this portion of the apparatus is not necessary herein, since the present invention is not concerned therewith.

As clearly appears in both Figures 1 and 2, the storage space or compartment defined by the inner liner 11 is sub-divided into an upper freezing compartment 14 and a lower food storage compartment 15 by means of a thermally non-conductive partition or vapor barrier, represented in its entirety by the reference numeral 16, which thermally isolates the freezing compartment from the food storage compartment and prevents exchange of heat, air and moisture between said two compartments.

As indicated above, the refrigerator is of the so-called "single door" type, being provided with a main door 17 extending across the access opening bounded by the breaker strips 13 and closing the space sub-divided into the two compartments aforesaid. While the partition 16 may take forms other than that shown in the accompanying drawings, it is to be noted that the forward edge of said partition terminates in a stile 18 against the forward face of which seats a horizontally extending gasket 17a carried by the door 17. This gasket, together with the usual peripheral gaskets provided, seals the cabinet when the door is closed, and prevents interchange of moisture between the compartments 14 and 15. The door 17 is further provided with a portion 19, recessed within the rear face of the door, ahead of the compartment 14, and within which recessed portion may be stored beverages and the like, the containers being retained within the door by means of a horizontal strap structure spanning the door and shown at 20.

The two compartments 14 and 15 are each provided with individual cooling means (see Figure 2), the cooling means for the freezing compartment taking the form of a rectangular evaporator having top and bottom walls 21 and 22, respectively, and a pair of side walls which lie closely adjacent the side walls of inner liner 11. In the embodiment illustrated the evaporator defines the freezing compartment. The lower compartment may conveniently be cooled solely through the agency of a plate-like evaporator member 23 carried by the rear wall of inner liner 11. Preferably the lower, plate-like evaporator 23 is periodically defrosted by automatic means, and the two evaporators, in combination with refrigerant circulating and control apparatus (not shown), serve to maintain both compartments of the refrigerator at a stable predetermined temperature. Preferably the circulating and control means is of the type fully described and claimed in the co-pending application of Malcolm G. Shoemaker, Serial No. 296,995, filed July 3, 1952.

The upper evaporator has an opening confronting the main door and spaced therefrom, and an auxiliary evaporator door 24 extends across the evaporator opening to close the same. As mentioned above, opening of the main door results in inflow of moisture-laden air into the space between the front of the evaporator door 24 and the panel which defines the recessed storage area 19, such air inflow heretofore creating a problem in that there is a tendency for moisture to be deposited upon the front of the evaporator door.

In particular accordance with the present invention means is provided to prevent such condensation while yet minimizing the collection of frost upon the exposed interior walls of the freezer evaporator. In the embodiment shown in Figures 1 to 4 this means takes the form of a restricted, rectangular, duct or channel 25 disposed within the evaporator and upon interior surfaces of which the deposition of frost is localized.

To accomplish such localization, and to prevent deposition of moisture upon the above-mentioned critical surfaces, the evaporator door 24 is so constructed and so arranged with respect to the forward edge 26 of the freezing evaporator as to provide a limited air inlet opening at the top of the evaporator and a limited air outlet opening adjacent the bottom wall thereof. It will be observed that the door 24 is provided with a pair of vertically extending gaskets or sealing strips 27 along its lateral edges (see Figures 1 and 2), and that the lower front edge of duct 25 carries a horizontally extending gasket 28, the gaskets 27 and 28 cooperating to seal portions of the door against the front of the evaporator. However provision is made for flow of air across the top of the evaporator door and inwardly of the duct structure 25. In this connection reference should be had to the space shown at 29 in Figure 2 and to the inlet ports 30 which are provided in the forward face of the duct structure. These ports may be provided in any convenient manner, and one satisfactory arrangement is clearly illustrated in Figure 3.

By virtue of this construction, moisture-laden air present in the space between said main door and said evaporator door flows into said evaporator, through the space 29 and the ports 30 and passes through the duct 25, the gaskets 27 and 28 preventing flow of air directly into the space underlying the duct. Air is free to flow out of the duct through openings provided at the back edge thereof, from whence it flows downwardly toward the floor 22 of the evaporator and outwardly through a slot 31 which is provided by spacing the lower rear edge of the door forwardly of the front edge of floor member 22. From the slot 31 air is, of course, free to return upwardly past the front of the evaporator door for recirculation through the duct 25.

It is to be noted that the top wall 32 of duct 25 lies closely adjacent to the top 21 of the evaporator, that is, the duct is disposed in high heat exchange relation with the top wall of the evaporator. Since the duct is comprised

of material of high heat conductivity its interior surfaces are maintained at a temperature considerably lower than the temperature prevailing within the space ahead of the door 24 and, consequently, moisture present in the circulating air is deposited upon the interior surfaces of the duct. As is clear from Figure 2, the duct extends substantially throughout the depth of the evaporator.

To facilitate removal of the collected frost, without the necessity of a defrosting "shut-down," the duct is removably mounted within the evaporator, its rear edge being supported by a pair of pins, one of which appears at 33 in Figure 2, and its front edge being carried by spaced supports, one of which appears to good advantage in Figure 3. These supports take the form of studs 34 suitably secured to the top of inner liner 11 and passing through the upper portion 21 of the evaporator. As appears most clearly in Figure 4, the forward edge of the top 32 of duct 25 is provided with spaced recesses 35 and 36 each of which is provided with a slot 37 leading inwardly from the front edge of said duct top 32. Referring to Figures 2 and 3 it will be seen that the duct may be removed by shifting the same backwardly along the pins 33, against the resistance of a pair of springs, thereby releasing slots 37 from the studs 34. When this position is reached the forward part of the duct may be lowered, and the duct withdrawn from the pins 33. Collected frost is of course removed by heating the duct, as for example by the use of warm water.

The pattern of air circulation achieved is represented by arrows applied to Figure 2, and it is believed that the operation of the apparatus will be entirely clear from a consideration of that figure in conjunction with the foregoing description. It will be noted that the circulating air, following dehydration in the duct 25, returns to the space 19 where it absorbs more moisture, prior to recirculation through the duct. In practice it has been found that equipment of the type described results in virtually complete elimination of condensation upon the evaporator door or surfaces adjacent thereto, and the bulk of the collected frost is localized within the duct 25.

In Figures 5 and 6 there is illustrated a modified embodiment of the invention and, in considering this embodiment it should be understood that parts of the apparatus which are similar to those shown in the embodiment of Figures 1 to 4 are designated by similar reference numerals. Essentially, and as respects the pattern of air flow, the operation of the apparatus of this second embodiment is the same as the operation of the apparatus of Figures 1 to 4.

In the modified form of the invention, however, a novel baffle structure 38 is utilized in place of duct member 25. This baffle structure, which is illustrated in perspective in Figure 6, comprises a floor member 39, upstanding front and rear flanges 40 and 41, respectively, and a plurality of individual scraper elements 42 which are carried by the floor 39 and extend toward the top wall 21a of the evaporator. The elements 42 are arranged across the face of the baffle in such manner as to assure that all portions of the evaporator top wall will be subjected to a scraping operation when the baffle is withdrawn from the refrigerator. As is apparent from the drawing the front and rear flanges 40 and 41, and the scraper elements 42, are apertured to provide for free movement of air through the space between the top wall 21a and the baffle floor member 39. The baffle structure is cooperable with the evaporator door and with the top wall 21a, to define a restricted air flow passage similar to that provided by the duct 25. As is the case in the first embodiment, a gasket 28a is carried by the forward edge of the baffle, and this gasket, together with the vertical gaskets 27 fixed to the evaporator door 24, confine the air to a path such that it flows through the aforesaid passage. Again, an upper air passage 29a permits passage of air across the top of the door and in-

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wardly of the evaporator above the baffle structure, through ports 30a provided in the front flange 40. The air is returned to the space ahead of the evaporator door through a lower slot or channel shown in this embodiment at 31a. The baffle structure is supported upon a pair of tracks or guideways carried by the side walls of the evaporator. One of these tracks is shown at 43.

In an embodiment of this type, in which the baffle is not disposed in high heat exchange relation with the top wall 21a of the evaporator, the major portion of the collected frost will be deposited upon the top of the evaporator, and the form of the invention shown in Figures 5 and 6 is therefore of particular value where it is desired to remove the accumulated frost by a simple scraping operation, rather than to resort to the use of warm water or other heating means. As will be understood without further description the baffle structure may readily be withdrawn from the refrigerator, being guided by the channels 43 in a horizontal path. During withdrawal of the baffle structure, the blades or elements 42 scrape the top of the evaporator and free the same of frost. The freed frost is supported upon the baffle as the latter is withdrawn from the evaporator, and is of course removed prior to replacement of the baffle.

From the foregoing description it will be understood that the present invention provides a refrigerator in which moisture and frost collection problems are virtually eliminated, the apparatus being particularly characterized in that these objectives are accomplished in such a way as to minimize the need for terminating operation of the refrigerating system to effect defrosting of the freezer evaporator.

We claim:

1. In refrigeration apparatus, a cabinet having therein a storage compartment provided with an access opening, a main door extending across the access opening and closing said compartment, a freezing chamber within said cabinet, said chamber including an evaporator and having an opening confronting said main door and spaced therefrom, a door disposed between said main door and said chamber and extending across the chamber opening to close the same, the chamber door being so constructed and so arranged with respect to said chamber as to provide a limited air inlet opening adjacent a wall portion of the evaporator, said chamber being provided with an outlet opening for said air, whereby moisture-laden air present in the space between said main door and said chamber door flows into said chamber through said inlet opening and out of said chamber through said outlet opening, and means disposed adjacent said wall portion of the evaporator and extending from said door, in the region of said inlet opening, for a considerable distance inwardly of said chamber, said means providing a passage through which the inletted air flows in high heat exchange relation with said evaporator wall portion prior to passage through said chamber and thence through said outlet opening.

2. In refrigeration apparatus, a cabinet having therein a storage compartment provided with an access opening, a main door extending across the access opening and closing said compartment, an evaporator defining a freezing compartment within said cabinet and having an opening confronting said main door and spaced therefrom, a door disposed between said main door and said evaporator and extending across the evaporator opening to close the same, the evaporator door being so constructed and so arranged with respect to said evaporator as to provide a limited air inlet opening adjacent the top wall of the evaporator, said evaporator being provided with an air outlet opening adjacent the bottom wall thereof, whereby moisture-laden air present in the space between said main door and said evaporator door flows into said evaporator in the region of the top wall thereof and out of said evaporator from the region of the bottom wall thereof, and means disposed adjacent said

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top wall and extending from said door, in the region of said inlet opening, for a considerable distance inwardly of said evaporator, said means providing a passage through which the inletted air flows in high heat exchange relation with said evaporator top wall prior to passage through said outlet opening.

3. In refrigeration apparatus, a cabinet having therein a storage compartment provided with an access opening, a main door extending across the access opening and closing said compartment, an evaporator defining a freezing compartment within said cabinet and having an opening confronting said main door and spaced therefrom, a door disposed between said main door and said evaporator and extending across the evaporator opening to close the same, the evaporator door being so constructed and so arranged with respect to said evaporator as to provide a limited air inlet opening adjacent upper wall portions of the evaporator and a limited air outlet opening adjacent lower wall portions thereof, whereby moisture-laden air present in the space between said main door and said evaporator door flows into said evaporator through said inlet opening and out of said evaporator through said outlet opening, and means disposed adjacent the said upper wall portions of said evaporator and extending from the evaporator door, in the region of said inlet opening, toward the back of said evaporator, said means providing a passage through which the inletted air flows in high heat exchange relation with the said upper portions of said evaporator, the air thereafter flowing downwardly through said evaporator, across said lower wall portions, and through said outlet opening.

4. In refrigeration apparatus, a cabinet having therein a storage compartment provided with an access opening, a main door extending across the access opening and closing said compartment, an evaporator defining a freezing compartment within said cabinet and having an opening confronting said main door and spaced therefrom, a door disposed between said main door and said evaporator and extending across the evaporator opening to close the same, the evaporator door being so constructed and so arranged with respect to said evaporator as to provide a limited air inlet opening adjacent the top wall of the evaporator and a limited air outlet opening adjacent the bottom wall thereof, whereby moisture-laden air present in the space between said main door and said evaporator door flows into the evaporator just beneath the top wall thereof and out said evaporator across the bottom wall thereof, and means disposed adjacent the top of said evaporator and extending from the evaporator door, in the region of said inlet opening, toward the back of said evaporator, said means providing a passage through which the inletted air flows in high heat exchange relation with the top wall of the evaporator, the air thereafter flowing downwardly through said evaporator, across said bottom wall, and through said outlet opening.

5. Apparatus in accordance with claim 1, and further characterized in that said means includes a duct-like member comprised of material of high heat conductivity, forward and rear portions of said member being configured to permit flow of air therethrough, said member being removably associated in high heat exchange relation with the said evaporator wall portion, and the forward portion of said member being disposed to receive air flowing into said chamber through said inlet opening.

6. Apparatus in accordance with claim 1, and further characterized in that said means comprises baffle structure spaced from said evaporator wall portion and cooperating with said chamber door and said wall portion to define the said passage.

7. In refrigeration apparatus, a cabinet having therein a storage compartment provided with an access opening, a main door extending across the access opening and closing said compartment, a freezing chamber within said cabinet, said chamber including an evaporator and

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having an opening confronting said main door and spaced therefrom, a door disposed between said main door and said chamber and extending across the chamber opening to close the same, the chamber door being so constructed and so arranged with respect to said chamber as to provide a limited air inlet opening adjacent a wall portion of the evaporator, said chamber being provided with an outlet opening for said air, whereby moisture-laden air present in the space between said main door and said chamber door flows into said chamber through said inlet opening and out of said chamber through said outlet opening, and baffle structure disposed adjacent said wall portion of the evaporator and extending from said door for a considerable distance inwardly of said chamber, said baffle structure being cooperable with said chamber door and said wall portion to define a passage through which inletted air flows in high heat exchange relation with said evaporator wall portion prior to passage through said inlet opening, said baffle structure being withdrawable from said chamber and including means extending toward said evaporator wall portion and adapted to scrape frost from the same during the withdrawing operation.

8. Evaporator apparatus adapted for use with refrigeration equipment of the type in which moisture-laden air is free to contact said apparatus in the region of the access opening thereto, said apparatus comprising: a generally box-like evaporator provided with an access opening in one wall thereof, a door for closing said access opening and being so constructed and so arranged with respect to the evaporator as to provide a limited air inlet opening adjacent an upper wall portion of the evaporator; and means disposed within the evaporator in adjacency to the said wall portion thereof and extending from said door, in the region of said inlet opening, toward the back of the evaporator, said means providing a passage through which air entering the evaporator through said inlet opening flows in high heat exchange relation with the said wall portion of said evaporator prior to contact with other portions thereof.

9. Apparatus in accordance with claim 8, and further characterized in that said means includes a duct-like

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member comprised of material of high heat conductivity, spaced portions of said member being configured to permit flow of air through said member, said member being removably associated in high heat exchange relation with the said evaporator wall portion, and one of said portions of said member being disposed to receive air flowing into said evaporator through said inlet opening.

10. In refrigeration apparatus, a cabinet having a storage compartment provided with an access opening, a main door extending across the access opening and closing said compartment, a freezing chamber within said cabinet, said chamber having evaporator means in heat exchange relation therewith and further having at least one opening confronting said main door and spaced therefrom, a door spaced rearwardly from said main door and extending across the mentioned opening to close the same, there being a limited air inlet opening above said door adjacent an upper portion of the evaporator means and there being a limited air outlet opening leading from said chamber to the space between said doors, whereby moisture-laden air present in the space between said main door and said chamber door flows into said chamber through said inlet opening and out of said chamber through said outlet opening, and means disposed adjacent said upper portion of said evaporator means and extending from the region of said air inlet opening rearwardly of said refrigerator, said means providing a passage through which the inletted air flowing from said space between said doors passes in high heat exchange relation with the said upper portion of said evaporator means prior to passage through said outlet opening and return to the mentioned space.

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