June 12, 1934. A. LENNING 1,962,512

EVAPORATOR

Filed May 22, 1929 2 Sheets-Sheet 1

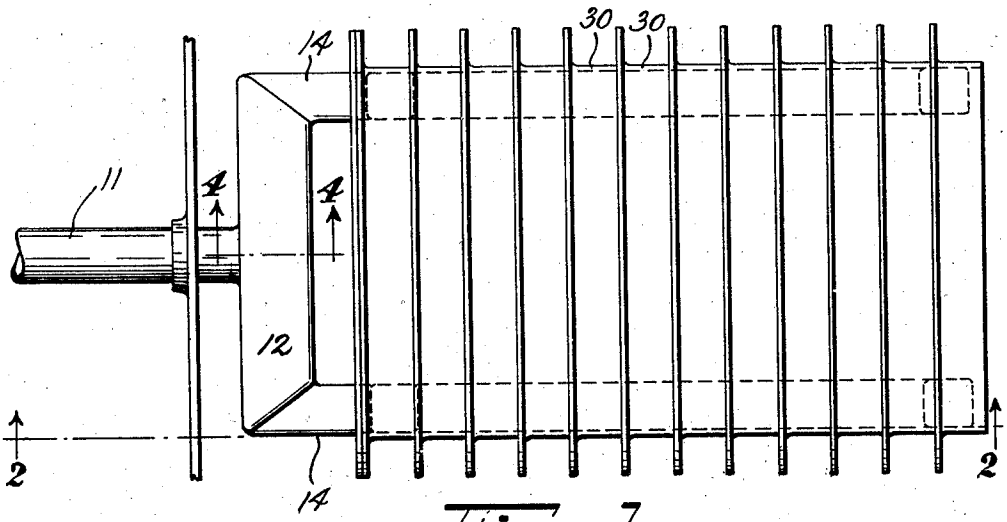


Fig. 1.

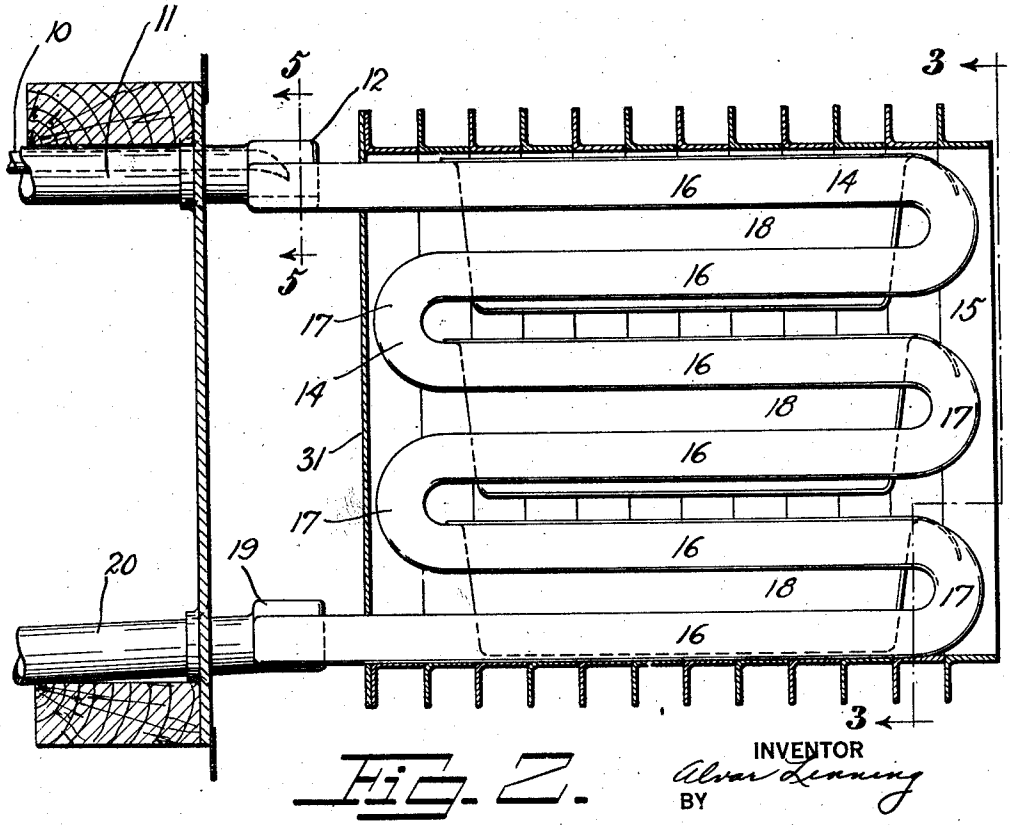


Fig. 2.

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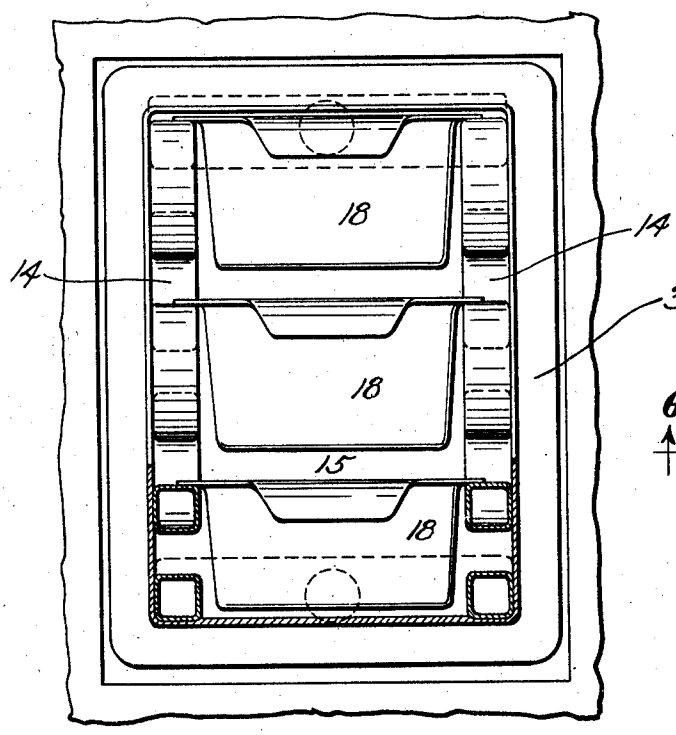


Fig. 3.

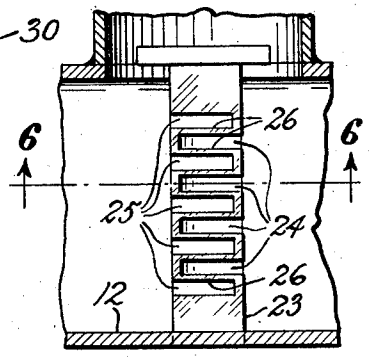


Fig. 7.

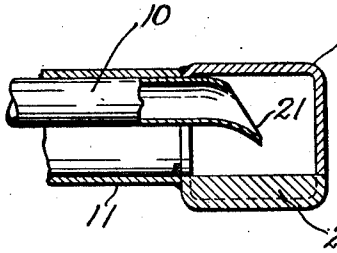


Fig. 4.

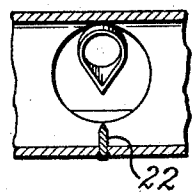


Fig. 5.

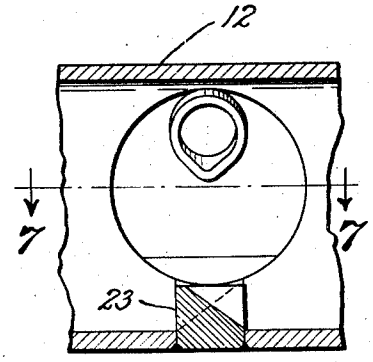


Fig. 6.

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UNITED STATES PATENT OFFICE

1,962,512

EVAPORATOR

Alvar Lenning, Jackson Heights, N. Y., assignor to Electrolux Servel Corporation, New York, N. Y., a corporation of Delaware

Application May 22, 1929, Serial No. 364,971

27 Claims. (Cl. 62—126)

My invention relates to refrigerating systems and more particularly to evaporators for refrigerating systems. Still more particularly my invention relates to evaporators for use in systems in which the pressure is equalized by means of a gas which is inert with respect to the refrigerant.

In refrigerating systems where there is no drop in pressure between the point of liquid supply to the evaporator and the evaporator, division of liquid into a plurality of streams presents a problem. Subdivision into a plurality of streams facilitates construction of an evaporator in whole or in part of tubing. When there is only one path of liquid flow through the evaporator in one direction as in gravity evaporators, it has been found necessary to provide relatively elaborate means for obtaining good heat transfer between the space to be cooled and the evaporator.

My present invention provides means for separating liquid refrigerant into several streams without having a drop in total pressure, thereby facilitating the construction of an evaporator, particularly for systems of the equalized pressure type.

To do this I cause the liquid refrigerant to drop onto a knife edge separator which divides the drops, part of the liquid passing to one side and part to the other of the knife edge separator.

Another object of my invention is to provide a novel form of evaporator particularly suited for equalized pressure systems.

The nature of the invention will become apparent from the following description taken in connection with the accompanying drawings forming part of this specification and of which:

Fig. 1 is a top view of an evaporator embodying the invention;

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

Fig. 3 is a view taken on the line 3—3 of Fig. 2;

Fig. 4 is a sectional view of part of the evaporator taken on line 4—4 of Fig. 1;

Fig. 5 is a sectional view of part of the evaporator taken on line 5—5 of Fig. 2;

Fig. 6 is a sectional view of an evaporator showing a second embodiment of the invention, which view is taken on line 6—6 of Fig. 7; and

Fig. 7 is a sectional view taken on line 7—7 of Fig. 6.

The particular evaporator shown in Fig. 1 is designed for a system of the type shown in U. S. Patent 1,609,334 granted December 7, 1926, to von Platen and Munters. Such system is of equal pressure throughout by virtue of an auxiliary agent such as hydrogen into which the cooling agent or refrigerant such as ammonia evaporates.

The evaporator is supplied with a cooling agent or refrigerant such as ammonia through conduit 10 which extends within conduit 11. Conduit 11 supplies an auxiliary agent or inert gas such as hydrogen to the evaporator. Conduit 11 is connected to a horizontal hollow cross connection 12 preferably made of rectangular or square tubing. The ends of cross-connection 12 are connected to a pair of similar vertically disposed zig-zag conduits 14. Conduits 14 are arranged to each side of a freezing chamber 15. They comprise horizontal portions 16 and bends 17 connecting the horizontal portions. The horizontal portions at the upper ends of forwardly posited loops serve for supporting ice trays 18 in chamber 15. The ice trays have upper flanges for supporting them on the horizontal conduit portions. The ice trays can be removed from chamber 15 by merely pulling them forward. Conduits 14 are preferably of square or rectangular form to give good supporting surfaces for the trays and to provide adequate liquid surface inside the same.

The lower ends of conduits 14 are connected to a cross-connection 19 positioned below connection 12. A conduit 20 conducts the gaseous mixture formed in the evaporator away therefrom and toward the absorber.

Conduit 10, which conducts liquid refrigerant from the condenser of the system to the evaporator projects within connection 12. The end 21 of conduit 10 is formed to make drops of the liquid passing therethrough, the end being bent downwardly and tapered in a snout-like formation.

Immediately below projection 21 is a member 22 which is set into connection 12. Member 22 extends upwardly and has a knife edge top. Drops of liquid falling down from projection 21 onto the knife edge of member 22 are split, part of the drop passing to each side of the knife edge.

The liquid flows downwardly through conduits 14 evaporating into the auxiliary gas supplied through conduit 11. The evaporation takes up heat thereby producing refrigeration. The flat bottom of the conduits give greater surface for evaporation than would be the case with round tubes.

The conduits of the evaporator are enclosed in a box-like casing comprising flanged members 30 which are slipped over the conduits and spot welded thereto and a back plate 31. When close together the plate 31 and flanged members 30 give a closed chamber. A door may be placed over the front opening. The flanges project outwardly and serve to aid the heat transfer. Sufficient space is left above the top horizontal conduit portions under the flanged members to permit hanging the upper tray thereon.

With an arrangement as above described comprising a single knife edge it would be necessary

to have the evaporator level so that the dropping point is vertically over the knife edge. To avoid the necessity of leveling I propose the arrangement shown in Fig. 6 and Fig. 7 wherein a cross-piece 23 is fitted into the connection 12. This cross-piece may be made of a block of metal cut alternately from one side downwardly to the other to form inclines running to opposite sides. Cuts 24 run from the top downwardly to the right as shown and cuts 25 run from the top downwardly to the left as shown. The ridges 26 left between the cuts are very narrow and constitute a plurality of knife edges. The cuts are preferably of less width than the diameter of a normal drop. Thus there is formed a number of knife edges parallel to each other and so arranged that the drops will be divided even though the evaporator is out of level position by a considerable amount. The parts of the drops run down the inclines to opposite sides.

While I have shown two embodiments of the invention, it will be understood that the invention may be embodied in a great number of forms of apparatus.

Having thus described my invention, what I claim is:

1. An evaporator comprising members forming a plurality of paths of liquid flow, a liquid supply conduit adapted to drop liquid therefrom for supplying liquid to said members and a liquid divider element in said means in the path of liquid dropping from said supply conduit.

2. An evaporator comprising members forming a plurality of paths of liquid flow, a liquid supply conduit adapted to drop liquid therefrom for supplying liquid to said members and a liquid divider element having a knife edge in said means in the path of liquid dropping from said supply conduit.

3. An evaporator comprising a pair of vertically extending conduits, a hollow connection connecting the upper parts of said conduits, a liquid supply conduit projecting into said hollow connection and means in said hollow connection providing a knife edge vertically below the projection of the liquid supply conduit into the hollow connection.

4. An evaporator comprising a pair of vertically extending conduits, a hollow connection connecting the upper parts of said conduits, a liquid supply conduit projecting into said hollow connection adapted to drop liquid thereinto and a liquid divider in said hollow connection below the projection of the liquid supply conduit thereinto and in the path of liquid dropping from the supply conduit for separating the dropping liquid into separate streams.

5. An evaporator comprising a pair of vertically extending conduits, a hollow connection connecting the upper parts of said conduits, a liquid supply conduit projecting into said hollow connection and a liquid divider in said hollow connection below the projection of the liquid supply conduit thereinto comprising a cross-piece having a zig-zag upper edge and inclined surfaces extending downwardly to each side of the cross-piece.

6. An evaporator comprising a pair of vertically extending conduits, a hollow connection connecting the upper parts of said conduits, a liquid supply conduit projecting into said hollow connection, means in said hollow connection providing a knife edge vertically below the projection of the liquid supply conduit thereinto and means to supply an auxiliary gas to the evaporator.

7. An evaporator comprising a pair of vertically extending conduits, a hollow connection connecting the upper parts of said conduits, a liquid supply conduit projecting into said hollow connection, a liquid divider in said hollow connection vertically below the projection of the liquid supply conduit thereinto for separating liquid dropping from said supply conduit into separate streams and means to supply an auxiliary gas to the evaporator.

8. An evaporator comprising a pair of vertically disposed similar zig-zag conduits having horizontal portions serving to support ice trays, a hollow connection connecting the upper parts of said conduits, a liquid supply conduit projecting into said hollow connection, a liquid divider in said hollow connection below the projection of the liquid supply conduit thereinto and a connection between the lower ends of the zig-zag conduits.

9. An evaporator comprising a pair of vertically disposed similar zig-zag conduits having horizontal portions serving to support ice trays, a hollow connection connecting the upper parts of said conduits, a liquid supply conduit projecting into said hollow connection, a liquid divider in said hollow connection below the projection of the liquid supply conduit thereinto, a connection between the lower ends of the zig-zag conduits and flanged members encasing said zig-zag conduits.

10. An evaporator comprising a pair of vertically disposed similar zig-zag conduits having horizontal portions serving to support ice trays, a hollow connection connecting the upper parts of said conduits, a liquid supply conduit projecting into said hollow connection, a liquid divider in said hollow connection below the projection of the liquid supply conduit thereinto, a connection between the lower ends of the zig-zag conduits, flanged members encasing said zig-zag conduits and means for supplying an auxiliary gas to the evaporator.

11. An evaporator comprising an upper cross-connection, a lower cross-connection, a pair of spaced zig-zag conduits connected at top and bottom to said cross-connections, said zig-zag conduits having horizontal portions and ice trays having lateral flanges, said trays supported by said flanges on said horizontal portions.

12. An evaporator comprising an upper cross-connection, a lower cross-connection, a pair of spaced zig-zag conduits of rectangular cross-section connected at top and bottom to said cross-connections, said zig-zag conduits having horizontal portions and ice trays having lateral flanges, said trays supported by said flanges on said horizontal portions.

13. An evaporator comprising members forming a plurality of paths of flow and means for subdividing a stream of liquid to flow in said paths without change of total pressure comprising an edge directed toward the stream.

14. An evaporator comprising an upper cross-connection, a lower cross-connection, a pair of zigzag conduits connected at top and bottom to said cross-connections, said zigzag conduits having horizontal portions, ice trays supported on said horizontal portions, a liquid supply conduit projecting into said upper cross-connection, and a liquid divider in said upper cross-connection below the projection of the liquid supply conduit thereinto comprising a cross-piece having a zigzag upper edge and inclined surfaces extending downwardly to each side of the cross-piece.

15. An evaporator comprising an upper cross-connection, a lower cross-connection, and a pair of laterally disposed parallel zigzag conduits connected at the top and at the bottom to the aforesaid cross-connections, said zigzag conduits having parallel horizontal portions and curved portions connecting the horizontal portions alternately at the front and back of the evaporator and providing receiving spaces accessible from the front for receiving supporting parts of ice trays and horizontal portions of the conduits at the upper ends of forwardly posited curved portions serving to support ice trays hung thereon between the zigzag conduits.

16. An evaporator comprising an upper cross-connection, a lower cross-connection, a pair of laterally disposed zigzag conduits connected at the top and bottom to said cross-connections, said zigzag conduits having parallel horizontal portions and curved portions connecting the horizontal portions alternately at the front and back of the evaporator, a box-like heat transmitting structure enclosing said zigzag conduits and having an opening in the front thereof, and ice trays provided with upper longitudinally extending flanges, said flanges engaging the horizontal portions of said zigzag conduits to support the trays thereon and within said box-like structure.

17. An evaporator comprising an upper cross-connection, a lower cross-connection, a pair of laterally disposed zigzag conduits connected at the top and bottom to said cross-connections, said zigzag conduits having horizontal portions, a box-like structure surrounding said zigzag conduits, said structure comprising a series of rectangular bands with out-turned flanges formed thereon, and ice trays supported on said horizontal portions and within said structure.

18. An evaporator comprising an upper cross-connection, a lower cross-connection, a pair of laterally disposed zigzag conduits connected at the top and bottom to said cross-connections, said zigzag conduits having parallel horizontal portions, a box-like structure surrounding said zigzag conduits, said structure comprising a series of rectangular bands with out-turned flanges formed thereon, ice trays provided with upper longitudinally extending flanges, said flanges engaging the horizontal portions of said zigzag conduits to support the trays thereon and within said box-like structure, a liquid supply conduit communicating with said upper cross-connection and means for dividing liquid supplied through said liquid supply conduit.

19. An evaporator comprising a pair of vertically extending conduits, a hollow connection connecting the upper parts of said conduits, a liquid supply conduit projecting into said hollow connection for dropping liquid thereinto, a liquid divider in said hollow connection below the projection of the liquid supply conduit thereinto and in the path of liquid dropping from the supply conduit for separating the dropping liquid into separate streams, a lower hollow connection connecting the lower ends of said vertically extending conduits and a conduit for conveying vapor from said lower hollow connection.

20. An evaporator comprising a pair of vertically extending conduits, a hollow connection connecting the upper parts of said conduits, a liquid supply conduit projecting into said hollow connection for dropping liquid thereinto, a liquid divider in said hollow connection below the projection of the liquid supply conduit thereinto and in the path of liquid dropping from the supply conduit for separating the dropping liquid into separate streams, a lower hollow connection connecting the lower ends of said vertically extending conduits, means for supplying an auxiliary gas to said evaporator and a conduit for conveying vapor from said lower hollow connection.

21. An evaporator comprising horizontally spaced conduits having substantially parallel horizontal portions connected by conduit bends, and substantially opposite horizontal portions of said spaced conduits being arranged to support lateral flanges of an ice tray.

22. An evaporator comprising a sheet metal casing, a refrigerant conduit secured in good thermal contact with an inner surface of each side wall of said casing, said spaced conduits being provided with substantially horizontal parallel portions for receiving and supporting the lateral flanges of ice trays.

23. An evaporator comprising a sheet metal casing, a refrigerant conduit secured in good thermal contact with an inner surface of each side wall of said casing, said spaced conduits being provided with substantially horizontal parallel portions for receiving and supporting the lateral flanges of ice trays, said conduits being interconnected at their extremities.

24. An evaporator comprising a sheet metal casing, a refrigerant conduit secured in good thermal contact with an inner surface of each side wall of said casing, said spaced conduits being provided with substantially horizontal parallel portions for receiving and supporting the lateral flanges of ice trays, said casing being formed of a plurality of sections having heat-radiating fins.

25. An evaporator comprising a conduit having horizontally spaced parts comprising substantially parallel horizontal portions connected by conduit bends, and substantially opposite horizontal portions of said spaced parts being arranged to support lateral flanges of an ice tray.

26. An evaporator comprising a heat conducting casing forming an enclosure open at the front for insertion of ice trays, conduits in heat exchange relation with each side of the casing having substantially horizontal portions and connected for continuous downward flow of liquid refrigerant therethrough and having no portions thereof at the front of the enclosure, said conduits being constructed and arranged for flow of inert gas therethrough, and separate conduits for supplying liquid refrigerant and inert gas to the aforementioned conduits.

27. An evaporator comprising a housing structure enclosing an ice tray chamber, and a conduit in heat exchange relation with said housing structure, said conduit being of such large cross-sectional area as to carry a volume of liquid refrigerant necessary for evaporation and a considerably greater volume of inert gas, said conduit comprising substantially horizontal portions connected by bends and being confined to the side and back parts of said housing structure, separate pipes for admitting liquid refrigerant and inert gas to said conduit and means to withdraw inert gas from said conduit.

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