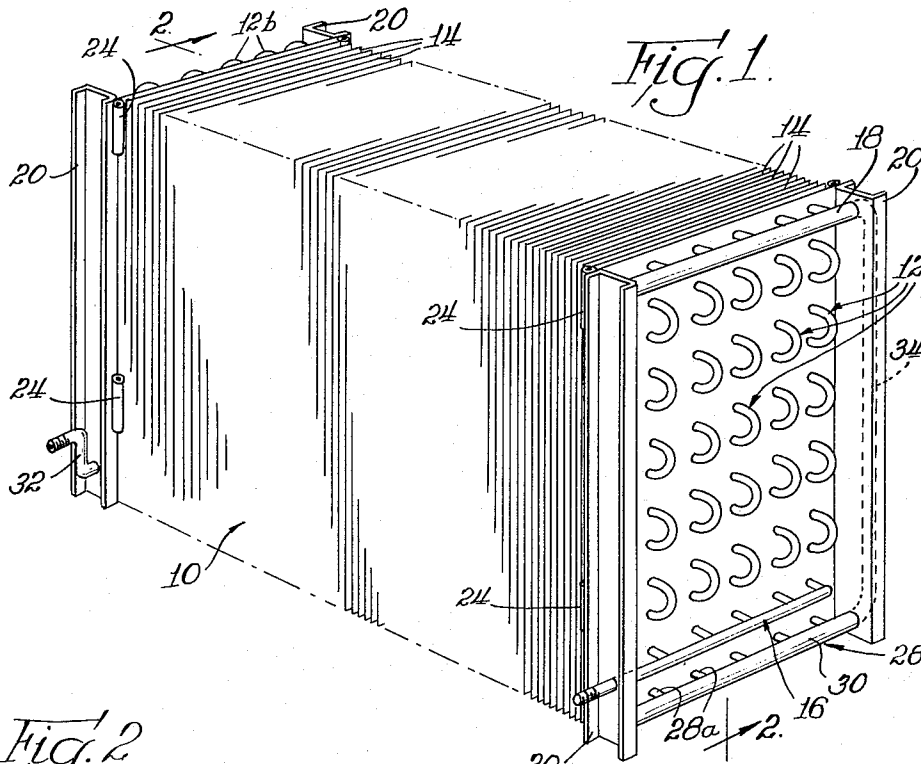
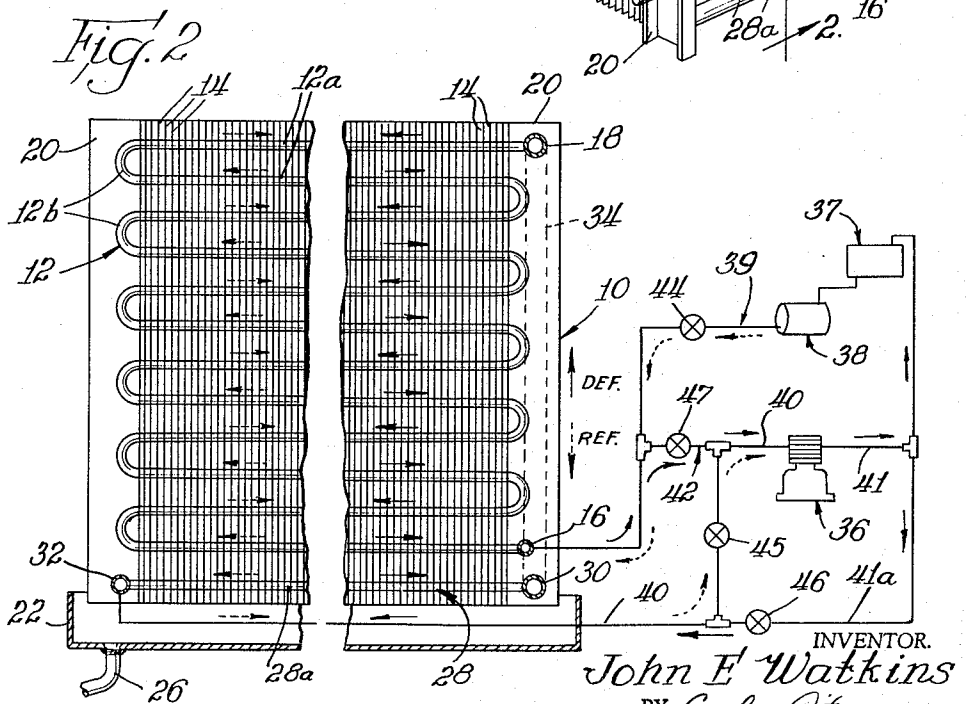


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REFRIGERANT EVAPORATOR

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REFRIGERANT EVAPORATOR

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The present invention relates generally to refrigerating systems and more particularly to evaporators for use in such systems.

It is an object of the invention to provide in a refrigerating system of the compressive process type refrigerant evaporator means of improved construction and arrangement which permits of economical manufacture, which is efficient in operation, and which facilitates defrosting.

Another object is to provide a new and improved construction for a refrigerant evaporator which affords complete coil utilization for refrigerating operation and which is effective to insure complete defrosting not only of the coils but also of the associated drain pan.

A further object of the invention is to provide for incorporation in a refrigerating system having a liquid refrigerant supply line, a suction line and a hot gas line, a refrigerant evaporator of improved construction together with control valve means operable to direct liquid refrigerant through all of the evaporator coils during normal refrigerating operation and alternatively to direct hot gas through the defrosting coil to clear the drain pan of frost and ice and then through the cooling coils for defrosting them.

The objects of the invention thus generally set forth together with other objects and ancillary advantages are attained by the construction and arrangement shown in the accompanying drawing, in which:

FIGURE 1 is a perspective view of an evaporator embodying the features of the present invention.

FIG. 2 is a central vertical section taken substantially in the plane of line 2-2 in FIG. 1 and including a diagrammatic representation of a typical compressive process type refrigerating system.

While the invention is susceptible of various modifications and alternative constructions, there is shown in the drawing and will herein be described in detail a preferred embodiment. It is to be understood, however, that it is not intended to limit the invention to the specific form disclosed. On the contrary, it is intended to embrace all modifications and alternative constructions falling within the spirit and scope of the appended claims.

Referring more particularly to the drawings, there shown for purposes of illustration is a refrigerant evaporator embodying the features of the present invention. The evaporator, which is generally designated by the reference numeral 10, includes a plurality of cooling coils 12. Each of the coils 12 preferably consists of continuous tubing formed into successive longitudinal runs 12a which are uniformly spaced and are connected by smoothly rounded reentrant or bight portions 12b. As shown the coils 12 are vertically disposed and in laterally spaced relation to each other, being so maintained and supported by a large number of transverse fins 14. The fins are formed of heat conducting material such as sheet metal, and each is intimately connected with the coil tubing. The individual fins are spaced apart and provide heat exchange surfaces over which the fluid medium, such as air, which is to be cooled, is passed.

The terminal ends of the coils 12 are interconnected, or manifolded, by transversely disposed headers 16 and 18. Thus the coils 12 are arranged to provide for parallel fluid flow therethrough. To facilitate mounting of the evaporator the finned coil bank is provided at its ends with spaced support members 20 here shown to be of channel form. The inlet and outlet headers 16 and

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18, respectively, are preferably formed of somewhat heavier material than that of the coil tubing and are fixed at their ends to the supports 20 for purposes of strength and to minimize application of strain to the junctions between the terminal ends of the coils 12 and the headers.

During refrigerating operation frost forms on the coils and on the fins. This frost has an insulating effect and should be removed in order to obtain efficient refrigerating operation. For this purpose defrosting is periodically effected during which the accumulated frost melts and runs off the fins and coils. To catch the melted frost a drain pan 22 is provided. The drain pan is of shallow tray form and extends entirely beneath the finned coil bank of the evaporator. The drain pan 22 being disposed beneath the finned coil bank may, if desired, be supported in such position by suspension bolts (not shown) and the supports 20 are equipped with sleeves 24 to receive such bolts. The drain pan 22 is provided with a runoff pipe 26 to convey away the melted frost.

To facilitate defrosting of the evaporator and particularly to insure melting of any ice which might have formed in the drain pan during preceding refrigerating operation a defrosting coil 28 is provided. The defrosting coil is disposed beneath the cooling coils 12 and adjacent the drain pan 22. As shown, the defrosting coil includes a plurality of parallel runs 28a of tubing corresponding in number and spacing to the cooling coils. The tubing runs 28a extend through and are joined to the fins 14 and are interconnected at their ends by headers 30 and 32. The headers 30 and 32 are fixed at their ends to the support members 20.

In accordance with one aspect of the present invention all of the coils including the cooling coils 12 and defrosting coil 28 of the evaporator are utilized for cooling during refrigerating operation. To this end the upper cooling coil header 18 and the defrosting coil header 30 are interconnected by a conduit 34. Desirably these two headers of the conduit may be formed of a continuous length of tubing joined by smoothly rounded corner bends disposed just outside of the web portion of one of the channel support members 20 with the conduit portion 34 being disposed between its flanges.

The improved evaporator is intended primarily for incorporation in a refrigerating system of the compressive process type. For purposes of illustration such a system has been diagrammatically indicated in FIG. 2. It includes a compressor 36, a condenser 37, and a liquid refrigerant receiver 38 as well as the evaporator 10. A liquid refrigerant supply line 39 is connected between the receiver 38 and the inlet cooling coil header 16 for supplying liquid refrigerant to the cooling coils 12 for flow therethrough from bottom to top and thence by way of the conduit 34 to the header 30 for flow through the defrosting coil. This refrigerant fluid flow is indicated in FIG. 2 by dotted arrows. So as to provide a return for spent refrigerant from the evaporator, the suction line 40 to the compressor 36 is connected to the defrosting coil header 32. From the compressor the refrigerant is delivered by way of a hot gas line 41 to the condenser 37.

For defrosting operation hot gas from the compressor is applied to the evaporator. Desirably the hot gas is supplied first to the defrosting coil 28 and thence, by way of the conduit 34 to the header 18 and through the cooling coils 12 from which it is returned by way of the suction line 40 to the compressor 36. Hot gas flow for defrosting is indicated in FIG. 2 by solid arrows. A branch hot gas line 41a is interconnected between the hot gas line 41 and the portion of the suction line 40 which connects with the defrosting coil header 32 to supply hot gas to the evaporator. To complete the hot

gas return to the suction line 40 a bypass conduit 42 is interposed between the liquid refrigerant supply line 39, adjacent the cooling coil header 16 and the suction line 40.

Valve means is provided for controlling refrigerant fluid flow. This valve means is normally operable for refrigerating operation to supply liquid refrigerant to the inlet ends of the cooling coils 12 by way of the header 16 and is alternatively operable for interrupting the supply of liquid refrigerant and for connecting the defrosting coil to the hot gas line and for connecting the header 16 so as to discharge from the finned coil bank any liquid such as refrigerant remaining from a preceding refrigerating cycle or any hot gas condensate, as shown, to the suction line 40. It will be understood, of course, that the valve means may take any suitable form. Thus the valve means may consist of four independent valves manually, mechanically, or electrically operated or they may be combined. For purposes of illustration and ease of understanding four independent valve elements have been diagrammatically indicated in FIG. 2. Thus there is shown a valve 44 in the liquid refrigerant supply line 39. A second valve 45 is included in the suction line 40. A third valve 46 is included in the hot gas line 41a and a fourth valve 47 is included in the bypass line 42.

For normal refrigerating operation the liquid refrigerant supply line valve 44 and the suction line valve 45 are open. For such operation the hot gas line valve 46 and the bypass line valve 47 are closed. Upon reference to FIG. 2, therefore, it will be seen that refrigerant fluid flow will be in accordance with the dotted arrows. For defrosting operation the liquid refrigerant supply is interrupted by closing the valve 44. The hot gas line valve 46 is opened to supply hot gas, and return to the compressor is effected by opening the bypass line valve 47 and closing the suction line valve 45. Thus it will be seen that fluid flow for defrosting operation is effected as indicated in FIG. 2 by the solid arrows.

From the foregoing it will be apparent that a refrigerant evaporator constructed in accordance with the present invention permits of economical manufacture, is efficient in operation, and insures complete defrosting. The integral, dual-purpose, defrosting coil effectively functions as an additional cooling coil so that all of the coils of the evaporator are utilized during refrigerating operation. This, it will be seen, increases the effective capacity of the evaporator through the provision of additional evaporator surface for refrigerating operation without increasing the overall size of the unit. The disposition of the defrosting coil below the cooling coils and adjacent the drain pan together with the supply of hot gas first thereto and thence through the cooling coils as described insures that ice and frost in the drain pan formed during preceding freezing operation is melted so that it can drain off and the operation of the drain pan and its runoff pipe to collect and convey away melted frost during defrosting is unimpeded. Furthermore, the disposition of the defrosting coil beneath and immediately adjacent to the cooling coils with subsequent connection to the upper cooling coil header effectively decreases defrosting time.

I claim as my invention:

1. In a refrigerating system having a liquid refrigerant supply line, a suction line, and a hot gas line, the combination comprising an evaporator including cooling coils interconnected at their upper and lower terminal ends, a defrosting coil, a drain pan disposed adjacent said defrosting coil for receiving melted frost from said coils, a conduit interconnecting the upper ends of the cooling coils and one end of the defrosting coil, a normally open liquid refrigerant supply valve for connection with the liquid refrigerant supply line, a second conduit interconnected between said liquid refrigerant supply valve and the lower ends of said cooling coils, a normally open

suction control valve for connection in the suction line, a third conduit interconnecting said suction control valve and the other end of said defrosting coil, a normally closed hot gas supply valve for connection in the hot gas supply line, a fourth conduit interposed between said hot gas supply valve and said third conduit, a bypass line including a normally closed bypass valve interconnecting said second conduit and the suction line, said valves in their normal positions effecting refrigerating operation by supplying liquid refrigerant to said lower ends of the cooling coils and thence by way of said first conduit and said defrosting coil to the suction line, and said valves in their alternative position effecting defrosting operation by supplying hot gas to the other end of said defrosting coil first and thence by way of said first conduit to the upper ends of said cooling coils, and from the cooling coils to the suction line by way of the lower ends of the cooling coils.

2. In a refrigerating system having a liquid refrigerant supply line, a suction line and a hot gas line, the combination comprising an evaporator including a plurality of cooling coils interconnected at their upper and lower terminal ends, a defrosting coil disposed beneath said cooling coils, a conduit interconnecting the upper ends of the cooling coils and one end of the defrosting coil, and valve means having alternative positions for supplying in one position thereof liquid refrigerant to the lower interconnected terminal ends of said cooling coils and thence by way of said conduit and said defrosting coil to the suction line of the refrigerating system for refrigerating operation, and in the other position thereof for interrupting the supply of liquid refrigerant, for connecting the other end of said defrosting coil to said hot gas line, and for connecting the lower ends of said cooling coils to the suction line of the refrigerating system whereby during defrosting operation hot gas is supplied first to said defrosting coil and thence by way of said conduit to said cooling coils.

3. An evaporator for use in a refrigerating system having a liquid refrigerant supply line, a suction line and a hot gas line, said evaporator comprising, in combination, a plurality of vertically disposed cooling coils of refrigerant conducting tubing supported in laterally spaced relation, an upper header interconnecting the upper terminal ends of said cooling coils, a lower header for alternative connection to the liquid refrigerant supply line and suction line of the refrigerating system and interconnecting the lower terminal ends of said cooling coils, a horizontal defrosting coil disposed beneath the cooling coils and including spaced longitudinal runs of tubing, said defrosting coil having a rear header for alternative connection to the suction line and the hot gas line of the refrigerating system and interconnecting the rear ends of said tubing runs, said defrosting coil further having a front header interconnecting the front ends of said tubing runs, and a conduit directly connecting said upper and front headers, whereby all of said coils including said cooling coils and said defrosting coil conduct refrigerant during refrigerating operation, and during defrosting operation said defrosting coil first receives hot gas.

4. In a refrigerating system having a liquid supply line, a suction line and a hot gas line, the combination comprising an evaporator including a plurality of cooling coils, a first header interconnecting the inlet terminal ends of said coils, a second header interconnecting the outlet terminal ends of said coils, a defrosting coil disposed beneath said cooling coils, a conduit interconnecting said outlet header and one end of said defrosting coil, and valve means having alternative positions for supplying in one position thereof liquid refrigerant to said inlet header and thence by way of said cooling coils, said conduit and said defrosting coil to the suction line of the system for normal refrigerating operation, and in the other position thereof for interrupting the supply of liquid

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refrigerant to said inlet header, for connecting the other end of said defrosting coil to the hot gas line of the system, and for connecting said inlet header for discharging any liquid refrigerant remaining in said coils from preceding refrigerating operation and of any hot gas condensate whereby during defrosting operation hot gas is supplied first to said defrosting coil and thence by way of said conduit to said cooling coils.

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