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S. M. BÄCKSTRÖM

REFRIGERATION

Filed May 4, 1927

Fig. 1.

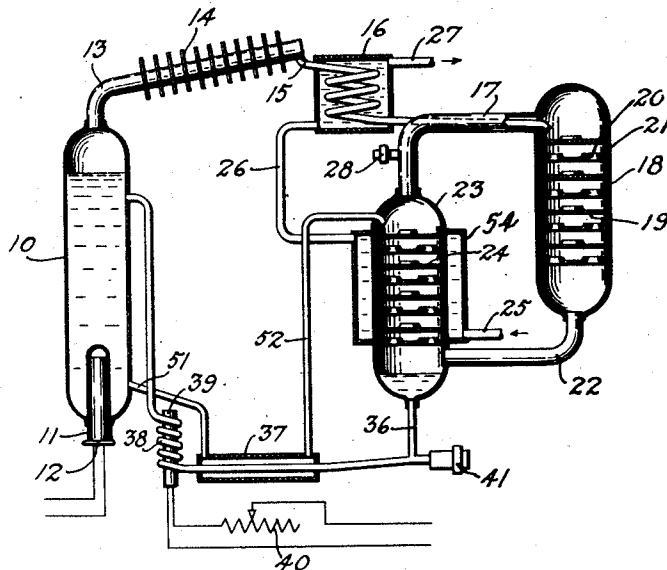


Fig. 2.

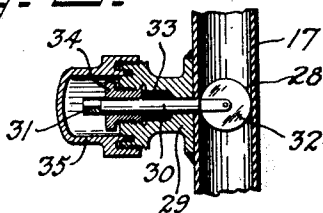
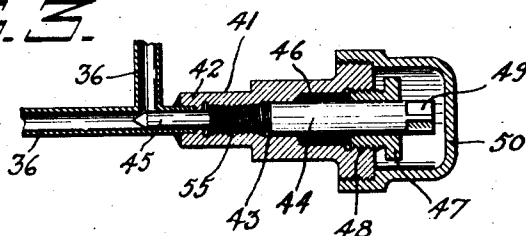


Fig. 3.



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REFRIGERATION.

Application filed May 4, 1927, Serial No. 188,653, and in Sweden May 22, 1926.

My invention relates to the art of refrigeration and particularly to refrigeration apparatus of the absorption type and still more particularly to absorption apparatus in which circulation of fluids is promoted by forces generated entirely within the system.

My invention has for its object, among other things, to provide means for adjusting and fixing the rate of flow of these fluids, so as to obtain the maximum efficiency possible from the apparatus. This and other objects and advantages will be apparent from the following description and accompanying drawings, of which:

Fig. 1 is a more or less diagrammatic showing of an absorption system to which my invention is applied;

Fig. 2 is a cross-sectional drawing of one of the devices for adjusting the speed of fluid flow; and

Fig. 3 is a cross-sectional drawing of another one of the adjusting devices.

Referring more particularly to Fig. 1, reference character 10 designates a vapor generator. A cylindrical member 11 extends for some distance upwardly within generator 10. An electrical heating element 12 is posited within member 11. A conduit 13 communicates with and extends upwardly from the top of generator 10 and for a portion of its length is provided with radiating fins 14. A conduit 15 communicates with the upper end of conduit 13 and extends in the form of a coil through water jacket 16 and thence through a portion of conduit 17 to within the upper part of evaporator 18.

Evaporator 18 is a cylindrical member in which is placed a series of disks 19. Disks 19 are provided with apertures 20 surrounded by raised rims and serve to retain liquid in shallow pools. A conduit 22 connects the bottom of evaporator 18 with the lower part of an absorber 23. Absorber 23 is provided with disks 24 which may be similar to disks 19 in evaporator 18.

Absorber 23 is partially surrounded by a water jacket 54. Cooling water is supplied to water jacket 54 through conduit 25 and is discharged therefrom through conduit 26 to water jacket 16 from whence it is finally discharged through conduit 27. Conduit 17 connects the top of absorber 23 with the upper part of evaporator 18. A valve or damper 28, shown more in detail in Fig. 2,

is situated in conduit 17 and serves to determine the rate of flow therethrough.

Valve 28 comprises a member 29 having a central passageway. Member 29 is welded, or otherwise secured, to conduit 17 so that the central passageway is aligned with an opening of the same diameter in the conduit. A stem 30 passes through the central passageway in member 29 and the opening in conduit 17 and has fixed to its end within the conduit a circular vane 32 of substantially the same diameter as the interior of the conduit. The other end of stem 30 is made in the form of a square head 31. A portion of the passageway in member 29 is of greater diameter than stem 30 and is partially filled with suitable packing material 33. A gland 34 is screwed into the outer end of the passageway and serves to compress packing 33, so as to prevent leakage past stem 30. A cap 35 screws onto member 29 and acts to further prevent leakage. After the valve has been satisfactorily adjusted, cap 35 may be welded to member 29 and thus absolutely prevent leakage.

A conduit 36 communicates with the bottom of absorber 23, extends downwardly and thence horizontally through jacket 37 and thence upwardly and communicates with the upper part of generator 10. A part of this upwardly extending portion of conduit 36 is in the form of a coil 38 which is situated below the level of liquid in the absorber. An electrical heating element 39 extends within coil 38. A variable resistance 40 is connected in series with heating element 38.

A valve 41, shown more in detail in Fig. 3, is placed in conduit 36 and serves to determine the rate of flow therethrough. Conduit 36 is here made in the form of an inverted T. A member 42 is welded, or otherwise secured, to one branch, the right hand one in Fig. 3, of the T. A central passageway 43 of various diameters extends through member 42. A stem 44 extends through passageway 43 and engages a portion of it by means of the threads 55. A valve member 45, of substantially the same diameter as the interior of conduit 36, is attached to the inner end of stem 44. Suitable packing material 46 is placed in an enlarged portion of passageway 43 around stem 44. Packing 46 is compressed by a gland 47 which screws into threads 48 formed on the inside of

passageway 43. The outer end of stem 44 is made in the form of a square head 49. When stem 44 is rotated in a clockwise direction, valve member 45 advances into conduit 36 and thus decreases the area of the passageway therethrough and finally reduces it to zero. A cap 50 screws onto member 42 and prevents the escape of any fluid that may have leaked past packing 46. After final adjustment of the valve has been made, cap 50 may be welded to member 42.

A conduit 51 connects the lower part of generator 10 with one end of jacket 37. A conduit 52 connects the other end of jacket 37 with the upper part of absorber 23.

The operation of the apparatus will now be described. A solution of a cooling agent or refrigerant, for instance ammonia, dissolved in an absorbing medium, for instance water, is contained in generator 10. The application of heat from heater 12 serves to drive the ammonia out of solution and it passes upwardly into conduit 13 in the form of a vapor. In conduit 13 the temperature of the vapor is reduced due to radiating fins 14, and any water that may have been vaporized with the ammonia is condensed and runs back to the generator. The now dry ammonia vapor passes into conduit 15, where it is condensed to a liquid by the cooling action of the cooling water in water jacket 16. The liquid ammonia continues through conduit 15 and is discharged onto disks 19 in evaporator 18.

In the evaporator the ammonia comes in intimate contact with an auxiliary agent, preferably a gas inert with respect to ammonia, for instance hydrogen, which is introduced through conduit 17. The ammonia evaporates in the presence of the hydrogen and a decreased temperature occurs which produces refrigeration. The ammonia vapor mixes with the hydrogen and the mixture, being heavier than the relatively pure hydrogen in conduit 17, passes downwardly through the apertures 20 in disks 19. The vaporous mixture leaves the bottom of evaporator 19 through conduit 22 and enters the lower part of absorber 23.

In the absorber the mixture comes in intimate contact with water which contains but relatively little ammonia in solution and which passes downwardly over the disks 24. This water absorbs the ammonia and leaves the hydrogen. The lighter hydrogen passes upwardly through the absorber and through conduit 17 to evaporator 18, where it again mixes with ammonia.

The rich solution of ammonia in water formed in the absorber passes therefrom through conduit 36 and is pre-heated by the warmer liquid in jacket 37 before it enters coil 38. The application of heat from heating element 39 to the liquid in coil 38 vaporizes a portion of it and thus reduces

the specific weight of the fluid column to such an extent that flow takes place upwardly to the upper part of generator 10.

The ammonia is again driven out of solution in the generator and the weak solution passes downwardly therethrough and through conduit 51 to jacket 37. Here it exchanges heat with the strong solution in conduit 36 and is cooled thereby. It passes from jacket 37 through conduit 52 to the upper part of absorber 23 and again absorbs ammonia vapor.

To obtain the highest efficiency possible in the operation of this apparatus, it is necessary that a definite proportion is maintained between the quantity of ammonia which enters the evaporator and the quantity of hydrogen gas which circulates between the absorber and the generator. To obtain this proportion, regulation of the flow of hydrogen is controlled by means of the valve 28 in conduit 17. Likewise, for highest efficiency, it is necessary that a definite amount of absorbing medium circulates between the evaporator and the absorber. For this reason, valve 41 is provided in conduit 36 and regulates the flow therethrough. Likewise, highest efficiency is obtained when the heat supplied to coil 38 is just sufficient to properly circulate the quantity of absorbing medium as controlled by valve 41. Hence a variable resistance 40 is connected in series with heating element 39 and serves to regulate the current supplied thereto independently of supply of heat to the main generator.

In effect, I provide conduits of more than ample cross-sectional area for the flow within the local cycle of circulation of absorption liquid between the generator and absorber and within the local cycle of circulation of the auxiliary agent between the evaporator and absorber and provide restrictive devices which may be adjusted to give a cross-section for limitations of flow which will provide highest efficiency.

While I have shown and explained a more or less specific form of my invention, it is to be understood that I am not limited by the structure so disclosed. For instance, other types of valves may be employed and other means for regulating the current supplied to electrical heater 39 may be used without in any way detracting from the spirit of my invention which is to be limited only by the prior art taken in connection with the appended claims.

Having thus described my invention, what I claim is:

1. A refrigerating system of the absorption type comprising a generator, an evaporator containing a plurality of fluids adapted to have complementary diffusion and to produce refrigeration, an absorber for separating the fluids of diffusion, conduits con-

necting elements of the system and forming a plurality of circuits of circulation including an absorber-evaporator cycle, means to continuously circulate fluid in one direction through said cycle due to force generated within the system and an adjustable member in said cycle arranged to determine the rate of flow of fluid therethrough.

2. A refrigerating system of the absorption type comprising a generator, an evaporator containing a plurality of fluids adapted to have complementary diffusion and to produce refrigeration, an absorber for separating the fluids of diffusion, conduits connecting elements of the system and forming a plurality of circuits of circulation including an absorber-evaporator cycle, means to continuously circulate fluid in one direction through said cycle due to force generated within the system and an adjustable valve in said cycle arranged to determine the rate of flow of fluid therethrough.

3. A refrigerating system of the absorption type comprising a generator, an evaporator containing a plurality of fluids adapted to have complementary diffusion, an absorber, conduits connecting elements of the system and forming a plurality of circuits of circulation including a generator-absorber cycle, means to continuously circulate fluid in one direction through said cycle due to force generated within the system and an adjustable member in said cycle arranged to determine the rate of flow therethrough.

4. A refrigerating system of the absorption type comprising a generator, an evaporator containing a plurality of fluids adapted to have complementary diffusion, an absorber, conduits connecting elements of the system and forming a plurality of circuits of circulation including a generator-absorber

cycle, means to continuously circulate fluid in one direction through said cycle due to force generated within the system and an adjustable valve in said cycle arranged to determine the rate of flow therethrough.

5. A refrigerating system of the absorption type comprising a generator, an evaporator containing a plurality of fluids adapted to have complementary diffusion and to produce refrigeration, an absorber for separating the fluids of diffusion, a condenser, conduits connecting elements of the system and forming a plurality of circuits of circulation including an absorber-evaporator cycle and a generator-absorber cycle, means to continuously circulate fluid in one direction through the absorber-evaporator cycle and through the generator-absorber cycle due to force generated within the system and adjustable members within each of the cycles arranged to determine the rate of flow of fluid therethrough.

6. A refrigerating system of the absorption type comprising a generator, means to heat the generator, an evaporator, an absorber, a condenser, conduits connecting elements of the system and forming a plurality of circuits of circulation including a generator-absorber cycle, means to heat said cycle to continuously circulate fluid in one direction therethrough and means to adjust the intensity of heat supply to said cycle to determine the rate of flow of fluid therethrough independently of the supply of heat to the generator, said last mentioned means thereby operating to vary the relative values of heat supply to the generator and to the generator-absorber cycle.

In testimony whereof I hereunto affix my signature.

SIGURD MATTIAS BÄCKSTRÖM.