

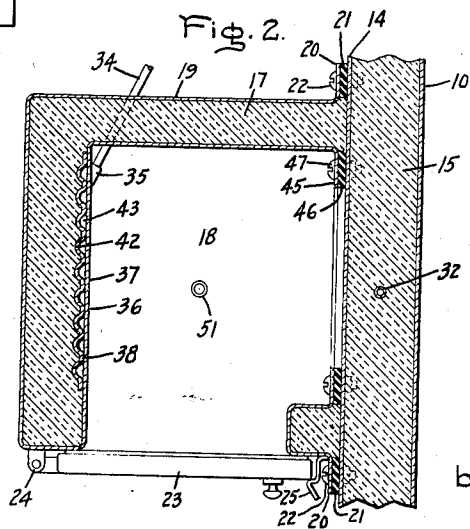
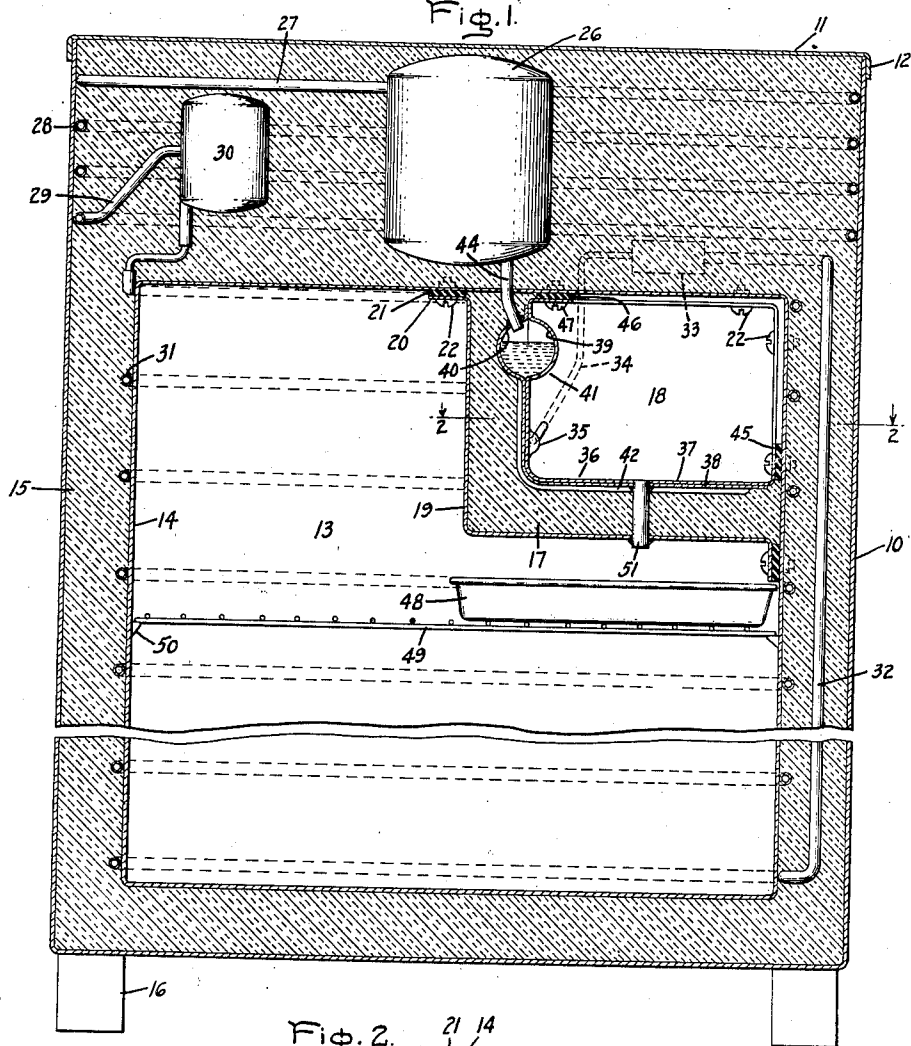
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REFRIGERATOR

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REFRIGERATOR

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My invention relates to refrigerators and more particularly to refrigerators of the type provided with a cooling compartment and an arrangement for abstracting heat therefrom while maintaining the relative humidity of the air in the cooling compartment at a comparatively high value.

Refrigerators of the type described, and particularly those designed for domestic use, are frequently provided with a refrigerant evaporator which contains a vaporizable refrigerant, the refrigerant being vaporized by the absorption of heat from the contents of the compartment. Even when a relatively small differential exists between the temperature of the evaporator and that of the air in the compartment, some moisture is condensed on the surface of the evaporator. Since this surface may be quite extended in area, there is difficulty in providing a suitable arrangement for removing the moisture therefrom.

It is an object of my invention to provide a refrigerator of the type described in which the relative humidity of the air therein is maintained at a comparatively high value and including an improved arrangement for localizing the area on which moisture is condensed within the cooling compartment of the refrigerator.

Another object of my invention is to provide a refrigerator of the type described in which the exterior walls of the cabinet are utilized for dissipating heat from a refrigerant condenser conduit and having an arrangement for minimizing the transfer of heat from such exterior walls to the cooling compartment of the refrigerator.

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 a part of this specification.

For a better understanding of my invention, reference may be had to the accompanying drawing in which Fig. 1 is a side elevation, partly in section, of a refrigerator embodying my invention, the central portion of the cabinet being broken away and Fig. 2 is a fragmentary plan view, partly in section, along the line 2—2 of the freezing compartment and the evaporator therefor of the refrigerator, shown in Fig. 1.

Referring to the drawing, I have shown in Fig. 1 a refrigerator of the household type provided with a cabinet, the outer walls of which are formed by a rectangular open top sheet metal outer shell 10 made of steel or the like. The top of the cabinet is closed by a rectangular sheet metal cover 11 having a depending peripheral flange 12 which

closely surrounds the adjacent top portion of the shell 10. A cooling compartment 13 is formed within the cabinet, the inner walls thereof being formed by a rectangular sheet metal inner liner 14 which is arranged in spaced relation with respect to the outer shell 10. The inner and outer walls of the cabinet thus formed are separated by suitable heat insulation 15. The cabinet is supported on a series of sheet metal legs 16. Access may be had to the interior of the cooling compartment 13 through a door opening formed in the front thereof which is closed by a heat insulated door (not shown).

The refrigerator illustrated is also provided with a freezing compartment which is located within the cooling compartment and is separated therefrom by a heat insulated wall 17, which surrounds the bottom and two side walls of the freezing compartment 18. The exterior sides of the wall 17 are covered by a sheet metal casing 19 made of steel or the like which is exposed to the interior of the cooling compartment 13. The edges of the casing 19 are provided with a peripheral flange 20 which extends parallel to the adjacent portion of the inner liner 14 and is separated therefrom by a gasket 21 of heat insulating material such as rubber which extends entirely about the flange 20. The casing 19 is secured to the inner liner 14 by a series of bolts 22 which pass through the flange 20, gasket 21, and adjacent portion of the inner liner 14. The open front of the freezing compartment 18 is closed by a heat insulated door 23 which is mounted on hinges 24 arranged at the side of the opening in the front of the freezing compartment. The door 23 is retained in its closed position by a suitable spring catch 25, one end of which is secured to the adjacent portion of the casing 19.

The refrigerator cabinet described above is provided with a refrigerating machine which includes an arrangement for maintaining the air in the cooling compartment at a temperature suitable for preserving foods such as vegetables and the like, preferably about 45° F., and an arrangement for maintaining the interior of the freezing compartment at a temperature suitable for preserving meat and the like, and for freezing ice or similar articles, preferably about 20° F. The refrigerating machine for the cabinet described includes a refrigerant circulatory unit which, in the illustrative form of my invention, is a motor driven refrigerant compressor mounted in a hermetically sealed steel casing 26, which is embedded in the heat insulation 15 above the top wall of the cooling compartment 13. The casing 26 contains a body of lubricant for lubricating the motor and

compressor. Gaseous refrigerant compressed by the motor driven compressor contained in the casing 26 is discharged therefrom through a conduit 27 and passes therethrough to a condenser conduit 28. The condenser conduit 28 extends about the interior sides of the four side walls of the shell 10 and is arranged in good thermal contact therewith. The conduit 28 is preferably soldered, or otherwise rigidly secured, to the inner surface of the outer shell 10. The outer shell 10 is thus utilized to dissipate heat from the compressed gaseous refrigerant in the conduit 28 and forms a condenser surface. Heat passes from the refrigerant in the conduit 28 through the walls thereof to the outer shell 10 and the latter is cooled by the surrounding air which circulates upwardly thereover due to natural draft.

The compressed gaseous refrigerant flowing through the condenser conduit 28 is liquefied by the cooling action described above and the refrigerant thus liquefied passes through a conduit 29 to a flow controlling float valve 30. Liquid refrigerant is supplied from the flow controlling float valve 30 to an evaporator conduit 31, which is utilized to abstract heat from the cooling compartment 13. The evaporator conduit 31 extends about three side walls of the inner liner 14 in good thermal contact therewith, being soldered, or otherwise rigidly secured, to the adjacent outer surface of the inner liner 14, the inner liner being thus utilized to form an evaporator cooling surface. A portion of liquid refrigerant passing through the evaporator conduit 31 is vaporized by the absorption of heat from the contents of the cooling compartment. Since the evaporator conduit 31 is in thermal contact with a large portion of the side walls of the inner liner 14, an evaporator having a relatively large area presented to the interior of the cooling compartment 13 is thus provided. The inner liner 14 is thus maintained at a temperature of approximately 35° F. to 40° F. when the air in the interior of the cooling compartment 13 is at a temperature of 45° F. It is possible to cool the air within the cooling compartment 13 while maintaining such a small temperature differential between it and the surface of the evaporator, because of the relatively large area of the evaporator surface. It is advantageous to maintain the temperature differential between the evaporator surface and air within the cooling compartment as small as possible in order to minimize the condensation of moisture on the surface of the evaporator and, hence, minimize the dehydration of articles stored in the cooling compartment. With the arrangement described, the relative humidity of the cooling compartment 13 may be maintained at between 80% and 85%. It has been found that it is particularly important to maintain the relative humidity of the air in the cooling compartment at a comparatively high value when vegetables or similar articles are preserved therein since the dehydration of such articles is the principal source of their taking on a withered and unpalatable appearance.

The location of the evaporator for cooling the cooling compartment 13 in the walls thereof also aids in maintaining a small temperature differential between the temperature of the surface of the evaporator and the interior of the compartment, since heat flowing through the insulated side walls of the cabinet from the warmer air on the exterior thereof reaches the evaporator before it has an opportunity to warm the con-

tents of the cooling compartment. If the heat thus leaking into the cabinet was first transferred to the air within the cooling compartment and then to the evaporator, it would be necessary to maintain the evaporator at a lower temperature, because of the greater amount of heat to be absorbed thereby from the air within the cooling compartment. In the arrangement which I have provided, however, the heat leaking through the insulation 15 from the shell 10 is absorbed by the evaporator 31 before reaching the air in the compartment 13. This factor is of particular importance in a refrigerator of the type illustrated in which the exterior walls of the cabinet are utilized to dissipate heat from the refrigerant condenser conduit 28. Since the exterior side walls are utilized in this manner, they are maintained at a temperature above that of the surrounding air and, hence, somewhat more heat flows from the exterior walls through the insulation 15 toward the cooling compartment 13. The evaporator arrangement, which I have described, in which the evaporator forms the side walls of the cooling compartment, effectually prevents the heat from the exterior side walls of the cabinet reaching the interior of the cooling compartment 13.

Vaporized and gaseous refrigerant are discharged from the evaporator conduit 31 through a conduit 32 and pass therethrough to a differential pressure valve 33. The differential pressure valve 33 connects the evaporator conduit 31 in series with a flooded type evaporator 36, which is located in the freezing compartment 18. The pressure differential valve 33 maintains a predetermined differential in pressure between the two evaporators, such as to maintain the desired temperature in the compartments 13 and 18. A higher pressure and, hence, a higher temperature is maintained in the evaporator conduit 31 than in the flooded evaporator located in the freezing compartment 18. Liquid and vaporized refrigerant passing through the differential pressure valve 33 flow through a conduit 34 to the inlet 35 of a flooded type evaporator 36. The evaporator 36 is of the sheet metal type and the walls thereof are formed by inner and outer portions or sheets of steel or the like 37 and 38, respectively, which are substantially L-shaped in cross section. The sheets 37 and 38 are provided with complementary indentations 39 and 40, respectively, which form a longitudinal cylindrical header 41 adjacent the top of the side wall of the L-shaped evaporator 36. A series of corrugations 42 formed in the outer sheet 38 cooperate with the inner sheet 37 to form a series of refrigerant circulatory passages 43 communicating with the header 41 below the normal liquid level therein. The passages 43 thus formed extend down the side wall of the evaporator 36 and across the bottom wall thereof. The sheets 37 and 38 are welded or otherwise rigidly secured together about the edges thereof and between the indentations and corrugations formed therein. The welding may be a line weld or a series of closely spaced spot welds.

The evaporator 36 is flooded with liquid refrigerant, the header 41 being normally maintained about half full of liquid refrigerant. The vaporized refrigerant discharged into the passages 43 from the conduit 34 moves upwardly to the header 41 and aids in inducing a rapid circulation of liquid refrigerant in the passages 43. The liquid refrigerant in the header 41 and refrigerant circulatory passages 43 is vaporized

by the absorption of heat from articles contained in the freezing compartment 18 and the vaporized refrigerant is collected in the header 41 above the level of the liquid refrigerant therein. The vaporized refrigerant thus collected in the header 41 is returned to the motor driven compressor in the casing 26 through a suction conduit 44 which communicates with the header 41 above the normal liquid level therein. The conduit 44 communicates with the casing 26 above the level of lubricant therein, and the vaporized refrigerant flows from the casing to the intake of the compressor in the casing.

The edges of the inner sheet 37 of the evaporator 36 adjacent the inner liner 14 are provided with a peripheral flange 45, which is separated from the adjacent portion of the inner liner 14 by gasket 46 of heat insulating material such as rubber. The flange 45 is secured to the inner liner 14 by a series of bolts 47 which pass through the flange 45, gasket 46, and inner liner 14.

Trays of water or other material to be frozen may be inserted into the freezing compartment 18 through the door opening closed by the door 23 and conveniently supported on the flat bottom of the freezing compartment formed by the evaporator 36. Since the interior of the freezing compartment 18 is ordinarily maintained at a temperature below 32° F., preferably at about 20° F., ice or the like may be readily frozen therein, and meats or similar articles, which are preferably preserved at such low temperature, may be stored therein. Trays containing water or other material to be frozen may be placed in direct thermal contact with the inner surface of the evaporator 36, thus insuring a rapid transfer of heat.

The thickness and character of the heat insulation 17 of the wall surrounding the cooling compartment 13 are so proportioned that the temperature gradient therethrough, between the evaporator 36 and the casing 19, will be such as to maintain the casing 19 at a temperature close to but somewhat below the temperature of the other interior walls of the cooling compartment 13. When the walls of the inner liner 14 are maintained at 40° F. at least a portion of the casing 19 may be maintained at about 35° F. In this way, a surface is provided within the cooling compartment 13 on which the condensation of moisture will be localized since this surface is at a lower temperature than any other surface within the compartment. It is also desirable that this surface, on which condensation is to be localized, should be maintained above 32° F., in order that no frost will be formed thereon. It will be understood that the area of the cold surface on which condensation is localized may be reduced as the temperature thereof is lowered. By such an arrangement, the remaining side, top, and bottom walls of the cooling compartment 13 are maintained in a dry condition and the moisture which collects or accumulates on the casing 19 may be conveniently collected in a removable drip tray 48, which is slidably supported on a wire shelf 49. The ends of the shelf 49 are supported on inwardly extending integral shoulders 50 formed in the inner liner 14.

A conduit 51 extends through the bottom wall of the freezing compartment 18, the lower end thereof being positioned above the drip tray 48. During defrosting of the evaporator 36, any frost collected on the inner surfaces thereof is melted

and the resulting moisture may drain through the conduit 51 to the drip tray 48.

Although the casing 19 is normally maintained at a temperature below that of the remaining side walls of the cooling compartment 13, in order to localize the condensation of moisture thereon, the temperature of the casing is maintained sufficiently close to the temperature prevailing in the cooling compartment, as pointed out above, in order that excessive condensation of moisture on the casing, and, hence, excessive lowering of the relative humidity within the air of the cabinet is avoided. It will thus be seen that I have provided an arrangement by which the humidity of the air within the cooling compartment 13 is maintained at a comparatively high value and yet in which the condensation of moisture therein is localized in such manner as to facilitate the removal thereof.

While I have shown a particular embodiment of my invention in connection with a compression type refrigerating machine, I do not desire my invention to be limited to the particular construction shown and described and I intend, in 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 Patents of the United States is:

1. A refrigerator comprising a heat insulated cooling compartment and a freezing compartment, an extended evaporator presenting a heat exchange surface of relatively large area for abstracting heat from said cooling compartment, a second evaporator for cooling said freezing compartment, means including a wall for preventing the circulation of air from said cooling compartment over the surfaces of said second evaporator, said wall being exposed to the air in said cooling compartment and being arranged to limit the flow of heat from said cooling compartment to said second evaporator and to maintain the temperature of at least a portion of said wall close to and slightly less than the temperature of the remaining walls in said cooling compartment to localize the condensation of moisture on said portion of said wall.

2. A refrigerator comprising a heat insulated cooling compartment and a freezing compartment, an extended evaporator presenting a heat exchange surface of relatively large area for abstracting heat from said cooling compartment and forming at least a portion of one side wall of said cooling compartment, a second evaporator for cooling said freezing compartment, means including a wall for preventing the circulation of air from said cooling compartment over the surfaces of said second evaporator, said wall being exposed to the air in said cooling compartment and being arranged to limit the flow of heat from said cooling compartment to said second evaporator and to maintain the temperature of at least a portion of said last mentioned wall close to and slightly less than the temperature of the remaining interior walls of said cooling compartment to localize the condensation of moisture on said portion of said last mentioned wall.

3. A refrigerator comprising a heat insulated cooling compartment and a freezing compartment, an extended evaporator presenting a heat exchange surface of relatively large area for abstracting heat from said cooling compartment, a second evaporator for cooling said freezing compartment, said second evaporator being of the flooded type and having a header and means including a plurality of passages communicating

with said header below the normal liquid level therein for circulating liquid refrigerant, said last mentioned means including a horizontal portion for supporting articles to be frozen, a wall for preventing the circulation of air from said cooling compartment over the surfaces of said second evaporator, said wall being exposed to the air in said cooling compartment and being arranged to limit the flow of heat from said cooling compartment to said second evaporator and to maintain the temperature of at least a portion of said wall close to and slightly less than the temperature of the remaining walls in said cooling compartment to localize the condensation of moisture on said portion of said wall.

4. A refrigerator comprising a heat insulated cooling compartment and a freezing compartment, an extended evaporator presenting a heat exchange surface of relatively large area for abstracting heat from said cooling compartment, a second evaporator for cooling said freezing compartment, means including a sheet metal casing exposed to the interior of said cooling compartment for preventing the circulation of air from said cooling compartment over the surfaces of said second evaporator, and means limiting the flow of heat through said sheet metal casing to said second evaporator for maintaining the temperature of at least a portion of said sheet metal casing close to and slightly less than the temperature of the remaining walls in said cooling compartment to localize the condensation of moisture on said portion of said casing.

5. A refrigerator comprising a cabinet having a heat insulated cooling compartment, an extended evaporator presenting a heat exchange surface of relatively large area for abstracting heat from said cooling compartment, a second evaporator located in said cabinet, means including a wall extending about said second evaporator for preventing the circulation of air from said cooling compartment over said second evaporator and forming a freezing compartment in which said second evaporator is located, said wall being exposed to the air in said cooling compartment and being arranged to limit the flow of heat from said cooling compartment to said second evaporator and to maintain the temperature of at least a portion of said wall close to and slightly less than the temperature of the remaining walls in said cooling compartment to localize the condensation of moisture on said portion of said wall.

6. A refrigerator comprising a heat insulated cooling compartment, a sheet metal inner liner forming the inner walls of said cooling compartment, an L-shaped evaporator located within said inner liner, said evaporator including complementary L-shaped inner and outer portions of sheet metal defining a refrigerant circulatory

passage therebetween, means for securing the upper and lower edges of said L-shaped evaporator to the adjacent portions of said inner liner to define a freezing compartment having an opening in the front thereof, at least one of said portions of sheet metal having an integral rear portion forming a rear wall of said freezing compartment, and means for limiting the transfer of heat from said cooling compartment to said evaporator.

7. A refrigerator comprising a heat insulated cooling compartment, a sheet metal inner liner forming the inner walls of said cooling compartment, an L-shaped evaporator located within said inner liner, said evaporator including complementary L-shaped inner and outer portions of sheet metal defining a refrigerant circulatory passage therebetween, at least one of said portions of sheet metal being provided with inwardly extending flanges along the upper and lower edges thereof lying adjacent the top and side walls respectively of said inner liner, said evaporator co-operating with said liner to define a freezing compartment, a gasket of heat insulating material positioned between each of said flanges and the adjacent portions of said inner liner, means for securing said flanges and gaskets and adjacent portions of said inner liner together, and a heat insulated wall extending about the exterior sides of said evaporator.

8. A refrigerator comprising a heat insulated cooling compartment, an extended evaporator presenting a heat exchange surface of relatively large area for abstracting heat from said cooling compartment, said evaporator forming a portion of at least one wall of said cooling compartment, means for maintaining a temperature of a portion of a wall of said cooling compartment close to and slightly less than the temperature of the remaining walls of said cooling compartment to localize the condensation of moisture on said portion of said wall, said portion of said wall constituting at least a part of the upper inner surface of said cooling compartment, and collecting means adjacent said portion of said wall for receiving moisture condensed on said portion of said wall.

9. A refrigerator comprising a heat insulated cooling compartment, an extended evaporator presenting a heat exchange surface of relatively large area for abstracting heat from said cooling compartment, means for maintaining the temperature of said extended evaporator above freezing, and means including a heat exchange surface of somewhat lower temperature than the surface of said extended evaporator for localizing the accumulation of moisture in said cooling compartment.