

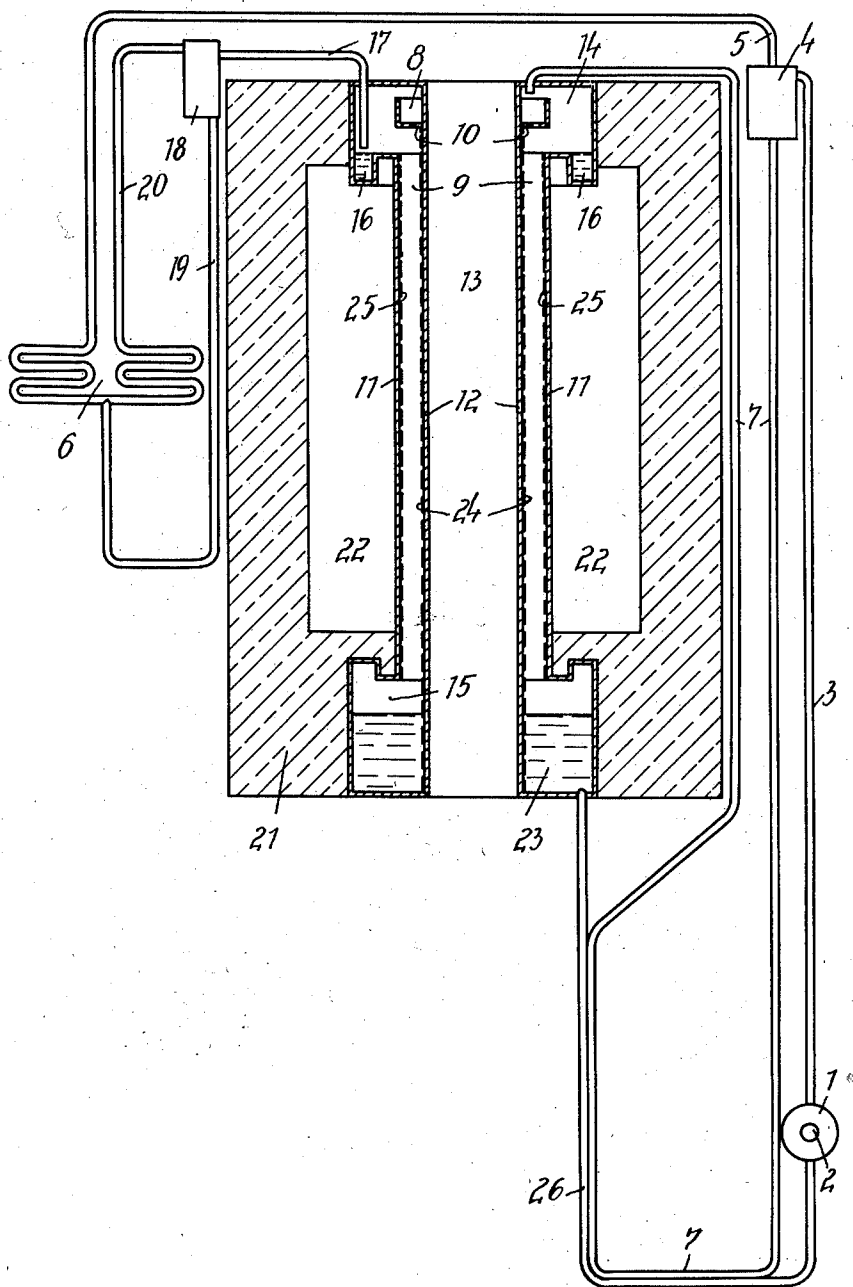
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CONTINUOUS ABSORPTION MACHINE

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UNITED STATES PATENT OFFICE

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CONTINUOUS ABSORPTION MACHINE

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My invention relates to improvements in continuous absorption machines.

In continuous absorption machines with admixed neutral gas, it is known to make the vapors of the working medium evaporating in taking heat from the surroundings, reach the absorbing solution substantially only through diffusion. The known absorption machines of this kind contain so much neutral gas in the diffusion chamber that the difference between the evaporation and condensation pressures is practically completely balanced. However, even if they are operated with water cooling and therefore at a comparatively low absorber temperature, their efficiency is poor and proves to be quite insufficient. But the solution of the problem becomes entirely impossible if, at higher temperatures of the absorber, as with air cooling comparatively low temperatures of the evaporator are to be obtained.

These conditions are radically changed if according to the invention neutral gas is added to the working-medium vapor in the diffusion chamber in such small quantities that the total pressure of the mixture remains low compared to the pressure of the vapor of the working medium alone at the normal temperature of vaporization. With the subject matter of the invention, the difference of pressure between the diffusion chamber and the chambers in which the working-medium vapor is driven off and condensed, is therefore substantially maintained in spite of the admixture of neutral gas.

By this means an extraordinary increase in output and efficiency is obtained. The reason for this is that the rate of diffusion increases proportionally to the decrease of the pressure, whilst the losses owing to heat conduction in the diffusion chamber, upon which the efficiency depends, remain constant.

To maintain the said difference of pressure when the machine is in operation, pumps or valves may be employed. It is, however, more advantageous to maintain, according to the further improvement, the said difference of pressure not equalized by the neutral gas, through the means of liquid columns. In order not to exceed the desired moderate

height for the machine, particularly for household refrigerators, it is advisable to use as a working medium substances having at the normal temperature of vaporization a comparatively low vapor pressure (less than 20 cm water head). Substances of that kind are, for example, water (absorption means: sulphuric acid or alkali), toluene (absorption means: chinoline or paraffin oil) etc.

In the drawing affixed hereto, an embodiment of my invention is illustrated in connection with an absorption machine serving to produce cold.

In a generator 1, absorption solution (lye solution) is heated by means of an electric heating element 2. The water-vapor bubbles developed thereby lift the solution, which has now become weaker in water, in an upwardly extending pipe 3 into a vapor separation chamber 4 where the water vapor and the absorption solution separate. Whilst the water vapor is conveyed through a pipe 5 to an air-cooled condenser coil 6 where it is condensed, the absorption solution flows through a U-shaped pipe 7 into a ring-shaped collector 8 disposed in the likewise ring-shaped gas chamber 9 of a closed vessel, containing the absorber and the evaporator. Around the bottom of the ring-shaped collector 8, at its inner edge, openings 10 are provided for the absorption liquor. The vessel containing the gas chamber 9 has substantially the shape of an upright cylinder. It is double walled and so constructed that the said ring-shaped hollow space 9, between the outer wall 11 and the inner wall 12, enclosing a chimney-like space 13, remains free. The hollow space 9 is filled with the neutral gas (nitrogen), into which the evaporating working medium diffuses. The said hollow space 9, which is hereinafter called the diffusion chamber, has at the top a widened part 14 and at the bottom a widened part 15. The widened part 14 at the top contains the above mentioned ring shaped collector 8 for the absorption solution and also a ring-shaped channel 16 serving as a collector for the condensate. At its bottom part, the ring-shaped channel 16 is fitted in the top of a refrigerating chamber 22 surrounding the wall 11 of the vessel and enclosed by a heat

insulating mass 21. The condensate flows to the collector 16 through a pipe 17 coming from an equalizing vessel 18. The equalizing vessel 18 is connected at the bottom through a U-shaped pipe 19 and at the top through a pipe 20 with a condenser 6 in the manner shown in the drawing.

At its bottom part the pipe 20 is provided with a few coils, in which the water vapor which has not been liquefied can be condensed.

The bottom widened part 15 serves to take a store 23 of absorption solution flowing from the ring-shaped space 8 through the holes 10 and trickling down over the wall 12 of the vessel. The wall 12 of the vessel is covered from top to bottom with a distributing structure (e. g. a porous substance) 24, whereby the most favourable conditions are obtained for the absorption of the working-medium vapor. This working-medium vapor is formed in the diffusion chamber from the condensate coming from the ring-shaped collecting channel 16 and trickling down the wall 11 over a distributing structure 25 covering same. During the trickling down the working-medium vapor diffuses into the neutral gas. Working medium which does not evaporate passes into the liquid supply 23. From the latter a U-shaped pipe 26 forming a heat exchanger with the pipe 7 conveys the rich absorption solution back to the generator 1.

The heat of absorption produced by the absorption of the water vapor out of the gas mixture in the diffusion chamber 9, is carried away by the current of air formed in the chimney-like space 13 surrounded by the wall 12 of the vessel.

The cooling chamber 22 arranged concentrically round the diffusion chamber 9 and kept at a low temperature by the cold produced through the evaporation, is protected by means of the insulating mass 21 from the penetration of heat from the surroundings.

The action of the above arrangement is as follows:

The water vapor developed from the absorption solution by heat applied to the generator, passes, after being separated from the solution of reduced water content in the vapor separation chamber 4, to the condenser 6, where it condenses and assumes a cooling temperature of 40° C. at a pressure of a water head of about 75 cm. In the diffusion chamber 9, filled with nitrogen a mixture of water vapor and nitrogen takes place when the condensate evaporates, the said mixture assuming a temperature of evaporation of -5° C. and having a pressure of a water head of about 15 cm. The danger of the condensate solidifying may be avoided by adding to it a small quantity of lye. This can, for example, be done by a suitable arrangement and dimensioning of the vapor separation chamber 4 and the vapor pipe 5.

The heat produced by the absorption on the wall 12 is carried away at about 45° C. by the current of air passing through the space 13.

The difference of pressure to be maintained by liquid columns amounts according to the above to a $75 - 15 = 60$ cm water head. As the evaporating pressure of the water alone at -5° C. corresponds to the pressure of a 4.3 cm water head, the gas pressure of the mixture of nitrogen and water vapor, which has the value of a 15 cm water head, is but little above the vapor pressure of the working medium alone. It is on the other hand considerably lower than the condensing pressure of the working medium amounting to a 75 cm water head. The height of the liquid column from the level of the surface of the liquid store 23 to the middle of the generator 2 is, as will be seen on the drawing, greater than the height of the liquid column between the point of union of the condenser 6 and the pipe 19 on the one hand, and the point where the condensate flows out of the equalizing vessel 18 on the other hand. The depth of immersion required for an undisturbed operation of the generator is thereby assured, so that a comparatively small development of vapor bubbles in the generator 1 suffices to lift the absorption liquor in the upwardly extending pipe 3 up to the vapor separation chamber 4.

Instead of arranging the refrigerating chamber 22 concentrically to the diffusion chamber 9, it may also be arranged eccentrically.

Contrary to the manner shown in the example illustrated by the drawing, the space in contact with the air may also be disposed on the outer side and the chamber to be kept cool on the inner side. Finally, it is also possible to place the condenser 6 inside of the chimney-like space 13 and in this manner not only to save room but also at the same time provide a particularly good cooling arrangement for the condenser. The conveyance of the liquid by means of gas bubbles makes it possible without mechanically moving parts and without an additional application of heat to operate a diffusion machine, in which high heads can be overcome in the liquid circulating circuit. In this way, it is possible to let the absorption liquid trickle down freely through a diffusion chamber of considerable height.

I claim as my invention:

1. In a continuous absorption refrigerating machine comprising a generator, a condenser or liquefier, a common evaporation and absorption chamber, said chamber containing a neutral gas through which the working medium vapor passes over to the absorption liquor substantially only through diffusion, said gas being admixed to the working medium vapor only in such a small quantity that the total pressure of the mixture of

neutral gas and working medium vapor remains low compared to the vapor pressure of the working medium alone measured at the normal temperature of evaporation, and
5 liquid columns for maintaining the difference of pressure existing between the diffusion chamber on the one hand and the generator and liquefier on the other hand, said working medium having a vapor pressure of less than
10 20 cm water head at the normal temperature of evaporation (0 to -10° C).

2. In a continuous absorption refrigerating machine comprising a generator, a condenser or liquefier, a common evaporation
15 and absorption chamber, said chamber containing a neutral gas through which the working medium vapor passes over to the absorption liquor substantially only through diffusion, said gas being admixed to the
20 working medium vapor only in such a small quantity that the total pressure of the mixture of neutral gas and working medium vapor remains low compared to the vapor pressure of the working medium alone measured at the normal temperature of evaporation, and liquid columns for maintaining the
25 difference of pressure existing between the diffusion chamber on the one hand and the generator and liquefier on the other hand, said absorption liquor consisting of a mixture of water and alkali lye.

3. In a continuous absorption refrigerating machine comprising a generator, a condenser or liquefier, a common evaporation
35 and absorption chamber, said chamber containing a neutral gas through which the working medium vapor passes over to the absorption liquor substantially only through diffusion, said gas being admixed to the working
40 medium vapor only in such a small quantity that the total pressure of the mixture of neutral gas and working medium vapor remains low compared to the vapor pressure of the working medium alone measured at
45 the normal temperature of evaporation, and liquid columns for maintaining the difference of pressure existing between the diffusion chamber on the one hand and the generator and liquefier on the other hand, said absorption
50 liquor consisting of a mixture of toluene and paraffin oil.

In testimony whereof I affix my signature.
EDMUND ALTENKIRCH.