March 18, 1952 H. A. GOLDBERG 2,589,490

EVAPORATOR FOR HOUSEHOLD REFRIGERATORS

Filed Sept. 11, 1948 4 Sheets-Sheet 1

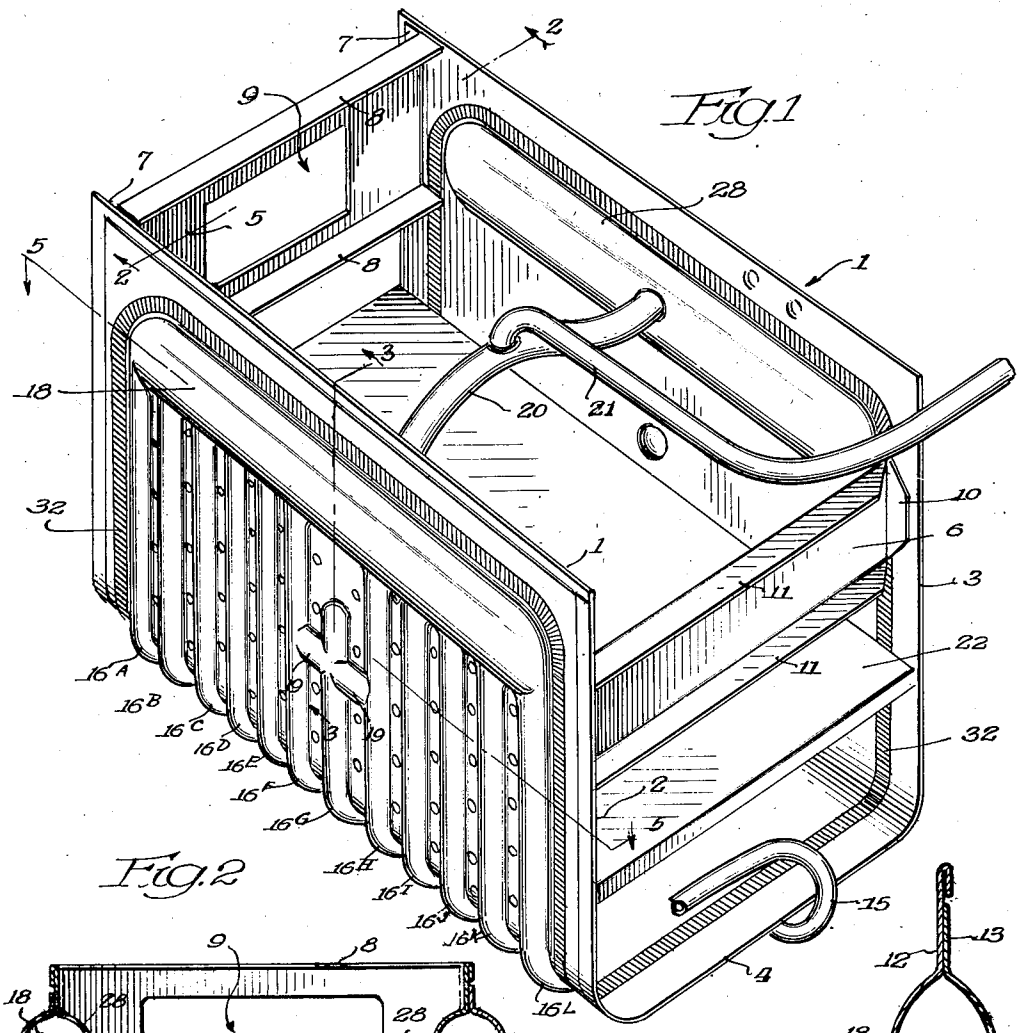


Fig. 1

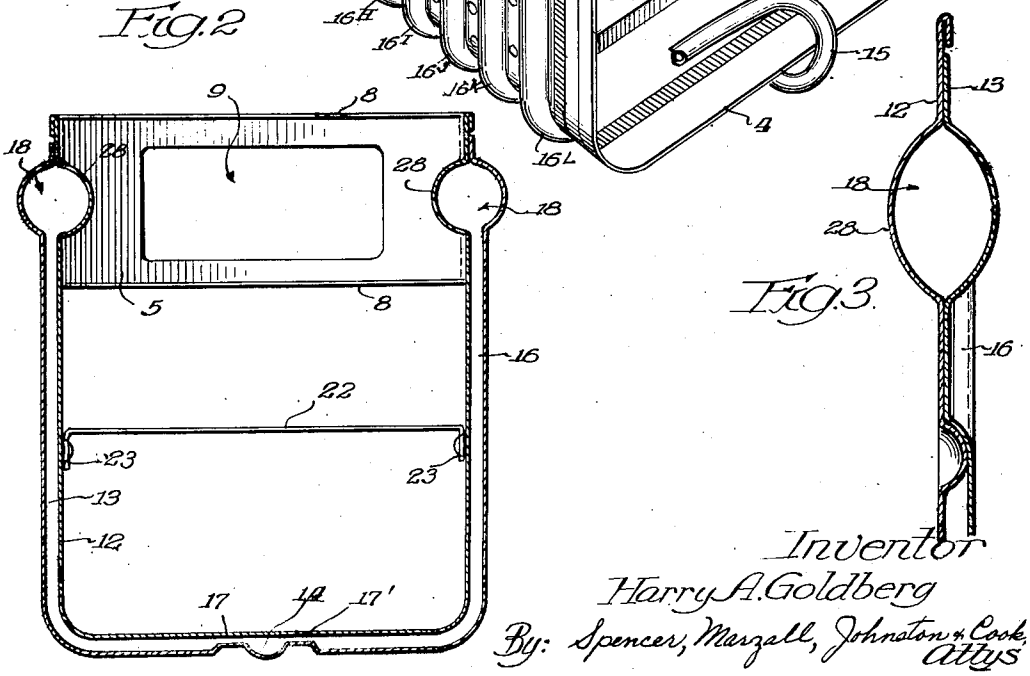


Fig. 2

Fig. 3

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FIG. 4

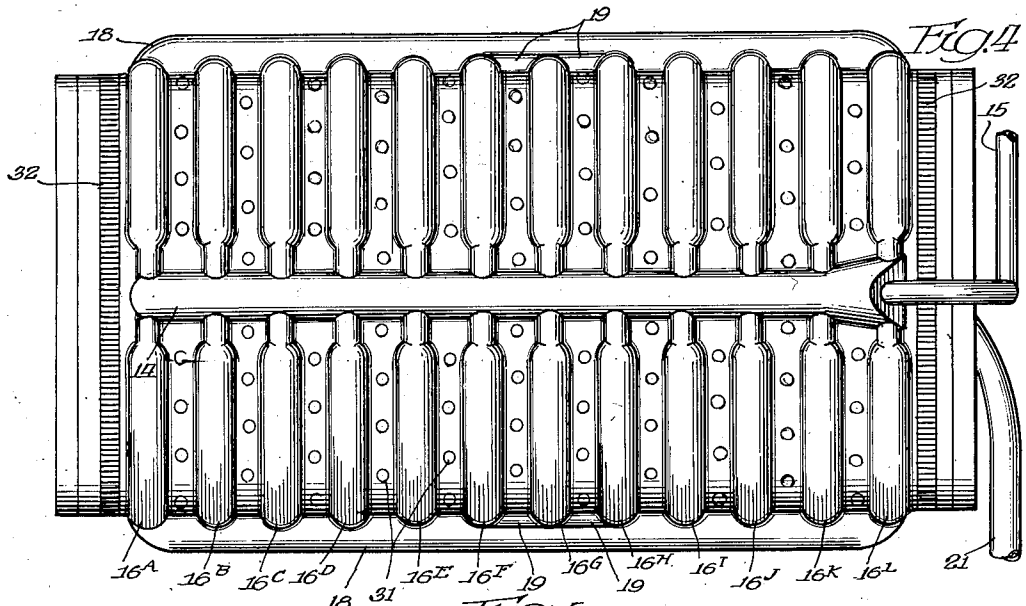
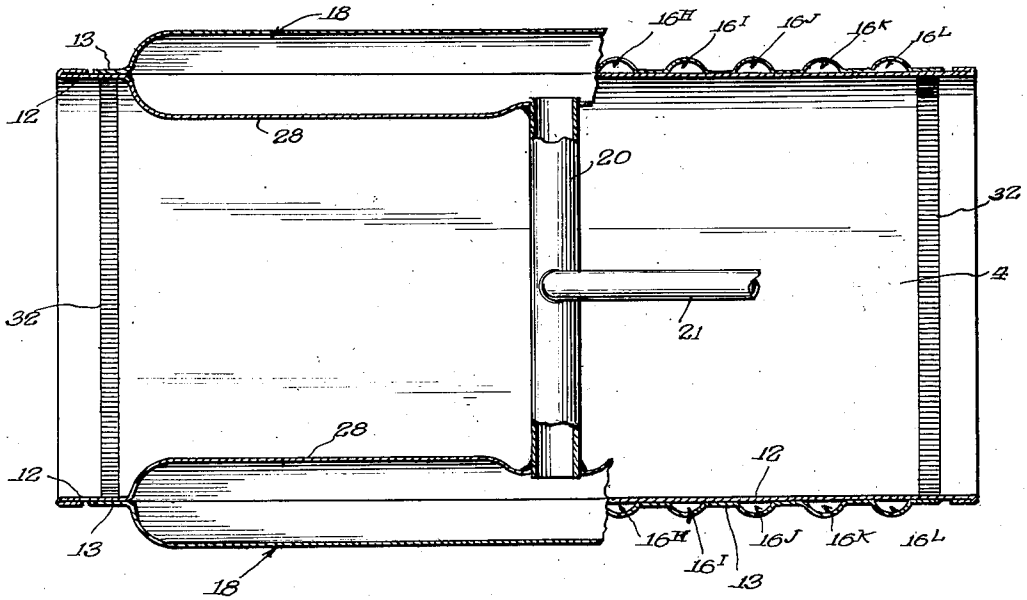


FIG. 5.



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Fig. 6.

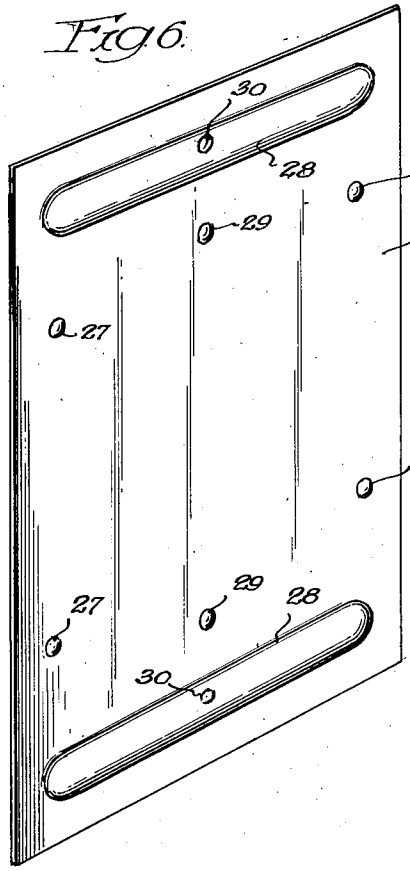


Fig. 7.

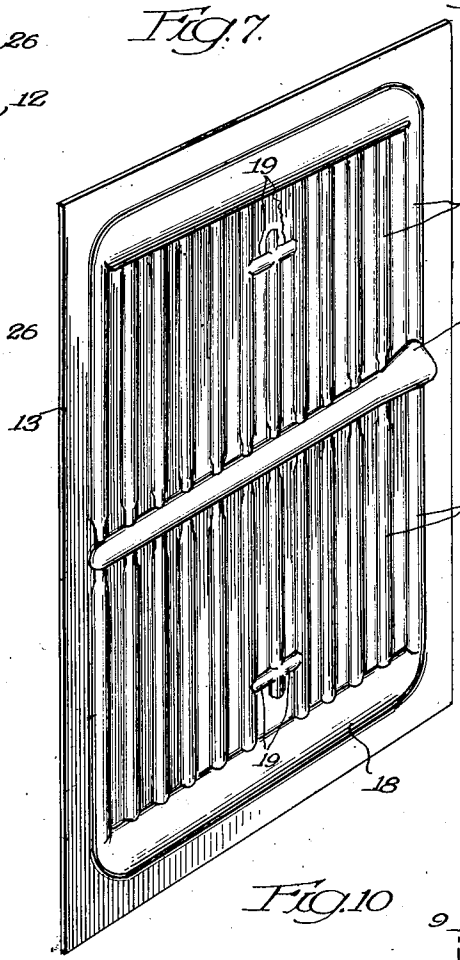


Fig. 8

Fig. 9

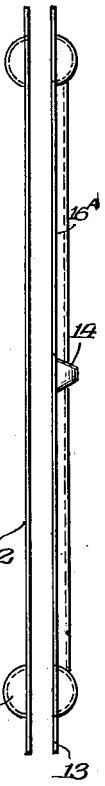


Fig. 10

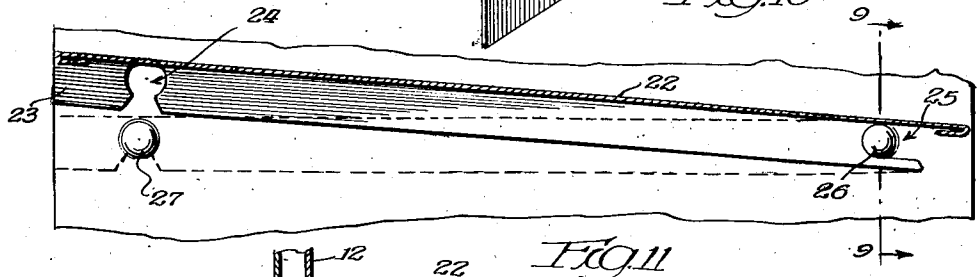
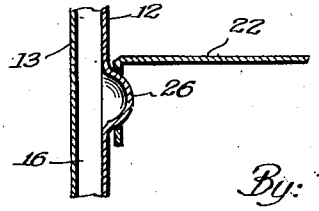


Fig. 11



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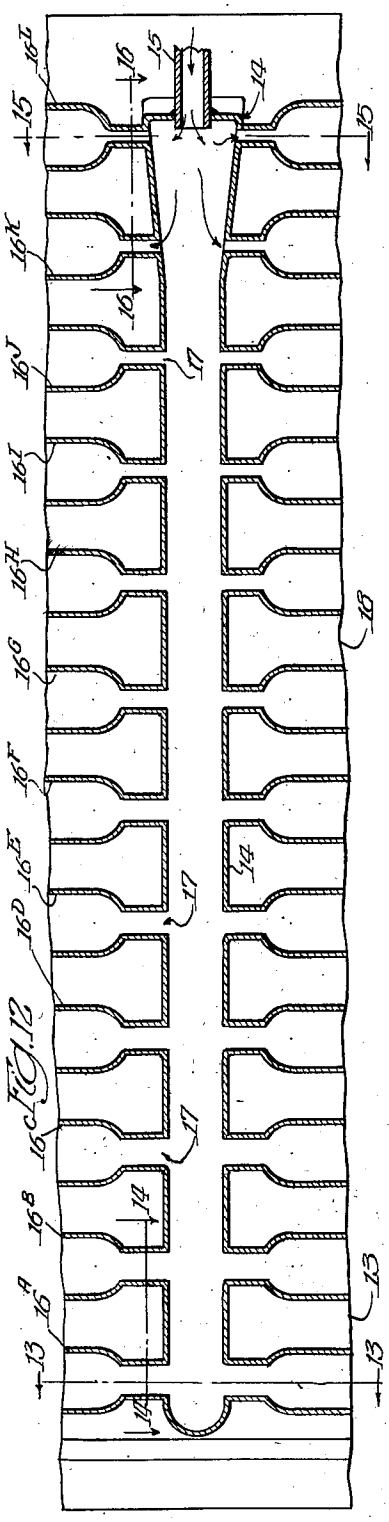


FIG. 12

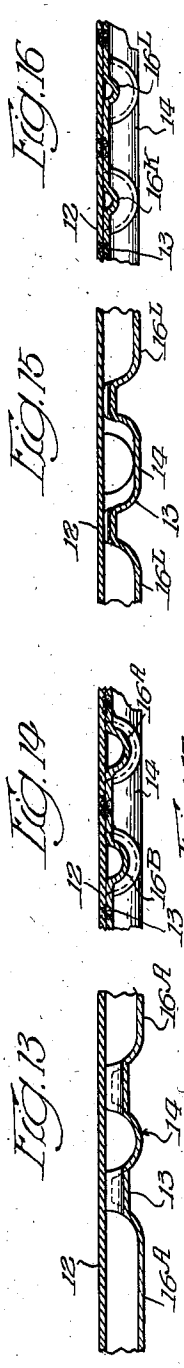


FIG. 13

FIG. 14

FIG. 15

FIG. 16

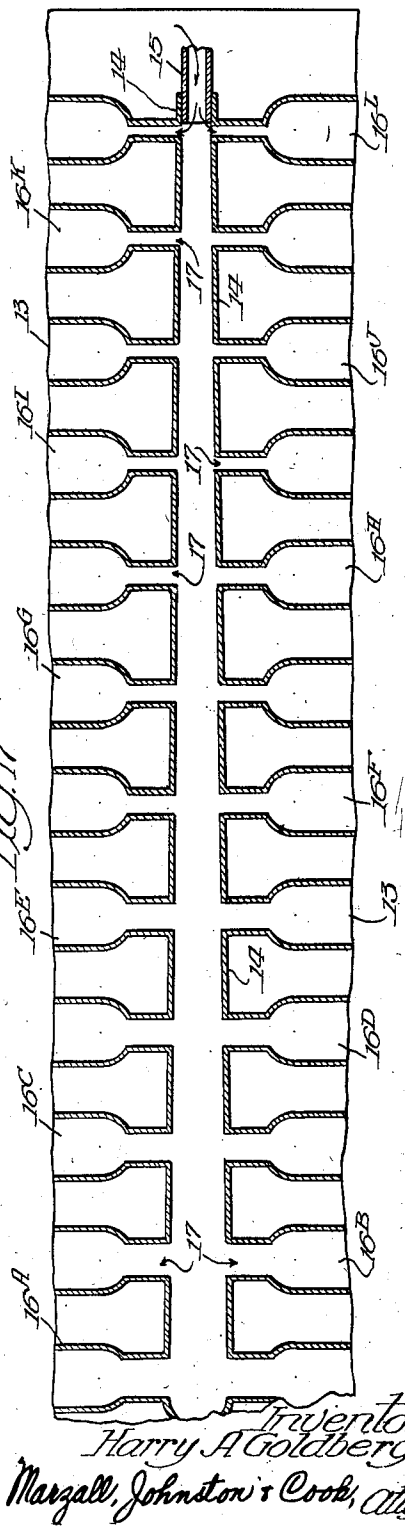


FIG. 17

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UNITED STATES PATENT OFFICE

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EVAPORATOR FOR HOUSEHOLD REFRIGERATORS

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Application September 11, 1948, Serial No. 48,918

7 Claims. (Cl. 62—126)

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This invention relates to a refrigerator evaporator in general and particularly to an evaporator used in connection with refrigerators of the domestic household type.

The primary object of the present invention is the provision of a new and novel evaporator of improved type wherein a distributing tube or manifold to receive refrigerant is constructed and arranged to supply refrigerant equally to a plurality of restricted communicating passages leading directly from the manifold and positioned on each side thereof.

Another important object of the invention resides in the provision of a manifold into which, and through which, refrigerant is adapted to flow into connecting branch passages having restricted inlets which increase in size progressively from the forward inlet end of the manifold toward the rear end thereof, each branch passage being individually and directly fed from said manifold so as to insure the proper amount of refrigerant entering into all branch lines, and in that way providing for an equal pressure drop of refrigerated vapors in all branch passages and thus assuring proper cooling and preventing so-called hot or warm spots occurring in the evaporator.

A further object is the provision of a new and novel evaporator construction emboding features to insure the proper amount of refrigerant flowing into restricted passages leading from a single manifold into which refrigerant is received, thereby eliminating excessive and unequal pressure drop such as would be encountered where a multiple manifold construction, such as two or more manifolds, is used.

A still further object is the provision of a new and novel method of forming and fabricating an evaporator to permit the evaporator to be assembled quickly and easily at a relatively low cost.

Still another object relates to the provision of complementary means to effect proper indexing of the parts to speed production and insure uniformity and precision in assembly.

A still further object is the provision of a novel evaporator embodying shelves or supports for the ice cube trays whereby the shelves may be removed and inserted quickly and easily.

Numerous other objects and advantages will be apparent throughout the specification which follows:

The accompanying drawings illustrate a seleted embodiment of the invention and the views therein are as follows:

Fig. 1 is a perspective view of the improved evaporator unit;

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Fig. 2 is a vertical sectional view on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged fragmentary sectional view on the line 3—3 of Fig. 1;

Fig. 4 is a bottom plan view of the evaporator unit;

Fig. 5 is a horizontal sectional view on the line 5—5 of Fig. 1, certain parts being broken away for the sake of clearness;

Fig. 6 is a perspective view of the inner plate of the evaporator body before being bent to shape;

Fig. 7 is a perspective view of the outer plate of the evaporator body before being bent to shape;

Fig. 8 is an end view of the inner plate shown in Fig. 6;

Fig. 9 is an end view of the outer plate shown in Fig. 7;

Fig. 10 is an enlarged detail fragmentary view showing an inside wall of the evaporator and the manner of mounting the ice cube tray shelves within the evaporator unit; and

Fig. 11 is a detail vertical sectional view on line 9—9 of Fig. 10.

Fig. 12 is a bottom plan view showing the restricted passage leading from the manifold, parts being broken away for the sake of clearness, and showing the branch channels in section.

Figs. 13 to 16 inclusive are sectional views taken on the lines 13—13 to 16—16 inclusive of Fig. 12; and

Fig. 17 is a bottom plan view, similar to Fig. 12, but showing the manifold tapered from front to rear, parts being broken away for the sake of clearness.

The particular embodiment of the invention herein disclosed for the purpose of illustrating the invention comprises a U-shaped body member 1 having oppositely disposed parallel vertical side walls 2 and 3 which are connected integrally at their lower edges to a horizontal bottom wall 4. The side walls 2 and 3 are maintained in rigid spaced relationship with respect to each other by means of a forward bracing plate 5 and a rearward bracing plate 6.

The forward bracing plate 5 is interposed between the side walls 2 and 3 near the forward end of the body 1. An integral flange 7 is preferably arranged at each end of the plate 5, and this flange 7 may be secured to the side wall adjacent thereto. The forward bracing plate 5 also may have a pair of integral flanges 8 which project horizontally from the top and bottom edges of this plate. These flanges 8 serve to pre-

vent the plate 5 from flexing or bending. An opening 9 may be formed in the bracing plate 5 for the reception of suitable refrigeration controls (not shown), which are adapted to be mounted on the forward bracing plate 5.

The rearward bracing plate 6 is interposed between and secured to the side walls 2 and 3 near the rearward end of the body 1. This bracing plate 6 has, at each end, an integral flange 10 which may be secured to the side wall adjacent thereto. The plate 6 also has a pair of flanges 11 which project horizontally from the top and bottom edges, said flanges 11 serving to strengthen the plate 6.

The walls 2, 3 and 4 of the body member 1 preferably are formed of an inner plate 12 and an outer plate 13, which said plates are in suitable and proper juxtaposition. These plates are suitably embossed to form a plurality of refrigerant passages arranged between the inner plate 12 and the outer plate 13.

One of the refrigerant passages between the plates 12 and 13 may comprise a distributor tube or manifold 14. This tube or manifold 14 is formed by embossing the outer plate 13 so that when the plate 13 is arranged in position with respect to the inner plate 12, a proper passage is formed. The tube or manifold 14 extends longitudinally and medially along the bottom wall 4 of the body 1 when the plates 12 and 13 have been arranged in U-shaped formation, as shown in Fig. 1. The tube or manifold 14 is closed at its forward end and its rearward end may be joined to a small hollow tube or passage 15 which leads from a suitable refrigeration condensing unit (not shown).

The distributor tube or manifold 14 communicates with a series of hollow conduits 16A to 16L inclusive, each of said conduits leading directly from the manifold 14 so that each conduit is individually fed. The conduits 16 extend laterally outward from opposed sides of the distributor tube or manifold 14 and thence pass upwardly along the side walls 2 and 3. The cross sectional area of each conduit is reduced or constricted at either side of the distributor tube 14 at the points where the conduits join the manifold 14, as indicated at 17, Figs. 12 to 17. The area of constriction of each of the conduits 16 increases progressively from the inlet end of the distributor manifold or tube 14 towards its other end. When the refrigerant enters the inlet of the distributor tube or manifold 14, it will seek the channel of least resistance, which is conduit 16L; then conduit 16K, etc. By restricting conduit 16L at the manifold more slightly than 16K and 16K more slightly than 16J, and so on down the distributor tube, it is possible to accomplish an even flow to all parts of the coil, thus giving an equal coil temperature throughout with no non-refrigerated areas, commonly known as "dead spots." This arrangement provides that there will be no unwanted pressure drop, as would occur when two or more manifolds are used. It also makes it possible to feed each conduit individually and directly from the manifold. This arrangement and construction also gives exceptional results in the field of refrigeration and heat transfer over other constructions known and presently used. The upper ends of all the conduits 16, with the exception of the conduit 16G communicate with horizontal headers, branches or accumulators 18, there being a header 18 on each of the side walls 2 and 3. The ends of the conduit 16G terminate below the

headers on the side walls 2 and 3, respectively. A pair of short horizontal passages or tubes 19 on each of the side walls 2 and 3 provide communication between the conduit 16G near its upper end and the adjacent conduits 16F and 16H.

The branches or headers 18 preferably are joined to, and communicate with, the ends of a hollow tube 20 which is interjoined between these headers. This tube 20 may be joined at its center to, and may have communication with, a second hollow tube 21, which is preferably smaller in diameter than the tube 20. The tube 21 leads either directly or indirectly to the aforesaid refrigeration condensing unit.

A removable ice cube tray supporting shelf 22 is adapted to be supported in a horizontal position between the side walls 2 and 3 of the body member 1. Each of the opposed longitudinal edges of this shelf 22 has an integral flange 23 which projects downwardly therefrom. The forward end of each flange 23 has a keyhole-shaped slot 24 which is open at the lower edge of the flange, as shown clearly in Fig. 10. The rearward end of each flange 23 has an elongated slot 25 which is open toward the rearward end of the flange. The rearward slots 25 are adapted to engage a pair of inwardly projecting protuberances 26, there being a protuberance 26 on each of the side walls 2 and 3 near the rearward end of these walls. The forward slots 23 on each of the flanges 23 are adapted to engage a pair of inwardly projecting protuberances 27, there being a protuberance 27 on each of the side walls 2 near the forward end of these walls.

The shelf 22 may be mounted between the side walls 2 and 3 by first engaging the elongated slots 25 with the protuberances 26, as shown in the full line position of Fig. 10. The forward end of the shelf 22 is then lowered or forced downwardly so that the keyhole-shaped slots 24 at the forward end of the flanges 23 engage the protuberances 25, as shown in the dotted line position in Fig. 10. The keyhole-shaped slots 24 and the elongated slots 25 are shaped so that the shelf 22 will be rigidly supported in a horizontal position by the protuberances 26 and 27 when all of the slots are in full engagement with their corresponding protuberances.

The evaporator is preferably formed and fabricated by employing a novel method which permits the evaporator to be assembled quickly and easily at a relatively low cost. This method consists in configurating the inner plate 12, which is in the form of a rectangular sheet of metal. The sheet is first embossed on one side to provide a pair of hollow horizontal ribs 28 which are adapted to form the curved inwardly extending walls of the respective headers 18. The sheet is also embossed to provide the two pairs of shelf supporting protuberances 26 and 27 as clearly shown in Fig. 7. The plate 12 is then embossed on the other side thereof to provide a pair of indexing protuberances 29, as clearly indicated in Fig. 7. A small hole 30 is drilled through the center of each of the ribs 28.

The outer plate 13, which also is initially a flat sheet of metal, is stamped on one side thereof to provide the embossments which form the outer walls of the distributor tube 14, the conduits 16A to L, the short horizontal interconnecting passages 19, and the headers 18, as shown in Fig. 8.

The plates 12 and 13 are next placed together and arranged so that each of the index protuberances 29 on the plate 12 properly register with

the corresponding recess in the plate 13. The recesses, as embossed in the plate 13, comprise extensions at each end of the convolution which forms the outer wall of the conduit 16G. The plates 12 and 13 are then tacked together by spot-welding these plates near their outer edges. The plates 12 and 13 may then be spotwelded at spaced points between each of the conduits 16, as indicated at 31, Figs. 1 and 4.

The plates 12 and 13 are then bent together to form the U-shaped body member 1.

The present evaporator is further assembled and fabricated by welding the inner plate 12 and the outer plate 13 together at or near their outer edges by a seam weld, as indicated at 32, Fig. 1. This seam weld 32 serves to prevent any refrigerant fluid from leaking outwardly from the various refrigerant passages and between the inner and outer plates 12 and 13 respectively.

The brace plates 5 and 6 are then placed in their respective positions. The end flanges 7 on the brace plate 5 are welded to the side walls 2 and 3 near the forward end of the body 1. Similarly, the end flanges 10 on the brace plate 6 are welded to the side walls 2 and 3 near the rearward end of the body 1.

As a next step, the tube 20 is positioned between the ribs 28 so that the opposite ends of this tube properly register with the openings 30 in said ribs. The ends of the tube 20 are then joined to the ribs 28 by any suitable means, such as by silver soldering. Finally, the inlet tube 15 may be soldered to the rearward or inlet end of the distributor tube 14 and one end of the outlet or discharge tube 21 may be soldered to the center of the cross tube 20.

It has been found that good results are also obtained if the distributor tube 14 is tapered from its inlet end to its other end, as clearly shown in Fig. 17. In this latter embodiment it may be desirable and practical, also, to increase the restrictions from end to end as shown in Fig. 17 as well as in Figs. 12 to 16.

The present invention provides a new and improved evaporator which is strong and durable, and which may be constructed easily and rapidly at a relatively low cost. The invention further provides constricting means for causing the refrigerant to flow from a single distributor tube or manifold by equal amounts through each of a series of branching conduits, so that hot spots do not occur at various points on the walls of the evaporator. Novel means have been provided to permit an improved ice cube tray shelf to be inserted and removed easily from the evaporator.

Changes may be made in the form, construction, and arrangement of the parts without departing from the spirit of the invention or sacrificing any of its advantages and the right is hereby reserved to make all such changes as fall fairly within the scope of the following claims.

The invention is hereby claimed as follows:

1. An evaporator comprising a pair of sheets arranged face to face and bent in the form of a U, forming a bottom and side legs, one of said sheets being embossed to provide a main passage between the sheets and forming a single manifold for the reception of refrigerant, a hollow header at the upper end of each leg, a discharge line connecting said headers, a plurality of spaced conduits leading from said single manifold and terminating at said headers, said manifold having a passage increasing in cross-sectional area from one end to the other.

2. An evaporator comprising a pair of sheets arranged face to face and bent in the form of a U, forming a bottom and side legs, one of said sheets being embossed to provide a main passage between the sheets to form a single manifold for the reception of refrigerant, a hollow header at the upper end of each leg, a discharge line connecting said headers, and a plurality of spaced conduits leading from said manifold passage and terminating at said headers, said conduits having restrictions where they join with the said passage in the manifold, said restrictions decreasing progressively in size from one end of said passage in the manifold toward the other end thereof.

3. An evaporator comprising a pair of spaced side walls, a bottom connecting said side walls, a manifold at the bottom and forming a longitudinal passage adapted to receive refrigerant, a header adjacent the upper end of each side wall to provide a longitudinal passage in each wall, and a plurality of spaced conduits connecting the manifold and a header on one wall and having communication therewith, said conduits diminishing in size where they connect with the manifold to provide a restriction in each conduit, each restriction being different in cross-sectional area.

4. An evaporator comprising a pair of spaced side walls, a bottom connecting said side walls, a manifold at the bottom and forming a longitudinal passage adapted to receive refrigerant, a header adjacent the upper end of each side wall and forming a longitudinal passage in each wall, a plurality of spaced conduits connecting the manifold and a header on one wall, said conduits diminishing in size where they connect with the manifold to provide a restriction in each conduit, the cross-sectional area of said restrictions decreasing in size from one end of the manifold to the other, and additional conduits connecting the manifold and the other header, said additional conduits also being restricted at the manifold to provide restricted passages, the cross-sectional area of the restrictions of the latter conduits also decreasing in size from one end of the manifold toward the other end.

5. An evaporator comprising a bottom member, spaced side walls connected to said bottom, a hollow manifold on said bottom and forming a longitudinal passage to receive refrigerant, a plurality of spaced hollow branch lines connected to the manifold and having communication with the manifold passage, restrictions in the branch lines adjacent the point where the branch lines connect with the manifold to reduce the area of the branch lines, the restrictions diminishing in area in each branch line from one end of the manifold toward the other.

6. An evaporator comprising a bottom member, spaced side walls connected to said bottom, a hollow manifold on said bottom and forming a longitudinal passage to receive refrigerant, a plurality of spaced hollow branch lines connected to the manifold and having communication with the manifold passage, restrictions in the branch lines adjacent the point where the branch lines connect with the manifold to reduce the area of the branch lines, the restrictions diminishing in area in each branch line from one end of the manifold toward the other, said manifold being tapered to provide a passage at one end greater than the area at its other end.

7. An evaporator comprising a hollow manifold having a fluid passage therein, a hollow fluid

inlet line communicating with the manifold passage to supply refrigerant thereto, a plurality of adjacently spaced hollow branch lines leading from the manifold passage and having communication therewith, each branch having a constriction, the branch closest to the inlet having a constriction of smaller area than the other branches, the other branches increasing in area of constriction whereby the branch line closest to the inlet will have the constriction of smallest area and the branch line farthest removed from the inlet will have the constriction of largest area, said manifold increasing in size from the point where the branch closest to the inlet line connects with the manifold toward the branch connected to the manifold which is farthest removed from the inlet.

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