Feb. 15, 1938. L. M. CROSLEY ET AL 2,108,744

DIAPHRAGM TYPE EVAPORATOR

Filed Aug. 27, 1934 2 Sheets-Sheet 1

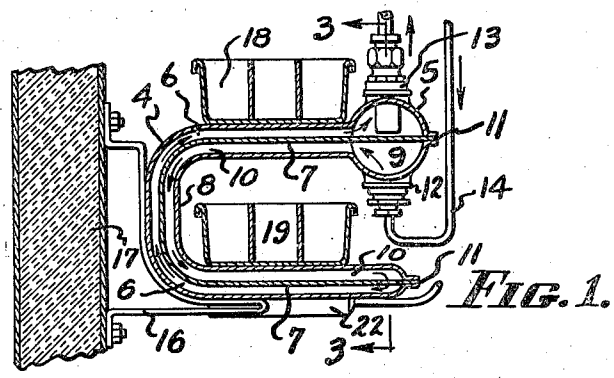


FIG. 1.

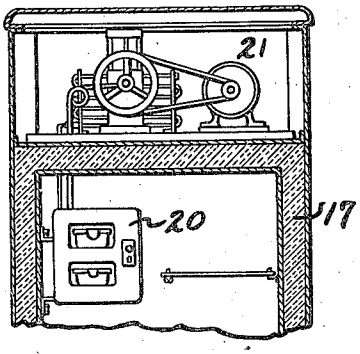


FIG. 2.

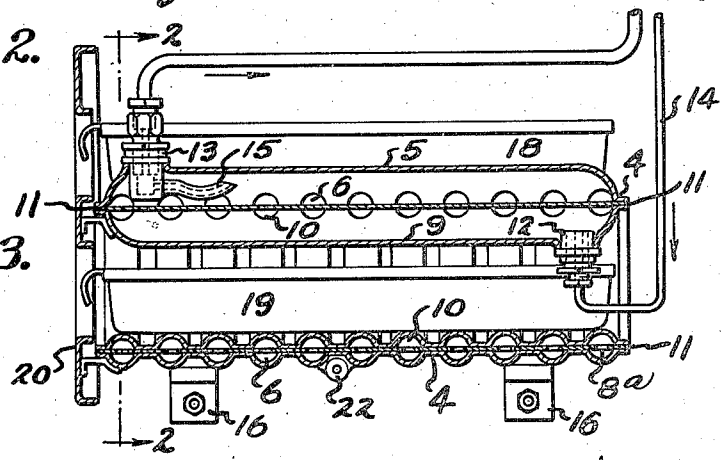


FIG. 3.

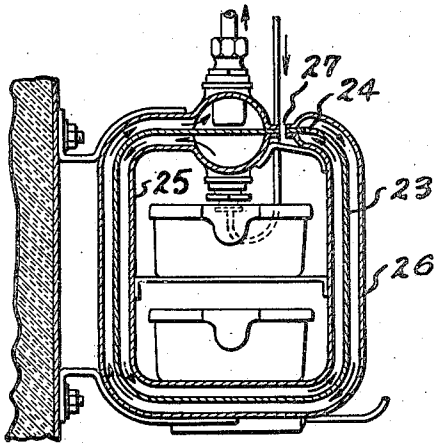


FIG. 4.

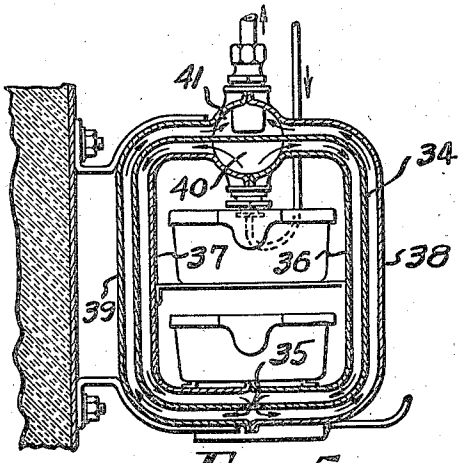


FIG. 5.

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DIAPHRAGM TYPE EVAPORATOR

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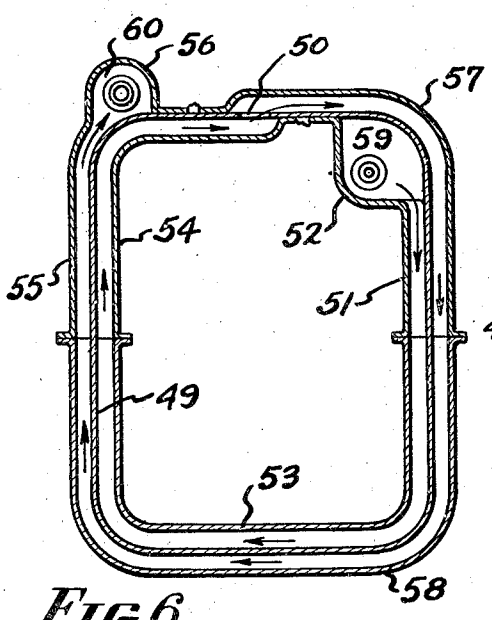


FIG. 6.

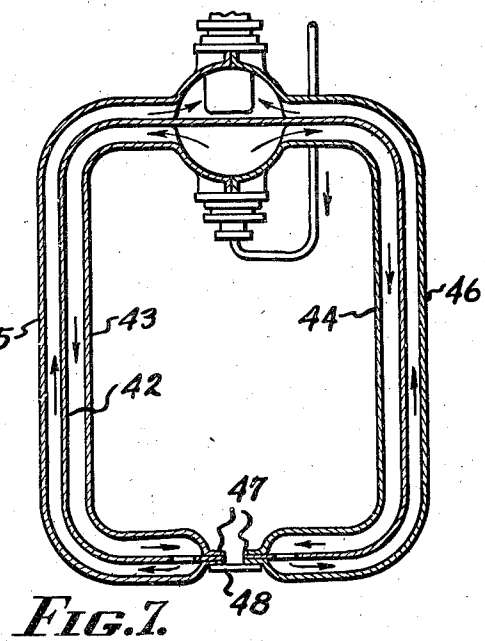


FIG. 7.

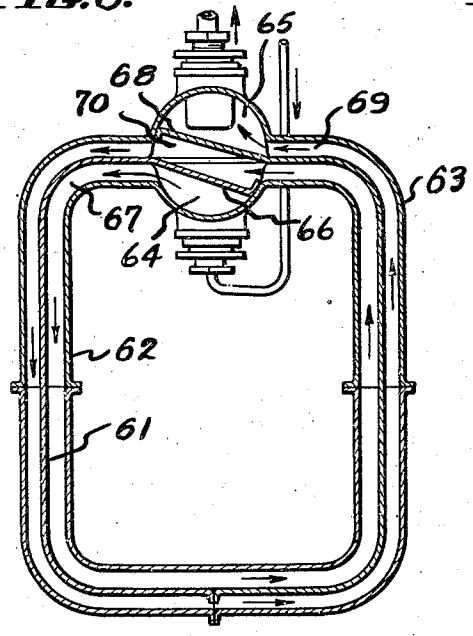


FIG. 8.

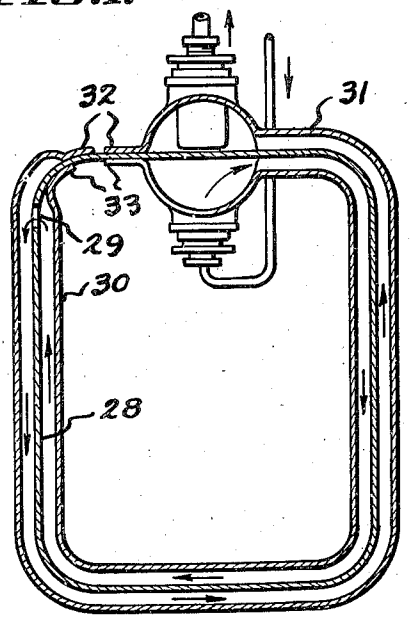


FIG. 9.

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UNITED STATES PATENT OFFICE

2,108,744

DIAPHRAGM TYPE EVAPORATOR

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Application August 27, 1934, Serial No. 741,541

11 Claims. (Cl. 62—126)

Our invention relates to the provision of evaporators for refrigerators and the like, which can be easily and cheaply made of sheet metal. Our objects comprise that of employing a novel means to secure continuity and uniformity of circulation of refrigerant in an evaporator. Another object is to promote uniformity of temperature throughout an evaporator by circulating the refrigerant two or more times about the same freezing space and bringing colder and warmer portions of the refrigerant into heat exchanging relationship with each other. Another object is the construction of evaporators of the shell type, by which we mean evaporators adapted to enclose a freezing space upon at least three sides or portions thereof, having internal diaphragms to control the circulation of refrigerant.

These and other objects of our invention, which will be set forth hereinafter or will be apparent to one skilled in the art upon reading these specifications, we accomplish by that certain construction and arrangement of parts of which we shall describe certain exemplary embodiments, reference being had to the drawings which form a part hereof, and in which:

Figure 1 shows a portion of a refrigerator cabinet with one of our evaporators installed therein.

Fig. 2 is a vertical sectional view of a simple form of our invention, and corresponding to the lines 2—2 in Fig. 3.

Fig. 3 is another vertical section of the device of Fig. 2 taken along the lines 3—3 of Fig. 2.

Fig. 4 is a vertical section of an evaporator similar to the device of Fig. 2, but adapted to enclose a freezing space on four sides.

Fig. 5 is a sectional view of an evaporator similarly enclosing the freezing space but having two paths for simultaneous flow of the refrigerant.

Figs. 6 and 8 show in section types of evaporator in which the refrigerant circles about the freezing space in one continuous path.

Fig. 7 shows a modified form of evaporator having an action like that of Fig. 5.

Fig. 9 shows a modified form of evaporator having an action like that of Fig. 4.

We shall describe first a simpler form of evaporator to which Figs. 1, 2 and 3 pertain. Referring first to Fig. 2, we have shown an evaporator formed essentially of three plates of metal.

An outer U-shaped plate of stamped sheet metal 4, forms an outer top, side, and bottom of the evaporator. The metal of this plate is deformed or drawn up into embossings which form a header 5 and finger-shaped passageways 6 extending from the header toward the furthest portion of the plate.

A second, un-embossed, U-shaped plate of sheet metal 7 forms a diaphragm and fits inside the member 4. The diaphragm has holes 8a near one of its edges, and adapted to come into substantial registry with the end portions of the passageways 6.

A third U-shaped plate of metal 8 is formed to fit inside the other two. This plate is embossed to form a lower header 9 and a plurality of finger-like passageways 10 communicating with the header.

When the plates are assembled as shown in Figs. 2 and 3 the headers lie opposite each other, as do the several parallel passageways 6 and 10. The plates are so shaped that their edges come together as shown at 11 in the figures. Consequently the evaporator may be completed by welding the plates together at their meeting edges, by welding into place an inlet fitting 12 and an outlet fitting 13 in holes previously formed in the headers, by spot welding the plates together between the passageways, and by treating the evaporator in whatever way may be desired to prevent corrosion.

The evaporator was designed primarily for use as a flooded type device. It is shown as fed by a capillary tube 14. A skimmer 15 is placed in the upper header. The diaphragm member 7 closes off the upper header from the lower and likewise closes the open sides of the passageways 6 and 10 allowing no fluid to pass therebetween excepting through the perforations 8. The refrigerant enters the lower header 9 and flows through the passageways 10 about three sides of the freezing space, passing through the diaphragm at the perforations 8, and again flowing about three sides of the freezing space through the passageways 6 to the upper header 5. The refrigerant will be coldest just after it has entered the evaporator. It will be seen that the fluid in header 9 is in heat exchanging relationship with the fluid in header 5. Similarly all parts of the fluid in each of the passageways 10 is in heat exchanging relationship with corresponding parts of the fluid in opposite passageways 6. These conditions make for uniformity of evaporator temperature and efficiency. Moreover, all parts of the fluid leaving header 9 must go to the very end of the evaporator and pass through the perforations 8 before ultimately reaching the header 5. This makes for uniformity of flow and prevents the formation of dead spots.

In the figures, 16 indicates brackets by which the evaporators may be fastened to the insulated wall 17 of a refrigerator, if desired. In the evaporator hitherto described the top and bottom portions form shelves upon which ice cube trays 18 and 19 may rest. A face plate for concealing the evaporator and having openings for the removal of the trays is shown at 20; and the evaporator is indicated as installed in a refrigerator in Fig. 1, having an upper machine compartment

21. The bulb of a cold control device is shown held against the evaporator at 22.

A modification of the device of Figs. 1 to 3 is shown in Fig. 4, where the evaporator is so constructed as to enclose all four sides of the freezing space. A special description of the parts will not be necessary because they are made in the same way and with the same types of configurations as the parts heretofore described. The evaporator of Fig. 4 comprises a diaphragm plate 23 perforated as at 24, an inner plate 25, and an outer plate 26. The plates, considered as a whole, are tube-like in formation, but are not complete tubes, being open at the place marked 27. Welding is done at the meeting edges of the plates adjacent the opening 27, and around the lateral meeting edges of the plate. Still another type of evaporator having the same principle of operation is shown in Fig. 9, where there is a diaphragm member 28 of closed tube-like form. This plate is perforated as at 29. There is an inner plate 30 not in the form of a closed tube, and an outer plate 31 also not in the form of a closed tube. The plates are welded together at their lateral meeting edges, and also are welded where the longitudinal edges of the plates 30 and 31 contact the tube member 28 as at 32 and 33.

Our invention likewise contemplates types of evaporator construction in which there are a plurality of individual flow paths. We have shown in Fig. 5 a diaphragm member 34, which may either be in the form of a closed tube perforated as at 35, or may be in the form of an open tube-like member having edge portions which do not quite come together at the place marked 35. The inner member may be unitary or made up of two or more parts. We have shown two parts indicated at 36 and 37. The meeting edges of these parts are clearly shown; and these meeting edges will, of course, be welded together. The outer member also may be made up of two or more plates, and we have shown two plates 38 and 39. In this evaporator, the refrigerant, being introduced into the lower header member 40, follows two paths along the interior side portions of the evaporator (as shown by the arrows) to the bottom thereof, whereupon it passes through the perforations or space 35 and returns to the upper header 41 about two exteriorly disposed paths, as also shown by the arrows.

In Fig. 7 we have shown a modification of the evaporator of Fig. 5. A diaphragm member of tube-like formation but not closed is shown at 42. An inner plate or plate members 43 and 44 are provided as shown, and an outer plate or plate members 45 and 46. The inner and outer plate members and the diaphragm member are welded together at their longitudinal edge portions 47, and there may be a bracing member 48 spanning the space therebetween and serving to strengthen the evaporator.

The evaporators of Figs. 1 to 4 and 7 may be made up in the flat and bent to shape if desired; but this is not ordinarily a preferred method of manufacture. It is more convenient to make up the individual plate or plate portions in their final form, and then to assemble them to form the completed evaporator. The usual practice, however, will be to stamp the inner and outer plate members or portions in the flat, and afterwards bend these in suitable dies to their final form.

In Figs. 6 and 8, we have shown a type of evaporator in which the freezing space is enclosed on all four sides, but in which there is a single continuous path from the inlet header to the outlet header passing substantially twice about the periphery of the evaporator. In the device of Fig. 6 we have shown a diaphragm member 49 of a tubular form, which may either be closed and perforated as at 50, or which may be open, the edges failing to meet so as to provide the space 50. We have shown welded to this diaphragm member, an inner-plate portion 51 stamped to form a header member 52, and other inner plate portions 53 and 54. The manner of joining these plate portions will be clear from the foregoing. We have likewise shown an outer plate portion 55 stamped to form a header portion 56, and co-operating outer plate portions 57 and 58 to complete the exterior of the evaporator. Starting at the entrance header member 59, the refrigerant passes once completely around the evaporator in a clockwise direction as shown by the arrows, on the inside of the diaphragm member 49. Thence it passes through the perforations or opening 50, and again travels around the evaporator in a clockwise direction, finally reaching the upper header member 60.

In Fig. 8 we have shown a modified form of the device, consisting of a diaphragm member or members indicated generally at 61, an inner plate member or members indicated generally at 62, and an outer plate member or members indicated generally at 63. The inner and outer plate members form respectively a lower header 64 and an upper header 65. The diaphragm member has an extension 66 in the header assembly, which serves to close off the lower header excepting for the passageway 67. The diaphragm member has on its other end another extension 68, which serves to close off the upper header 65, excepting for the passageways 69. The space between the two extensions 66 and 68 has been indicated at 70, and serves as a passageway connecting the passageways 67 and 69. The arrows will enable one to follow the course of the refrigerant, which in this instance passes from the lower header 64 in a counter-clockwise direction twice about the freezing space before it reaches the header 65.

Modifications may be made in our invention without departing from the spirit thereof.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent, is:—

1. A refrigerator evaporator comprising a sheet metal member of substantial U-shape embossed to form a header and a plurality of passageways extending therefrom, a second sheet metal member of substantial U-shape acting as a diaphragm, and a third sheet metal member of substantial U-shape, and embossed to form an exit header and a plurality of passageways, said members being assembled one inside the other and joined to provide a closed system, said diaphragm member being perforated to provide access from one group of passageways to another at a point remote from said headers, and serving to complete said headers and passageways.

2. A sheet metal evaporator comprising three members as follows: an outer member providing a refrigerant chamber and a plurality of passageways extending therefrom, an intermediate member acting as a diaphragm to complete the chambers and passageways in the other members, and an inner member providing a refrigerant chamber and a plurality of passageways extending therefrom, said several members being of a shape when assembled to enclose a freezing

space upon a plurality of sides, and means for the passage of refrigerant from passageway to passageway through said diaphragm member at a point remote from said chambers so as to cause reverse flow of the refrigerant about the sides of the evaporator.

3. A sheet metal evaporator comprising three members as follows: an outer member providing a refrigerant chamber and a set of passageways extending therefrom, an intermediate member acting as a diaphragm to complete the chambers and the passageways in the other members, and an inner member providing a refrigerant chamber and a set of passageways extending therefrom, said several members being of a shape when assembled to enclose a freezing space upon a plurality of sides, and means for the passage of refrigerant from passageway to passageway through said diaphragm member at a point remote from said chambers, and said members being disposed to cause flow of refrigerant about certain of the sides of said evaporator in one set of passageways and again about the sides thereof in other of said passageways.

4. A sheet metal evaporator comprising three members as follows: an outer member providing a refrigerant chamber and a plurality of passageways extending therefrom, an intermediate member acting as a diaphragm to complete the chambers and the passageways in the other members, and an inner member providing a refrigerant chamber and a plurality of passageways extending therefrom, said several members being of a shape when assembled to enclose a freezing space upon a plurality of sides, means for the passage of refrigerant from passageway to passageway through said diaphragm member at a point remote from said chambers, all of said members when assembled being of substantially tubular shape, and said diaphragm member enforcing a circulation of refrigerant substantially twice through said sides.

5. A sheet metal evaporator comprising three members as follows: an outer member providing a refrigerant chamber and a plurality of passageways extending therefrom, an intermediate member acting as a diaphragm to complete the chambers and the passageways in the other members, and an inner member providing a refrigerant chamber and a plurality of passageways extending therefrom, said several members being of a shape when assembled to enclose a freezing space upon a plurality of sides, means for the passage of refrigerant from passageway to passageway through said diaphragm member at a point remote from said chambers, all of said members when assembled being of substantially tubular shape, and said diaphragm member enforcing a circulation of refrigerant substantially twice about all sides of a freezing space in a single continuous path, in reverse directions.

6. An evaporator comprising a sheet metal member embossed to form an entrance chamber and passageways extending therefrom about a plurality of sides of a freezing space, a diaphragm member confining refrigerant to said entrance chamber and completing said passageways, a second sheet metal member embossed to form an exit chamber and passageways extending therefrom about a plurality of sides of a freezing space, said diaphragm member also confining refrigerant to said exit chamber and completing said passageways, and means for the passage of refrigerant through said diaphragm member from one group of passageways to another at a point remote from said chambers.

7. An evaporator of a type adapted to enclose a freezing space upon at least three sides, said evaporator comprising entrance and exit chamber portions located adjacent each other upon one side of said freezing space and extending across said side, and a continuous passageway from said entrance chamber to said exit chamber, extending about and returning about the remainder of said sides, said chamber portions and passageways being formed of a pair of embossed plates and a diaphragm member interposed therebetween, the said diaphragm being perforated to permit individual interconnection between the passageways formed in the one exterior plate with the passageways formed in the other exterior plate.

8. An evaporator of the type adapted to enclose a freezing space upon at least four sides, said evaporator comprising an entrance chamber portion and an exit chamber portion, both located on the same side of the evaporator, and a continuous passageway for refrigerant from one chamber to the other, said continuous passageway extending about all four sides of said freezing space once, and more than once about certain of said sides, said passageways and chambers being formed of metallic members all of which are in direct heat exchanging relationship with each other, said metallic members comprising a pair of embossed plates and a diaphragm member interposed therebetween, the said diaphram being perforated to permit individual interconnection between the passageways formed in the one exterior plate with the passageways formed in the other exterior plate.

9. A sheet metal evaporator of a type enclosing a freezing space upon at least three sides, said evaporator comprising a pair of opposed sheet metal members, each embossed to form a chamber and passageways extending therefrom, and a diaphragm member interposed between said opposed embossed members confining refrigerant to said chambers and completing said passageways, and formed to permit flow of the refrigerant from the passageways in one embossed member to the passageways in the other, the said passageways and diaphragm being so arranged that refrigerant is caused to pass from one chamber through the group of passageways embossed in the member containing said chamber, about a plurality of sides of said evaporator, and to pass to the chamber embossed in the other of said embossed members in the passageways embossed in the said other member, about the same sides of said evaporator, the passageways in each member being in heat exchange relationship with the passageways in the other member.

10. An evaporator as claimed in claim 9, which encloses the said freezing space upon four sides, and in which the said passageways conduct refrigerant and return it about less than four sides of said evaporator.

11. An evaporator as claimed in claim 9, which encloses the said freezing space upon four sides, and in which there are sets of passageways extending oppositely from each chamber, and in which the said passageways conduct refrigerant and return it about less than four sides of said evaporator.

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