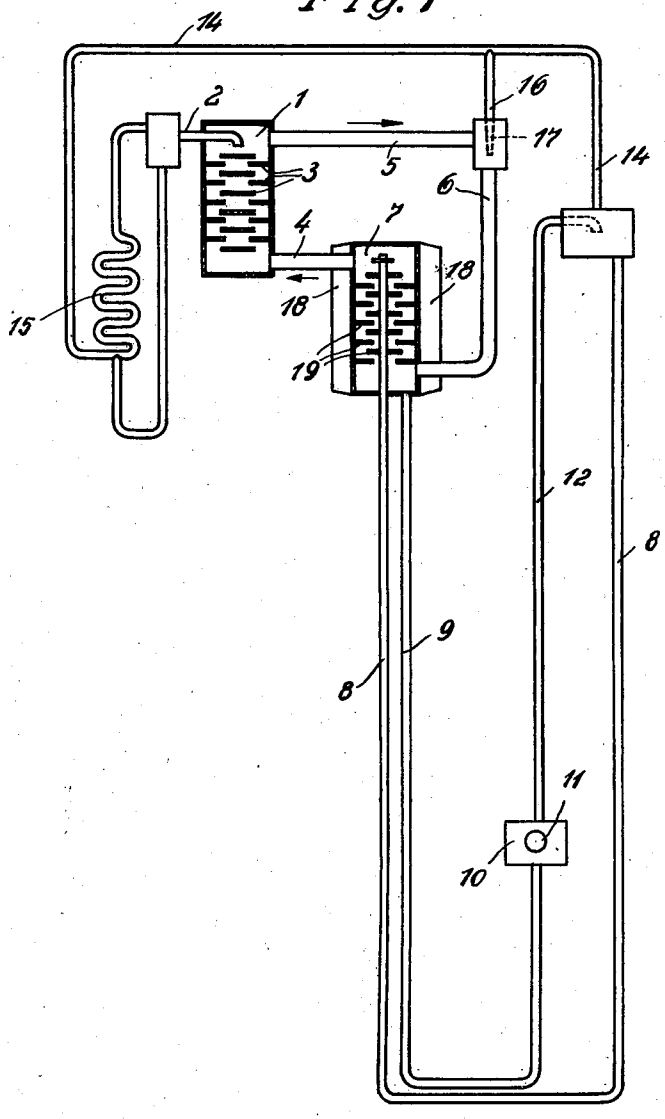
May 21, 1935. E. ALTENKIRCH 2,001,697

ABSORPTION REFRIGERATING MACHINE

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Fig. 1



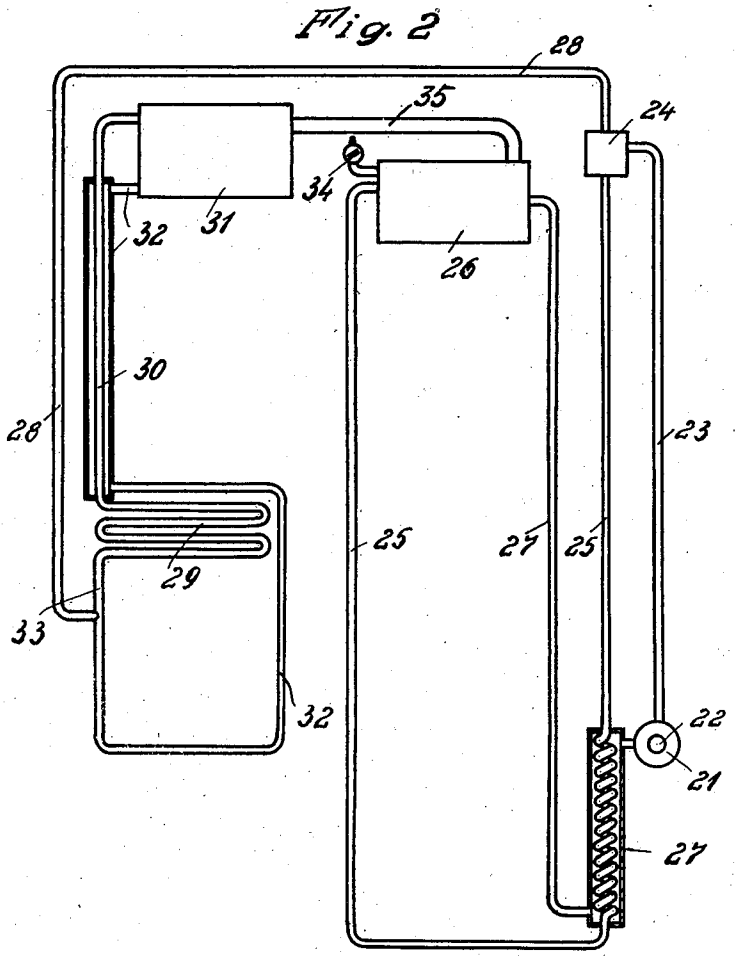
Inventor
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Fig. 2



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UNITED STATES PATENT OFFICE

2,001,697

ABSORPTION REFRIGERATING MACHINE

Edmund Altenkirch, Neuenhagen, near Berlin, Germany, assignor, by mesne assignments, to The Hoover Company, North Canton, Ohio, a corporation of Ohio

Application August 14, 1930, Serial No. 475,206
In Germany August 20, 1929

4 Claims. (Cl. 62—119.5)

My invention relates to an absorption refrigerating machine with a working medium which condenses at atmospheric pressure at a temperature of about 10 to 20 degrees centigrade above the highest room temperature practically occurring. This is, for example, the case with ethylene dichloride. An absorption refrigerating machine of this kind has a number of important advantages. The pressure at which the pure working medium condenses in an air-cooled condenser, even under unfavorable cooling conditions is just below the atmospheric pressure, whereas in the absorption refrigerating machines known up to the present the condensing pressure was as a rule either considerably higher or considerably lower than the atmospheric pressure. With the subject-matter of the invention, both disadvantages, existing if the internal pressure of the machine is above atmospheric, for instance, the possibility of the working medium escaping into the surrounding space, and the difficulties caused if a high vacuum is to be maintained, are eliminated.

Owing to the comparatively low pressure in the whole machine, the difference in pressure between the evaporator and the liquefier is also small. If water cooling is employed, the difference in pressure can therefore, be equalized by columns of liquid, in order to be able to operate without pumps or valves. The liquid columns need in this case only be made moderately high, so that the machine is very suitable for household purposes. If air cooling is employed, the height can be maintained within the desired limits by admixing a neutral gas.

Among the organic substances possessing the property mentioned at the beginning, the said ethylene dichloride is, according to the invention, employed to great advantage as a working medium. Its condensation point is (at atmospheric pressure) at +55 degrees centigrade, its solidifying point lower than —70 degrees centigrade i. e. lower than the necessary evaporating temperature practically required for most purposes.

As a solvent for ethylene dichloride, according to the further invention, paraffin oil is to be employed. Paraffin oil has a very high boiling point, about 360 to 390 degrees centigrade. This fact makes it possible to raise the temperature for heating the expeller to a considerably higher degree than is possible for example with aqueous ammonia solutions even at high pressures. Now, large differences between the expelling temperature and the condensation temperature mean corresponding low temperatures in the production of cold. Moreover, when ethylene dichloride is being expelled from a solution in paraffin oil, an evaporation of considerable quantities of the solvent need not be reckoned with.

The specific gravity of paraffin oil is lower than that of ethylene dichloride, and this fact influences favorably an automatic circulation of the liquid between the generator and the absorber, disposed at a higher level.

If cold is not produced by evaporating the condensate but by expelling gas from a strong absorption solution of ethylene dichloride in paraffin oil, the mentioned working medium is also suitable for absorption refrigerating machines operating with air cooling and without an indifferent gas. The differences in pressure can in this case also be maintained by means of columns of liquid of a small height.

If water cooling is preferred, then one obtains, for operation with ethylene dichloride, a very simple construction of the absorption machine, since the admixture of indifferent auxiliary gas is in that case not necessary. Thermically, the manner in which a machine of that kind operates is so favorable, that it is suitable for being built for very large refrigeration outputs.

In the drawings, the invention is diagrammatically illustrated in two modifications.

Figure 1 shows a continuously acting absorption refrigerating machine operating with condensation, in which an indifferent auxiliary gas (air) is mixed with the gaseous working medium (ethylene dichloride) in the evaporator and absorber, whereas

Figure 2 illustrates an absorption refrigerating machine operating on the re-absorption principle and without an auxiliary gas.

In the arrangement according to Fig. 1, liquid ethylene dichloride flows from an air cooled condenser 15 through a pipe 2 into the evaporator 1. By falling in drops over the baffle plates 3 in the evaporator, it evaporates into the mixture of air and ethylene dichloride, which is weak as to its content of working medium, and which passes through the evaporator from the bottom to the top. The gas mixture streaming into the bottom of the evaporator 1 through the pipe 4, leaves the evaporator, after having enriched itself with ethylene dichloride, at the top through the pipe 5, and then passes through the pipe 6 into the bottom of the air cooled absorber 7, provided with ribs 18. Inside the absorber, weak absorption solution, conveyed into same through the pipe 8 and consisting of paraffin oil and ethylene dichloride, falls in drops over the baffle plates 19 fitted in the absorber; it gathers at the bottom and flows off again through the pipe 9. The pipes 8 and 9 are so arranged as to exchange heat with each other. In the absorber, the solution absorbs a great part of the working medium from the gas mixture, so that the latter only retains a small content of ethylene dichloride, when it leaves the absorber through the pipe 4. The enriched solution flows from the absorber through the pipe 9 into the generator 10 which is heated

by a heating element 11. Owing to the supply of heat, the ethylene dichloride gas is here again expelled. In rising through the pipe 12, it takes the paraffin-ethylene solution up with it and lifts it into a gas separator 13 at a higher elevation. From the gas separator, the weak absorption solution flows through the pipe 8 into the absorber 7, whilst the expelled ethylene dichloride gas is conveyed through the pipe 14 into the condenser 15. Here it is condensed, the heat of condensation being given up to the surrounding air. From the pipe 14, a pipe 16 branches off, which ends in a nozzle 17 arranged in pipe 6 conveying gas mixture. The ethylene dichloride gas discharged through this nozzle imparts a motion to the gas mixture, causing it to move in an upward direction through the absorber and the evaporator. The circulation of the gas mixture through the evaporator and the absorber takes place in the direction indicated by arrows, i. e. in the contrary direction to the flow of the liquids.

In the arrangement according to Fig. 2, gaseous ethylene dichloride is developed in the generator 21, heated by an electric heating element 22, from a solution of ethylene dichloride in paraffin oil. The gas expelled through the supply of heat rises, in mixture with the absorption solution, in the upwardly extending pipe 23 up into the gas separation chamber 24, where the gas and the absorption liquid separate. Whilst the liquid passes through the U-shaped pipe 25 into the air-cooled absorber 26, the gas is conveyed through a pipe 28, opening into a rising pipe 33, filled with solution, to a re-absorber 29, also air cooled, which is connected, by means of a pipe 30, with the gas space of the evaporator 31, at a higher elevation. Through a pipe 32 connected to the liquid space of the evaporator 31, and forming a heat exchanger with the pipe 30, absorption liquid (ethylene dichloride in paraffin oil) flows from the evaporator 31 into the above-mentioned rising pipe 33. The gaseous working medum flowing from the pipe 28 into the pipe 33 rises with this solution into the re-absorber 29. Here it is absorbed by the solution and gives up heat to the surroundings. The ethylene dichloride vapor evaporated from the absorption solution in the evaporator 31, for which process heat is taken from the surroundings, passes through a pipe 35 into the absorber 26, where it enriches the weak solution entering through the pipe 25. The enriched solution flows through a pipe 27, which forms a heat-exchanger with the pipe 25, to the generator 21. The gas space of the absorber 26 is provided with an air discharging device 34 by the means of which gaseous parts, which may have penetrated into the absorber and are not absorbable, may be removed from the refrigerating machine.

In the refrigerating machine last described, two completely separate circulations of absorption liquid take place. In both systems (generator 21, gas separation chamber 24, absorber 26 on the one hand, and re-absorber 29, evaporator 31 on the other hand), the circulation of the liquid is maintained by the absorption liquid being lifted by the gaseous ethylene dichloride developed in the generator 21. The circulation of the liquid between the generator and the absorber, situated at a higher level, is facilitated by the fact that the strong solution containing much ethylene dichloride and therefore having a higher specific gravity moves mostly downwards in the pipe 27, whereas a specifically lighter solution rises in the pipe 23.

I claim as my invention:—

1. In a continuous absorption refrigerating system using ethylene dichloride as a refrigerant and paraffin oil as an absorbent, an absorber, a generator located below said absorber, conduits connecting the generator and the absorber for circulating the paraffin oil between and through the same, means for causing the ethylene dichloride to evaporate from a liquid to produce a cooling effect, means for conveying the ethylene dichloride vapor into the absorber to cause it to be absorbed by the paraffin oil therein and be conveyed to the generator, means for applying heat to the generator to expel the ethylene dichloride from the paraffin oil and means for condensing the expelled ethylene dichloride and conducting it into the evaporating means, the arrangement being such that as the ethylene dichloride is supplied to the paraffin oil in the absorber, conducted downwardly from the absorber to the generator in solution in the paraffin oil and expelled from the paraffin oil in the generator the circulation of the paraffin oil is favorably influenced due to the fact that the density of the solution of ethylene dichloride and paraffin oil is greater than the density of the paraffin oil per se.

2. A continuous absorption refrigerating system including an absorber, a generator located below the absorber, conduit means for conveying an absorption liquid downwardly from the absorber to the generator, conduit means for conveying the absorption liquid from the generator back to the absorber, means for adding a refrigerant to the absorption liquid in the absorber and for removing the refrigerant from the absorption liquid in the generator, said refrigerant having a greater specific gravity than the absorption liquid whereby the density of the liquid is increased in the absorber and decreased in the generator due to the addition and removal of refrigerant to foster circulation of the absorption liquid under the influence of gravity.

3. A continuous absorption refrigerating system including an absorber, a generator, a conduit for conveying a liquid from the absorber to the generator, a conduit for conveying a liquid from the generator to the absorber and an arrangement causing circulation of said liquid through said conduits including means for adding a fluid to the liquid in an absorber and removing the fluid from the liquid in the generator, the fluid having a greater specific gravity than the liquid thereby increasing the density of the liquid in the absorber and decreasing the density of the liquid in the generator whereby circulation may be fostered by the action of gravity on the portions of the liquid of different density.

4. The method of causing the circulation of an absorption liquid in a circuit between the absorber and the generator of a continuous absorption refrigerating system which includes the steps of causing the liquid to absorb a gas, in the absorber to thereby increase the density of the absorption liquid and expelling the absorbed gas in the generator to decrease the density of the absorption liquid, and fostering circulation of the liquid under the influence of gravity action on the portions of the absorption liquid of different density.

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