PUBLISHED
APRIL 27, 1943.
BY A. P. C.

R. BÖTTCHER
THERMAL PUMP
Filed June 8, 1940

Serial No.
339,562

Fig. 1

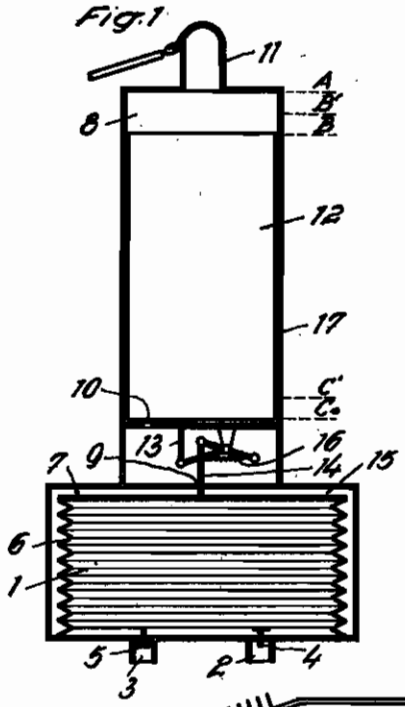


Fig. 2

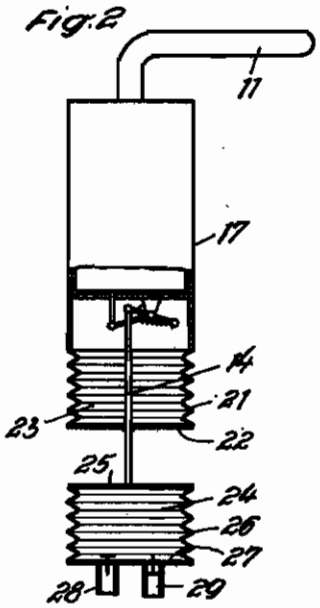
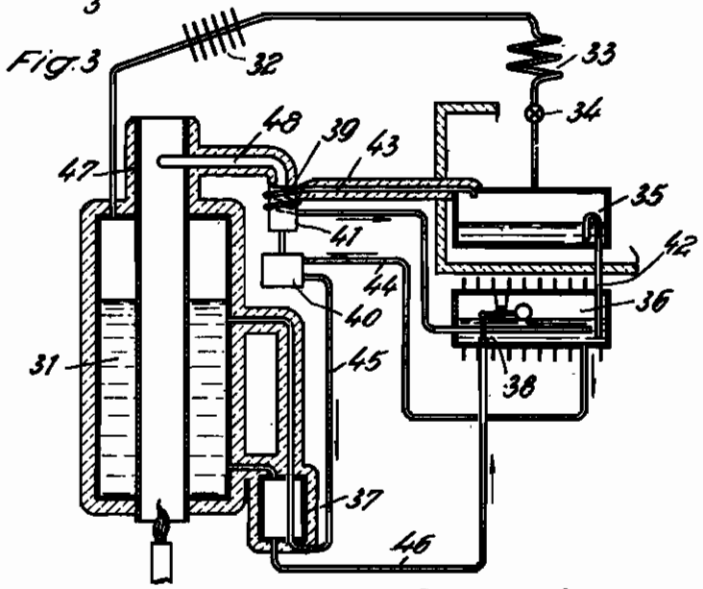


Fig. 3



Inventor:
Rudolf Böttcher
By Richardson & Auer
Attys.

418

Published Apr. 27, 1943 Serial No. 339,562

ALIEN PROPERTY CUSTODIAN

THERMAL PUMP

Rudolf Böttcher, Hohen-Neuendorf B. Berlin, Germany; vested in the Alien Property Custodian

Application filed June 8, 1940

This invention relates to a thermal pump, the volume of the working chamber of which is varied by a heated fluid. According to the invention the working chamber of the pump is separated from the fluid chamber by a resilient wall and the decrease in volume of the working chamber is brought about by heating the fluid and correspondingly increasing the pressure in the fluid chamber, but to increase the volume of the working chamber with the aid of a displacer cooperating with the fluid the latter is moved away from the zone of the heat source, so that as a result of the subsequent cooling the pressure in the fluid chamber is decreased. In this manner a pump is obtained with the aid of simple means in which the heat source for the auxiliary fluid may remain continuously in operation. For this reason the pump according to the invention lends itself particularly to such cases where a pumping effect is brought about without employing auxiliary means for putting the heat source in and out of operation. The arrangement according to the invention may, for instance, be employed to advantage as a pump for circulating the solution in absorption refrigerating apparatus of the continuous type, in which case the heat necessary for the operation of the pump may be supplied by any suitable heat source, such as, for instance, by the generator of the absorption apparatus. The arrangement according to the invention is so designed that the operating fluid of the pump is heated up to such an extent as to develop during the compression stroke of the pump vapors in order to attain the desired increase in pressure. The heating surface of the fluid chamber is preferably arranged at the upper end of the liquid chamber, the displacer in the central portion and the working chamber of the pump in the lower end of the liquid chamber.

In the accompanying drawings are shown two embodiments of the invention in diagrammatic form in which

Fig. 1 is a vertical sectional view of the heat pump according to the invention.

Fig. 2 shows an elevational view partly in section of a modified form of the heat pump.

Fig. 3 shows the heat pump as applied to an absorption refrigerating apparatus of the continuous type.

Referring to the drawings, 1 denotes the working chamber proper of the pump to which are connected a suction conduit 2 and a pressure conduit 3 in which are arranged the corresponding valves 4 and 5 respectively. The working chamber 1 is separated from the space 7 to which is supplied the auxiliary liquid necessary to operate the pump, by a resilient wall 6. The space 7 is in open communication with the liquid container 8 through the openings 9 and 10. On the top of the container 8 is located a heated tube 11. A displacer 12 is arranged in the container 8 and serves to reverse the suction stroke or compression stroke. The container 8 is associated with the cover plate 15 of the working chamber 1 through a rocking lever system 13, 14. The two pairs of levers 13 and 14 are connected with each other by a spring 16 in the manner as shown in Fig. 1.

In the position of rest the chambers 7 and 8 are completely filled with auxiliary liquid up to the point A. By applying heat to the upper end of the liquid container 8, the liquid is caused to evaporate and the pressure produced thereby is transmitted to the working chamber 1 of the pump. The resilient wall 6 is compressed so that the liquid filling the working chamber 1 is forced out through the pressure conduit 3. Owing to the evaporation of the liquid, the latter assumes the level B. At the end of the compression stroke the displacer 12 is in the position B', C'. The arrangement is so dimensioned that the quantity of liquid contained between the points B and C is such as to fill up as soon as the displacer 12 has reached the position B', C' the space between the points C, C'. Upon the upward movement of the displacer, the auxiliary liquid in the container 8 is therefore out of the direct heat contact with the heating surface. Consequently, the vapors produced as a result of the heating of the liquid condense again on the air-cooled surface 17 so that the pressure prevailing in the spaces 7 and 8 decreases. Accordingly, a suction effect is exerted on the working chamber 1 of the pump which causes the space 1 to increase and draws in the liquid supplied through the suction conduit 2. As soon as the inclined position of the lever system 13, 14 is exceeded upon the movement of the cover plate 15 in the upward direction, the displacer 12 is brought again automatically into the lower position. In this manner the liquid is displaced again from the space C, C' in the upward direction so that it comes again into direct heat contact with the heating surface 11, and the compression stroke of the pump is then repeated. The form of the invention shown in Fig. 1 is characterized by the fact that the movable parts of the pump are completely surrounded by rigid walls. This is of particular advantage, since the pump is thus

completely protected against external mechanical influences.

Fig. 2 shows a somewhat modified form of the invention. 11 denotes the heated tube connected to the pump. 17 is the condensation surface of the pump. To the rod 14 of the rocking lever system is secured the plate 22 which forms together with the resilient wall 21 the lower closure of the working chamber 23 of the pump. The rod 14 is secured to the upper cover plate 25 of the working chamber 24 proper of the pump. 26 denotes a resilient wall of the pump and 27 the stationary bottom of the working chamber 24 to which are connected the pressure conduit 28 and the suction conduit 29.

Fig. 3 shows as an embodiment of the invention an absorption refrigerating apparatus of the continuous type provided with a pump 40, 41 designed according to the invention. This pump serves to circulate the solution. 31 is the generator of the absorption apparatus. The vapors developed in the generator 31 pass through a rectifier into the condenser 33, from where the liquefied refrigerant flows through a throttle valve 34 into the evaporator 35 arranged in the cooling chamber. The vaporous refrigerant then passes from the evaporator 35 into the air-cooled absorber 36. The vaporous refrigerant flows through the conduit 43 and the conduit 39 wound around the part 41 of the pump. This part of the pump is thus additionally cooled by the cold refrigerant vapors. The conduit 42 serves to remove the liquid absorbent which might be entrained with the liquid refrigerant into the evaporator. 44 and 45 denote the conduits leading to the pump 40 and through which the rich solution is forced by the pump 40 through the heat exchanger 37 into the generator 31. The poor solution passes again through the conduit 46 and the float-operated valve 38 back into the absorber 36. The heated tube 48 of the part 41 of the pump extends into the passageway 47 of the generator 31 heated by a gas flame. In this case the pump is therefore heated by the waste gases of the generator.

The condensation surface of the part 41 of the pump is intensely cooled by the vaporous refrigerant flowing from the evaporator to the absorber. By suitably dimensioning the condensation surface the number of strokes of the pump may be varied at the same time in accordance with the quantity of vaporous refrigerant.

To create the desired pressure within the pump suitable solutions may be employed as an operating fluid.

RUDOLF BÖTTCHER.