

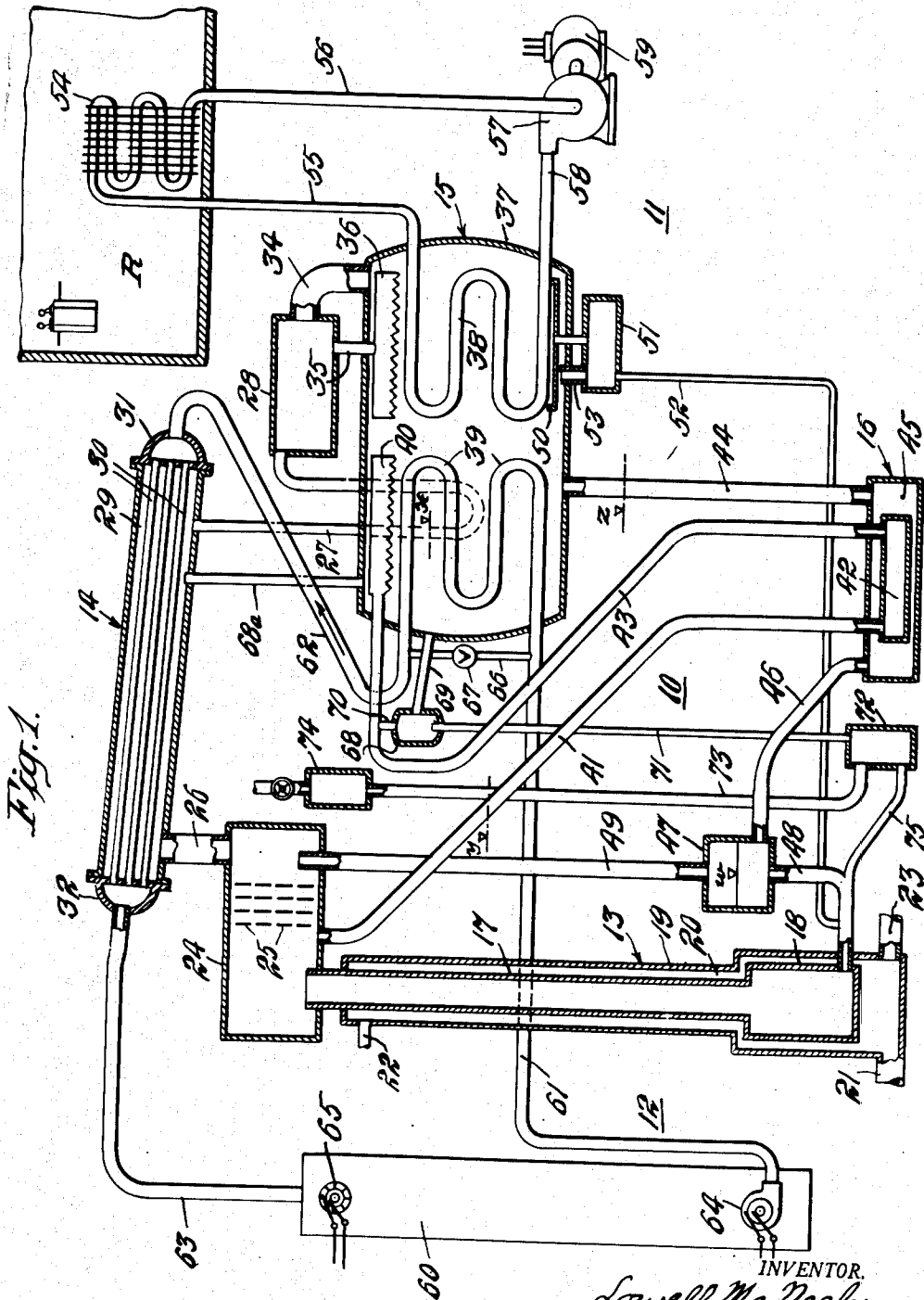
Sept. 21, 1954

L. MCNEELY
EVAPORATOR AND ABSORBER UNIT FOR ABSORPTION
REFRIGERATION SYSTEMS

2,689,465

Filed June 30, 1951

3 Sheets-Sheet 1



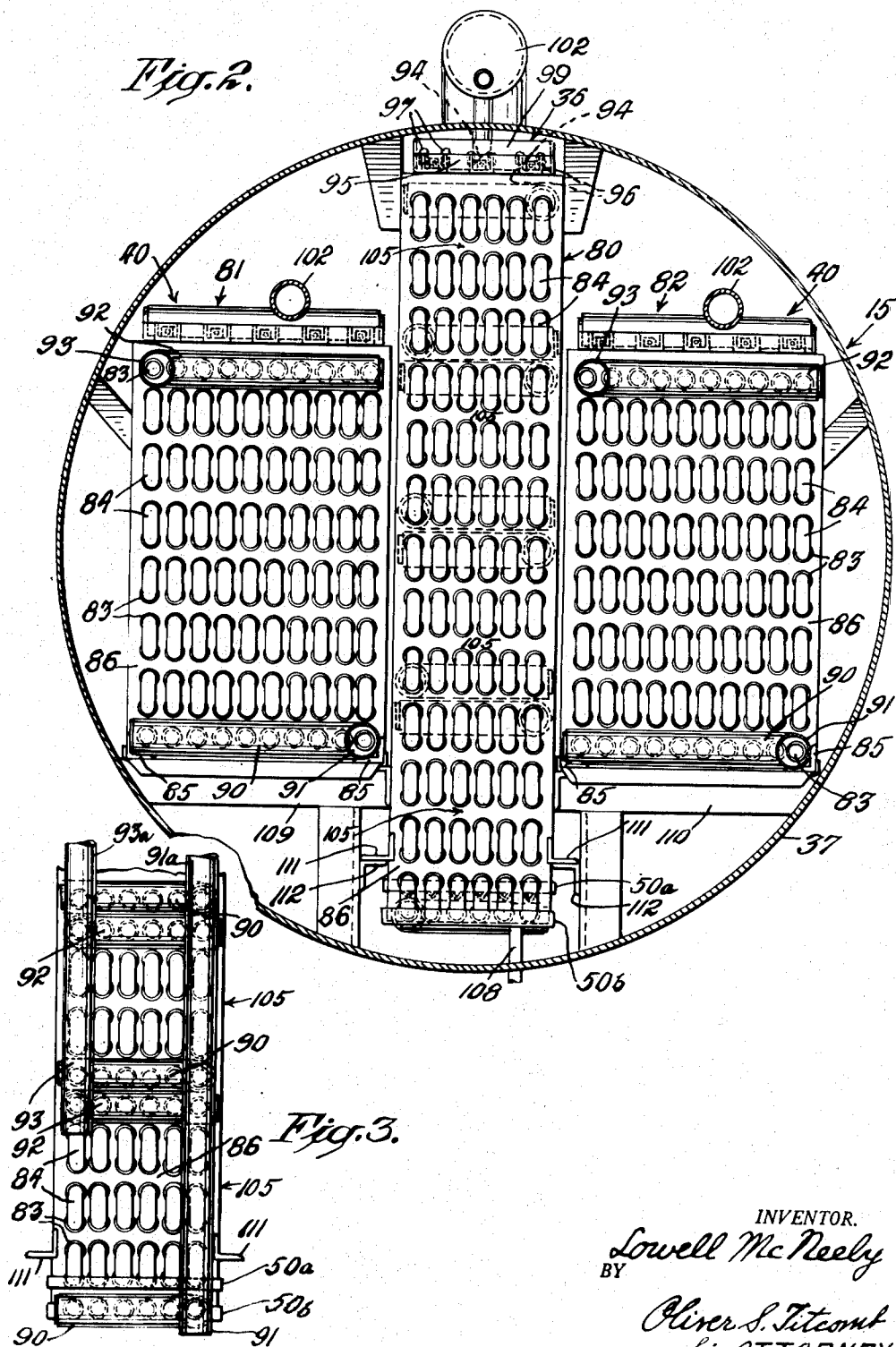
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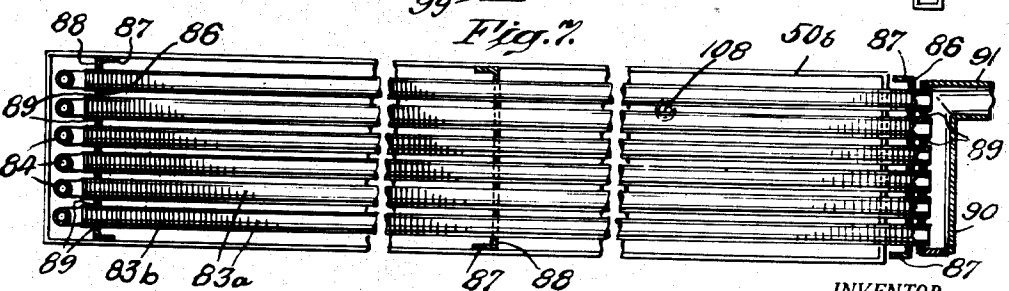
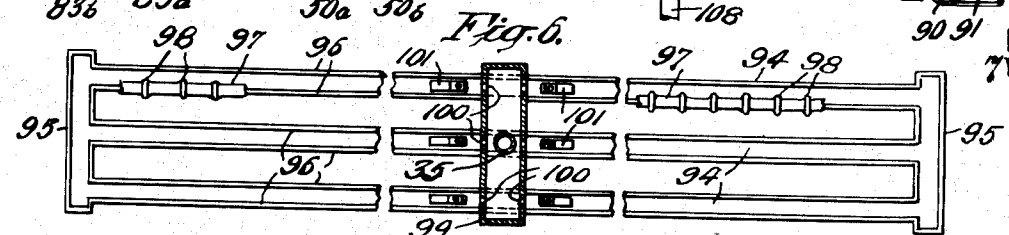
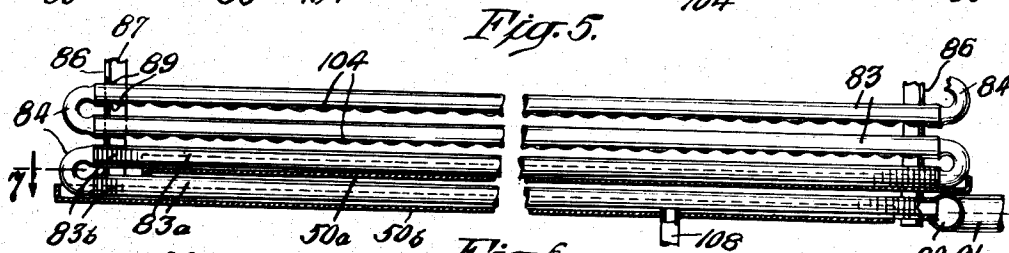
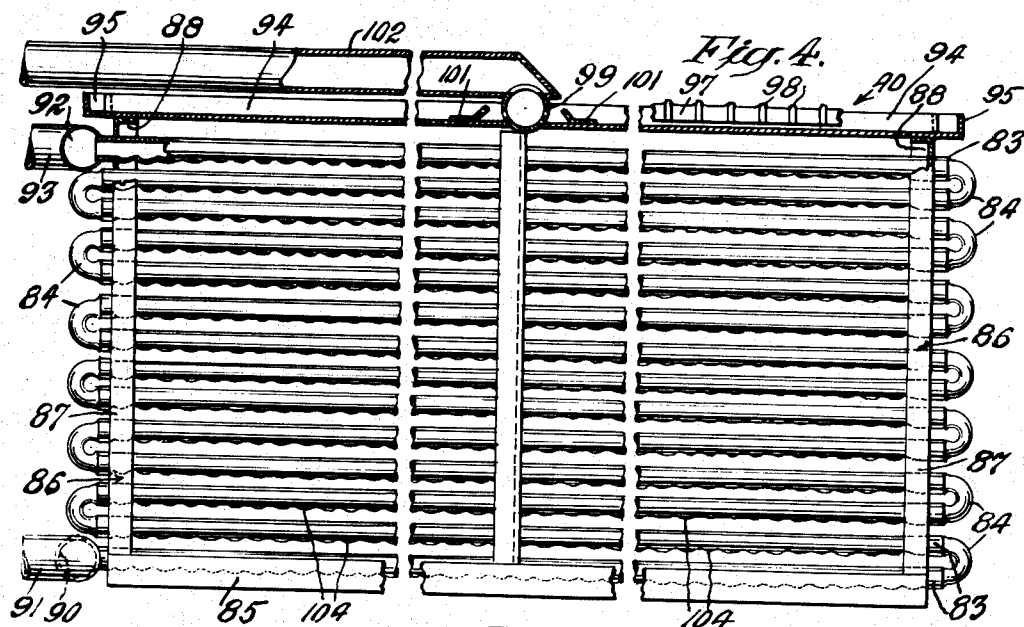
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3 Sheets-Sheet 3



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2,689,465

EVAPORATOR AND ABSORBER UNIT FOR
ABSORPTION REFRIGERATION SYSTEMSLowell McNeely, Evansville, Ind., assignor to
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Application June 30, 1951, Serial No. 234,515

8 Claims. (Cl. 62-119)

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The present invention relates to refrigeration and more particularly to an evaporator and absorber construction for absorption refrigeration systems.

When small refrigeration units are used for air conditioning, the refrigerant may be evaporated at the interior of a finned coil and the air to be cooled passed over the exterior of the coil and between the fins. With self-contained refrigeration units of larger capacity such a direct expansion evaporator is impractical because it increases the size and weight of the unit to such a degree as to prevent it from being transported through door openings of usual dimensions and presents a problem of air distribution. These difficulties may be avoided and a greater flexibility of installation can be obtained by utilizing a primary refrigerant to cool a secondary refrigerant which, in turn, is delivered to a single heat transfer coil or a plurality of heat transfer coils at different locations where the air is to be cooled.

One of the objects of the present invention is to provide an evaporator in the form of spaced tubes over which a primary refrigerant trickles by gravity and through which a secondary refrigerant is circulated.

Another object is to provide a combined evaporator and absorber for absorption refrigeration systems having tubes arranged in side-by-side open communication with each other in an enclosing shell with one group of tubes connected to provide an evaporator and another group of tubes connected to provide an absorber.

Another object is to arrange the tubes in vertical rows with means to distribute liquid refrigerant and absorbent onto the uppermost tubes of different rows and so forming the tubes as to cause the liquid to drip at selected points from each tube onto the next lowermost tube from the top to the bottom of the rows to produce an equal distribution of liquid over the entire surface of the tubes of each row.

Another object is to drip liquid refrigerant from the top to the bottom of a row of evaporator tubes and automatically lift refrigerant liquid upwardly from the bottom of the evaporator and distribute it over the surface of the lower tubes of the row.

Still another object of the invention is to provide a combined evaporator and absorber of simple and compact construction comprising banks of tubes in an enclosing shell connected to provide a central evaporator section and absorber sections at either side of the evaporator section.

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These and other objects will become more apparent from the following description and drawings in which like reference characters denote like parts through the several views. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and not a definition of the limitation of the invention, reference being had for this purpose to the appended claims. In the drawings:

Fig. 1 is a diagrammatic view of an air conditioning system having a vacuum type absorption refrigeration unit incorporating the evaporator and absorber construction of the present invention;

Fig. 2 is a transverse sectional view showing one end of the combined evaporator and absorber in detail and the arrangement of the banks of tubes constituting a centrally located evaporator and absorber sections at opposite sides of the evaporator;

Fig. 3 is a sectional view of a portion of the opposite end of the evaporator from that illustrated in Fig. 2 and showing the sectional arrangement of the tubes and connecting means for delivering secondary refrigerant thereto;

Fig. 4 is a side elevational view partly in section showing one vertical row of tubes, the liquid distributing means overlying the row and the spaced drip formers at the bottom of each tube;

Fig. 5 is a side elevational view of the lower portion of a vertical row of tubes constituting the evaporator and showing the capillary grooving on the lower two tubes and the pans underlying the grooved tubes;

Fig. 6 is a plan view partly in section of the liquid distributor for supplying refrigerant to the bank of evaporator tubes; and

Fig. 7 is a sectional plan view of the lower portion of the evaporator and showing the plurality of grooved tubes overlying each pan.

Referring to Fig. 1 of the drawings, the air conditioner comprises a primary vacuum type absorption refrigeration system 10, an auxiliary cooling system 11 containing a secondary refrigerant for removing heat from the air to be conditioned and transferring it to the primary refrigeration system at a relatively low temperature, and a tertiary cooling system 12 for removing heat from the primary refrigeration system at relatively high temperature.

The primary vacuum type absorption refrigeration system as illustrated in the drawings comprises in general a combined generator and vapor liquid-lift 13, a condenser 14, a combined evaporator and absorber 15 constituting the

subject matter of the present invention, and a liquid heat exchanger 16 interconnected for the circulation of refrigerant and absorbent. The combined generator and vapor liquid-lift 13 is described and claimed in a copending application for United States Letters Patent of Walter M. Simpson Serial No. 219,777, filed April 7, 1951. Suffice it to state herein that the element 13 comprises a single conduit having an upper vapor liquid-lift portion 17 and a depending portion 18 with an extended wall for increasing the heat transfer surface. The vapor liquid-lift 17 and depending portion 18 are enclosed in a jacket 19 providing a heating chamber 20 therebetween. A steam supply conduit 21 is connected to the bottom of the jacket 19 to supply the required amount of steam to operate the refrigeration system at full capacity. Steam supplied to the heating chamber 20 is maintained at atmospheric pressure by a vent tube 22 at the upper end of the jacket 19 and a condensate drain 23 is provided at the lower end of the jacket.

A separating chamber 24 surrounds the upper end of the lift conduit 17 and has suitable baffles 25 for separating refrigerant vapor from absorption solution delivered from the lift conduit. A vapor pipe 26 connects the separating chamber 24 to the condenser 14 and a liquid pipe 27 connects the outlet from the condenser to a flash chamber 28. Condenser 14 may be of any known type which hermetically seals the refrigerant from the cooling medium and in the illustrated embodiment comprises a chamber 29 with tubes 30 extending therethrough from an inlet header 31 to an outlet header 32. The liquid refrigerant pipe 27 is in the form of a U-tube to provide a liquid trap for maintaining a liquid column to balance the difference in pressure between the condenser 14 and combined evaporator and absorber 15.

Flash chamber 28 is a vessel which receives liquid refrigerant from the liquid pipe 27 at the high temperature of the condenser 14 and flashes a portion of the refrigerant to cool the remainder to a low temperature corresponding to the boiling point of the refrigerant at the low pressure in the combined evaporator and absorber 15. Such flashing is a violent boiling and is performed prior to the introduction of the refrigerant into the evaporator to prevent agitation and splashing. A vapor pipe 34 connects the flash chamber 28 above the liquid level therein to the top of the combined evaporator and absorber 15 and a liquid pipe 35 connects the bottom of the flash chamber to a liquid distributor 36, later to be described in detail.

The combined evaporator and absorber 15 is shown in detail in Figs. 2 through 7 but for purposes of illustrating its relationship in the refrigeration system it is shown diagrammatically in Fig. 1. As illustrated diagrammatically, the combined evaporator and absorber 15 comprises a closed vessel or shell 37 having an evaporator coil 38 and an absorber coil 39 in open communication with each other. The evaporator coil 38 is of serpentine form and arranged vertically with straight tube sections located one above the other. Liquid refrigerant is distributed by the liquid distributor 36 onto the top of the uppermost straight section of the evaporator coil 38 and drips from each section to the next lowermost section from the top to the bottom of the coil. The absorber

coil 39 also is of serpentine form having straight sections arranged one over the other and a liquid distributor 40 delivers absorption solution for gravity flow over the exterior of the coil from each straight section to the next lowermost section throughout the height of the coil.

Absorption solution weak in refrigerant flows by gravity from the separating chamber 24 to the liquid distributing means 40 for the absorber coil 39 in a path of flow comprising conduit 41, inner passage 42 of the liquid heat exchanger 16 and conduit 43 connected to the liquid distributor. Absorption solution strong in refrigerant flows by gravity from the shell 37 to the base of the combined generator and vapor liquid-lift 13 in a path of flow comprising conduit 44, outer passage 45 of the liquid heat exchanger 16, conduit 46, leveling vessel 47 and conduit 48. Leveling vessel 47 is for the purpose of maintaining a substantially constant liquid level of solution and is connected by a vent pipe 49 to the separating chamber 24. The combined generator and vapor liquid-lift 13 and condenser 14 operate at a pressure corresponding to the vapor pressure of the refrigerants at its condensing temperature and the combined evaporator and absorber 15 operates at a lower pressure corresponding to the vapor pressure of the refrigerant in the absorber. During operation of the refrigeration system, liquid columns will stand in U-tube 27 and conduits 43 and 44 to balance the difference in pressure, the liquid standing at some level x in U-tube 27, at level y in conduit 41 connected to conduit 43 through heat exchanger 16, at level z in conduit 44, and at a level w in the reservoir vessel 47.

Underlying the evaporator coil 38 is a tray 50 for collecting any excess unevaporated liquid refrigerant and delivering it to a concentration control vessel 51. The bottom of the concentration control vessel 51 is connected to the base of the combined generator and vapor liquid-lift 13 by a conduit 52 and the top of the vessel is connected to the evaporator by a vent pipe 53. Unevaporated liquid refrigerant accumulates in the concentration control vessel 51 to increase the concentration of the absorption solution until an equilibrium is reached at which all of the refrigerant is evaporated in the evaporator, the height of the liquid column and amount of liquid refrigerant stored in the concentration vessel being controlled by the difference in pressure between the high and low pressure sides of the system.

A secondary refrigerant is circulated in the auxiliary cooling system 11 in heat exchange relation with the evaporator and air in an enclosure R to be cooled. The auxiliary cooling system comprises the evaporator coil 38 and a heat exchange coil 54 in the room or rooms R to be cooled. A conduit 55 connects the upper end of the evaporator coil 38 to one end of the heat exchange coil 54, a conduit 56 connects the opposite end of coil 54 to a circulating pump 57 and a conduit 58 connects the outlet from the pump to the lower end of the evaporator coil to complete a circuit. Pump 57 is driven by an electric motor 59 for circulating the secondary refrigerant through the evaporator coil 38 and heat exchange coil 54, successively.

The tertiary cooling system 12 for removing heat from the refrigeration apparatus comprises the absorber coil 39 and tubes 30 of the condenser 14. A source of cooling medium such as cooling tower 60 delivers cooling water for flow through a

conduit 61 to the bottom of the absorber coil 39, a conduit 62 connects the top of the absorber coil to header 31 at one end of the condenser 14 and header 32 at the opposite end of the condenser 14 is connected by a conduit 63 to the top of the cooling tower to complete the circuit. A pump 64 at the base of the cooling tower 60 circulates the cooling water through the cooling system and a fan 65 at the top of the tower circulates air in contact with the cooling water flowing there-through to reduce its temperature by evaporative cooling. A by-pass 66, as described and claimed in an application for Letters Patent of Harry C. Shagaloff, filed concurrently herewith, is connected between the inlet and outlet conduits 61 and 62 leading to and from the absorber coil 39 to shunt the absorber at the beginning of a period of operation as controlled by a valve 67.

A purging device 68 is provided for continuously withdrawing non-condensable gases from the shell 37 of the combined evaporator and absorber 15 and a restricting conduit 68a continuously passes gases from the condenser to the shell while limiting the amount of vapor flowing there-through. The purge device 68 is in the form of a vessel connected to the combined evaporator and absorber shell 37 by a suction tube 69. Absorption solution weak in refrigerant is supplied to the purge vessel 68 from conduit 43 through a connecting pipe 70 and a fall tube 71 connects the bottom of the vessel to a separating chamber 72. A riser 73 connects the separating vessel 72 adjacent the top thereof to a gas storage vessel 74 and a liquid line 75 connects the separating vessel to conduit 48 leading to the base of the combined generator and vapor liquid-lift 13.

In accordance with the present invention the combined evaporator and absorber 15 shown diagrammatically in Fig. 1 comprises a plurality of tubes arranged in vertical rows in closely adjacent side-by-side relationship with the rows in open communication with each other. At least one of the rows of tubes constitutes an evaporator while one or more of the other rows constitutes the absorber. Alternate tube rows or alternate pairs of tube rows may constitute the evaporator and absorber, respectively, within the scope of the present invention.

In the preferred embodiment of the invention illustrated in detail in Figs. 2 to 7, the combined evaporator and absorber 15 comprises banks 80, 81 and 82 of tubes 83. The bank of tubes 80 constitutes the evaporator, illustrated diagrammatically as a single coil 38 in Fig. 1, located centrally of the shell 37 while the banks of tubes 81 and 82 constitute separate absorber sections, illustrated diagrammatically as a single coil 39 in Fig. 1, located at each side of the evaporator tube bank 80, closely adjacent thereto and in open communication therewith. The tubes 83 of each of the banks 80, 81 and 82 are all arranged in generally the same way, that is, one over the other in vertical rows, see Figs. 2 and 4, and the ends of adjacent tubes in each row are connected by U-shaped couplings 84 to provide a continuous serpentine coil.

The tubes of each bank 80, 81 or 82 are supported in a frame having spaced angle-iron side rails 85 at the bottom and upright rectangular plates 86 welded to the ends and middle of the bottom rails, see Fig. 4. The rectangular plates 86 extend throughout the width and height of the respective banks 80, 81 and 82, see Fig. 2, and have right angular flanges 87 at each side, see Figs. 4 and 7, right angular flanges 88 at the top and aligned perforations 89, see Figs. 5 and 7.

In assembling a bank of tubes 80, 81 or 82, tubes 83 are inserted throughout the aligned perforations 89 in the plates 86 of the frame and the U-shaped couplings 84 inserted in the ends of adjacent tubes alternately at opposite ends thereof and brazed or welded thereto to form a continuous serpentine coil 38 or 39 of each vertical row of tubes. The inlet ends of the plurality of serpentine coils of the bank are connected by a header 90 having a supply pipe 91 and the outlet ends of the coils are connected by a header 92 having a discharge pipe 93. Mounted on the flanges 88 at the top of the plates is a liquid distributor 36 or 40 as illustrated in Figs. 2, 4 and 6. The liquid distributor comprises a plurality of parallel troughs 94 connected by transverse end troughs 95. Each trough 94 is of a width corresponding to the distance between the rows of tubes 83 and has walls 96 overlying the center of adjacent rows of tubes throughout their length. A U-shaped syphon plate 97 overlies each wall 96 of the liquid distributor 36 or 40 and has spaced capillary grooves 98 for feeding liquid onto the top of the uppermost tube 83 of a row at spaced points therealong. Thus, if there are six vertical rows of tubes in a bank, three troughs as illustrated in Fig. 6 will provide six walls for delivering liquid onto the respective rows of tubes. Extending transversely of the troughs 94 is a closed tube or vessel 99 having an orifice 100 for each trough 94 at opposite sides of the vessel 99 to feed liquid thereto. Preferably, baffles 101 are provided in the troughs 94 adjacent the orifice 100 to dampen the flow of liquid and prevent agitation. Liquid may be supplied to the closed tube or vessel 99 from a laterally extending feed pipe 102 used on the tube banks 81 and 82 constituting absorber sections as illustrated in Fig. 4 or by a vertical feed pipe 35 used on the tube bank 80 constituting the evaporator, as illustrated in Figs. 2 and 6.

Each of the tubes 83 of the banks 80, 81 and 82 has depending drip formers 104 at spaced points along its bottom as illustrated in Fig. 4. Preferably such drip formers are formed by striking one side of the tube with a straight tool in a direction at right angles to the axis of the tube, as described and claimed in a copending application for Letters Patent of Eugene P. Whitlow, Serial No. 102,863, filed July 2, 1949.

The tubes 83 of bank 80 constituting the evaporator are arranged in vertical rows from the top to the bottom of the bank, but are connected at their ends to provide separate groups or sections 105, four of such sections being illustrated in Fig. 2 of the drawings. The inlet and outlet headers 90 and 92 for each section 105 are illustrated in Fig. 3 and the supply pipes 91 for the plurality of inlet headers 90 are connected together by a main conduit 91a while the discharge pipes 93 from outlet headers 92 for the sections 105 are connected together by a discharge conduit 93a so that secondary refrigerant will flow in parallel through the separate sections to reduce the pressure drop in the coils. While the majority of the tubes 83 are provided with spaced depending drip formers 104, several of the lower tubes 83a of each row of the evaporator bank 80 are formed with peripheral capillary grooves as described and claimed in United States Letters Patent to John G. Reid, Jr., No. 2,485,844, issued October 25, 1949. As illustrated in Fig. 5, the two lowermost tube sections 83a have peripheral capillary grooves 83b. The single tray 50 illustrated diagrammatically in Fig. 1 actually comprises a plurality of trays or pans

in the preferred embodiment, one 50a underlying the next to the bottom tube of all of the rows and a second 50b underlying the lowermost tubes of all of the rows. The upper pan 50a has side walls on three sides and the bottom of the pan at its open end overlies the lower pan 50b to deliver liquid thereto. The lowermost pan 50b has side walls around its entire periphery. The pans 50a and 50b are so arranged with respect to tubes 83a that liquid will be lifted from the pans by capillary action in the grooves 83b and distributed over the surface of the tubes. A drain tube 198 projects a predetermined distance above the bottom of the pan 50b and constitutes an overflow pipe connected to the concentration control vessel 51.

The banks of absorber tube sections 81 and 82 have tubes 83 with depending drip formers 104 arranged in vertical rows and alternately connected at opposite ends to provide a plurality of vertically arranged serpentine coils extending throughout their height. The absorber tube banks 81 and 82 are supported on spaced brackets 109 and 110, see Fig. 2, at each end of the shell 37, the bottom rails 85 and cross plates 86 of the frames resting on the top of the brackets. The evaporator tube bank 80 is supported between the tube banks 81 and 82 by angle iron rails 111 on the flanges 87 resting on rails 112 projecting from the upright legs of brackets 109 and 110. It will be understood that the evaporator tube bank 80 and absorber tube banks 81 and 82 are completely fabricated as sub-assemblies and mounted in the shell 37 as separate units with the supply and discharge conduits 91 and 93 for the coils and the absorbent and refrigerant feed pipes 102 and 35 projecting outwardly from the shell before the end plates of the shell are assembled and the joints welded or brazed to hermetically seal the combined evaporator and absorber 15. The absorbent feed pipes 102 are preferably connected to supply conduit 43 and the chilled water supply and exhaust pipes 91 and 93 are connected to mains 91a and 93a at the exterior of the shell 37. One form of the invention having now been described in detail, the mode of operation of the air conditioner is explained as follows.

To initiate operation of the complete air conditioning apparatus illustrated in Fig. 1, steam is supplied through the conduit 21 to the heating chamber 20 of the combined generator and vapor liquid-lift 13 to heat the solution therein. Refrigerant vapor expelled from absorption solution lifts the latter in the lift tube 17 at a controlled rate into the separating chamber 24. Vapor flows through the baffles 25 and vapor pipe 26 into the condenser 14 and absorption solution weak in refrigerant flows by gravity to the liquid distributor 40 in a path including the conduit 41, inner passage 42 of heat exchanger 16 and conduit 43.

Simultaneously with the supply of steam to the combined generator and vapor liquid-lift 13, cooling water is supplied from the cooling tower 60 through the conduit 61, by-pass 66, and conduit 62 to the header 31 of condenser 14. Cooling water flows from header 31 through the tubes 30 to header 32 and from the header through the conduit 63 back to the cooling tower 60. The flow of cooling water through the tubes 30 of condenser 14 removes the heat of vaporization and condenses the refrigerant vapor to a liquid. The liquid refrigerant flows from the condenser 14 through the U-shaped liquid pipe 27 to the flash chamber 28 and from the flash chamber through

the liquid pipe 35 to the refrigerant distributor 36.

Liquid refrigerant and absorbent is siphoned from the distributors 36 and 40 through the spaced capillary grooves 98 of syphon plates 97, see Fig. 6, onto the uppermost tubes 83 of the respective banks 80, 81 and 82 and drips over successive tubes from the top to the bottom of the evaporator and absorber simultaneously. Due to the affinity of the refrigerant, water, for the absorbent, lithium bromide solution, the refrigerant evaporates at a low pressure and temperature and the vapor is absorbed in the absorption solution. Any unevaporated liquid refrigerant drips into the lower pan 50b and flows into the concentration control vessel 51 to adjust the concentration of the absorbent until an equilibrium condition is reached at which all of the refrigerant will evaporate as it drips from coil section to coil section from the top to the bottom of the evaporator coil 38. Absorption solution strong in refrigerant flows from the combined evaporator and absorber shell 37 back to the base of the combined generator and vapor liquid-lift 13 in a path of flow including the conduit 44, outer passage 45 of liquid heat exchanger 16, conduit 46, leveling vessel 47 and conduit 48.

Simultaneously with the initiation of the primary absorption refrigeration system 10 the pump 57 in the auxiliary cooling system 11 will be initiated to circulate a secondary refrigerant through the evaporator coil 38. The heat exchange coil 54 in room R will remove heat from the air and transfer it through the walls of the evaporator coil 38 to the primary refrigerant on the outside surface thereof. Thus, the auxiliary cooling system 11 of the air conditioner operates to remove heat from the air in a room or rooms R and transfer it to the refrigerant in the primary refrigeration system 10 and the primary refrigeration system then transfers the heat to the tertiary cooling system 12. After the primary refrigeration system has been operating for a period of time sufficient to insure a full loading of the evaporator both internally and externally, the valve 67 in the by-pass 66 will be closed to cause the cooling water to flow through the absorber coil 39 and condenser 14 successively.

Referring to Figs. 2 to 7, the liquid refrigerant supplied to the liquid distributor 36 through the supply pipe 35 enters the closed vessel 99 and is distributed through the orifices 100 into the troughs 94 overlying the centrally located bank of evaporator tubes 83. The liquid refrigerant continuously siphons from the troughs 94 through the capillary grooves 98 in the distributing plates 97 onto the uppermost tubes of each of the rows of tubes constituting the evaporator. The liquid refrigerant spreads over the upper smooth surface of the tubes and then accumulates on the depending drip formers 104 from which it drips onto the next lowermost tube from the top to the bottom of the evaporator. Any liquid refrigerant dripping from the next to the bottom tube 83a of the rows of tubes is caught by the upper pan 50a which directs it into the lower pan 50b. The upper and lower pans 50a and 50b contact the bottom of the grooved tubes 83a and the capillary grooves 83b lift the liquid from the pans and saturate the surfaces of the tubes above the liquid level to insure maximum evaporation of the refrigerant. However, when the level of the liquid refrigerant in the lower pan 50b rises above the end of the drain tube 198 the liquid refrigerant will overflow into the concentration control vessel 51.

Absorption liquid delivered to the liquid distributor 40 for each absorber section 81 and 82 is distributed by the closed vessel 99 into the troughs 94 overlying the rows of the absorber tubes and is distributed along the uppermost tubes of each row in the same way refrigerant is distributed over the bank of evaporator tubes 80. Liquid absorbent drips from each tube 83 onto the top of the next lowermost tube from the top to the bottom of the absorber sections 81 and 82. Refrigerant vapor from the evaporator 80 is absorbed in absorption liquid as it flows over the tubes and at the lowermost tubes the absorption liquid drips into the enclosing shell 37 and flows to the outlet conduit 44.

It will now be observed that the present invention provides a novel construction of combined evaporator and absorber comprising vertical rows of tubes arranged in side-by-side relation and in open communication with each other in a single hermetically sealed enclosing shell. It will further be observed that the present invention provides for connecting the tubes to provide a centrally located evaporator section with absorber sections on either side thereof. It will still further be observed that the present invention provides a combined arrangement of tubes in the evaporator section having drip formers for uniformly distributing refrigerant over all except the lowermost tubes and capillary grooves on the periphery of the lowermost tubes to lift refrigerant over their surface.

While a single embodiment of the invention is herein illustrated and described, it will be understood that modifications may be made in the construction and arrangement of the elements without departing from the spirit or scope of the invention. Therefore, without limitation in this respect, the invention is defined by the following claims.

I claim:

1. In an absorption refrigeration system, an hermetically sealed shell enclosing both the evaporator and absorber at substantially the same level, said combined evaporator and absorber comprising a plurality of tubes in said shell and arranged in vertical rows, said rows being in closely adjacent side-by-side relation and in open communication with each other, means to deliver liquid refrigerant onto the exterior of the uppermost tube of at least one row, means to deliver liquid absorbent onto the exterior of the uppermost tube of at least one of the other rows of tubes, the liquid dripping from each tube onto the next lowermost tube from the top to the bottom of its respective row, means for flowing a medium to be cooled through the interior of the row of tubes over which the liquid refrigerant is distributed, and means for flowing a cooling medium through the interior of a row of tubes over which the absorbent is distributed.

2. In a two-pressure absorption refrigeration system of the type in which the difference in pressure is maintained by pressure balancing liquid columns, a combined evaporator and absorber for reducing the overall height of the system comprising an hermetically sealed shell, a plurality of coils arranged vertically in side-by-side relation in open communication with each other in said shell, each of said coils having sections arranged one over the other, means to deliver liquid refrigerant onto the exterior of the uppermost section of at least one of the coils, means to deliver liquid absorbent onto the exterior of the uppermost section of at least one

of the other coils, the liquid on the respective coils dripping from each section onto the next lowermost section from the top to the bottom of the coil, means for delivering a medium to be cooled for flow through the interior of the refrigerant coil, and means for delivering a cooling medium for flow through the interior of the absorbent coil.

3. In an absorption refrigeration system, a combined evaporator and absorber comprising an hermetically sealed shell, an evaporator arranged centrally in said shell, an absorber having sections at each side of the evaporator and in open communication therewith, said evaporator and absorber sections comprising tubes connected to provide separate paths of flow, means for distributing liquid refrigerant and absorbent on the tubes of the evaporator and absorber, respectively, to wet the exterior surfaces thereof, means for flowing a fluid to be cooled through the interior of the evaporator tubes, and means for flowing a cooling medium through the interior of the absorber tubes.

4. In an absorption refrigeration system, a combined evaporator and absorber comprising a single hermetically sealed cylindrical shell, a plurality of tubes in said shell connected to provide a central evaporator section and absorber sections at each side of the evaporator section, the tubes of said evaporator and absorber sections being arranged one over the other in vertically aligned rows in closely adjacent side-by-side relationship and in open communication with each other, means for supplying liquid refrigerant and absorbent to the uppermost tubes of the evaporator and absorber, respectively, which drips from each tube to the next lowermost tube from the top to the bottom of the rows, means for flowing a medium to be cooled through the tubes constituting the evaporator, and means for flowing a cooling medium through the rows of tubes constituting the absorber.

5. In an absorption refrigeration system, a combined evaporator and absorber comprising an hermetically sealed shell having spaced brackets, an evaporator comprising a frame located between the brackets and secured thereto, said frame mounting a bank of tubes arranged one over the other in vertical alignment, absorber sections at either side of the evaporator with each section comprising a frame resting on the brackets and mounting a bank of tubes arranged one over the other in vertical alignment, a liquid distributor mounted on the top of each of the evaporator and absorber section frames and having means for delivering liquid refrigerant and absorbent onto the upper tube of each row of the respective banks of tubes, said liquid dripping from each tube to the next lowermost tube from the top to the bottom of each row, means for flowing a medium to be cooled through the bank of evaporator tubes, and means for flowing a cooling medium through the banks of tubes of the absorber sections.

6. In a refrigeration system, an evaporator comprising an hermetically sealed shell, a bank of tubes arranged one over the other in vertically aligned rows and connected to provide separate paths of flow, liquid distributing means for supplying liquid refrigerant uniformly along the top of the uppermost tube of each row which drips from the bottom of each tube onto the top of the next lowermost tube from the top to the bottom of the evaporator, a pan underlying the evaporator to receive any surplus liquid refrigerant.

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erant dripping therefrom, and the lowermost tubes of each row having a capillary surface for lifting liquid refrigerant from the pan and distributing it over the surface of the tubes above the liquid level in the pan.

7. In a refrigeration system, an evaporator comprising an hermetically sealed shell, a bank of tubes arranged one over the other in vertically aligned rows and connected to provide parallel paths of flow, the lower tubes of each row having peripheral capillary grooves, the remainder of the tubes of each row having a plain upper surface and spaced depending drip formers, a liquid distributor for delivering liquid refrigerant onto the uppermost tube of each row uniformly throughout its length, said liquid refrigerant flowing over the plain surface off each tube and dripping from the drip formers onto the next lowermost tube from the top to the bottom of the row, a pan underlying the bank of tubes to receive liquid refrigerant, and the capillary grooves on the lower tubes lifting liquid refrigerant from the pan to wet their surface above the liquid level.

8. In a refrigeration system, an evaporator comprising an hermetically sealed shell, a plurality of serpentine coils arranged one over the other in vertical rows in said shell, the corresponding coils in each row being connected to provide a plurality of separate coil sections, each of the coils having longitudinal tube portions

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arranged one over the other from the top to the bottom of a row, a plurality of the lower tubes of each row having peripheral capillary grooves, the remainder of the tubes of each row having a plain upper surface and spaced depending drip formers, a liquid distributor for delivering liquid refrigerant onto the uppermost tube of each row uniformly throughout its length, said liquid refrigerant flowing over the plain surface of each tube and dripping from the drip formers onto the next lowermost tube from the top to the bottom of the row, a pan underlying each horizontal layer of corresponding grooved tubes of adjacent coils, the upper pan having means for directing liquid refrigerant into the next lowermost pan, and the capillary grooves lifting liquid from the pans over the surface of the tubes above the liquid level.

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