Refrigerated evaporator shelf

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This invention relates to improvements in the evaporator elements of mechanical refrigerators, and more particularly of refrigerators of domestic type.

One object of the invention is to provide an evaporator of the type adapted for operation at temperatures below the freezing point of water, having novel and effective means for facilitating defrosting.

To this end, the invention contemplates provision of an evaporator of the aforesaid type constituting an element of a main refrigerating system and having a detachable portion, or portions, comprising a closed secondary refrigerant circuit and arranged for operative association of the said circuit with the main system.

More specifically, an object of the invention is to provide an evaporator of the stated type having a detachable shelf member comprising a closed independent refrigerant system, wherein provision is made for mounting the shelf in the evaporator structure in a manner effecting an intimate thermal transfer relation between the said closed system and the main refrigerating system of which the evaporator constitutes an element.

Still another object of the invention is to provide an evaporator structure of a type designed for refrigeration of frozen foods and the like wherein those portions of the structure which are more accessible to moisture laden air are made as readily detachable parts which may be removed from the evaporator for defrosting purposes, thereby materially extending the periods of continuous use between general defrosting operations.

To this latter end the invention contemplates the provision of an evaporator structure shaped to provide a low temperature frozen foods compartment of the top access type, said structure having in the upper portion thereof one or more detachable shelves incorporating an independent closed refrigerating system which, when the shelf is installed in the evaporator structure, is in intimate heat transfer relation with the main refrigerating system with which the evaporator is directly associated.

A still further object of the invention is to provide a novel shelf structure of the aforesaid character incorporating an independent refrigerant circuit and designed for operative association with the evaporator of a refrigerating system as set forth.

The invention further resides in certain structural and mechanical details hereinafter described, including novel means for supporting the aforesaid shelf in the evaporator structure and for breaking the frost bond between the shelf and the said structure when the shelf is to be removed.

In the attached drawings:

Figure 1 is a view in perspective of an evaporator being made in accordance with the invention, said evaporator being of a type adapted for use in mechanical refrigerators of the domestic type;

Figure 2 is a view in perspective of the detachable shelf element which, in accordance with the invention, is provided with an independent closed refrigerant circuit;

Figure 3 is a fragmentary sectional view illustrating the manner in which the shelf is supported in the evaporator structure;

Figure 4 is a fragmentary sectional perspective view showing a portion of a domestic refrigerator incorporating a low temperature compartment for frozen foods and provided with an evaporator for cooling said compartment constructed in accordance with the invention;

Figure 5 is a view in perspective of one of the detachable shelf elements of the evaporator structure shown in Figure 4;

Figure 6 is a fragmentary front elevational view illustrating the manner in which the shelf illustrated in Figure 5 is supported in the evaporator structure, and

Figure 7 is a fragmentary sectional view illustrating a device by means of which the detachable shelf shown in Figures 5 and 6 can be freed from the body of the evaporator structure, or can be supported in a position to reduce the rate of heat transfer between the primary refrigerating system and the secondary system of the detachable shelf.

With reference first to Figures 1 to 3, inclusive, of the drawings, the evaporator wherein illustrated comprises a U-shaped body having in the upper portions of the opposite side walls 2 and 3 thereof, respectively, a refrigerant intake manifold chamber 4 and a discharge manifold chamber 5. Below the manifold 4, the wall is pro-
vided with a passage 6 arranged in substantially horizontal convolutions, said passage communicating at the top with the manifold 4 and at the bottom with a series of passages 7 which extend downwards and under the bottom of the evaporator to the opposite side 3. A passage in the wall 3, corresponding to the passage 6 of the wall 2, establishes communication between the passages 1 and the discharge manifold 5 in the upper part of the shelf.

In the present instance, the U-shaped body of the evaporator is composed of metal plates 8 and 9 secured together in face-to-face relation, the said plates, or one of them, having recesses which form the bottom manifold chambers and passages described above.

In the present instance, the upper edges of the side walls 2 and 3 are united by extensions of the plates 8 and 9 in the form of transverse straps 11 and 12 which span the top of the U-shaped structure and which are provided with apertures for reception of securing elements by which the evaporator may be suspended in the structure of the evaporator of which said evaporator constitutes a functional element.

In accordance with the present invention, the evaporator is provided with a detachable shelf designated generally by the reference numeral 13, see Figure 2. This shelf takes the form, in the present instance, of a shallow U-shaped structure having a plurality of channels forming an independent closed refrigerating circuit. As illustrated, the circuit includes a horizontal channel 14 in each of the side walls 15 and 16 of the shelf and a plurality of parallel passages 17 which extend downwardly from the chambers 14 and across the bottom of the shelf to a central channel 18 in said bottom which extends longitudinally of the shelf structure as illustrated in Figure 2. This shelf may be of double plate construction corresponding to that of the body 1 of the evaporator and it is to be noted that whereas the outer plate 19 is pressed outwardly to form one wall of each of the chambers 14, 18, those portions of the passages 17 which communicate with the chambers 14 are formed by recessing the inner plate 21 of the structure. Thus the outer faces of the side walls 15 and 16 are flat except for the projecting walls of the chambers 14.

These projecting walls of the chambers 14 constitute elements of the means for detachably supporting the shelf in the body of the evaporator. A manner affording an intimate heat transfer relationship between the refrigerating system of which the evaporator constitutes a part and the closed circuit of the shelf. It will be noted that the inner surface of each of the side walls 2 and 3 of the evaporator is provided with a horizontally extending recess 22 which, in assembly, receives the projecting walls of the chambers 14 of the shelf and thereby slidably support the shelf within the body of the evaporator. Each of the recesses 22 is formed at the inner face of one of the horizontal traverses of the passage 6, the corresponding recesses in the side wall 2 being made of greater depth than the recesses of the other traverses so as to permit recessing of the inner wall without restriction of the passage. Thus, when the shelf is in position in the evaporator, structure the walls of the chambers 14 of the shelf and of the passage 6 of the body of the evaporator lie in intimate surface contact, as illustrated in Figure 3, and the remaining portions of the side walls 15 and 16 of the shelf which contain the ends of the passages 17 are in substantially close contact with the inner faces of the walls 2 and 3 of the main portion of the evaporator which contain the passages 6 and 7. By this means an intimate heat transfer relation is established between active areas of the evaporator of the primary refrigerating system and the closed secondary system of the shelf.

In operation, heat from relatively warm foodstuffs placed upon the shelf will be absorbed by the liquid refrigerant in the under portions of the closed circuit, and the resultant gas will pass through the passages 17 upwardly in the side walls 15 and 16 and to the chambers 14 wherein, by reason of transfer of heat to the evaporator, the gas will be condensed to liquid state and will be returned by gravity flow through said passages to or toward the channel 18. The portions of the closed circuit in the bottom wall of the shelf thus constitute the evaporator of the secondary refrigerating system in the shelf, and the portions in the walls 15 and 16, which are in intimate heat transfer relation with the evaporator 1 of the primary refrigerating system, constitute the condensers of the said secondary system.

It is to be noted that the shelf 13 is provided at its forward end with a depending lip 23 to facilitate withdrawal of the shelf from the evaporator structure for defrosting or for other purposes; and at the rear with two upturned lips 24 which act as stops at the rear edge of the shelf for articles placed upon the latter.

Figures 4 to 7, inclusive, illustrate the principle of the invention as applied to a frozen foods compartment of a domestic refrigerator. As illustrated in Figure 4, the evaporator, which is installed within the insulated walls 25 of the refrigerator cabinet, is shaped in its lower portion to provide a chamber 27 constituting the frozen foods compartment. In addition to side walls 21 and 28, the evaporator is provided at the bottom with a front wall 29, said wall terminating below the tops of the side walls as shown. Access to the compartment is had over the top of the front wall. Certain features of the particular evaporator illustrated, are disclosed and claimed in the co-pending application of Donald E. Daley, Serial No. 516,950, filed December 28, 1943.

The top of the access opening 31 is defined by a detachable shelf 32 of the shelf being slidably supported upon rails 33, 34 on the inner faces of the side walls 27 and 28 of the evaporator. A second shelf 34 is detachably mounted between the upper ends of the walls 27 and 28, this shelf, as shown in Figure 5, having a side wall 35 the upper edge of which is turned over to form an outwardly extending hood 36. The upper end of the wall 28 of the evaporator is formed with an upwardly projecting head 37 adapted for coaction with the hook 38 to afford a suspension for the shelf.

As shown in Figure 4, the shelf 32 is provided with a vertical side wall 39 which, in assembly, seats flatly against the inner face of the wall 28 of the evaporator; and, as shown in Figure 6, the wall 35 of the shelf 34 is correspondingly normally retained by said suspension means in flat engagement with the inner face of the said wall 28. As shown also in Figure 6, the walls of the evaporator are provided with refrigerant passages 39 constituting elements of a primary refrigerating system and connected, as by means of a capillary tube 41, with a compressor 42, return flow to the compressor taking place through the usual suction line (not shown). The passages 39 extend across the bottom of the evaporator structure and upwardly in the wall 29, said
5 passages, as indicated in Figures 6 and 7, extending in the wall 28 to a point closely adjoining the upper end thereof so that this entire wall is directly associated with the primary refrigerating system.

Each of the shelves 32 and 34 is provided with a system of passages 43, indicated by dotted lines in Figures 4 and 5, which form in each of the shelves a closed secondary refrigerating circuit. These passages extend to the vertical walls 34 and 36 of the said shelves and are thereby brought into intimate thermal transfer relation with the passages 39 of the primary system in the wall 28 of the evaporator. Thus, each of the shelves comprises a secondary refrigerating system which constitutes an integral part of the shelf structure.

These refrigerated shelves, forming in effect detachable elements of the evaporator structure, are located in the upper part of the structure immediately above the top of the compartment 25 and in a relatively exposed position with respect to moisture laden air within the refrigerated chamber. The function of these passages in effect as baffles interrupting the normal flow of the moist air into relatively cold interior of the compartment 25 so that the moisture will tend to condense in the form of frost upon the surfaces of the shelves rather than on the walls of the compartment. A major part of the frost deposit therefore forms upon these shelves which, by reason of their detachable nature, may readily be removed for purpose of defrostation. This device makes possible long periods of continuous operation without general defrosting.

A means to facilitate removal of the shelves, each is provided at the lower end of the vertical wall, 34 and 36, respectively, with a rock shaft 44, said shaft having thereon one or more cams 45 which, when the shaft is rocked, exerts pressure against the wall 28 to force the shelf away from the latter. Each of the rods 46 may be provided with a suitable handle or knob 47 at its forward end. By this means, the frost bond between the shelves and the wall 28 may be readily broken. Another function of the cams 45 is to retain the vertical walls of the shelves in more or less remote position to the refrigerated wall 28, as shown, for example, in Figure 7, to reduce the rate of thermal transfer between the primary and secondary systems and to thereby regulate the local temperatures of the shelves.

It will be noted by reference to Figure 4 that the interior space of the refrigerator is divided by a double walled horizontal partition 47 positioned in the present instance somewhat above the upper shelf 34. The chamber below the shelf 47 thus constitutes a low temperature storage space with the top access freezing compartment 26 at the bottom thereof. As previously set forth, by reason of the relatively exposed position of the secondary shelves 32 and 34, these shelves will normally receive a major part of the frost deposit within the low temperature compartment. By reason of the removability of the shelves the low temperature compartment may be kept relatively free from frost deposits adversely affecting the efficiency of the refrigeration.

I claim:

1. In an evaporator for refrigerating systems, a main evaporator structure, a detachable shelf comprising a bottom wall and oppositely disposed side walls, means operatively associated with the side walls for slidably supporting the shelf in the evaporator structure with the said side walls thereof in thermal transfer relation with said structure and with the bottom wall free from such relation, and a closed refrigerant circuit in said shelf having portions thereof in said side walls and in the bottom wall respectively.

2. In an evaporator for refrigerating systems, a detachable shelf comprising a bottom and elevated opposite side portions, channels in said side and bottom portions constituting elements of a closed refrigerant circuit, one of the channels in each of said side portions having a wall projecting beyond the outer side surface of said side portion, and oppositely disposed recesses in said side portion, and evaporator arranged for coaction with said projecting walls of the channels to detachably support the shelf with the said closed refrigerant circuit in intimate thermal relation with said evaporator.

3. An evaporator for refrigerating systems, said evaporator comprising a substantially U-shaped body having refrigerant circulating channels in the sides thereof, a shelf having upwardly extending side portions and channels formed in a closed refrigerant circuit, said channels extending from the lower portions of the shelf into the said side portions, and means on said side portions and on the sides of said evaporator for detachably supporting the shelf with the said side portions thereof in intimate heat transfer relation with the channeled sides of the evaporator body.

4. An evaporator for refrigerating systems having in the lower portion thereof an open topped bin constituting a low temperature food compartment, one wall at least of said bin extending upwardly above the top of the latter, a member comprising a closed refrigerant circuit, and means for supporting said member in position overlying the top of said bin and with a relatively elevated portion of said closed circuit in thermal transfer relation with said wall.

5. An evaporator for refrigerating systems, said evaporator comprising a low temperature frozen food compartment having a top access opening, and having side walls extended upwardly above said opening, a member comprising a closed refrigerant circuit, and means for detachably supporting the member between said evaporator wall extensions in position overlying said opening and with a portion of said circuit in thermal transfer relation with said active portion of the evaporator.

6. In refrigerating apparatus, a refrigerated chamber, an evaporator in said chamber shaped to afford in the bottom thereof a top access low temperature compartment for frozen foods, said evaporator having an active portion extending upwardly in the chamber, and a shelf containing a closed refrigerant circuit removably supported in said chamber in an elevated position with respect to and overlying said compartment and with a portion of said circuit in thermal transfer relation with the said active portion of the evaporator.

7. In refrigeration apparatus including refrigerated wall surfaces defining a chamber, a shelf-like structure extending between said wall surfaces and providing a partition dividing said chamber into sub-compartments, said shelf-like structure including a closed refrigerant system having an evaporator portion and a condenser portion, said condenser portion being arranged...
in heat exchange relation with portions of said refrigerated wall surfaces.
8. In refrigeration apparatus including refrigerated wall surfaces defining a chamber, a partition extending between and supported by said wall surfaces and dividing said chamber into sub-compartments, said partition including a closed refrigerant system having an evaporator portion and a condenser portion, said condenser portion being arranged in heat exchange relation with the adjoining supporting portion of said refrigerated wall surface.

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