ABSTRACT: A combination side-by-side refrigerator-freezer having a unitary freezer liner with a condensate trough integrally formed in a lower horizontal portion thereof. Internal conduit means connect the bottom of the trough to a condensate disposal area. A radiant type defrost heater is situated below the evaporator and above the trough.
SIDE-BY-SIDE REFRIGERATOR-FREEZER
CONSTRUCTION

This invention relates in general to domestic refrigerators and, in particular, to combination refrigerator-freezers wherein a single upright unit houses both a vertical refrigerator compartment and a vertical freezer compartment, separated by a partition wall.

There have been numerous improvements made in domestic refrigeration apparatus in the last few years. The recent development of the frost-free freezer, in conjunction with the already well-developed frost-free refrigerator, provides the consumer with a completely automatic unit requiring no manual defrosting. In these frost-free systems, accumulated frost is periodically melted and the condensate removed to a condensate disposal or drip tray where it is evaporated.

Another improvement has been the development of one piece or unitary liner assemblies for both refrigerators and freezers. These liner assemblies, in conjunction with expanded foam insulation, have resulted in substantial cost savings in refrigeration manufacture as well as reduced wall thicknesses and in general have proven a superior type of construction.

Such unitary liners are preferably molded of plastic or deep drawn out of sheet metal and "porcelainized."

Early two-door combination refrigerator-freezers included separate evaporators for each compartment. Such units have all but given way to the single evaporator type in which some air from the freezer compartment is circulated through the refrigerator or fresh food compartment. This, of course, requires passageways interconnecting the refrigerator and freezer sections.

In the side-by-side vertical combination refrigerator-freezers under discussion, these passageways were located in the upper rear and lower front on the refrigerator side of the dividing wall. The evaporator was usually located on the upper part of the freezer rear wall and, to preclude the moisture laden air from the refrigerator compartment traveling through a large part of the freezer compartment (and producing frost), a relatively complicated lower passageway was formed in the dividing wall. The inlet side of the passageway was in the lower front of the refrigerator compartment, but the outlet side was directly beneath the evaporator where accumulated frost could be periodically removed with defrost heaters. For a description of a unit of this type construction, see U.S. Pat. No. 3,359,751 issued Dec. 26, 1967.

The location of the evaporator also required a separate condensate trough beneath the evaporator with consequent mounting and sealing problems and a conduit system, for removal of condensate, which was mounted outside the housing.

Recent improvements in these refrigerators have resulted in lowering of the evaporator on the freezer rear wall and moving the refrigerator-to-freezer air passage to the rear. This has simplified the passage to a mere opening through the dividing wall.

The refrigeration of the invention includes a novel combination of unitary freezer liner having an integrally formed condensate collection trough in a lower horizontal portion which eliminates mounting and sealing parts and labor associated with separate drain troughs.

The principal object of this invention is to provide an improved refrigerator apparatus embodying a unitary liner.

FIG. 1 is a partially cutaway view of a combination freezer-refrigerator of the side-by-side type incorporating the invention.

FIG. 2 is a sectional view of the refrigerator of FIG. 1 taken along line 2-2 in Fig. 1.

In FIG. 1, there is shown a refrigerator unit 10 of the side-by-side type including a freezer compartment 11 and a refrigerator compartment 12. An outer housing 13 is adapted to support therein a freezer liner 14 and a refrigerator liner 15 in side-by-side relationship such that a dividing wall 16 is established therebetwixt. This type construction has in recent years become fairly standard in the art, and the spaces between the outer housing 13 and liners 14 and 15 are filled with an expanded polyurethane foam material for insulation purposes. The value of this material as an insulator is well known and has contributed greatly to the reduction in wall thickness of modern refrigerators.

A partially broken away decorative panel 17 forms a "false front" spaced forwardly of the rear wall of freezer liner 14. Between the rear wall of freezer liner 14 and decorative front panel 17 are included a pair of vertically oriented and serially connected evaporators 20, a fan 21 for distribution of cold air throughout the refrigerator and freezer compartments and a pair of rodlike radiant defrost heaters 26. In general, these defrost heaters comprise electrical resistance coils encased within quartz tubes to which electrical end connections are made. The defrost heaters are operated on a cyclical basis by a control timer (not shown) to provide for removal of accumulated frost from the freezer compartment every few hours. Melted frost and ice from the evaporators is collected by a depression in the floor 23 comprising a depressed portion in the horizontal step 30 of freezer liner 14. Drain trough 31 terminally in an outlet 32 to which a conduit 35 is connected. Conduit 35 carries condensate to a pan 40 where it is put into the atmosphere by evaporation.

As shown in FIG. 1, a pair of ducts 23 and 24 are formed in dividing wall or partition 16 to allow distribution of chilled air throughout refrigerator compartment 12 and return of warmer, moisture laden air to the lower part of evaporator 20 in the freezer compartment. As indicated by the thin arrows, chilled air is distributed by fan 21 over a decorative deflector plate 25 throughout freezer compartment 11 and returned to the lower part of the evaporator through a plurality of slots 45 in the bottom portion of wall 17. As indicated by the thick arrows, chilled air is drawn upwardly over evaporator 20, forced against the rear surface of decorative deflector 25 and, as a result of the pressure buildup, a portion flows through upper duct 23 into the refrigerator compartment. The cold air introduced into the refrigerator compartment falls, both as a result of its higher density and because of the pressure differential and is returned through lower duct 24 to the bottom of the evaporator. In practice, a control valve (not shown) is included on the outlet side of upper duct 23 and allows the user to regulate the temperature of the evaporator by controlling the rate of air flow from the evaporator compartment. This valve may be manual or automatic.

It will also be noted that a drain trough heater 41 is shown beneath the bottom surface of drain trough 31. This heater is provided to assure that condensate does not refreeze while in the drain trough. Here again, it is sometimes necessary to place a supplemental heater around or within conduit 35 to guard against possible freeze up. It is recognized that the number and location of such heater elements will be dictated by good design practice.

FIG. 2 is a cross-sectional view of the refrigerator of FIG. 1 taken along line 2-2 to more clearly show the position of the elements. It is readily seen how drain trough 31 is integrally formed in horizontal shelf 30 of freezer liner 14. The freezer liner also includes a second horizontal portion 33 defining the bottom wall of the freezer compartment. This figure also shows how the foamed insulation fills the spaces between freezer liner 14 and outer shell 13.

As mentioned previously, front panel 17 is spaced from the rear wall of liner 14 and sandwiches therebetween the evaporator, defrost heaters and fan. Decorative deflector plate 25 is shown positioned in front of fan 21 for forcing the chilled air from the evaporator into predetermined flow patterns and allowing a pressure buildup for distribution of air into the refrigerator compartment (not shown).

The combination and positioning of these elements result in a fairly substantial savings in labor and material. The advantages of a condensate trough integrally formed in the liner
are readily apparent. The radiant type defrost heaters cooperate with the drain trough in keeping condensate from refreezing such that drain trough heater 41 may not be required.

The embodiments of the invention in which an exclusive property or privilege I claim is defined as follows:

1. A refrigerator comprising a first compartment defined by a unitary liner; an evaporator in the lower part of said first compartment; a second compartment separated from said first compartment by an insulating mullion; passage means in said mullion conveying air between said compartments; fan means moving air from both said compartments over said evaporator; a drain trough formed in said liner below said evaporator; and conduit means communicating with said trough and a point exterior of said compartments.

2. The refrigerator of claim 1, wherein said passage means comprise upper and lower channels in said mullion; said upper channel communicating with said fan means and said lower channel discharging air near said evaporator.

3. The refrigerator of claim 2, further including defrost heater means for melting accumulated frost on said evaporator, said drain trough collecting said melted frost; and condensate disposal means located at said point exterior of said compartments.

4. The refrigerator of claim 3, wherein additional heater means are located outside said liner under said drain trough for assuring free removal of melted frost therefrom.

5. In combination in a side-by-side refrigerator-freezer including a freezing compartment defined by a unitary liner, and a fresh food compartment; an insulating mullion separating said compartments; an evaporator on the rear wall in the lower part of said freezer compartment; an upper passageway in said mullion conveying cold air from said freezer compartment to said fresh food compartment; a lower passageway in said mullion conveying warm, moist air from said fresh food compartment to said freezer compartment; fan means drawing air upwardly over said evaporator; said evaporator being subject to frost build-up; defrost heater means periodically melting accumulated frost on said evaporator; a condensate disposal area located outside said compartments; a condensate trough integrally formed in said unitary liner below said evaporator and said lower passageway for collection of melted frost; and conduit means conveying condensate from said trough to said disposal area.

6. The refrigerator of claim 5, wherein further heating means are disposed adjacent said condensate trough outside said freezer compartment; said further heating means assuring free movement of condensate within said trough and said conduit means.

7. The refrigerator of claim 6, wherein said defrost heater means comprises a radiant heater element located beneath said evaporator and above said condensate trough; said radiant heating element during operation directing heat energy to said trough.