May 9, 1950 W. L. MORRISON 2,507,379

DEMOUNTABLE COLD BOX

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Fig. 1

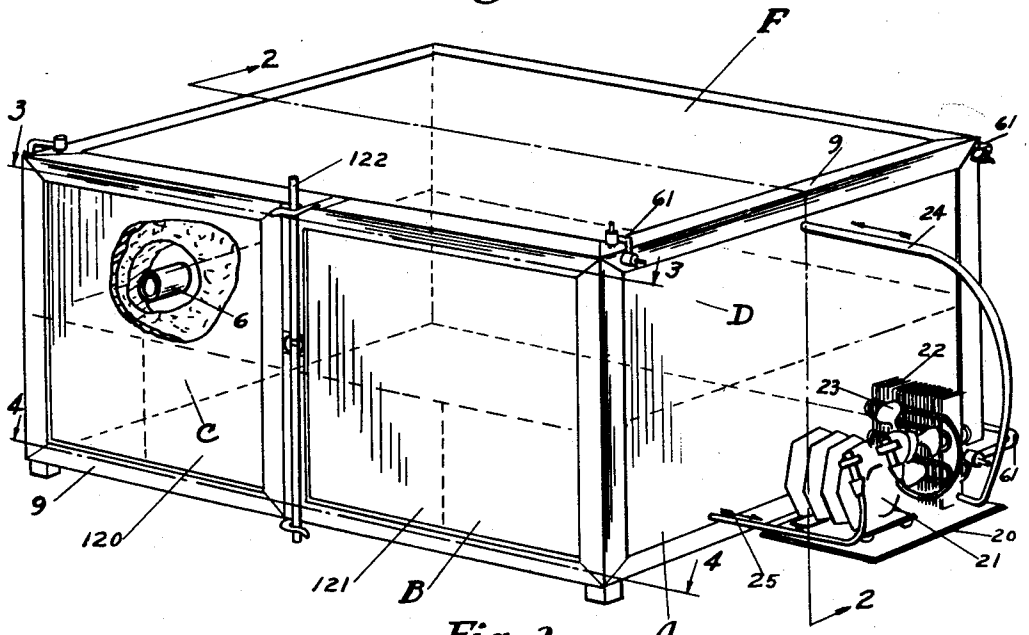
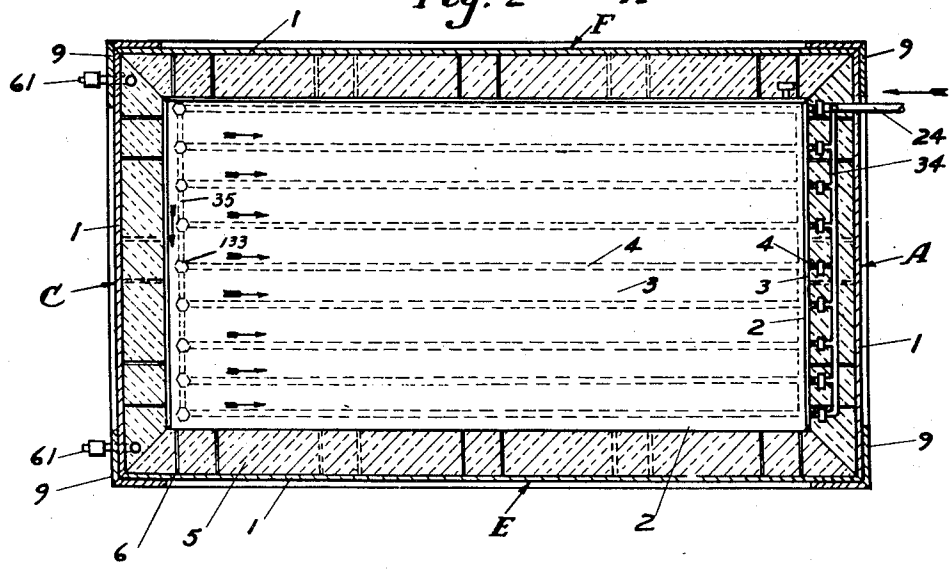


Fig. 2



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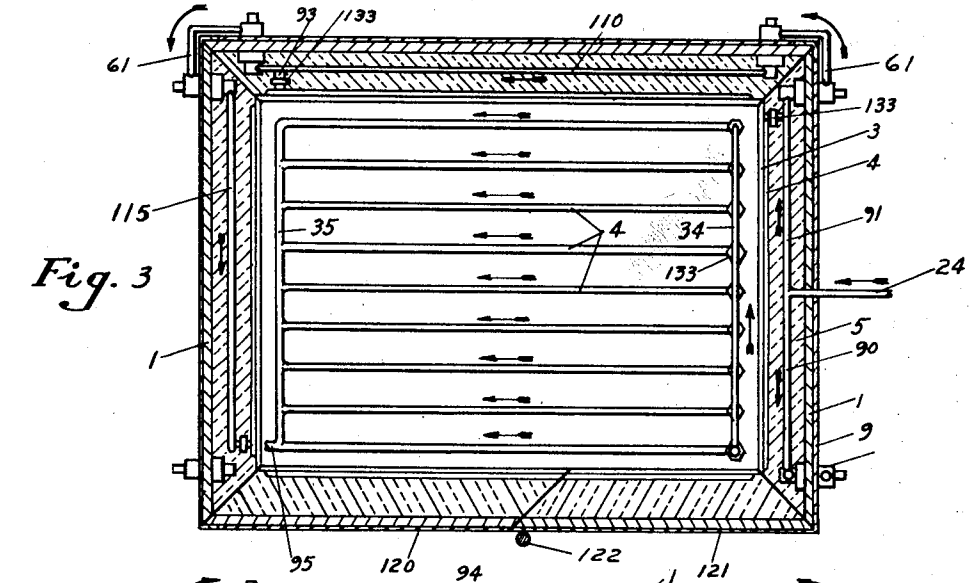


Fig. 3

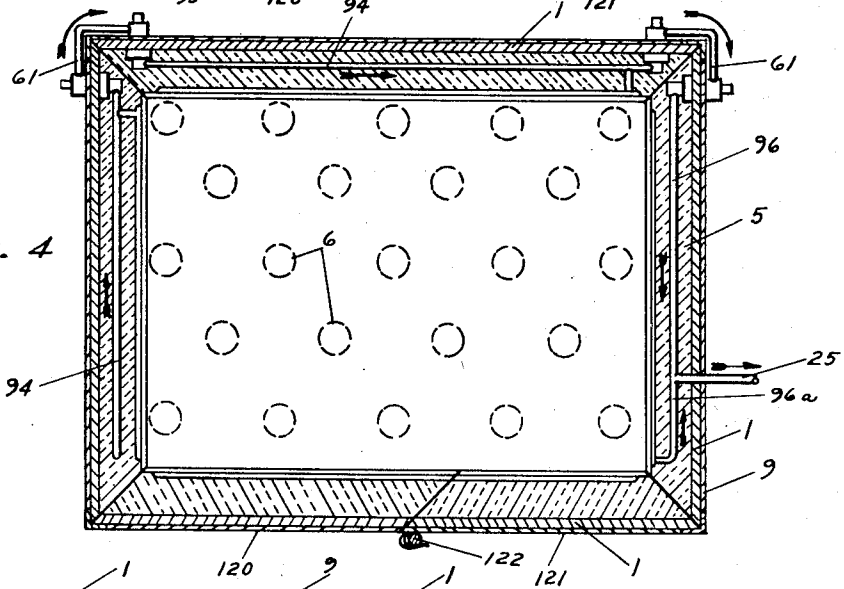


Fig. 4

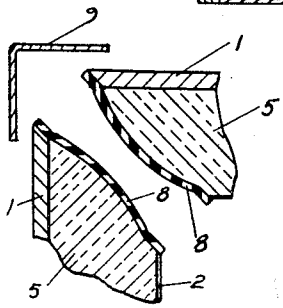


Fig. 5

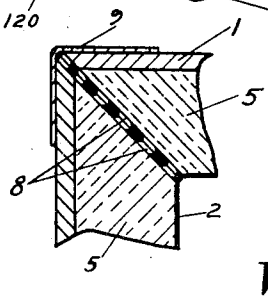


Fig. 6

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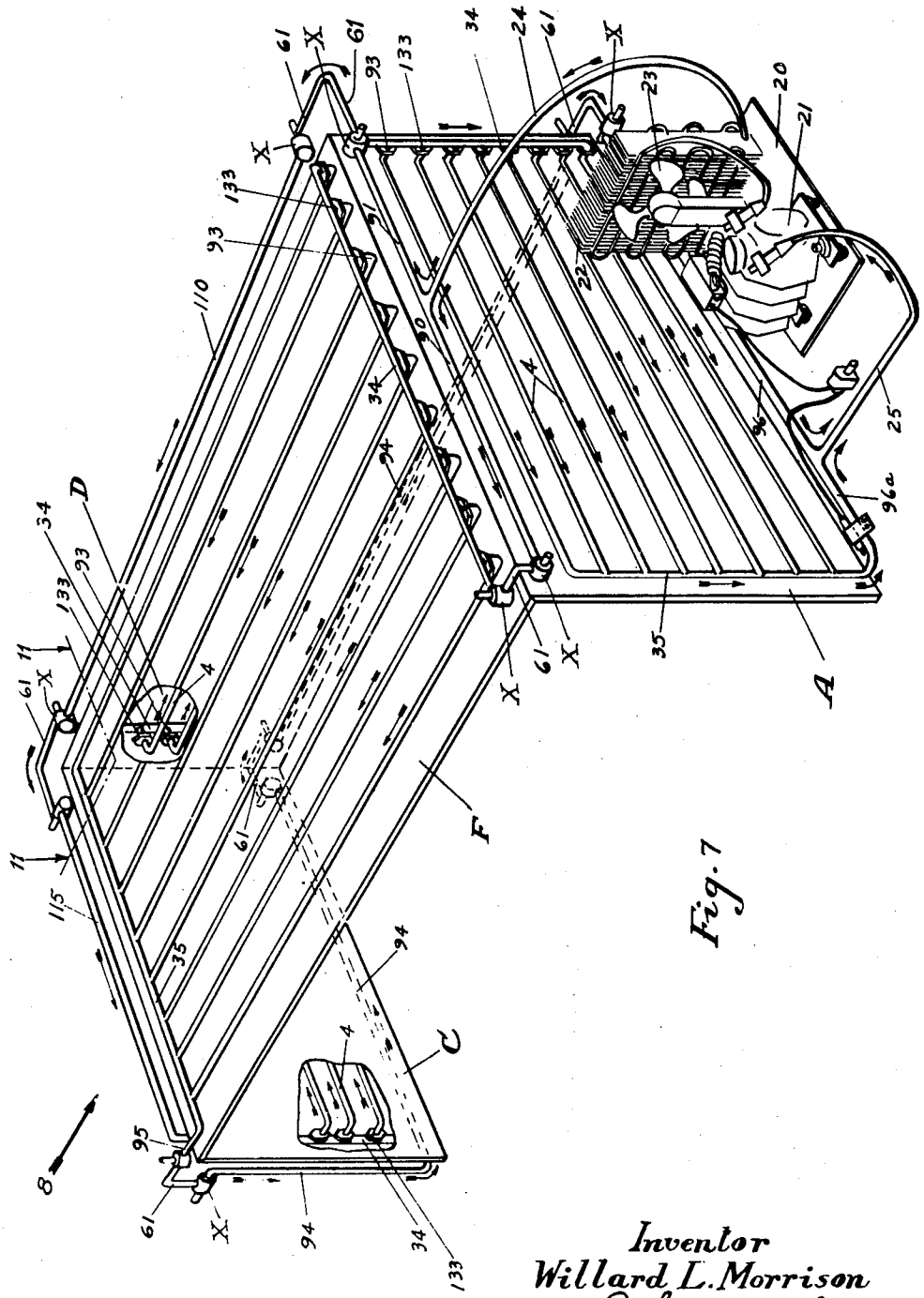


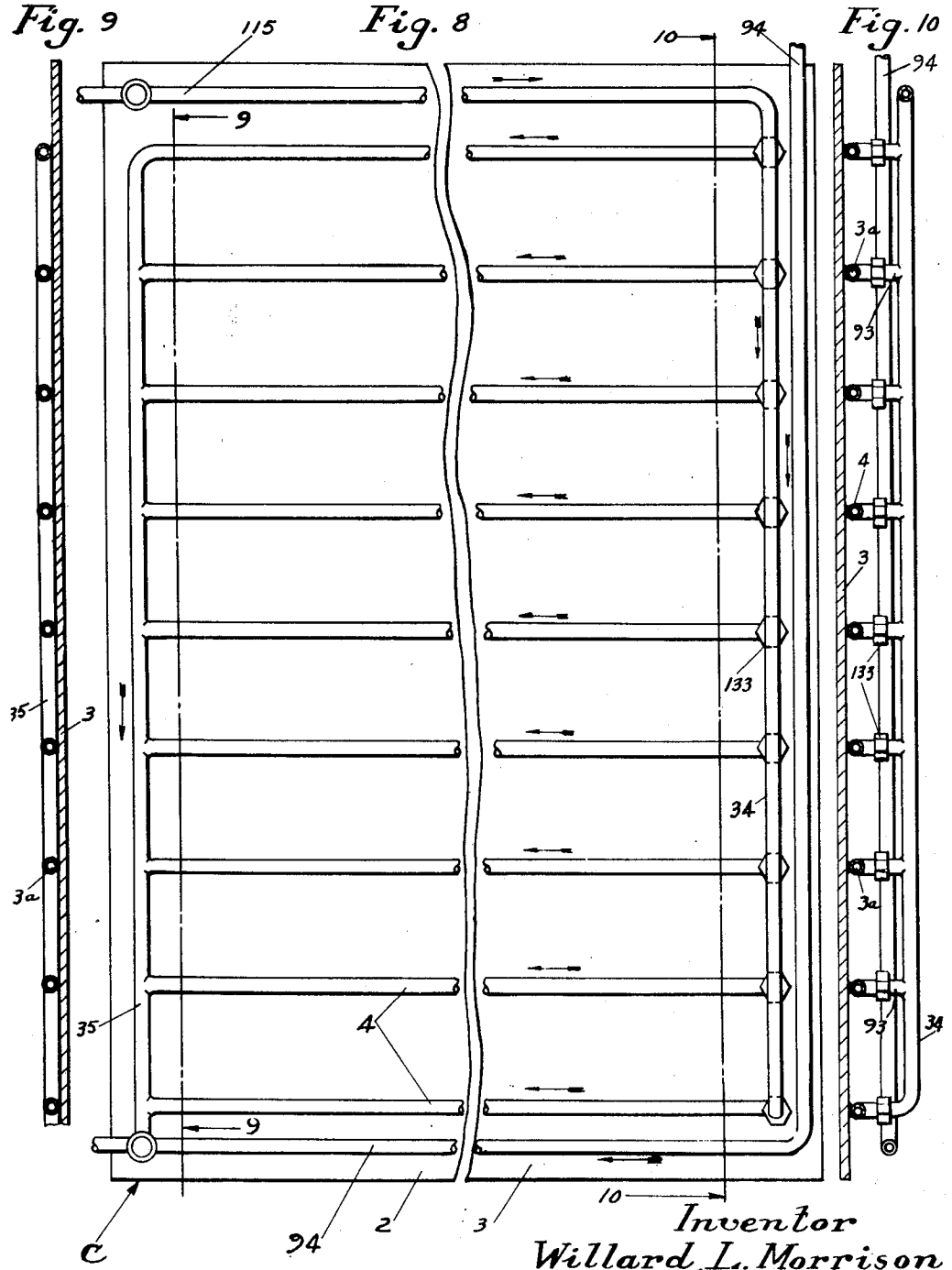
Fig. 7

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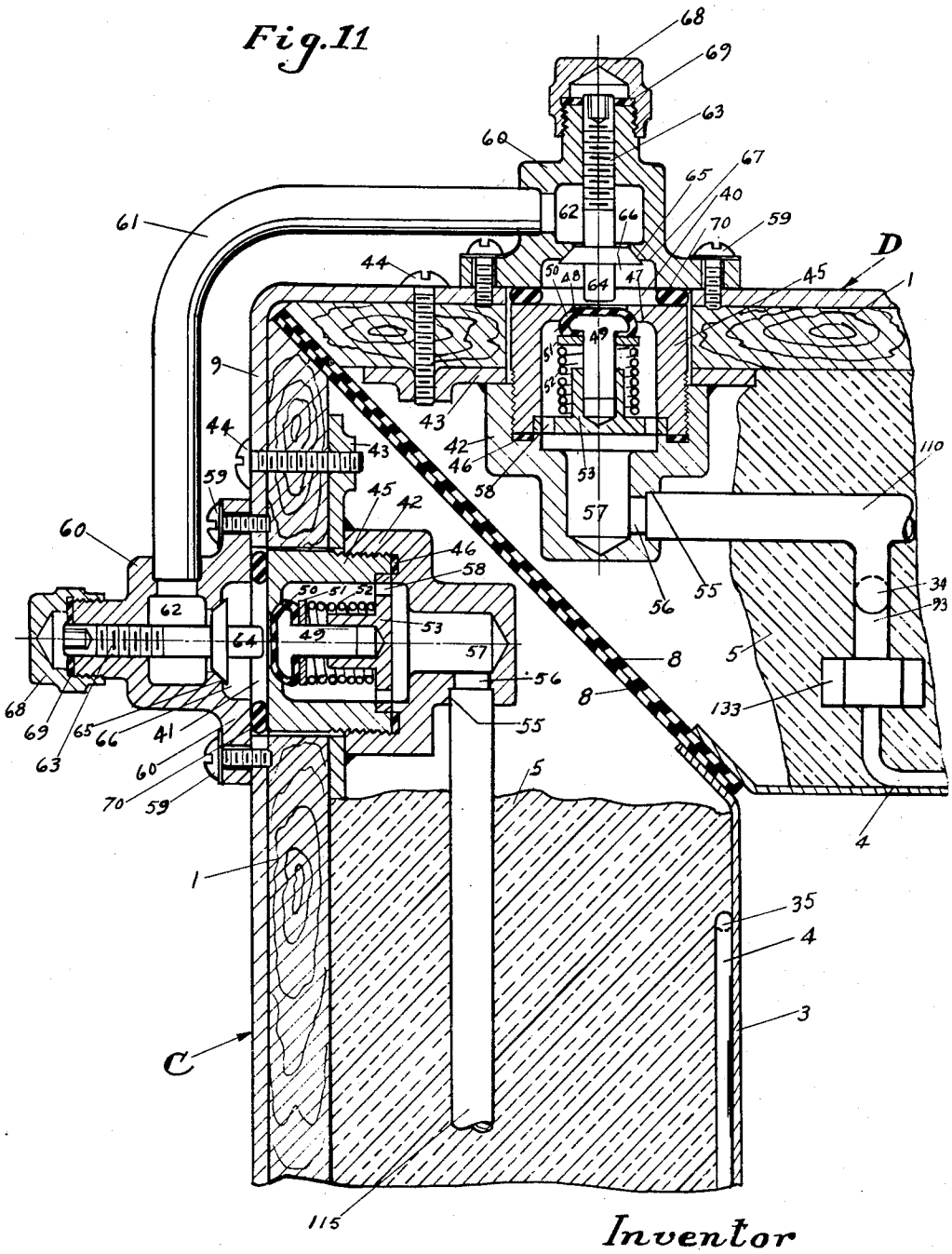
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Fig. 11



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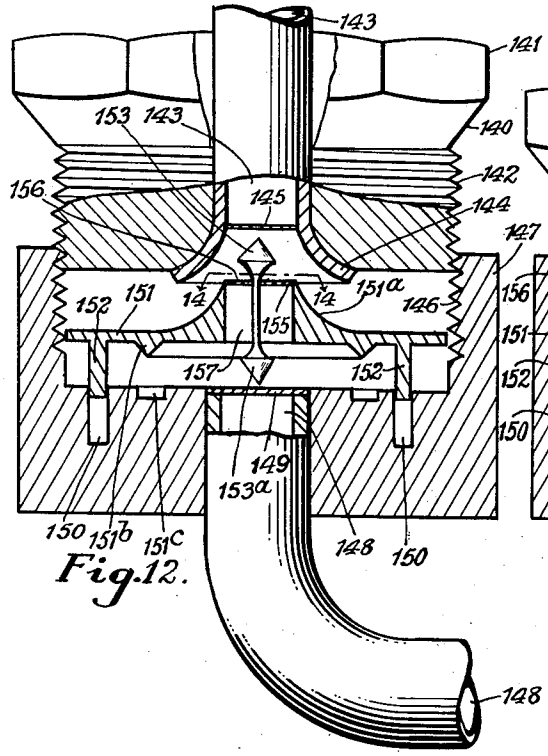


Fig. 12.

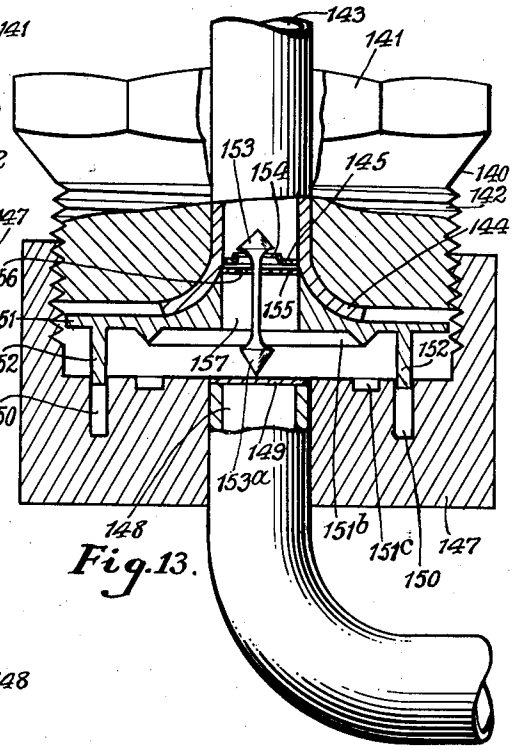


Fig. 13.

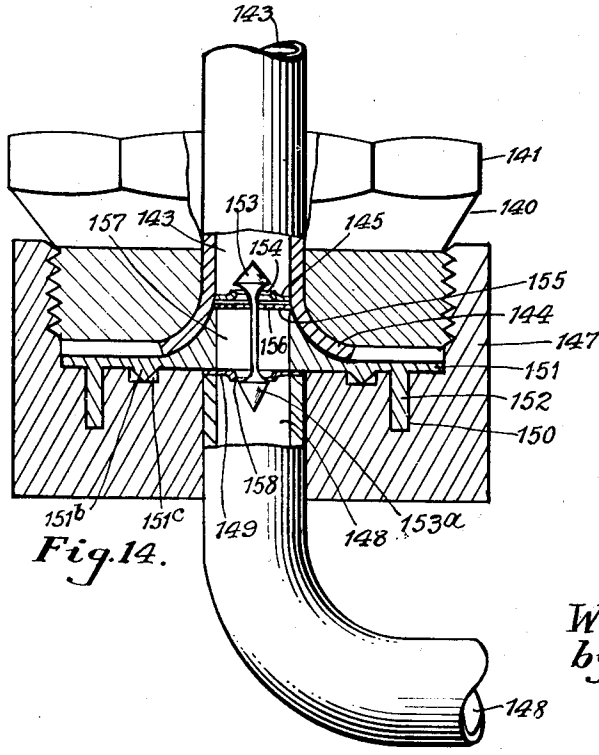


Fig. 14.

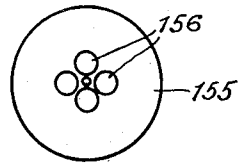


Fig. 15.

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Patented May 9, 1950 2,507,379

UNITED STATES PATENT OFFICE

2,507,379

DEMOUNTABLE COLD BOX

Willard L. Morrison, Lake Forest, Ill.

Application February 9, 1946, Serial No. 646,588

17 Claims. (Cl. 62—116)

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My invention relates to an improvement in refrigerating means and has for one purpose to provide storage means for perishable articles.

Another purpose is to provide a storage element which may be shipped knocked down, and which may be assembled on the premises by the user, or without special labor.

Another purpose is to provide a refrigerating unit in which the refrigerating element or elements are formed unitarily with demountable sides of the container which surround the articles to be stored.

Another purpose is to provide a storage member which is built in independent demountable wall units, and which may be assembled readily at the point of use. Another purpose is to provide a wall unit which includes, as a single unit, a cold plate, insulation and ducts for the cold plate, and an outer wall finish or surface member.

Another purpose is to provide improved sealing means for permitting a demountable refrigerator to be readily and easily assembled into a substantially leak proof refrigerating container.

Other purposes will appear from time to time in the course of the specifications and claims.

I illustrate the invention more or less diagrammatically in the accompanying drawings wherein:

Figure 1 is a perspective view with parts broken away;

Figure 2 is a section on the line 2—2 of Fig. 1;

Figure 3 is a horizontal section of the structure of Fig. 1 taken at the level of the line 3—3;

Figure 4 is a horizontal section of the structure of Fig. 1 taken at the level of the line 4—4;

Figure 5 is a cross section illustrating abutting corner members unassembled with all ducts omitted;

Figure 6 is a cross section of joining corner members assembled, with all ducts omitted.

Figure 7 is a perspective view of an assembly illustrating the cold plate or refrigeration components with the insulation and outer covering eliminated;

Figure 8 is an outside view of plate C;

Figure 9 is a section on the line 9—9 of Fig. 8;

Figure 10 is a section on the line 10—10 of Fig. 8;

Figure 11 is a section on an enlarged scale illustrating a typical joint or connection between two adjacent side members, with the duct connections between the two members indicated, for example, taken in the plane of the lines 11 of Fig. 7;

Figure 12 is a vertical section through a variant

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form of connection between adjacent plates, illustrating the connection before its completion;

Figure 13 is a similar view illustrating the partially completed connection;

Figure 14 is a similar section illustrating the completed connection; and

Figure 15 is a detail.

Like parts are indicated by like symbols throughout the specification and drawings.

Referring to the drawing, I illustrate a demountable refrigerator which is shown as including four individually demountable side elements, a bottom element, and a top element. As will appear below, a door constitutes one of the side elements, but if desired a door could be employed as part of the top element.

Referring to the drawing in detail, each wall member or panel is shown as including an outer wall element 1 which may, for example, be of plywood or thin sheet metal or any other finish or material suitable to form the outside of the completed refrigerator.

The inner wall 2 of the end panels shown in Figure 2 is illustrated as formed of a cold plate which may consist of an inner sheet 3, to the outer face of which are secured any suitable number of ducts, tubes or runs 4, as shown in detail in Figs. 8, 9 and 10. It will be understood that the runs 4 may be of tubular metal suitably formed to define and surround open spaces 3a in which the refrigerant is evaporated, but other types of cold plate may be used. Any suitable connecting ducts, which will later be described in detail, may be positioned in the space between the walls 1 and 2, the ducts being embedded in whatever filling or insulation means are employed, and constituting the means for connecting the various cold plates into a single refrigerant system or cycle.

I illustrate, for example, a mass of insulation 5 which may be of balsam wool or of any other suitable material. The walls 1 and 2 may be spaced apart by any suitable means. I illustrate, for example, cylinders 6 which may be of heavy paper or fibre or any other suitable material, being necessarily, of a material which is a poor heat conductor. They are effective to space the inner and outer walls apart, and provide a relatively solid wall unit.

At the corner of the wall units, it will be noted that the inner walls, or the cold plates, terminate at their edges at a proper distance within the edges of the outer walls, to provide a corner with a meeting surface at an angle of generally 45 degrees to the outer faces of the abutting wall units.

The opposed surfaces of the joints thus formed are preferably of flexible material, to provide a yielding sealing effect. With reference, for example, to Figs. 5 and 6, it will be noted that the corner faces are provided with flexible surface members 8 of a suitable yielding material, such as Neoprene, or any other suitable rubber substitute.

When the structure is knocked down or disassembled, the body of insulation 5 is preferably tightly packed to bulge out the walls 8, as shown in Fig. 5. When the parts are joined together, as shown in Figs. 6 and 11, the opposed neoprene or yielding members 8 are tightly pressed together by the insulating material 5 behind them, and the result is a tight seal. Any suitable angle members 9 may be employed to hold the parts in assembled position, as shown in Figs. 2 and 11.

Referring to the general structures of Figs. 1 to 4, 7 and 8, I illustrate an assembly having four side walls. Three of these side walls and the top are each provided with, or in part formed, by one of the above described cold plate assemblies, each with its inner wall 3 and runs 4. These separate wall panels are illustrated as at A, C, D and F in Figs. 1 and 7.

As one side member, I illustrate a unit having a side door opening closed by two movable insulated door elements 120 and 121, with any suitable locking member 122.

One of the side walls A has associated therewith a conventional compressor-condenser unit, shown as including a base 20, a compressor 21, a condenser 22, a fan 23, and a high pressure supply duct 24, extending from the condenser. The details of the motor, compressor and condenser do not of themselves form part of the present invention, and their illustration is to be taken as diagrammatic.

It is understood that the base 20, if desired, may be secured permanently to the wall A, but it may be advantageous to have all of the wall elements initially independent and separate, for ease and convenience in shipping, and they are so shown in the drawings.

Any suitable bottom member may be employed, which need not have a cold plate associated with it and is shown without a cold plate. If desired, it may be supplied with a cold plate. This bottom member is generally indicated as at E. If desired, the panel members may be connected and reinforced by angular reinforcing members 9. It will be understood that the details of the wall structure may be widely varied.

In considering the specific duct arrangement of the individual walls or plates, I find it advantageous to arrange the evaporating passages 4 of each plate in parallel, with a common supply duct for all of the individual passages or runs and a common return manifold. Considering first the cold plate unit A as shown, for example, in Fig. 7, the liquid refrigerant, under pressure, is delivered along the supply duct 24, from which it flows to the branch duct 91, 91 and thence to the high pressure distribution passage 34. Arranged in parallel, to receive the high pressure liquid refrigerant, are a plurality of pressure reducing devices or restrictors 133, the details of which do not of themselves form part of the present invention. Each of the restrictors 133 may receive the high pressure refrigerant by any suitable duct 93. The restrictors are preferably adjustable, so that the pressure drop to the individual parallel passages 4 can be controlled and rendered uniform. Evaporation takes place in the parallel passages or runs 4, and the vapor returns by the discharge manifold passages 35 and the duct 96a to the return pipe 25 to the compressor. It will be noted that the high pressure duct 24 delivers high pressure liquid refrigerant to two branches 90 and 91. The branch 91 supplies the distribution passage 34 of the unit A through any suitable fitting X, the details of which may be widely varied. Typical fittings are shown, for example, in Figs. 11 to 14 inclusive. From the right hand fitting X of Fig. 7 high pressure liquid refrigerant can flow through the duct 61 to the adjacent fitting X of the unit D. High pressure liquid refrigerant flows along the top passage 110 of the unit D to the second fitting X, shown at the opposite end of the unit D. Some of the liquid refrigerant flows from said last mentioned fitting X to the high pressure supply line 34 of the plate or unit D. Part of the high pressure liquid refrigerant flows to the corresponding high pressure duct 115 of the plate C. It will be understood that each plate has a high pressure supply duct or passage 34 and a return manifold passage 35, the passages 35, through any suitable duct system, eventually returning the evaporated refrigerant to the return passage 25 and thus to the compressor. With reference to Fig. 7, note that the return passages 94 receive the evaporated refrigerant from the units D, C and F for return to the passage 96 and thence to the return pipe 25. It will be understood that the arrangement of ducts can be widely varied, but that the system may advantageously have the following characteristics:

1. Each cold plate or heat exchange unit has associated with it its own pressure reducing means.

2. Each plate has its own individual high pressure supply duct 34 and its low pressure return duct or manifold 35.

3. In shipping the device each cold plate may be shipped with some refrigerant contained therein, the individual fittings X of each plate being closed or sealed by means which will later be described in detail.

4. The individual plates are connected by passages 61, which have for function to tie the entire duct system together, so that each of the high pressure supply or distribution passages 34 can simultaneously receive refrigerant under pressure from the compressor 21 and the condenser 22, and so that all of the return manifolds 35 are put in communication with the suction line or return duct 25 to the compressor.

In such a system, I find it advantageous not merely to have separate pressure reducing means for each plate, but to have individual pressure reduction means for each run on each plate. However, it will be understood that I do not wish to be limited to the employment of individual pressure reducing means or restrictors 133 for each run.

In Fig. 11, I illustrate practical means for connecting the duct system of adjacent plates, and illustrate the connection between the high pressure liquid passage 110 of plate D and the high pressure liquid passage 115 of plate C. In Fig. 11, the angle 9 is shown as apertured as at 40 and 41, each aperture being aligned with a corresponding aperture in the outer wall member 1. In the aperture thus formed, I position duct receiving elements each of which includes an outer member 42 shown as welded or otherwise secured to an inner securing plate 43 which

is secured to the wall 1 and the angle 9, for example, by any suitable securing screws 44. Screw threaded into the end of the member 42 is the fixed valve member 45, the two parts being sealed together for example by any suitable sealing ring or gasket 46. The member 58 is hollow and has an end member 47 provided with an opening having a somewhat spherical inner face 48. The opening is normally held closed, when the device is in its disassembled position, by the closure plug 49 with its flexible head 50. It is urged by the washer 51 and spring 52 into the closed position which is shown in Fig. 11. The stem or plug 49 is guided by the hollow flange 53 the exterior of which is effective to guide or center the spring 52.

55, 55 indicate the ends of ducts which may be secured in any suitable ports 56 of the members 42. It communicates with the space 57 and thru aperture 58, with the space in which the spring 52 is located. It may be understood, therefore, that when the parts are in the position in which they are shown in Fig. 11 whatever material is within the ducts 55 or can pass thru the ducts 55 is held against escape by the closure members 49, 50. It will be understood that the duct ends 55 are to be taken as typical of the system, and that the connection shown in Fig. 11, is typical of all of the duct connections between adjacent plates.

In shipping the individual wall members, they are preferably initially filled with a charge of refrigerant. However, part of the refrigerant of the system is sealed into the cold plate or cold plates of the individual wall elements. When the walls are assembled, the ducts 55 of adjacent plates or adjacent walls, are put into communication with each other in the following manner —an outside fitting 60 is secured to the exterior of the angle 9, for example, by the screws 59. Two such fittings, as shown in Fig. 11, are connected by the communication duct 61, which connects the internal apertures 62 of the members 60. Screw threaded into each of the members 60 is a screw 63 having an inner end portion 64. Before the two adjacent plates are put into communication, the ends 64 are out of contact with the member 49, 50 of the inner duct connection. The outer position of the screw 63 may be limited by the member 65 which closes an aperture 66 in the internal partition 67. Premature change in the adjustment of the screw 63 is prevented by a removable cap 68.

Assume that the parts have been put into the position in which they are shown in Fig. 11. The user removes the caps 68 and rotates the screws 63 until the end portions 64 engage the members 49, 50 and move them to open position against the springs 52. The result is to open a path between the duct system of two adjacent plates. When the screws 63 are in the proper position to hold the plugs 49 open, the closures 68 may be returned to the closed position and are provided with sealing means or washers 69, thus preventing unintended movement of the screws 63.

For additional leakage preventing means, I may employ any suitable packing ring 70 between the opposed members 45 and 60. Whereas I illustrate only one such connection in detail, it may be understood that duct connections between adjacent wall or cold plate sections may be employed wherever necessitated by the particular

duct arrangement employed in connection with a particular refrigerant cycle or system.

An alternative mode of connecting the duct systems of adjacent plates is shown in Figs. 12 to 15 inclusive. I illustrate only one end of the tubular passage or connecting duct 143, since the opposite end may be identically secured. The form of Figs. 12 to 15 may be advantageously employed when the storage refrigerator is intended to remain permanently assembled, whereas the connection of Fig. 11 is suitable, where the device may have to be knocked down and reassembled more than once. It will be understood that a body portion 147 may be secured in or form part of the structure of a wall section. 148 indicates any suitable duct through which fluid refrigerant is to flow. It may, for example, correspond to the duct 110 of Fig. 11. It is initially closed by a sealing cap 149, which serves to confine the refrigerant within the duct structure of a particular plate. The outside connecting member or tube 143 is also provided with a sealing cap 145. In order to make the connection I illustrate a body 151 in the form of a disc with a conic portion 151*a* at one side and an outwardly offset portion 151*b* at the other. The disc defines a central passage 157, aligned with the ducts 148. The passage 157 is partly closed by a disc 155 having a plurality of apertures 156, and also supporting a rupturing member having opposite conic heads 153 and 153*a*. The body 151 is guided by offset portions or lugs 152 which enter and are guided in the aperture or apertures 150 in the body 147. The body 147 is inwardly screw threaded as at 146 to receive the threads 142 of the nut 140. The nut with its octagonal faces 141, surrounds the passage 143, and is formed generally to conform to the exterior of the passage or duct 143 and its outwardly flared inner end 144. In making a connection between adjacent plates the body 151 may be slipped into the position in which it is shown in Fig. 12. The rupturing head 153*a* rests upon the sealing disc 149 of the passage 148. The nut 140 is shown in Fig. 12 as beginning its movement toward its final position. It is still out of contact with the member 151. In Fig. 13 it has penetrated the threads 146 of the body 147 sufficiently deeply to engage the flared duct portion 144 with the surface 151*a* of the member 151. The rupturing head 153 has already ruptured the seal 145 of the passage 143. A continued rotation of the nut 140 moves the parts to the position in which they are shown in Fig. 14. The body 151 has been thrust to the limit of its movement toward the end of the duct 148, and the rupturing head 153*a* has ruptured the seal 149. Thus the interiors of the passages 143 and 148 are now in full communication, and the nut 140 is effective to lock the flared portion 144 of the duct 143 against the opposed surface 151*a*, in effective sealing contact.

It will be realized that, whereas, I have described and illustrated a practical and operative device, nevertheless many changes may be made in the size, shape, number and disposition of parts without departing from the spirit of my invention. I therefore wish my description and drawings to be taken as in a broad sense illustrative or diagrammatic, rather than as limiting me to my precise showing.

The use and operation of my invention are as follows:

It is frequently desirable to provide a strong and practical refrigerator of substantial size,

which, if shipped whole, would be too large to be placed in the desired area of use. The demountable feature of my refrigerator makes it possible to ship it disassembled, and to assemble it at the point of use. The assembling structure is sufficiently simple, so that the device may be assembled, in many instances, by the ultimate user. For example, a farmer or suburban householder of ordinary intelligence, and with ordinary equipment, can himself assemble a refrigerator made in accordance with my invention without the need of difficult or complicated equipment, and without expert assistance.

My invention is particularly well adapted to refrigeration where a relatively high temperature is satisfactory. For example, it may be used as storage means for vegetables or for articles which will advantageously keep at a little below freezing, or at slightly above freezing. In particular, where the user wishes to store articles which may advantageously be stored at different temperatures, the user may obtain different temperatures in different parts of the device. Assume that a lower temperature is desirable in one part of the device than in the other, the pressure reducing devices of some of the runs may be adjusted, preferably at the factory, to obtain a lower temperature. The user can separate, by any suitable shelves or partitions, the various parts of the interior of the refrigerated space and may segregate the materials stored in relation to the optimum temperature to which the various materials should be subjected. The use of individual restrictors for each individual run thus gives to my refrigerating unit, a maximum of flexibility or adjustability. In fact, it is possible to set the different individual plates to obtain different temperatures, if such a result is desired by the user. Because of this flexibility, it may in practice, be advantageous to permit the user to arrange or vary whatever interior partitioning means he employs, employing temporary partitions between different parts of the storage space. For that reason, individual interior partitions are not illustrated in the drawings, since they are advantageously provided and arranged by the user.

In shipping the system, the refrigerant is distributed thru and sealed in the individual tubes of the cold plate members. It may be isolated in the individual members, for example, by the sealing structure shown in Fig. 11. When the structure has been assembled and the individual walls secured, the duct system is completed by opening the plugs **49**, **50** as shown in Fig. 11. This renders the angular ducts **61** operative to connect the entire system.

In a sense, each of the plates constitutes a plurality of individual evaporators. Each run of each plate is a separate evaporator, with its own restrictor or pressure reduction means. The individual restrictors are preferably adjustable, but are preferably adjusted at the factory, so that the ultimate user will not touch them. Once the plates have been connected to each other and to the compressor condenser unit, and the compressor is operated, refrigerant cycles thru the various plates and liquid refrigerant, under pressure, is delivered to the individual pressure reduction means for each duct **4** of each plate.

Each plate or wall unit is self-contained to the extent that it includes a cold plate **2**, an outer wall **1**, an enclosed body of insulating material **5**, and the ducts necessary to supply refrigerant to the individual runs of the plates and to remove

it from the plate. In practice, the cylinders **6** form a powerful stabilizing means for the whole structure and a robust and sturdy individual wall element is provided.

When the wall elements are secured together, they are adequately sealed by the opposed neoprene or yielding walls **8** as shown, for example, in Fig. 11.

It will be understood that whereas in the drawings I illustrated a plurality of separate ducts **4**, I may employ a single duct **4**, with a single pressure reducing device therefor. The duct **4** may be of any suitable shape. What I wish to emphasize is that whereas it may be advantageous to employ a plurality of ducts, and a plurality of separate pressure reducing means for each duct, I may employ a single duct per plate and a single pressure reducing means per plate.

I claim:

1. In a knock-down refrigerating device, a plurality of separate wall members adapted, when connected edge to edge, to form a storage space, each said wall member including a heat insulating layer, a plurality of said wall members having heat exchange members and inlet and outlet ducts therefor, the interior of the said heat exchange members and ducts having initially effective seals, means for connecting said wall members, including means for connecting the inlet and outlet ducts of the individual wall members into a unitary refrigerating system, means for opening said seals when said system is completed, and means for preventing communication of the interiors of said heat exchange members and ducts with the atmosphere, and means for circulating a refrigerant through the system thus formed.

2. The structure of claim 1 characterized by and including the employment, as heat exchange members, of evaporators having surfaces exposed to said storage space, and adapted for the circulation and evaporation of a volatile refrigerant.

3. The structure of claim 1 characterized by and including the employment, as heat exchange members, of evaporators having surfaces exposed to said storage space, and adapted for the circulation and evaporation of a volatile refrigerant, and individual pressure reduction means for the evaporators of the individual wall members.

4. The structure of claim 1 characterized by and including the employment of exterior ducts adapted to connect the inlet and outlet ducts of the individual wall members.

5. The structure of claim 1 characterized by and including the initial sealing, in the evaporators and ducts of the individual wall members, of a portion of the refrigerant ultimately used in the final system.

6. In a knock-down refrigerating device, a refrigerating container including a plurality of separate wall members, each said wall member including a heat insulating layer, a plurality of said wall members having evaporators and inlet and outlet ducts therefor, means for demountably joining said wall members in assembled relation, means for demountably connecting the inlet and outlet ducts of the individual walls into a unitary system, and means for circulating a volatile refrigerant through the system thus formed.

7. In a demountable refrigerating device, a refrigerating container including a plurality of separate wall members, each said wall member including a heat insulating layer, a plurality of said wall members having heat exchange mem-

bers and inlet and outlet ducts therefor, means for demountably joining said wall members in assembled relation, means for demountably connecting the inlet and outlet ducts of the individual walls into a unitary system, and means for circulating a refrigerant through the system thus formed.

8. The structure of claim 7 characterized by and including the provision of compressible and heat insulating sealing means along the opposed edges of the wall members, the means for connecting said wall members being adapted to place said sealing means under compression.

9. The structure of claim 7 characterized by and including the provision of compressible and heat insulating sealing means along the opposed edges of the wall members, the means for connecting said wall members being adapted to place said sealing means under compression, said compressible sealing means including normally convex flexible wall portions.

10. In a refrigerating device, a refrigerating container including a plurality of walls, means for removably securing said walls to each other, said walls, when secured, surrounding a storage space, a plurality of said walls including heat exchange members, forming an integral part of such walls and means for circulating a refrigerant through said heat exchange members.

11. In a knock-down refrigerating device, a refrigerating container including a plurality of walls, means for securing said walls to each other, said walls, when secured, surrounding a storage space, a plurality of said walls including evaporator portions adapted for the circulation of a volatile refrigerant, means for demountably connecting the evaporator portions of adjacent walls, and means for cycling a volatile refrigerant through said evaporator portions, and separate pressure reduction means for each such evaporator portion.

12. The structure of claim 11 characterized by and including the provision, for each evaporating portion, of a plurality of separate evaporator ducts and a separate pressure reducing element for each said duct.

13. In a knock-down refrigerator, a plurality of wall members adapted, when secured together, to define a storage space, evaporator means in and forming an integral part of some of said wall members, including portions in heat exchange relationship with said storage space, and means for circulating a volatile refrigerant through said evaporator means.

14. For use in a knock-down refrigerator, a wall panel having an inner plate of heat conductive material, an outer layer of heat insulating material, one or more evaporator passage elements secured to said inner plate and means for permitting the cycling of a volatile refrigerant through said passages, including supply and withdrawal ducts embedded in the heat insulating layer.

15. In a knock-down refrigerator structure, a

refrigerator including a pair of edgewise abutting walls, each said wall including an evaporator structure and ducts therefor, and means for connecting the ducts of adjacent walls including a duct exterior to said walls and a connection, therefrom, extending through each said wall to the evaporator duct of such wall, said evaporator ducts being located within the walls, a valve within each said wall, and in the line of flow between said outside passage and said inside ducts, means for normally holding said valves in closed position and means, operable from outside of said walls, from moving said valves to the open position and for thereby putting the evaporator ducts of adjacent walls into communication.

16. In a refrigerator adapted for assembly at the point of use, a plurality of wall members, some of said wall members including evaporators, said wall members being adapted, when secured together, to surround a storage space, inlet and outlet ducts for the evaporators of the individual wall members, connecting ducts adapted to be connected to said inlet and outlet ducts of adjacent wall members and to join the evaporators of the wall members in a unitary system, means for circulating a volatile refrigerant through said system, sealing means for the inlet and outlet ducts of the individual wall members, and means for rendering said sealing means inoperative when the refrigerator is assembled for use.

17. In a refrigerator adapted for assembly at the point of use, a plurality of wall members, some of said wall members including evaporators, said wall members being adapted, when secured together, to surround a storage space, inlet and outlet ducts for the evaporators of the individual wall members, connecting ducts adapted to be connected to said inlet and outlet ducts of adjacent wall members and to join the evaporators of the wall members in a unitary system, means for circulating a volatile refrigerant through said system, rupturable seals for the inlet and outlet ducts of the individual wall members, and means for rupturing said seals when said connecting ducts are connected to the inlet and outlet ducts of the adjacent wall members.

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