Jan. 16, 1940. J. KARMAZIN 2,187,035

REFRIGERATING APPARATUS

Filed Dec. 18, 1937 2 Sheets-Sheet 1

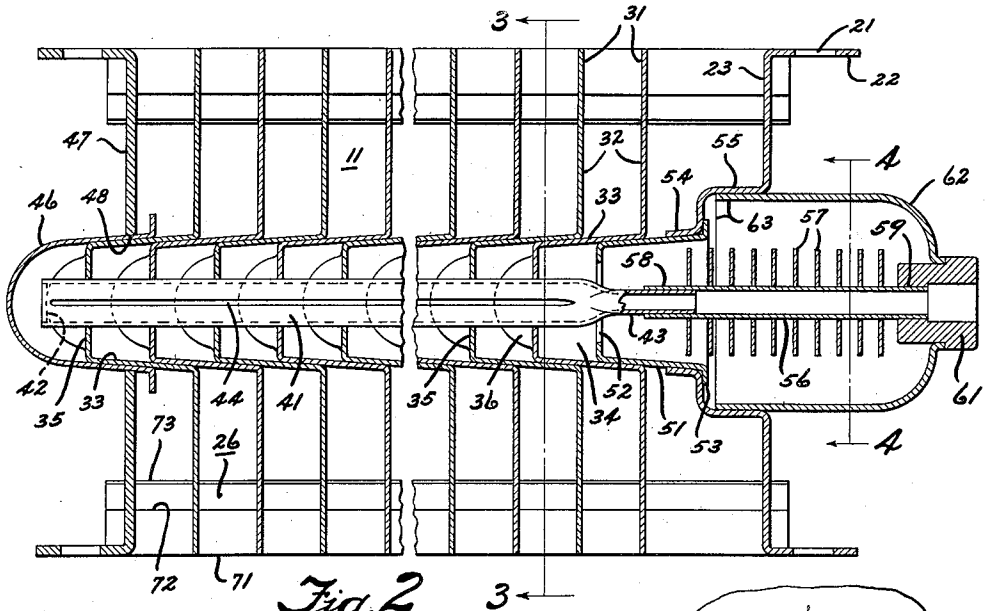


Fig. 2

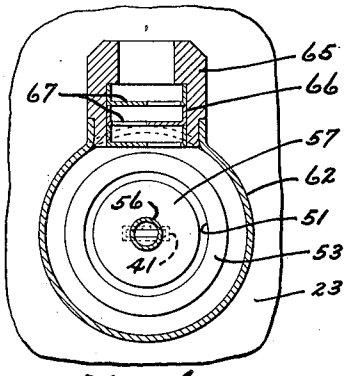


Fig. 4

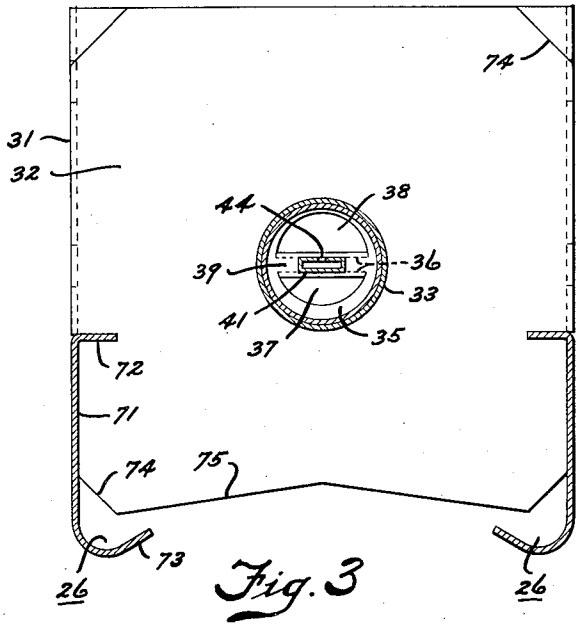


Fig. 3

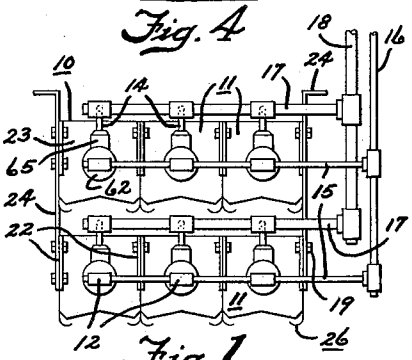


Fig. 1

INVENTOR.

JOHN KARMAZIN.

BY

Spencer, Hardman and Fehr.

HIS ATTORNEYS.

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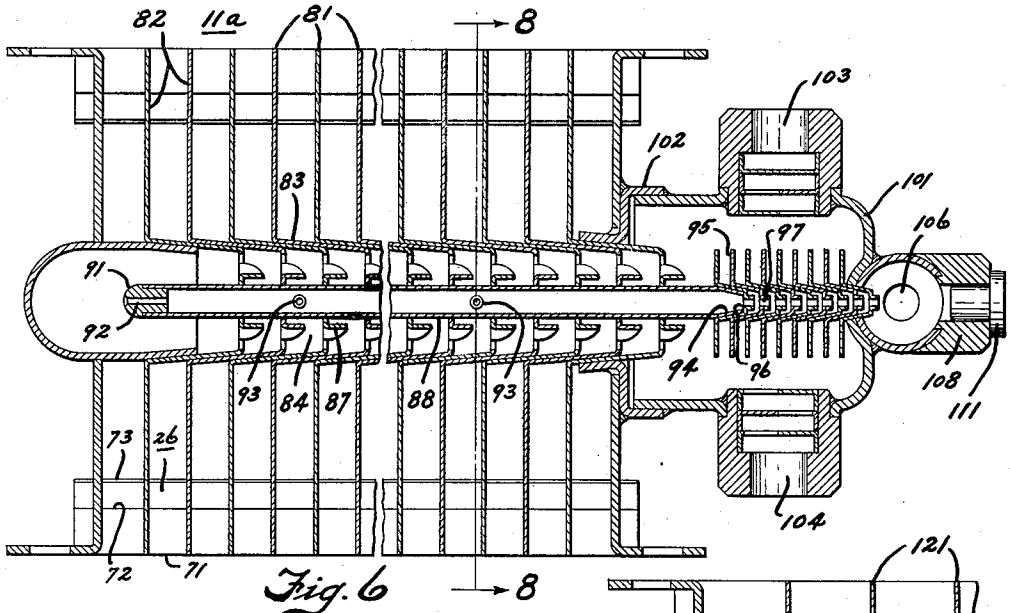


Fig. 6

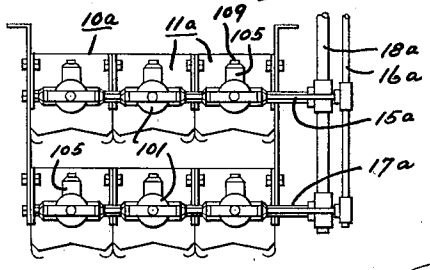


Fig. 5

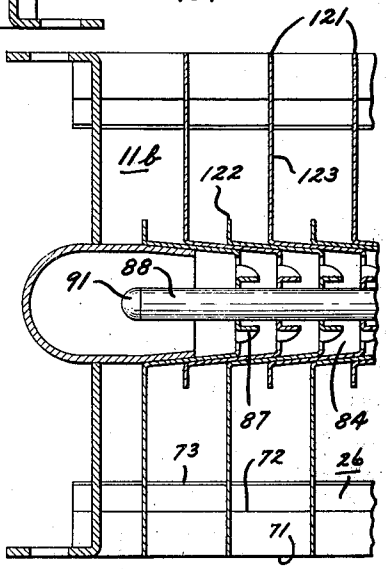


Fig. 7

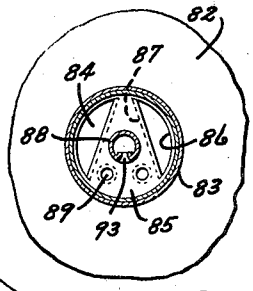


Fig. 8

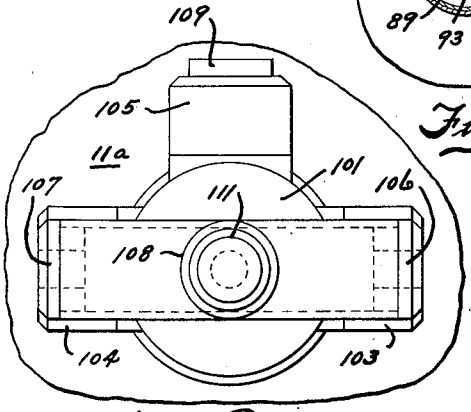


Fig. 9

INVENTOR.
JOHN KARMAZIN.

BY

Spencer, Hardman and Fehr.
HIS ATTORNEYS.

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REFRIGERATING APPARATUS

John Karmazin, Grosse Ile, Mich., assignor to General Motors Corporation, Dayton, Ohio, a corporation of Delaware

Application December 18, 1937, Serial No. 180,630

4 Claims. (Cl. 62—126)

This invention relates to cooling elements for refrigerating systems.

An object of my invention is to provide an improved cooling element of pressed sheet metal construction.

Another object of my invention is to unidirectionally nest a plurality of similar pressed sheet metal members together and to bond the members to one another to provide a unit having a finned closed refrigerant passage therein and to assemble a plurality of such units together to form a unitary cooling element of any predetermined size containing a plurality of banks or rows of such units.

A further object of my invention is to provide a cooling element of pressed sheet metal construction having a plurality of refrigerant passages therein and means for circulating liquid refrigerant to and gaseous refrigerant from the plurality of passages in parallel, which means provides for the exchange of heat between liquid refrigerant entering each of the passages and gaseous refrigerant flowing therefrom.

In making a cooling element having the features of the preceding objects embodied therein, it is a still further and more specific object of the invention to provide the element with means which, in addition to distributing the precooled incoming liquid refrigerant to a plurality of points along the length of the refrigerant passages thereof, also stiffens and increases the structural strength 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 an end view of a sectional unitary cooling element of a refrigerating system constructed in accordance with my invention;

Fig. 2 is an enlarged horizontal sectional view through one of the sections of the cooling element shown in Fig. 1 and disclosing a refrigerant passage provided therein;

Fig. 3 is a vertical sectional view taken on the line 3—3 of Fig. 2 showing a liquid refrigerant distributing tube within the refrigerant passage;

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 2 showing a heat exchanger incorporated in the end of a section of the cooling element;

Fig. 5 is an end view of a unitary cooling element comprising refrigerant evaporating sections of modified form;

Fig. 6 is a horizontal sectional view through one of the sections of the cooling element shown in Fig. 5;

Fig. 7 is a fragmentary sectional view similar to Fig. 6 showing a liquid refrigerant distributing pipe in elevation within the refrigerant passage of a modified cooling element section;

Fig. 8 is a fragmentary sectional view taken on the line 8—8 of Fig. 6; and

Fig. 9 is an enlarged end view of a header structure located on the end of each section of the unit of the unitary cooling element.

Referring to the drawings, for purposes of illustrating my invention, I have shown in Fig. 1 thereof a cooling element, generally represented by the reference character 10, such as an evaporator of a refrigerating system. The cooling element or evaporator 10 is of a unitary construction and comprises a plurality of sections or units 11, each of which includes a plurality of pressed sheet metal members to be hereinafter described. The sections 11 have a closed refrigerant passage formed therein, and each passage is provided with a refrigerant inlet connection 12 and a refrigerant outlet connection 14. The connections 12 are connected in parallel with one another to the sections 11 and communicate, through pipes 15, with a liquid refrigerant conveying pipe 16 of a closed refrigerating system (not shown). The connections 14 are likewise connected in parallel with one another to the sections 11 and communicate, through pipes 17, with a gaseous refrigerant return pipe 18 of the refrigerating system. The horizontally aligned rows of sections or units 11 of the element 10 are secured together by bolts or the like 19 passing through holes 21 (see Fig. 2) provided in outwardly flanged portions 22 of relatively heavy end plates 23. The plurality of superimposed horizontally disposed rows of sections or units 11 of element 10 are secured together by the bolts 19 extending through the flanges 22 and through a pair of brackets 24 utilized to mount the cooling element in a compartment to be cooled. Each section 11 of element 10 is provided with a drip trough, generally represented by the reference character 26, and the troughs 26 serve to convey moisture dripping from the units 11 to one end of the cooling element from where the water is conducted to a drain.

By referring now to Fig. 2 of the drawings, it will be noted that each unit or section 11 of the cooling element 10 comprises a plurality of sheet metal members 31. Each member 31 includes a fin portion 32 and a pressed cup-like tube portion

33. The cup or tube portion 33 of each member 31 is tapered and the members 31 are stacked one upon another with the cup portions 33 thereof telescoped together to provide walls of a closed refrigerant evaporating passage 34 in the section 11. The bottom wall 35 of the cup portion 33 of each member 31 has ear-like portions 36 punched therefrom to provide openings 37 and 38 (see Fig. 3) for the flow of refrigerant throughout the length of passage 34. The web portion 39, left in wall 35 of members 31 by the punching of ears 36 therefrom, has a small rectangular hole punched therefrom which receives a tube or pipe 41. Tube or pipe 41 is rectangular in cross-section and has its one end plugged as at 42 and has its other end rounded as at 43. Tube or pipe 41 is also provided with a long narrow slot 44 in its upper surface and the open communication of tube 41 with passage 34, between the ears 36, provides a plurality of outlets along the length of passage 34 for incoming liquid refrigerant. At one end of section or unit 11 a punched cup 46 is placed over the refrigerant passage forming cup portion 33 of the last member 31 to close that end of passage 34. A relatively heavy end plate 47, having a hole 48 provided therein, is positioned over the cup 46. At the other end of section or unit 11 a punched member 51, having an open inner end 52 and a flanged open outer end 53, is fitted into the end member 31. A flanged opening 54 on the relatively heavy end plate 23 is placed over the punched member 51 and is provided with a circular shoulder 55 of larger diameter than the flanged portion 54 thereof. A pipe or conduit 56 having a plurality of fins 57 secured thereto and extending therearound has its one end 58 fitted over the rounded end 43 of pipe 41. The other end 59 of finned pipe or conduit 56 is secured in a hollow plug-like connecting member 61 carried by header 62. The header 62 is of a cup-like shape and has its rim portion 63 secured within the depression of plate 23 which is formed by the shoulder 55. The cup-like header 62 is provided with a second connecting plug member 65 (see Fig. 4) which is hollowed out as at 66 and has a plurality of apertured baffles 67 alternately disposed relative to one another within this hollowed out part thereof. The sections 11 are in reality combined refrigerant evaporating and heat exchange units since the elements 56, 57, 61, 62 and 65 form a means for causing the exchange of heat between liquid refrigerant entering these sections and refrigerant leaving same.

After the members 31 are unidirectionally nested together and other parts of section or unit 11 are assembled to one another in the manner described, the troughs 26 are placed upon the unit 11. Each trough 26 comprises a strip of metal 71 which has a leg portion 72 fitted and secured within a slot provided in the members 31. A curved inwardly part 73 of strip 71 forms the trough portion of the trough 26, and this trough portion extends from one end to the other end of unit 11 along the bottom corners of members 31. It is to be noted that the sheet metal members 31 have their corners cut off as at 74 and also have their bottom edge cut at an angle as at 75 so as to slope this edge from a point centrally of the members to the cut-off corners 74. This contour of the edge portions of members 31 provides for the flow of moisture from members 31 to the point of juncture between the cuts 74 and 75 in the members. In other words moisture, taken up by the cooling effect produced by the evaporator 10, flowing from walls of refrigerant passage 34 and from members 31 is directed, by the angled edges 74 and 75, to a point directly above troughs 26 from which point the moisture drips into the troughs and is conveyed out of the compartment being cooled to a drain. The telescoping and securing together of the unidirectionally superimposed or nested passage-forming portions 33 of members 31 and the brazing of the liquid refrigerant conveying pipe 41 to the ears 36 and web portions 39 of the wall 35 of members 31 materially increases the structural strength of the sections or units 11 of the evaporator. The ears 36, being spaced apart along the length of pipe 41 closes portions of the narrow slot 44 in pipe 41, to thereby provide the pipe with a plurality of spaced apart outlets for distributing incoming liquid refrigerant to a plurality of points along the length of the passage 34. It is to be understood that the various parts of the section or unit 11 are secured together after assembly thereof to one another by brazing or soldering in any conventional or desirable manner well known to those skilled in the art. In building up a plurality of sections or units 11 in the manner described, it will be apparent that any desired size evaporator or cooling element may be provided. Thus, manufacturing costs are reduced by the present invention since substantially identical units 11 are provided to be assembled and secured together to provide an evaporator comprising any desired number of banks or rows of refrigerant evaporating sections. My invention eliminates the carrying in stock of a plurality of evaporators of different size to thereby save floor storage space while, at the same time, permitting evaporators of any desired over-all dimensions to be constructed.

Referring now to Fig. 5 of the drawings, it will be noted that I have shown an evaporator or cooling element 10*a* which resembles the evaporator 10 but comprises sections or units 11*a* of a modified construction. These sections or units 11*a* of evaporator 10*a* include metal members 81 having a fin portion 82 and a cup or tube-forming portion 83. These members 81 are superimposed upon one another with their portion 83 telescoped and secured together to form a refrigerant evaporating passage 84 within the unit 11*a*. The end wall 85 of the cup or tube portion 83 of members 81 is perforated as at 86 to provide ears 87. The end wall 85 also has an opening cut in the central part thereof for receiving a liquid refrigerant distributing pipe 88. End wall 85 of members 81 is further perforated as at 89 to form a plurality of holes disposed below the plane of pipe 88 for permitting free circulation of refrigerant within the refrigerant passage 84. The pipe 88 is closed at its one end by a plug 91 which has a small orifice 92 provided therein. Pipe 88 also has a plurality of horizontally spaced apart openings 93 provided therein. The end of pipe 88 opposite the plug end 91 is tapered as at 94 to receive similarly tapered portions provided on a plurality of fin members 95 which are telescoped and secured together. Members 95 have a wall surface 96 at the end of the tapered portions thereof which is apertured as at 97 to form a substantially restricted passage or conduit leading to pipe 88. The telescoped together fin members 95 are located within a header 101, secured to an end plate 102, which header is provided with outlet

pipe connections 103, 104 and 105 (see Figs. 5 and 9) and inlet pipe connections 106, 107 and 108. The fin members 95 located within headers 101 provide the sections or units 11a with a heat exchanger, the purpose of which will be hereinafter more fully described. When the headers are connected in a refrigerating system, as shown in Fig. 5 of the drawings, the refrigerant outlet connection 105 of header 101 is closed by a plug 109 (see Figs. 5 and 9) and the refrigerant inlet connection 108 is closed by a plug 111. The extra plugged refrigerant connections 109 and 111 to headers 101 described provides for a plurality of different pipe connecting arrangements of the evaporators 10 and 10a in a refrigerating system. For example, the evaporator 10a is connected in a refrigerating system in a manner similar to the connection of evaporator 10. However, if desired, the gaseous refrigerant return pipe 18a may be connected directly to each individual header 101 of evaporator 10a by plugging the outlet connections 103 and 104 of the headers and utilizing the outlet 105 only for withdrawing gaseous refrigerant from the sections or units 11a. The inlet connections 106 and 107 may also be plugged and the central inlet 108 employed to direct liquid refrigerant to a section 11a. In this manner the sections or units 11a are rendered substantially universal in use and need not be of different design should different hookups be required in various installations.

In Fig. 7 of the drawings I have disclosed a slightly modified construction of a section or unit of an evaporator. In this showing of the invention a section or unit 11b of an evaporator is composed of a plurality of punched sheet metal members 121 which have one of their side portions cut off as at 122. The members 121 are all of identical form or contour and are superimposed in alternate relation upon one another so that the fin portion 123 of one member 121 is disposed opposite the similar fin portion of another member 121. Aside from this difference the members 121 are punched and formed to correspond with the structure of the metal members 81 of section 11a. Thus, the modified showing in Fig. 7 provides refrigerant evaporating sections or units which, for certain or desired reasons, do not possess quite as much fin surface as the sections or units 11 or 11a.

Having described the various structures disclosed, I now wish to explain the manner in which refrigerant is circulated into and out of the sections of the improved evaporators. Liquid refrigerant flows from the feed pipe 16 through branch pipes 15 (see Fig. 1) to connections 12 and from these connections 12 through connecting members 61 and conduit 56 into the liquid refrigerant distributing pipe 14. Since every section 11 of evaporator 10 is provided with a connection 12 and connecting members 61, these sections each receive a supply of liquid refrigerant from the feed pipe 16. The slot 44 in pipe 41 is open between the ears 36, and these openings distribute the incoming liquid refrigerant at a plurality of points along the length of passage 34. The refrigerant, upon absorbing heat and evaporating within passage 34, flows to the header 62. The cool evaporated refrigerant contacting and flowing around the fins 57 and conduit 56 cools the liquid refrigerant flowing through this conduit 56 from connector 61 to pipe 41. The gaseous refrigerant in header 62 passes around the baffles 67 and through connector 65 to pipe 17 from where it is withdrawn from the sections 11 of evaporator 10 through pipe 18. In the embodiment of the invention shown in Figs. 5 and 6, the liquid refrigerant is directed to passage 84 through the holes or orifices 92 and 93, and the cool expanded refrigerant flows around the finned passage or conduit 97 to remove heat from the relatively warm incoming liquid refrigerant.

From the foregoing, it will be seen that I have provided an improved unitary evaporator or cooling element for a refrigerating system which can be made of any desired size by employing a predetermined number of similar sections constructed from a plurality of unidirectionally nested and secured together integral fin and tube members. My improved structure not only provides for the maximum heat transfer from a fluid to be cooled to refrigerant in the evaporator but also provides for the exchange of heat between the relatively warm liquid refrigerant flowing into the plurality of sections of the evaporator and cool expanded refrigerant leaving the sections of the evaporator. By providing each section of my evaporator with a heat exchanger of the type described, the evaporator is rendered more efficient and the various sections thereof are maintained at substantially the same temperature to thereby reduce the temperature gradiant between portions of the evaporator. My improved evaporator construction reduces manufacturing costs and also permits the construction of evaporators of different sizes relative to one another from a plurality of similar sections which are secured together.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An individual section having a single closed refrigerant evaporating passage therein for a sectional cooling element of a refrigerating system comprising, a plurality of fin members each having a tube portion extending therefrom, said fin members being superimposed one upon the other with the tube portion of one member telescoped with and secured to the tube portion of another member to provide said closed refrigerant evaporating passage which extends through the section, means secured to one end of said section and forming a part of said single closed refrigerant evaporating passage therein, said means being provided with a liquid refrigerant inlet connection and a refrigerant outlet connection, a conduit within said means extending from said inlet connection thereof into said refrigerant evaporating passage for directing liquid refrigerant entering said section to a point in said passage remote from said inlet connection, a portion of said conduit being disposed in the path of refrigerant flowing from said passage through said outlet connection and forming a heat exchanger within said section between refrigerant entering and refrigerant leaving same, and said conduit portion having fin means thereon for increasing the heat transfer surface of said heat exchanger.

2. An individual section having a single closed refrigerant evaporating passage therein for a sectional cooling element of a refrigerating system comprising, a plurality of fin members each having a tube portion extending therefrom, said fin members being superimposed one upon the other with the tube portion of one member tele-

scoped with and secured to the tube portion of another member to provide said closed refrigerant evaporating passage which extends through the section, means secured to one end of said section and forming a part of said single closed refrigerant evaporating passage therein, said means being provided with a liquid refrigerant inlet connection and a refrigerant outlet connection, a conduit wtihin said means extending from said inlet connection thereof into said refrigerant evaporating passage for directing liquid refrigerant entering said section to a point in said passage remote from said inlet connection, a portion of said conduit being disposed in the path of refrigerant flowing from said passage through said outlet connection and forming a heat exchanger within said section between refrigerant entering and refrigerant leaving same, and said portion of said conduit including a plurality of fin members each having a tubular part extending therefrom telescoped and secured together to form the walls of said conduit portion.

3. An individual section having a single closed refrigerant evaporating passage therein for a sectional cooling element of a refrigerating system comprising, means forming walls of said single closed refrigerant evaporating passage, means secured to said first named means at one end of said section and forming part of said refrigerant passage, said last named means being provided with a liquid refrigerant inlet connection and a refrigerant outlet connection, a conduit within said last named means extending from said inlet connection thereof into said passage for directing liquid refrigerant entering said section to a point in said passage remote from said inlet connection, a portion of said conduit being disposed in the path of refrigerant flowing from said passage through said outlet connection and forming a heat exchanger within said section between refrigerant entering and refrigerant leaving same, and said conduit portion having fin means thereon for increasing the heat transfer surface of said heat exchanger.

4. An individual section having a single closed refrigerant evaporating passage therein for a sectional cooling element of a refrigerating system comprising, means forming walls of said single closed refrigerant evaporating passage, means secured to said first named means at one end of said section and forming part of said refrigerant passage, said last named means being provided with a liquid refrigerant inlet connection and a refrigerant outlet connection, a conduit within said last named means extending from said inlet connection thereof into said passage for directiing liquid refrgerant entering said secton to a point in said passage remote from said inlet connection, a portion of said conduit being disposed in the path of refrigerant flowing from said passage through said outlet connection and forming a heat exchanger within said section between refrigerant entering and refrigerant leaving same, and said portion of said conduit including a plurality of fin members each having a tubular part extending therefrom telescoped and secured together to form the walls of said conduit portion.

JOHN KARMAZIN.