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REFRIGERATION APPARATUS

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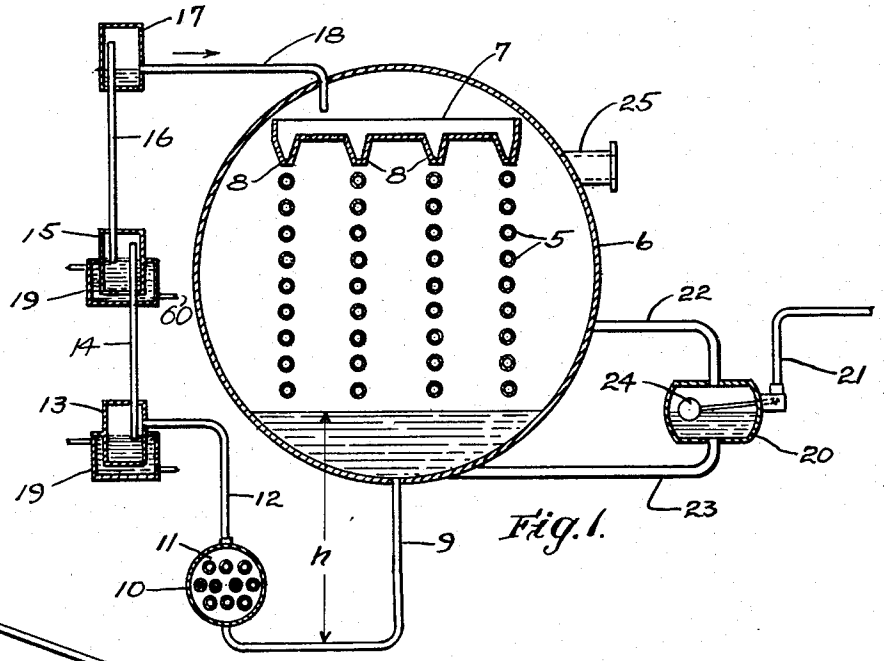


Fig. 1.

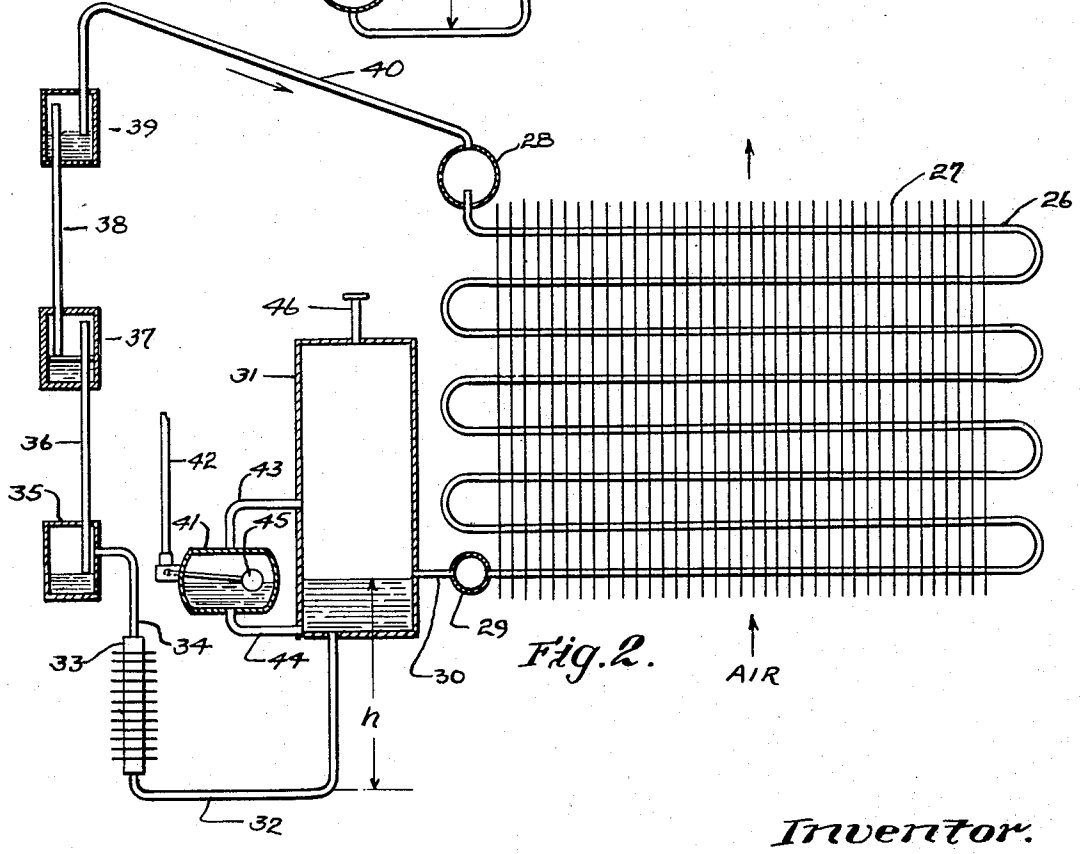


Fig. 2.

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REFRIGERATION APPARATUS

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9 Claims. (Cl. 62—125)

This invention relates to refrigeration apparatus and relates more particularly to apparatus utilizing refrigerant vapor for recirculating refrigerant liquid from accumulators used with flooded evaporators located at higher levels, into the evaporators.

In many installations utilizing refrigeration, a central condensing unit is used to supply refrigerant to a number of evaporators at different locations. For greatest economy and best results the evaporators are run flooded. This occasions some carry-over of liquid refrigerant with the vapor into the suction side of the compressor. This is undersirable and to prevent the carry-over of the liquid, an accumulator is placed in the suction line which traps out the liquid. This liquid accumulates and it is necessary to dispose of it. It is preferred to locate the evaporators above the accumulator and the most dependable method of disposing of the liquid in the accumulator has been to provide motor actuated pumps for evacuating the accumulator and for returning the liquid to the evaporators or associated receivers.

This invention provides lift fittings utilizing refrigerant vapor for evacuating accumulators and for recirculating the refrigerant from the accumulators to the evaporators.

Objects of the invention are to simplify and to reduce the cost of, and the operating expense of, refrigeration systems.

The invention will now be described with reference to the drawing, of which:

Fig. 1 is an elevation view in section of one embodiment of this invention applied to a liquid cooler, and

Fig. 2 is an elevation view in section of another embodiment of this invention applied to an air cooler.

Referring first to Fig. 1, the liquid cooling tubes 6 are located in the evaporator shell 6 and are interconnected as is conventional for cooling a liquid such for example, as brine. A liquid distributor trough 7 having the lower nozzles 8 feeds liquid refrigerant from a conventional condensing unit (not shown) over the surfaces of the tubes.

The unevaporated liquid collects in the bottom of the shell 6 which acts as an accumulator and drains under the static head indicated as h, through the tube 9 into the shell type pilot evaporator 10. The evaporator 10 contains the tubes 11 through which the liquid to be cooled is circulated so that heat may be absorbed for evaporating a portion of the liquid in the pilot evaporator 10.

A mixture of refrigerant liquid and vapor passes from the evaporator 10 through the tube 12 into the lift fitting 13. The blowing of the vapor due to the static head h and to the evaporation of refrigerant in the evaporator 10 causes liquid to be lifted from the lower lift fitting 13 through the tube 14 into the higher located lift fitting 15, by entraining the liquid in bubbles which move upwardly through the tube 14. This process is repeated in the lift fitting 15 and the tube 16 with the result liquid is lifted into the separator or discharge trap 17 and is recirculated from same through the tube 18 into the distributor trough 7.

Any number of lift fittings may be used depending upon the height to which the liquid is to be lifted.

The jackets 19 may be placed around the lift fittings 14 and 15 and a portion of the liquid to be supplied through the tubes 50 and cooled may be circulated through these jackets for aiding the lift effect by evaporating liquid refrigerant in the lift fittings.

The float chamber 20 is connected by the tube 21 to the condensing unit and receives liquid refrigerant therethrough. The upper portion of the chamber is connected by the tube 22 to the shell 6 above the liquid level to be maintained therein and the lower portion of the chamber is connected by the tube 23 to the shell 6 below the liquid level to be maintained therein. The float 24 regulates the inflow of liquid through the tube 21 for maintaining the proper liquid level in the chamber 20 and in the lower or accumulator portion of the shell 6.

The float chamber thus ensures that the proper liquid level is maintained in the accumulator for providing the head h necessary for proper operation of the lift fittings.

The pipe 25 connects the interior of the shell 6 with the suction side of the compressor for returning the refrigerant vapor thereto.

Referring now to Fig. 2, the interconnected evaporator tubes 26 are provided with the extended surface fins 27 and serve as a forced air cooler. The distribution header 28 connects the uppermost tube 26 with the condensing unit and supplies liquid refrigerant into the tubes. The lowermost tube connects with the suction header 29. The liquid drains in the tubes 26 and hence develops no liquid head when flooding the tubes.

Excess liquid and vapor pass through the tube 30 into the accumulator 31 and the liquid drains

therefrom through the tube 32 into the pilot evaporator 33. Evaporation takes place in the evaporator 33 and vapor is formed which lifts the refrigerant liquid between bubbles of vapor through the tube 34 into the lift fitting 35. Additional evaporation takes place in the lift fitting 35 and the vapor lifts the liquid refrigerant through the pipe 36 into the lift fitting 37. The process is repeated and the liquid is lifted through the tube 38 and into the lift fitting 39. Additional lift fittings could be used if the height the liquid to be lifted justifies more.

The liquid from the upper lift fitting 39 passes through the tube 40 into the distribution header 28.

The accumulator 31 is so located with respect to the lowest evaporator tube 26 and the lower end of the pilot evaporator 33 is so located with respect to the accumulator that the liquid head indicated as h on Fig. 2 is provided between the surface of the liquid in the accumulator and in the pilot evaporator.

The vapor actuating the lift fittings is at a pressure = h less the sum total height of the bubbles in the lift tubes and hence is positive pressure greater than the suction pressure.

The float chamber 41 is connected by the pipe 42 to the condensing unit for supplying liquid refrigerant into the float chamber. The upper portion of the chamber 41 is connected by the pipe 43 into the accumulator 31 above the liquid level therein. The lower portion of the chamber 41 is connected into the lower portion of the accumulator. The float 45 maintains the proper level in the float chamber for maintaining the desired liquid head h.

The upper end of the accumulator 31 is connected by the pipe 46 to the suction side of the compressor for returning the vapor thereto.

The lift fittings and the pilot evaporators of Figs. 1 and 2 may be heated by air or by steam or electricity or by any suitable source of heat for evaporating sufficient liquid refrigerant thereon for providing vapor bubbles for lifting the liquid.

While embodiments of the invention have been described for the purpose of illustration it should be understood that the invention is not limited to the exact apparatus and arrangements of apparatus illustrated as modifications thereof may be suggested by those skilled in the art without departure from the essence of the invention.

What is claimed is:

1. Refrigeration apparatus comprising a main evaporator, means forming a liquid accumulator connected to said evaporator, said accumulator having a sump located below said evaporator for draining liquid therefrom, a pilot evaporator connected to said accumulator for receiving liquid therefrom, and means including a plurality of lift fittings connecting said pilot evaporator and said main evaporator, said pilot evaporator absorbing heat and evaporating liquid therein and said lift fitting utilizing said vapor to lift liquid refrigerant from said pilot evaporator for supply to said main evaporator.

2. Refrigeration apparatus comprising a main evaporator, means forming a liquid accumulator connected to said evaporator, said accumulator having a sump located below said evaporator for draining liquid therefrom, a pilot evaporator connected to said accumulator for receiving liquid therefrom, means including a plurality of lift fittings connecting said pilot evaporator and said main evaporator, and means for maintaining a predetermined liquid level in said accumulator, said pilot evaporator absorbing heat and evaporating liquid therein and said lift fittings utilizing said vapor to lift liquid refrigerant from said pilot evaporator for supply to said main evaporator.

3. Refrigeration apparatus comprising a main evaporator, means forming a liquid accumulator connected to said evaporator, said accumulator having a sump located below said evaporator for draining liquid therefrom, a pilot evaporator connected to said accumulator and receiving liquid therefrom, means including a plurality of lift fittings connecting said pilot evaporator and said main evaporator, and float controlled means for supplying liquid refrigerant into said accumulator in addition to that supplied from said main evaporator, said pilot evaporator absorbing heat and evaporating liquid therein and said life fittings utilizing said vapor to lift liquid refrigerant from said pilot evaporator for supply to said main evaporator.

4. Refrigeration apparatus comprising a shell, a plurality of tubes in said shell, means for flowing liquid refrigerant over the outside surfaces of said tubes, the unevaporated liquid collecting in the lower portion of said shell below the lowermost of said tubes, a pilot evaporator connected to the lower portion of said shell for receiving liquid refrigerant therefrom, and means including a plurality of lift fittings connecting said evaporator with said flowing means, said pilot evaporator absorbing heat and evaporating liquid refrigerant therein to form vapor and said fittings utilizing said vapor to lift liquid refrigerant from said pilot evaporator for supply to said flowing means.

5. Refrigeration apparatus comprising a shell, a plurality of tubes in said shell, means for flowing liquid refrigerant over the outside surfaces of said tubes, the unevaporated liquid collecting in the lower portion of said shell below the lowermost of said tubes, a pilot evaporator connected to the lower portion of said shell for receiving liquid refrigerant therefrom, means including a plurality of lift fittings connecting said evaporator with said flowing means, and means for maintaining a predetermined liquid level in said lower portion of said shell, said pilot evaporator absorbing heat and evaporating liquid refrigerant therein to form vapor and said fittings utilizing said vapor to lift liquid refrigerant from said pilot evaporator for supply to said flowing means.

6. Refrigeration apparatus comprising a shell, a plurality of tubes in said shell, means for flowing liquid refrigerant over the outside surfaces of said tubes, the unevaporated liquid collecting in the lower portion of said shell below the lowermost of said tubes, a pilot evaporator connected to the lower portion of said shell for receiving liquid refrigerant therefrom, means including a plurality of lift fittings connecting said evaporator with said flowing means, and float controlled means for supplying liquid refrigerant into the lower portion of said shell in addition to that supplied by said flowing means, said pilot evaporator absorbing heat and evaporating liquid refrigerant therein to form vapor and said fittings utilizing said vapor to lift liquid refrigerant from said pilot evaporator for supply to said flowing means.

7. Refrigeration apparatus comprising a plurality of superimposed, interconnected evaporator tubes, means for supplying refrigerant liquid into the uppermost of said tubes, an accumulator having a sump arranged below and connected

to the lowermost of said tubes for receiving liquid therefrom, a pilot evaporator connected to said accumulator for receiving liquid therefrom, and means including a plurality of lift fittings connected to said pilot evaporator and to said one tube, said pilot evaporator absorbing heat and evaporating liquid refrigerant therein and forming vapor, and said fittings utilizing said vapor to lift liquid from said pilot evaporator for supply to said tubes.

8. Refrigeration apparatus comprising a plurality of superimposed, interconnected evaporator tubes, means for supplying refrigerant liquid into the uppermost of said tubes, an accumulator having a sump arranged below and connected to the lowermost of said tubes for receiving liquid therefrom, a pilot evaporator connected to said accumulator for receiving liquid therefrom, means including a plurality of lift fittings connected to said pilot evaporator and to said one tube, and means for maintaining a predetermined liquid level in said accumulator, said pilot evaporator absorbing heat and evaporating liquid refrigerant therein and forming vapor, and said fittings utilizing said vapor to lift liquid from said pilot evaporator for supply to said tubes.

9. Refrigeration apparatus comprising a plurality of superimposed, interconnected evaporator tubes, means for supplying refrigerant liquid into the uppermost of said tubes, an accumulator having a sump arranged below and connected to the lowermost of said tubes for receiving liquid therefrom, a pilot evaporator connected to said accumulator for receiving liquid therefrom, means including a plurality of lift fittings connected to said pilot evaporator and to said one tube, and float controlled means for supplying refrigerant liquid into said accumulator in addition to that supplied from said tubes, said pilot evaporator absorbing heat and evaporating liquid refrigerant therein and forming vapor, and said fittings utilizing said vapor to lift liquid from said pilot evaporator for supply to the uppermost of said tubes.

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