Dec. 4, 1934. P. KÖHLER 1,983,295

ABSORBER FOR REFRIGERATION SYSTEMS

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Fig. 1.

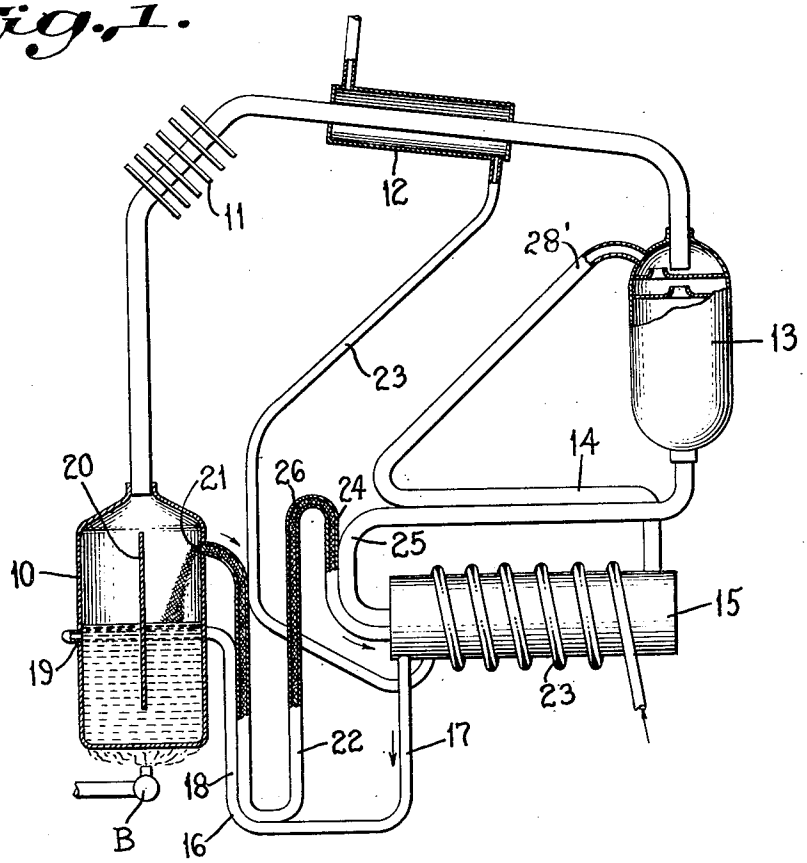
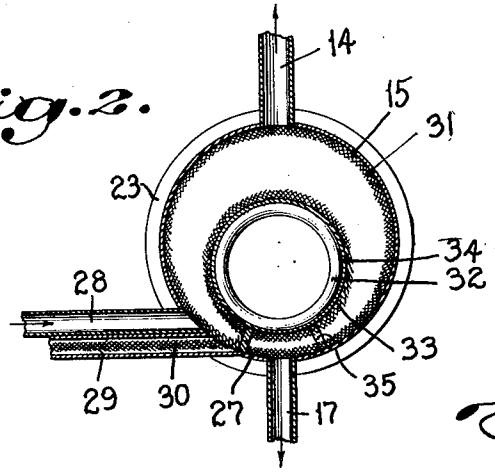


Fig. 2.



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ABSORBER FOR REFRIGERATION SYSTEMS

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14 Claims. (Cl. 261—104)

This invention relates to absorption refrigerating systems of the pressure equalized type and more particularly to an absorber for such a system.

An absorber contemplated by this invention provides improved liquid circulation and distribution therein, reduction in the amount of energy required to produce circulation within the system, and improved gas and liquid contact, with resulting greater efficiency of the system. These results are obtained by utilizing capillarity for producing circulation and distribution of absorption solution in the absorber.

Other objects and advantages of this invention will be apparent from the following description taken in connection with the accompanying drawing, in which—

Fig. 1 is a diagrammatic view illustrating one application of the invention; and

Fig. 2, a section through the novel absorber of Fig. 1.

Referrring to the drawing, reference character 10 indicates the boiler or generator of an absorption refrigerating apparatus heated by a gas burner B, which refrigerating apparatus, for the purpose of illustration, may be considered to employ ammonia as a refrigerant, water as an absorption medium and hydrogen as a pressure equalizing gas. The boiler 10 is connected with a rectifier 11 and a condenser 12, evaporator 13, heat exchanger 14, absorber 15 and a second heat exchanger 16 for the solution circulated between the boiler and the absorber. The general mode of operation of an apparatus of this character is well known and description of the same is therefore deemed unnecessary.

To the lower portion of the absorber is connected a descending pipe 17 which if desired may be cooled by any suitable means as by water or the like.

To obtain a circulation of the solution in a definite direction differences in density must be built up in a system of this character, since for the usual concentration of the strong and weak solutions and the usual temperatures in the boiler and absorber, only a small difference in density is available between the weak hot solution in the boiler and the strong cold solution in the absorber. The level established in the boiler when heated is only slightly higher than that of the absorber. The difference in density and thereby the driving force for the circulation is increased if the pipes between the boiler and absorber are designed to form a U-tube, one leg of which has a different temperature than the other. Thus the difference in weight between colder and warmer strong solution and warmer and colder weak solution is made effective in the production of the necessary circulation.

The pipe 17 is bent to form a U-tube having a pair of spaced upright legs, one of which connects to the absorber and is adapted to contain the cooler, denser liquid and the other of which connects to the boiler and contains warmer liquid, thus providing liquid columns of different densities. The leg 18 nearest the boiler extends around the boiler to a remote side and connects to the boiler at 19. The interior of the boiler is provided with a partition 20 which serves to force the strong solution entering the boiler at 19 downwardly in close proximity to the heated portion of the boiler where it is heated before it can pass out of the boiler at 21 through pipe 22 which connects to the absorber. The leg 18 of the pipe 17 is disposed in heat exchange relation with the pipe 22 and this serves to heat the pipe 18 and render the liquid passing up such pipe of less specific gravity and therefore assist in the circulating action. A portion of this branch pipe 22 is provided with a wick of gauze 21 or other capillary medium which protrudes into the boiler so that it is moistened directly by the boiler liquid or by the spray formed as the result of the boiling action.

It is of advantage to cool part of the descending branch 22 in any desired manner as with cooling water or the like in pipe 23, as it is advantageous to remove heat from the weak solution passing to the absorber so that such weak solution will enter the absorber with as low heat content as possible. To cause the heat removal in a descending leg of the conduit for weak solution to the absorber aids and accelerates the circulation.

The leg of the capillary siphon located in the boiler may have a temperature of 120 to 130 degrees C. The solution in the leg outside the boiler may be lowered to about 100 degrees C. by the effect of cooling the outer liquid by cooling water, so that a circulating force is created which lifts the solution out of the boiler.

In the heat exchanger 16 formed by pipes 17 and 22 the temperature of strong solution from the absorber in pipe 17 is raised and the temperature of weak solution from the boiler in pipe 22 is lowered. The pipe 22 is also a U-tube having its upright leg nearest the boiler in heat exchange relation with the pipe 17 and the upper extremity of its other upright leg bent over and extending downwardly at 24 to form an inverted U-tube disposed in heat exchange relation with

the pipe 25 connecting the evaporator and absorber through which cold gas passes and by means of which the pipe 22 is cooled in proximity to such absorber.

The pipe 22 is provided with a capillary medium 26 that lifts the solution out of the boiler into the U-tube and over to the absorber from the U-tube. The solution has a higher temperature in the intermediate portion than in the downwardly extending portion near the absorber. If desired, the capillary active surface or wick 26 which is necessary at both lifting places can also be run through the entire length of the pipe. A pipe 28' connects the upper portion of the evaporator with the absorber and permits passage therethrough of the auxiliary gas.

Since, in apparatus of this kind, the pipes are usually connected to the vessels by welding and the wire wicks might be destroyed during the welding process, it is advisable, to provide some means of protecting the wick, to weld a small plate, washer or the like to the pipe before the wick is pulled through the pipe and finally the pipe welded in place. This process eliminates damage to the wick by heat from the welding. Where the wick does not extend through the entire length of the pipe, it can be inserted after the pipe has been welded in place. It is preferable to employ this method of the invention also inside the absorber such as is shown in Fig. 2.

In Fig. 2 is shown an absorber which consists primarily of a casing 15 which is provided on its interior with a longitudinal strip 27 extending throughout the length of the same. This strip could be provided with small cavities if desired. The absorber has an inlet opening 28 for the auxiliary gas from the evaporator and an outlet opening 14 for such auxiliary gas. The weak absorption solution from the boiler is led to the absorber through pipe 29 which appropriately contains a capillary wick 30. The enriched solution leaves the absorber through pipe 17. The solution coming from the boiler is prevented by the strip 27 from flowing directly from the pipe 28 to the pipe 17. The inside of the casing 15 is provided with one or more layers of wire gauze 31 that suck up the solution by capillarity and siphon it over to the opposite side of the strip 27 so that it can be discharged from the absorber. This arrangement is of advantage when ammonia and water are used since in the solution being siphoned the layers already saturated diffuse to the wall of the tube due to the weight so that principally unsaturated solution is offered to the gas mixture flowing through the absorber on that side of the gauze exposed to the gas. Heat liberated by the absorption in the absorber is carried off by the cooling water in coil 23 around the absorber casing 15.

The gauze should lie flat against the interior wall of the casing and may simply be cut to size and pushed into the tube where its extremities will rest against opposite sides of the strip 27, the gauze being held in place by its own elasticity. If desired it may also be held in place by additional means, as by spot welding, soldering with material indifferent to the operating medium of the apparatus such as tin or the like.

If further increase in surface of the absorber is desired, an additional tube 34 may be inserted and may extend the entire length of the absorber and be welded at its extremities to the end plates of the same. This tube can also be provided with one or more layers of gauze 33 and heat liberated is preferably carried off by a cooling water coil 32 of copper or the like secured on the interior of the tube 34. The tube 34 is suitably supported on the strip 27 and with additional braces 35 circumferentially spaced from such strip so that the tube is held in place until it is secured at the front and back to the plates of absorber. A relatively tight fit should be provided between the longitudinal strip 27 and the tube 34 and the gauze omitted between the contacting surfaces to prevent the solution from siphoning directly through this gauze to the outlet pipe 17. Ordinarily the engagement of the strip 27 and tube 34 is sufficient to prevent solution from passing therebetween in any appreciable quantity. However, if desired, the joint may be made tight by soldering or by grinding the parts together or in some other desired manner.

The invention is not restricted to the showing on the drawing as various changes may be made without departing from the spirit and scope of the same, for example, if the absorber is air cooled, in which case the inner tube is cooled from the outside only with great difficulty, the circulating pressure equalizing gas can be led through inner tube 34 to carry away the heat of absorption liberated there. The inner tube 34 can also be provided with a slot or opening through which the absorption liquid may enter and a capillary siphon provided similar to that in the outer tube for transferring the absorption liquid. Also the gas mixture in the inner tube may be caused to flow counter to the flow of the liquid in the outer tube.

The characteristic quality of the capillary siphon may be used in the absorber as well as in the discharge or supply line, in which instance it is preferable to bring the capillary siphon of the pipe line in direct capillary connection with capillary active surfaces of the absorber. It is not only possible to provide the absorber with capillary active surfaces but other vessels in the system may be similarly provided.

It is advantageous for an apparatus working with small lifting heights and capillary siphons that the condensate should enter the evaporator in such a way that a liquid column can be built up in the condensate supply line. This raises the pressure in the evaporator-absorber system slightly above the pressure in the boiler condenser system corresponding to this liquid column. This excess pressure in the absorber assists in forcing the strong solution into the boiler and to overcome the frictional resistance in the pipe lines, and has very little effect on the capillary siphon. Water precipitated in the rectifier at a higher level than the absorber after being properly cooled can be returned through a U-tube preferably connected to the descending leg 24 of the tube 22 where it will on account of its greater density further increase the downward flow.

It will be obvious to those skilled in the art that various other changes may be made in the construction and arrangement without departing from the spirit of the invention and therefore the invention is not limited to what is shown in the drawing and described in the specification but only as indicated in the appended claims.

I claim:

1. An absorber comprising a tube within a tube, means at the ends of said tubes forming a closed chamber therebetween, inlet and outlet connections for circulation of both liquid and gas through said chamber, and cooling coils secured to the exterior of the outer tube and to the interior of the inner tube.

2. An absorber comprising a tube within a tube, cooling coils secured to the exterior of the outer tube and to the interior of the inner tube, and a capillary substance located around the interior of the outer tube.

3. An absorber comprising a tube within a tube, cooling coils secured to the exterior of the outer tube and to the interior of the inner tube, and a capillary substance located around the interior of the outer tube and around the exterior of the inner tube.

4. An absorber comprising a tube within a tube, cooling coils secured to the exterior of the outer tube and to the interior of the inner tube, a capillary substance located around the interior of the outer tube and around the exterior of the inner tube, said absorber having spaced inlet and outlet connections, and a baffle disposed therebetween whereby liquid will be transferred by capillarity from the inlet to the discharge opening.

5. An absorber comprising a casing having inlet and outlet passages, a baffle disposed longitudinally of the casing, a second casing within the first resting on said baffle, and capillary means for transferring liquid from the inlet to the outlet passages on opposite sides of said baffle.

6. An absorber comprising substantially horizontal inner and outer tubular casings forming a chamber therebetween, means closing the ends of said chamber, a longitudinal partition between said casings in the lower part of said chamber, inlet and outlet connections for liquid to said chamber, on opposite sides of said partition, connections for the circulation of gas through said chamber, a lining of capilliary material on the walls of said chamber, and means for cooling said casings.

7. An absorber comprising a closed vessel, a baffle extending upwardly from the lower part thereof, means for cooling said vessel, inlet and outlet connections for liquid on opposite sides of said baffle, a lining of capillary material in said vessel for distributing and transferring liquid over said baffle in a path of extensive surface, and connections for the circulation of gas through said vessel.

8. An absorber comprising a closed vessel, a partition having a hollow portion and dividing the lower part of said vessel, inlet and outlet connections for liquid on opposite sides of said partition, capillary means for transferring liquid over said partition in a path of extensive surface, connections for circulation of gas through said vessel, and cooling means in the hollow portion of said partition.

9. An absorber comprising a closed casing having connections for the circulation of gas therethrough, a connection for admitting liquid to the lower part of said casing, capillary means for distributing liquid from the lower part over the interior of said casing, and means for cooling said casing.

10. An absorber comprising a closed vessel having connections for the circulation of gas therethrough, a connection for admitting liquid to the lower part of said vessel, capillary means for conducting liquid upwardly in said vessel in bodies of extensive surface, and means for cooling said vessel.

11. An absorber comprising a closed vessel having connections for circulation of gas therethrough, a partition extending upwardly from the lower part of said vessel, an inlet connection for liquid to the lower part of said vessel on one side of said partition, a path for liquid formed by wick-like material of extensive surface extending from said inlet connection over said partition, means for cooling said path, and a discharge conduit for liquid on the other side of the latter.

12. An absorber comprising a closed vessel having connections for the circulation of gas therethrough, a partition extending upwardly from the lower part of said vessel, means for flowing liquid through said vessel from one side of said partition to the other, and a conduit for cooling fluid extending through said vessel in heat exchange relation with said means.

13. An absorber comprising a closed vessel having connections for the circulation of gas therethrough, inlet and outlet connections for liquid to the lower part of said vessel, an upwardly arched path for liquid between said liquid connections formed by capillary material of extensive surface, and means for cooling said path.

14. An absorber comprising a closed vessel having connections for the circulation of gas therethrough, inlet and outlet connections for liquid to the lower part of said vessel, a plurality of upwardly arched paths for liquid between said liquid connections formed by capillary material of extensive surface, and means for cooling said paths.

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