May 1, 1951 J. N. SALER 2,551,465

REFRIGERANT EVAPORATOR

Filed May 10, 1946 2 Sheets-Sheet 1

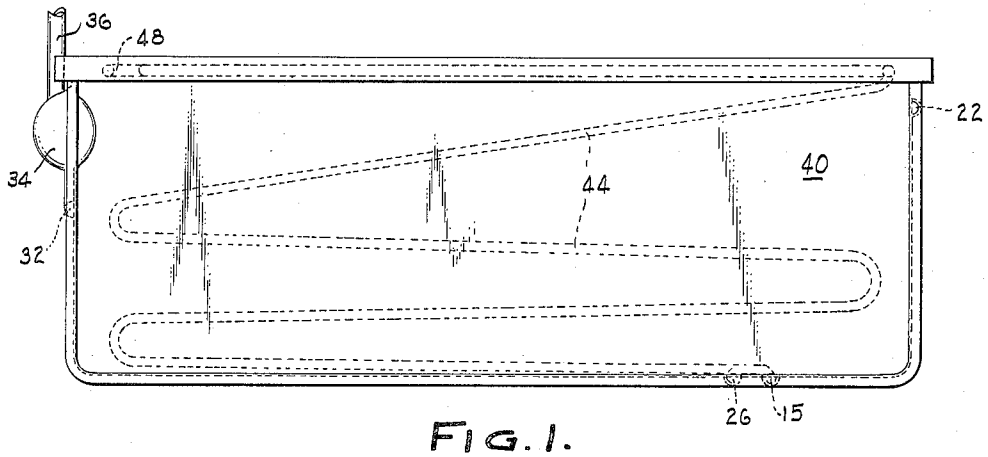


FIG. 1.

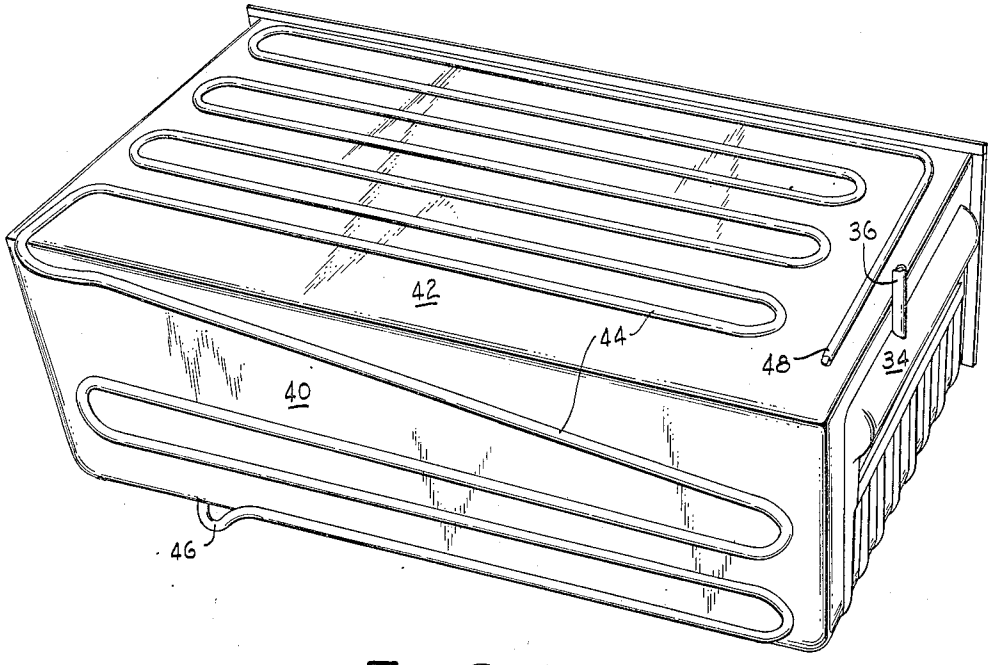


FIG. 2.

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REFRIGERANT EVAPORATOR

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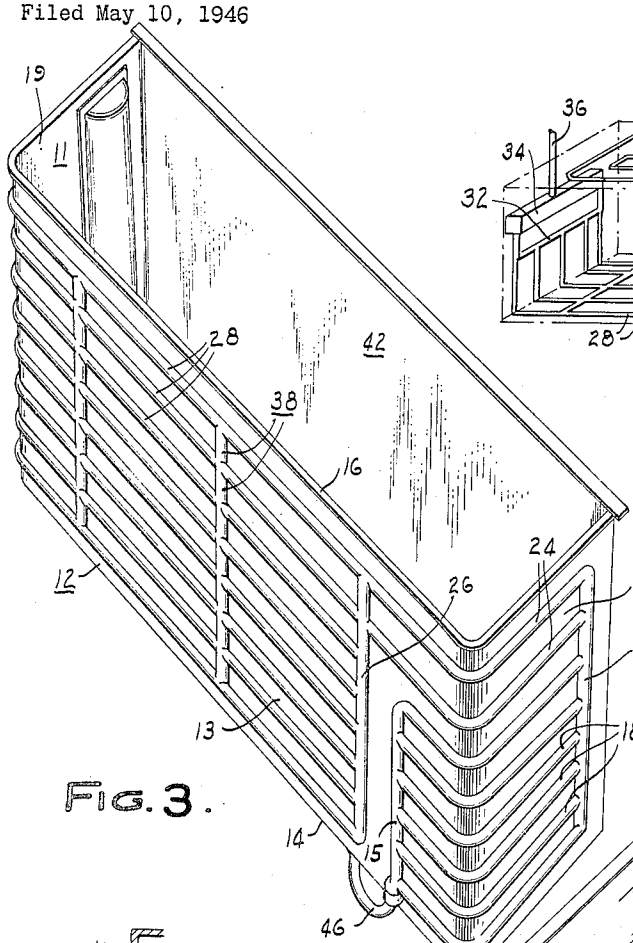


FIG. 3.

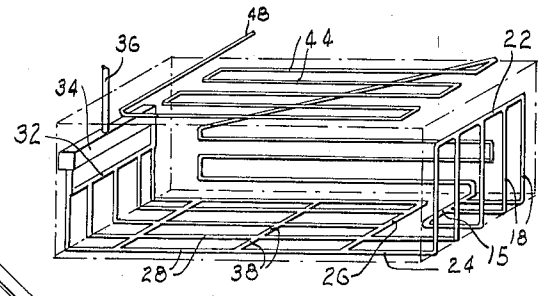


FIG. 6.

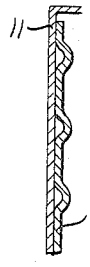


FIG. 5.

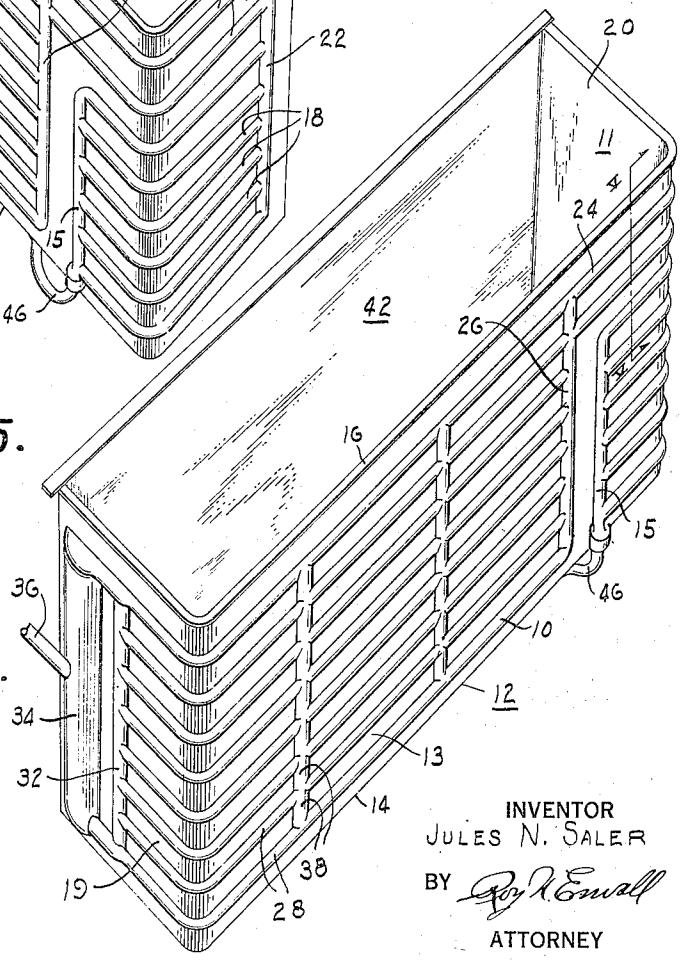


FIG. 4.

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UNITED STATES PATENT OFFICE

2,551,465

REFRIGERANT EVAPORATOR

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8 Claims. (Cl. 62—126)

1

This invention relates to refrigerating apparatus and more especially to an evaporator for such apparatus.

It is an object of the invention to provide a refrigerant evaporator in which the temperature distribution is substantially uniform.

It is another object of the invention to provide an evaporator having a multiplicity of refrigerant passages which offer a minimum of resistance to the flow of a vaporizing refrigerant.

It is a further object of the invention to provide an evaporator having a minimum of parts and hand-brazed connections.

These and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawings forming a part of this application, in which:

Fig. 1 is a front elevation of the evaporator of this invention;

Fig. 2 is a perspective of the evaporator of Fig. 1, showing the top, rear and one side wall thereof;

Fig. 3 is a perspective of the evaporator of Fig. 1, showing the bottom, the other side wall and the open front thereof.

Fig. 4 is a perspective of the evaporator of Fig. 1, showing the first-named side wall, the bottom wall, and the open front thereof;

Fig. 5 is a sectional view on the line V—V of Fig. 4; and

Fig. 6 is a phantom view showing schematically the refrigerant passages of the evaporator of this invention.

Referring now to the drawings, the reference numeral 10 designates the outer sheet and the reference numeral 11 the inner sheet of a U-shaped evaporator element 12. The sheets 10 and 11 form the bottom wall 13 and the two side walls 19 and 20 of a wide freezing chamber adapted to extend across the entire width and depth of a domestic refrigerator. The sheets 10 and 11 are electrically welded together at their edges and also at intermediate points and are embossed to provide a plurality of refrigerant passages.

One of these passages, located in the bottom wall 13 of the evaporator element 12 near the side wall 20, runs from the rear edge 14 toward the front edge 16 of the bottom wall 13, and forms an inlet manifold 15. A plurality of parallel and spaced-apart passages 18 each communicates with the inet manifold 15. They extend sidewardly thereof and then pass upwardly in the side wall 20 of the U-shaped evaporator element 12. The upper ends of the parallel passages 18 communicate with a collecting manifold 22 located near the upper edge of the side wall 20.

2

One end portion of the collecting manifold communicates with two parallel passages 24 which carry the refrigerant down the side wall 20 and along the bottom wall 13 to a distributing manifold 26 in the bottom wall 13 and parallel to and near the inlet manifold 15. A second group of parallel and spaced-apart passages 28 extends sidewardly from the distributing manifold 26 across the major portion of the bottom wall 13 of the U-shaped element 12 and up in the other side wall 19 to a second collecting manifold 32 lying parallel to but spaced from the upper edge of the side wall 19. The collecting manifold 32 communicates at both of its ends with the ends of a refrigerant header 34 lying parallel to and above the collecting manifold 32. A suction tube 36 communicates with the upper portion of the refrigerant header 34. The parallel passages 28 of the second group are preferably joined by cross passages 38 intermediate their ends.

A metal sheet 40 is secured to the rear edges of the U-shaped element 12 and a second metal sheet 42 is secured to the top edges thereof and to the top edge of the metal sheet 40. The sheets 40 and 42 form, respectively, the rear and the top walls of the evaporator. A convoluted metal tube 44 is brazed to sheets 40 and 42 and refrigerates substantially all portions thereof. The tube 44 is brazed at one end 46 with the inlet manifold 15 and is adapted to receive a volatile refrigerant at the other end 48.

Operation

The evaporator is adapted to receive the volatile liquid refrigerant through the end 48 of the tube 44 and to emit the vaporized refrigerant through the suction tube 36. Generally, the refrigerant passages, because of their parallel arrangement in parts of the evaporator, increase in carrying capacity as the refrigerant passes through the evaporator. This accommodates the refrigerant vapor which is formed and decreases the frictional resistance of the refrigerant in the passages.

A noticeable exception to this general rule is the downwardly-leading passages 24 which are of smaller cross-sectional area than the combined cross-sectional area of the parallel passages 18. Such restricted passages are preferred on the downward course in order to entrain the refrigerant liquid with the refrigerant vapor so that the ratio of the liquid and vapor in those passages remains relatively constant. This prevents alternating surges of rerfigerant vapor and of refrigerant liquid through these passages 24. The restricted passages 24 are made relatively short by

locating the distributing manifold **26** near to the side wall **20**. This minimizes the total frictional resistance in the passages **24**. The passage means **24** may comprise one or a plurality of conduits but its total cross-sectional area must be small in order to insure a flow rapid enough to entrain refrigerant liquid with the refrigerant vapor.

It will be noted that the flow of refrigerant between the inlet manifold **15** and the collecting manifold **22** is not impeded in any manner. This arrangement permits of upward or downward flow in any of the passages. The passage which absorbs the most heat, due, for example, to the placing of warm foods against it, will generate the most refrigerant vapor and, accordingly, will produce the most rapid upward flow of refrigerant, which flow may be greater than the quantity of refrigerant supplied to the inlet manifold **15**. Under such conditions, a downward flow will occur in some of the other parallel passages **18** to supply additional refrigerant to the warm passage, and thereby maintain a substantially uniform temperature.

The parallel passages **28**, similarly, communicate freely with the intermediate distributing manifold **26** and the collecting manifold **32**, and, in addition, have cross connections **38** to aid in the supplying of any passage having a high heat load with additional refrigerant.

It will be apparent from the above that this invention provides an evaporator having a low resistance to the flow of a volatile refrigerant therethrough and having a nearly uniform temperature throughout. The number of parts are few and the number of brazed connections in the refrigerant passages is limited to two, one connection being between the tube **44** and the inlet manifold **15** and the other between the suction tube **36** and the header **34**.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited but is susceptible of various changes and modifications without departing from the spirit thereof.

What I claim is:

1. A refrigerant evaporator element comprising two embossed metal sheets secured together at their edges and intermediate thereof to form refrigerant passages, said sheets being bent into the shape of a U to form the bottom and two side walls of a cooling chamber, said passages being characterized by an inlet manifold extending across a major portion of said bottom wall, a first group of spaced-apart passages extending sidewardly from said inlet manifold and then passing upwardly in one of said side walls, each of said passages of said first group communicating without restriction with said inlet manifold, a collecting manifold located adjacent the upper edge of said one side wall and communicating freely with each of the passages of said first series, passage means extending downwardly from said collecting manifold in said side wall and across a portion of said bottom wall, said passage means being of smaller cross sectional area than the combined cross sectional areas of said first group of passages, an intermediate distributing manifold communicating with said passage means and extending across said bottom wall, a second group of spaced-apart passages each communicating without restriction with said intermediate manifold, and extending sidewardly therefrom and then passing upwardly in said second side wall, and a second collecting manifold in said second side wall communicating freely with each of said passages of said second series.

2. The refrigerator evaporator element defined in claim 1 in which said first group of spaced-apart passages extends along less than one-third of the bottom wall of the cooling chamber and said second group of spaced-apart passages extends substantially across the remainder of said bottom wall.

3. The refrigerant evaporator element defined in claim 1 including a metal sheet forming the rear wall of said cooling chamber and a convoluted conduit adapted to carry a refrigerant in heat transfer relationship with said sheet, said conduit communicating at one end with said inlet manifold of the U-shaped evaporator element.

4. The refrigerant evaporator element defined in claim 1 including a metal sheet forming the rear wall of said cooling chamber, a second metal sheet forming the top wall thereof, and a convoluted conduit adapted to carry a refrigerant in heat-conducting relationship with both of said sheets, one end of said conduit communicating with said inlet manifold of the U-shaped evaporator element.

5. A refrigerant evaporator element comprising two embossed metal sheets secured together at their edges and intermediate thereof to form refrigerant passages and a refrigerant header, said sheets being bent into the shape of a U to form the bottom and two side walls of a cooling chamber, said passages being characterized by a narrow inlet manifold extending across a major portion of said bottom wall, a first group of spaced-apart passages extending sidewardly from said inlet manifold and then passing upwardly in one of said side walls, each of said passages of said first group communicating without restriction with said inlet manifold, a collecting manifold located adjacent the upper edge of said one side wall and communicating freely with each of the passages of said first series, passage means extending downwardly in said side wall and across a portion of said bottom wall, said passage means being of smaller cross sectional area than the combined cross sectional areas of said first group of passages, an intermediate distributing manifold communicating with said last-named passage means and extending across said bottom wall, a second group of spaced-apart passages each communicating without restriction with said intermediate manifold, and extending sidewardly therefrom and then passing upwardly in said second side wall, and a second collecting manifold in said second side wall communicating freely with each of said passages of said second series, said refrigerant header being located in said second side wall and communicating with said second collecting manifold.

6. In a refrigerator evaporator element having a horizontal wall, a first vertical side wall joined to a first edge of said horizontal wall and a second vertical side wall joined to a second edge of said horizontal wall, said second edge being opposite to said first edge of said horizontal wall, said horizontal wall and said two side walls forming the bottom and the side walls, respectively, of a rectangular cooling chamber, all of said walls having refrigerant passages, said passages being characterized by a narrow inlet manifold extending across said evaporator element near the junction of said bottom wall with said first side wall and parallel to said junction, a first group of spaced-apart passages extending side-

wardly from said inlet manifold and upwardly on said first side wall, a first collecting manifold adjacent the upper edge of said first side wall, each of the passages of the first group communicating without restriction with said inlet manifold and with said first collecting manifold, passage means extending downwardly from said first collecting manifold on said first side wall, said passage means being of smaller cross sectional area than the combined cross sectional areas of said first group of passages, an intermediate distributing manifold located adjacent said inlet manifold and communicating with said passage means, a second group of spaced-apart passages extending along said bottom wall and upwardly on said second side wall, and a second collecting manifold on said second side wall, said passages of said second group communicating without restriction with said intermediate distributing manifold and with said second collecting manifold.

7. The refrigerant evaporator element defined in claim 6 in which said inlet manifold is located on said horizontal wall and spaced from said junction not over one-third of the length of said horizontal wall.

8. The refrigerant evaporator element defined in claim 6 wherein each of the passages of said second group communicates individually with said intermediate manifold.

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