Aug. 3, 1943. L. A. PHILIPP 2,325,705

REFRIGERATING APPARATUS

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Fig. 1.

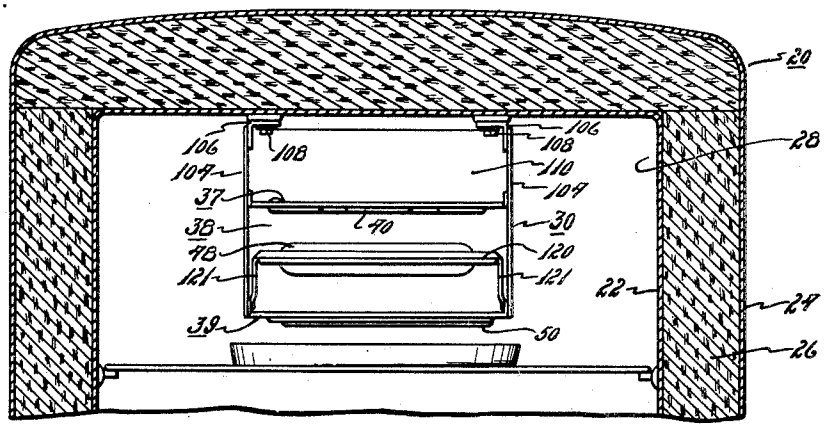


Fig. 2.

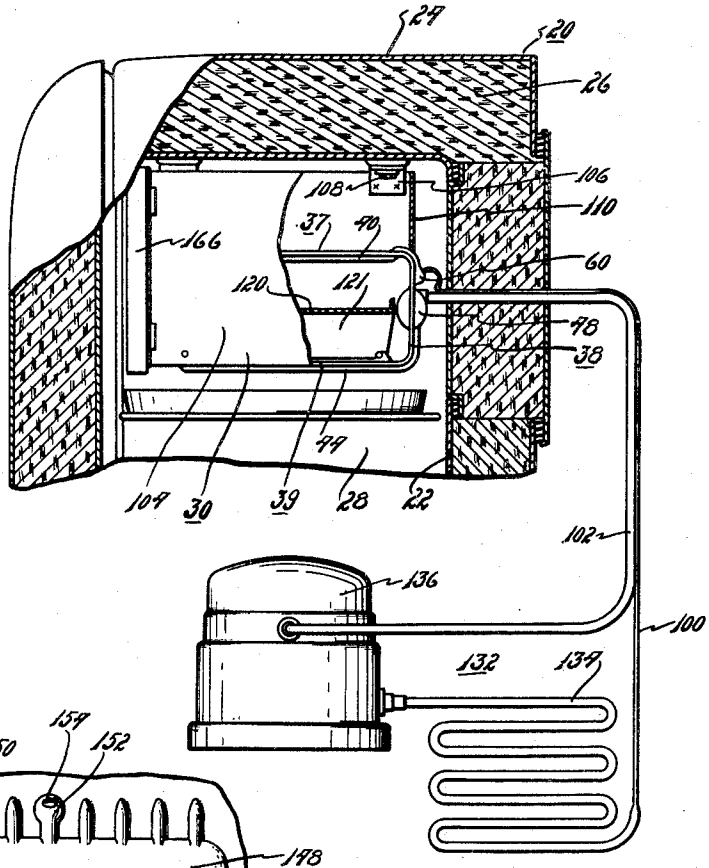
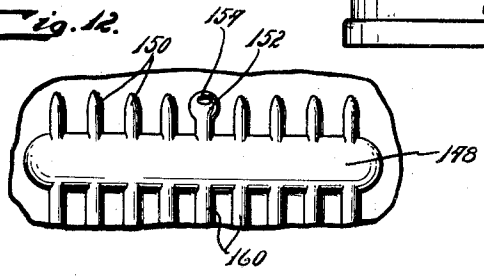


Fig. 12.



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Fig. 3.

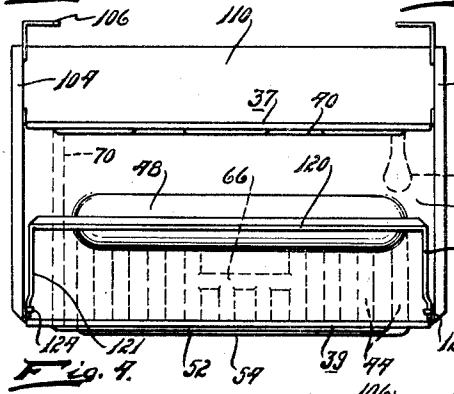


Fig. 4.

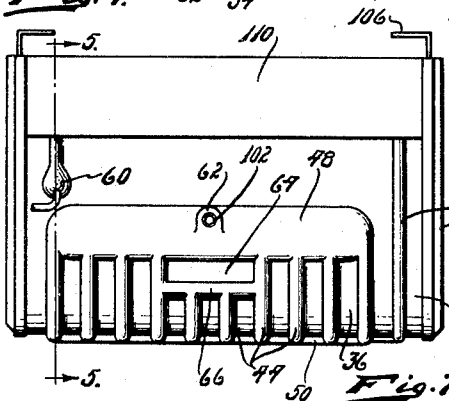


Fig. 5.

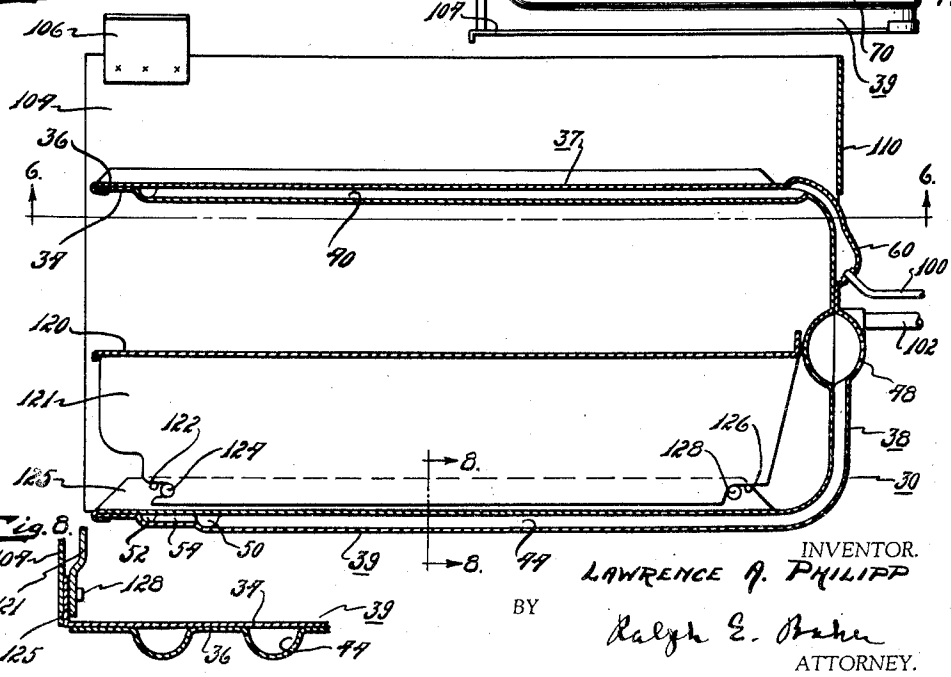


Fig. 6.

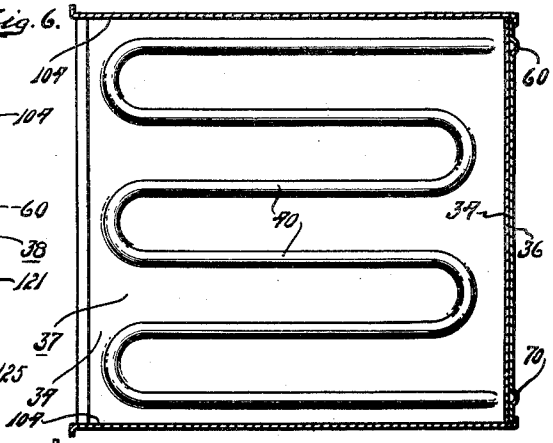


Fig. 7.

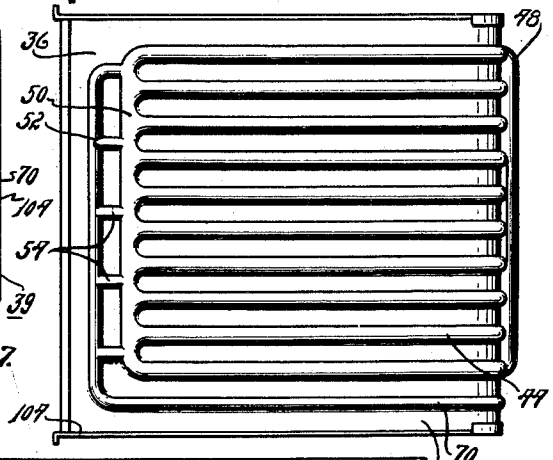


Fig. 8.

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REFRIGERATING APPARATUS

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Fig. 10.

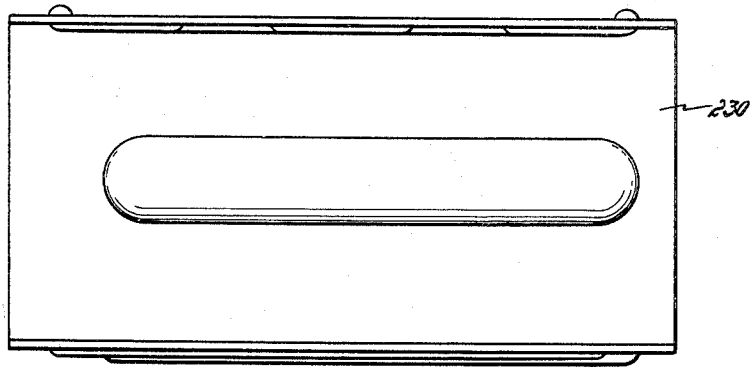


Fig. 11.

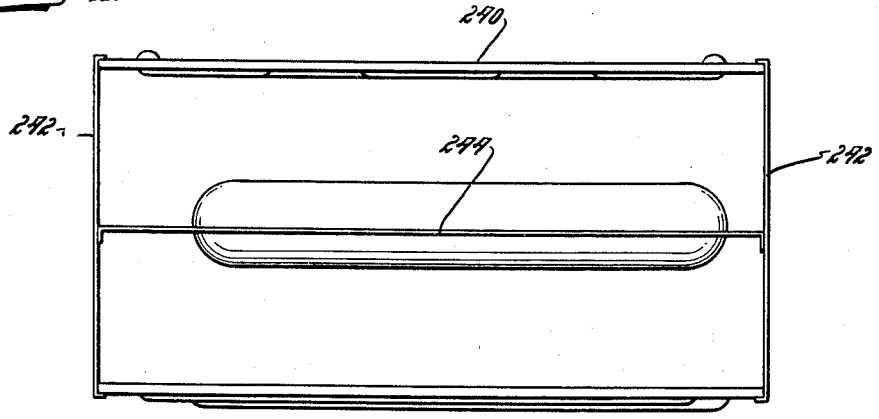
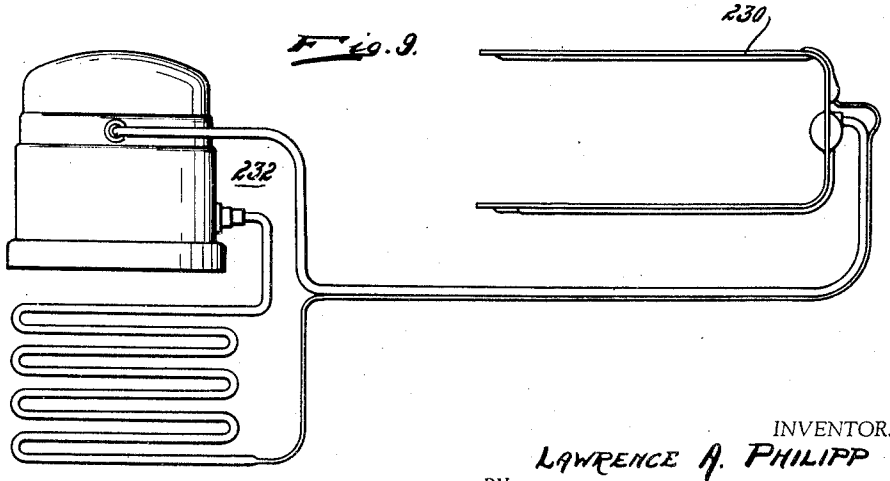


Fig. 9.



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UNITED STATES PATENT OFFICE

2,325,705

REFRIGERATING APPARATUS

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Application August 23, 1940, Serial No. 353,925

10 Claims. (Cl. 62—126)

This invention relates to refrigerating apparatus, and more particularly to refrigerant evaporating units used in connection with such apparatus.

One of the objects of my invention is to provide an improved refrigerant evaporating element which is particularly adapted for freezing substances, and has provisions for cooling circulating air in small spaces to be refrigerated.

Another object of my invention is to provide a refrigerant evaporator which is constructed in the general form of a C, with an upper horizontally positioned section and a lower horizontally positioned section spaced apart to provide a freezing zone, and arranged so that the perpendicular portion interconnects the upper and lower horizontal portions at the rear thereof to keep a circulatory path for the flow of refrigerant, and to provide inlet and outlet connections for the refrigerant in said perpendicularly arranged portions.

Another object of my invention is to provide a new and improved refrigerant evaporating element which is formed in the general shape of a C, and to construct the element in such a manner that the upper portion is provided with a serpentine passage for the flow of refrigerant and the lower portion is provided with parallel passages for the flow of refrigerant, and the perpendicular portion of the element is provided with a liquid and gaseous refrigerant header which interconnects the ends of the parallel passages in the lower portion of the element.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a fragmentary vertical front view in cross section of a refrigerator showing my improved refrigerant evaporating element;

Fig. 2 is a fragmentary view shown partly in elevation and partly in cross section of the side of the refrigerator showing my evaporating element and a refrigerating system diagrammatically associated therewith;

Fig. 3 is an enlarged front view of the evaporating element embodying features of my invention;

Fig. 4 is a rear view of the element shown in Fig. 3;

Fig. 5 is an enlarged view of the element taken alone the lines 5—5 of Fig. 4;

Fig. 6 is a view taken along the lines 6—6 of Fig. 5 on a somewhat reduced scale;

Fig. 7 is a bottom view of my evaporating element;

Fig. 8 is a view taken along the lines 8—8 of Fig. 5;

Fig. 9 is a modified form of the evaporating element embodying features of my invention and showing the refrigerant condensing unit diagrammatically connected therewith;

Fig. 10 is a front view of the element shown in Fig. 9 on a somewhat larger scale;

Fig. 11 is a view similar to Fig. 10 showing the sides of the element enclosed and a shelf mounted between the upper and lower portions of the evaporating element; and

Fig. 12 is a view of a modified form of header and outlet arrangement for my improved evaporator.

Referring to the drawings, the numeral 20 designates in general a refrigerator cabinet which includes inner liner 22 and outer casing 24. Interposed between the liner 22 and casing 24 is insulation 26. Liner 22 forms the inner walls of food storage compartment 28. Within the food storage compartment I have disposed my improved refrigerant evaporating element, designated in general by the numeral 30.

The refrigerant evaporating element is formed in the general shape of a C and consists of two sheets of metal; namely, inner sheet 34 and outer sheet 36, which are united together and form passages for refrigerant in the upper wall 37, rear wall 38 and bottom wall 39 of the element 30. As shown, the sheets are formed to provide a serpentine passage 40 in the upper wall of the refrigerated section and parallel passages 44 in the lower wall of the refrigerated section. Part of the passages 44 extend upwardly on the rear wall where they are joined in open communication with liquid and gaseous refrigerant header 48. The other ends of the passages 44 are interconnected by a distributing manifold 50 formed in the outer sheet 36 in bottom wall 39. Also, formed in the outer sheet 36 is second manifold 52 which is a receiving manifold for feeding refrigerant to the manifold 50. The manifold 52 is connected with the manifold 50 by restricted passages 54 which are formed in the outer casing 36 so as to provide for introducing injected refrigerant from the manifold 52 into the manifold 50. An inlet connection is formed in the outer sheet 36 in the rear wall 38 of the refrigerated section as at 60. The outlet connection 62 is provided in the header 48. Immediately below

the outlet 62 and the header 48, the sheets 36 and 34 are united together as at 64 so as to provide a quiescent zone in the header where refrigerant in the passages 44 cannot readily pass into the header 48. Below the united portion 64 is horizontal passage 66 which is connected on its ends to two of the passages 44. Thus when there is violent ebullition within the passages 44, such ebullition does not disturb the liquid refrigerant in the header 48 immediately below the outlet 62 where gaseous refrigerant is withdrawn from the evaporator to be returned to the compressor. Thus liquid is not taken back into the compressor. Preferably, the sheets 34 and 36 are welded together about their peripheral edges and between the corrugations formed in the sheets to provide the passages for refrigerant. As will be noted, the serpentine passage 40 is formed chiefly in the sheet 34 and the parallel passages are formed in the sheet 36, whereas the header 48 is formed in both sheets. Liquid refrigerant enters the inlet connection 60 whence it flows through the serpentine passage 40 which is connected on its outlet end to passage 70 which is connected with the manifold 52. The refrigerant then flows through the restrictions 54 into manifold 50 and from there upwardly through passage 44 into the header 48. Gaseous refrigerant is withdrawn from the upper portion of the header 48 through the outlet connection 62. Liquid refrigerant is introduced into the inlet connection 60 through a small diameter or capillary tube 100 and is withdrawn from the outlet connection 62 through a vapor return conduit 102.

In order to enclose the sides of the evaporator, I have provided sheet metal side walls 104. These side walls 104 are secured to the side edges of the walls 37 and 39 so as to prevent air within the food storage compartment 28 from entering the interior of the evaporator. The walls 104 extend above the upper portion of a sheet 36 and are provided with brackets 106 which are secured by bolts 108 to the top wall of the liner 22. Thus the evaporating element 30 is secured within the food storage compartment 28. The side walls 104 are united at their rear portion by connecting sheet of metal 110, which is preferably formed integral with the side walls 104 and extend downwardly from the top edges of the walls 104 to the sheet 36. Between the wall 37 and the bottom wall 39, I have mounted a removable shelf 120 in the general form of an inverted U. This shelf includes downwardly extending sides 121 which are provided with notches 122 at their front ends which pass over and rest upon pins or lugs 124 carried by upstanding flanges 125 of bottom wall 39. On the other ends of the shelf sides 121 are provided horizontally positioned slots 126 which rest on the pins or lugs 128. Since the shelf 120 is secured to the refrigerant containing shelf 39 the shelf 120 will conduct the heat of substances stored thereon to the shelf 39 for rapid freezing of such substances. As will be noted in Fig. 5, the rear end of the shelf 120 may be lifted or tilted upwardly until the bottom edge clears the lugs 128 and then may be slid rearwardly until the notch 122 clears lug 124. Then the front end of the shelf may be lifted upwardly and then removed from the evaporator through the front thereof.

Liquid refrigerant is delivered to and gaseous refrigerant withdrawn from the element 30 by a refrigerant condensing element 132. This unit includes condenser 134 and motor compressor unit 136. Evaporated refrigerant is withdrawn from the element 30 through vapor return conduit 102 by the motor compressor unit 136, which compresses it and delivers it to condenser 134. The condenser 134 liquifies the refrigerant and delivers it to the small diameter tube 100, which controls the flow of such liquid to the element 30. The condensing element 132 may be located in the lower portion of the cabinet 20 in the usual space provided for such units.

As shown in Fig. 12, the evaporator may include a header 148 which corresponds to header 48. Above the header may be provided corrugations 150 and 152. In this instance the corrugated portion 152 may be provided with outlet 154 to which the vapor return conduit 102 may be connected. This places the outlet 154 somewhat above the header where the parallel passages formed in the evaporator below the header will not discharge violently ebullating refrigerant into said outlet. In some instances it may be desirable to construct the header and parallel passages and outlet as disclosed in Fig. 12. The parralel passages in this disclosure are designated as 160 and correspond to the passages 44.

The front of the element 30 may be closed by hinged door 166. Thus the door 166 together with walls 104 and 110 prevents the circulation of air from the food storage compartment to the inner walls of the evaporator 30. Thus collection of frost and ice on the interior surfaces of the evaporator is greatly eliminated. Door 166 is shown in Fig. 2 only, it being omitted from the other figures of the drawings for the purpose of clarity.

From the foregoing it will be noted that I have provided a refrigerant evaporating element which is in the general form of a C and includes two horizontally positioned portions and one perpendicular portion which interconnects the two horizontal portions. As this unit is disposed within the food storage compartment, only the bottom horizontal portion and rear portion is exposed to the circulating air, the rest of the refrigerated surfaces being enclosed within sheet metal walls so that the circulating air in the food storage compartment does not come in contact therewith. The sheet metal walls and surrounding portion of the refrigerated surfaces are cooled somewhat by the C shaped portion and are utilized for cooling circulating air in the food storage compartment of the refrigerator. This particular type of evaporator is economical to manufacture and is very effective in freezing substances since the conventional type of ice tray may be mounted upon the horizontal refrigerated surfaces of the C-shaped evaporator and also upon the removable shelf spaced therebetween. Any suitable type of ice tray may be used for such purposes. The evaporator is also suited for cooling circulating air when the space to be cooled is not very large, it having very little refrigerated space presented to the circulating air in the compartment. Preferably, the system operates so that the serpentine passage section is operating in a non-flooded condition. The refrigerant enters such serpentine passage in the form of droplets and passes therethrough into the manifolds 52 and 50 whence it flows through passages 44 into the header 48. The liquid refrigerant collects in and forms a level in the header between the upper and lower portions thereof. If, when the compressor stops operating, any liquid is contained within the serpentine passage 40, it would drain to the lower portion of the evaporator, which operates in a

flooded condition due to the location of the manifolds and header and the parallel passages **44**, the open ends of which are connected to manifold **50** and header **48**. The passages **44** provide for circulation of liquid in such passages.

Referring now to Figs. 9 and 10, there is shown a refrigerant evaporating element **230** which corresponds to the evaporating element **30**, but does not include any sheet metal side walls or a shelf positioned between the upper and lower walls thereof as does the element **30**. The element **230** is supplied with liquid refrigerant and vaporized refrigerant is withdrawn therefrom by a refrigerant condensing element **232** which corresponds to refrigerant condensing element **132**.

In Fig. 11, I have disclosed evaporator **240** which is the same as that shown in Figs. 9 and 10 but includes sheet metal side walls **242** which extend from the front to the rear and from the top to bottom of the evaporator and are secured to the upper and lower refrigerated walls thereof. In this evaporator I have also positioned shelf **244** which is permanently mounted therein and is secured on its ends to walls **242**. The shelf **244** may be welded to walls **242**.

Although only a preferred form of the invention has been illustrated, and that form described in detail, it will be apparent to those skilled in the art that various modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. A refrigerant evaporating unit for refrigerating systems comprising sheet metal material united together to provide upper, rear and bottom walls and formed to provide a serpentine passage for refrigerant in the upper wall, parallel passages in the bottom wall and a header in the rear wall communicating with said parallel passages.

2. A refrigerant evaporating element comprising a horizontal portion having a single refrigerant flow passage, a second horizontal portion having a plurality of passages arranged in parallel relation, and a vertical portion interconnecting said portions and having a header for liquid and gaseous refrigerant substantially midway between said horizontal portions.

3. A refrigerant evaporating element comprising a horizontal portion having a single refrigerant flow passage, a second horizontal portion having a plurality of passages arranged in parallel relation, and a vertical portion interconnecting said portions and having a header for liquid and gaseous refrigerant substantially midway between said horizontal portions and sheet metal material secured to the side edges of said horizontal portions to enclose the space therebetween.

4. A refrigerant evaporator comprising spaced apart vertically extending single ply sheet metal members, a horizontal refrigerated shelf positioned between said members and between the upper and lower edges thereof, a second refrigerated shelf positioned between said members at their lower edges and a vertically extending refrigerated section extending substantially from one of said members to the other and interconnecting said shelves at the rear thereof.

5. A refrigerant cooling element comprising vertically extending spaced apart sheet metal members, a sheet metal section joined to each of said spaced apart members at the upper portion thereof and extending downwardly to a point substantially midway between the upper and lower edges thereof, and a C-shaped refrigerating element positioned between said spaced apart members with one refrigerated portion being located adjacent the lower edge of said members and another portion being positioned directly below said section.

6. A refrigerant evaporator comprising two sheets of metal formed to provide a serpentine refrigerant conduit, a plurality of refrigerant passages having an inlet manifold and an outlet manifold, and a plurality of restricted passages for injecting refrigerant from said serpentine conduit into said inlet manifold.

7. A refrigerant evaporator comprising a serpentine refrigerant conduit, a plurality of refrigerant passages having an inlet manifold and an outlet manifold, a plurality of restricted passages for conducting refrigerant from said serpentine conduit to said inlet manifold, said evaporator being arranged in a conformation having two substantially parallel portions connected by a web portion at one end of said conformation to enclose a freezing zone and to provide an air cooling surface.

8. A refrigerant evaporator comprising two sheets of metal formed to provide a header, a refrigerant distributing manifold, refrigerant passages between said header and said distributing manifold, a refrigerant receiving manifold, restricted passages between said receiving manifold and said distributing manifold, and a serpentine refrigerant passageway connected to said receiving manifold.

9. A refrigerant evaporating unit comprising a non-flooded refrigerant evaporating section, a flooded refrigerant evaporating section, said unit being arranged in a conformation having two substantially parallel portions connected by a web portion at one end of said conformation, two spaced apart refrigerant manifolds, one in direct communication with said non-flooded section and the other in direct communication with said flooded section, and restricted passages directly connecting said manifolds for conducting refrigerant from said non-flooded section to said flooded section.

10. A refrigerant evaporator comprising two sheets of metal formed to provide a serpentine refrigerant evaporating conduit, a refrigerant receiving manifold connected to said serpentine conduit, a refrigerant distributing manifold, restricted passages connecting said receiving manifold to said distributing manifold, a plurality of refrigerant evaporating passages communicating at one end with said distributing manifold at points displaced from the points of connection of said restricted passages to said distributing manifold, and a header arranged in communication with the other end of each of said refrigerant evaporating passages.

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