

Oct. 19, 1937.

E. DREVET

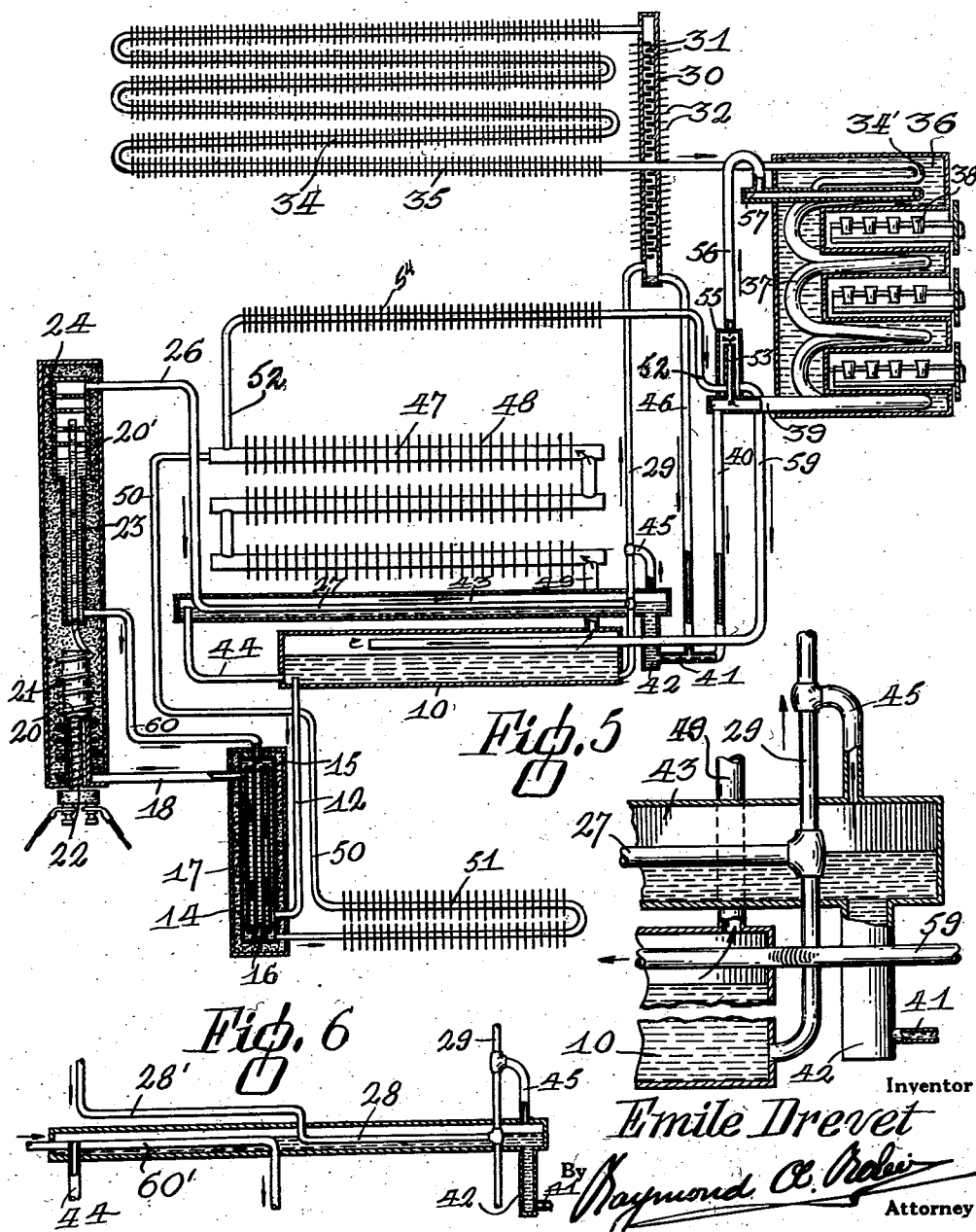
2,096,093

REFRIGERATION

Filed April 28, 1936

2 Sheets-Sheet 1

Fig. 1



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Filed April 28, 1936

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Fig. 2

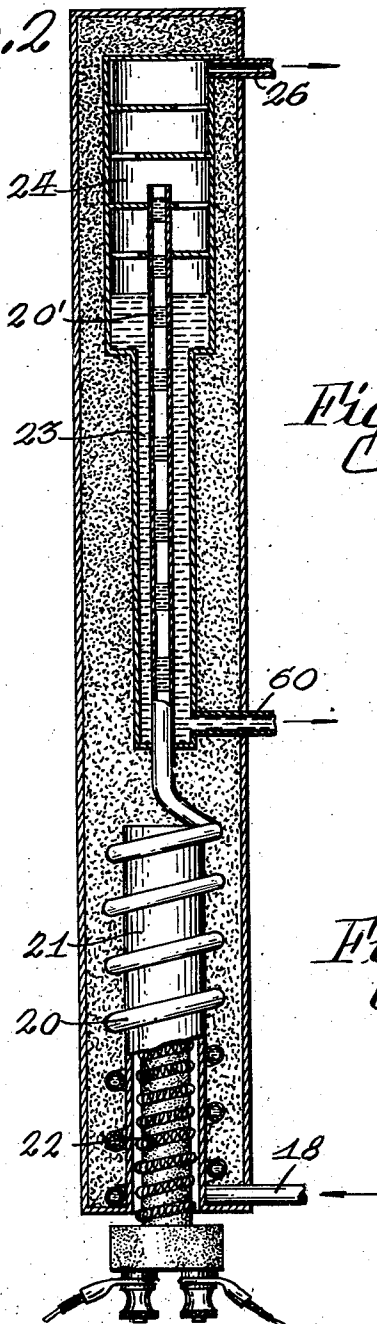


Fig. 3

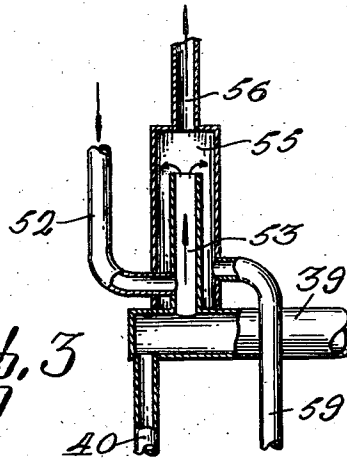
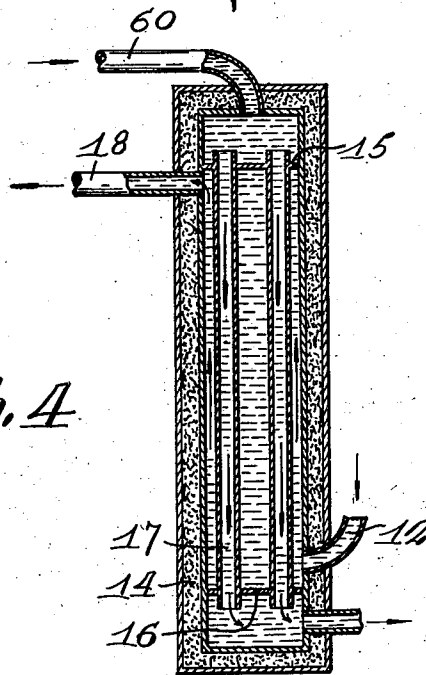


Fig. 4



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UNITED STATES PATENT OFFICE

2,096,093

REFRIGERATION

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Application April 28, 1936, Serial No. 76,803
In Canada April 29, 1935

7 Claims. (Cl. 62—119.5)

The present invention relates to the art of refrigeration and has particular reference to refrigeration of the absorption type.

An object of the invention is the provision of improved refrigerating means wherein the cycle of operations is automatically repeated.

Another object of the invention is the provision of refrigeration means of the above character which utilizes heat exchange action to attain improved refrigerating efficiency.

A further object of the invention is the provision of refrigeration means which may be installed in a refrigerator unit in such manner as to occupy a relatively small space.

Still another object of the invention is the provision of refrigeration means which operates without the use of movable mechanism.

A still further object of the invention is the provision of refrigeration means which is noiseless in operation.

Still another object of the invention is the provision of refrigeration means of the aforesaid character which is relatively simple and economical in construction.

Other objects and advantages of the invention will become apparent as the description progresses.

In the accompanying drawings forming a part of this specification and in which like reference characters are employed to designate corresponding parts throughout the same:

Figure 1 is an elevational view, partly in cross section, of a refrigerating apparatus embodying a preferred form of my invention.

Figure 2 is an enlarged fragmentary elevation, chiefly in cross section, of the generating means.

Figure 3 is an enlarged fragmentary section of a mixing device.

Figure 4 is a sectional view through a heat exchanger of the apparatus.

Figure 5 is an enlarged fragmentary section through a portion of the lower middle of Figure 1, and

Figure 6 is a section through a modified construction of a vaporizing device of the apparatus.

Referring to Figures 1 to 5 of the drawings, wherein for the purpose of illustration is shown a preferred embodiment of the invention, the numeral 10 generally designates a receiver, embodying an elongated closed container which normally contains a solution constituting a refrigerant, for instance ammonia dissolved in an absorption medium such as water. It is recognized, however, that other refrigerants such as alcohol,

ether, as well as other absorbent mediums may be used.

A conduit 12 having communicative connection with the bottom of the receiver 10, adjacent one end, depends downwardly therefrom and connects with a heat exchanger 14 embodying a vertical elongated insulated body having transverse partitions 15 and 16 disposed in the upper and lower portions of the interior chamber. A plurality of tubes 17 extend through the chamber and through the partitions, the ends of the tubes being open to communicate with the end chambers. As shown at Figures 1 and 4, the bottom of the conduit 12 connects with the central chamber adjacent the bottom thereof.

A horizontal conduit 18 connects with the upper portion of the intermediate chamber of the heat exchanger 14 and continues to form a spiral heating coil 20 disposed about a hollow cylindrical core 21 open at the bottom. Within the core 21 is fitted an electric heating element 22 although a gas burner or other heating means may be employed, if desired.

The upper portion of the heating coil 20 projects vertically upward concentrically through a vertical tubular element 23 closed at the bottom. The upper open end of the tubular element 23 has communicative connection with the bottom end of a cylindrical enlarged vaporizing chamber 24 provided with a plurality of transverse baffles having staggered openings therein. As shown at Figures 1 and 2, a vertical projection 20' of the generating coil 20 projects upwardly within the bottom portion of the vaporizing chamber and is open at the top to discharge therein.

A vapor conduit 26 is connected to the upper end portion of the chamber 24 and projects horizontally therefrom, this conduit being bent at a position spaced from the chamber and extends vertically downward and thereafter continues horizontally, as indicated at 27, away from the chamber. The end of the conduit 27 connects with a vertical conduit 29 the lower end of which connects with the bottom of the receiver 10. The upper end of the conduit 29 connects with the bottom portion of a vertically elongated rectifying tube 30 provided interiorly with a series of baffles 31 and exteriorly with cooling fins 32. To the upper end portion of the rectifier 30 is connected the upper extremity of a coil 34 having fins 35 thereon to form an air cooled condenser. The bottom of the coil 34 is extended to form a doubled loop 34' arranged in the top of an evaporating air cooler casing 36 and connecting with

the top of an evaporator coil 37 disposed in the casing. The evaporator casing may be filled with an anti-freeze solution and is provided with a plurality of recesses disposed to receive sliding elements carrying tapered containers 38 for the formation of ice.

To a horizontal projection 39 at the bottom of the coil 37 is connected a vertically depending conduit 40 connecting with the end of the projection 39 which preferably has a slight downward inclination. The conduit 40 is formed with a horizontal branch 41 at the bottom, which connects with the lower end portion of a tubular projection 42 depending from one end of a horizontal elongated vaporizing container 43. A conduit 44 connects one end of the container 43 with the receiver 10, the upper end of the conduit extending through the bottom of the container 43 so that its open end assumes an elevated position therein to maintain a predetermined liquid level while the lower end connects with the lower portion of the receiver 10 which is disposed at a lower level than the container 43. A branch conduit 45 connects with the top of the container 43, at the opposite end, and with the vertical conduit 29, above the container, as shown at Figure 1. A vertically disposed conduit 46 affords communication between the bottom of the rectifier 30 and the branch conduit 41 so that condensate liquor from the rectifier may drain into the container 43.

A coil 47 arranged above the receiver 10 and provided with cooling fins 48 forms an absorber. The lower end of the coil terminates with a vertical conduit 49 connecting with the top of the receiver 10. To the upper end of the absorber coil 47 is connected one end of a vertical conduit 50 connecting with a cooling coil 51 and with the lower chamber in the heat exchanger 14 and adapted to carry liquid from the exchanger to the top end of the absorber.

To the forward end portion of the absorber is also connected a conduit 52 extending upwardly and horizontally and bent downwardly at the rear end to connect with an upstanding tube 53 connected adjacent the outer end of the coil projection 39. Cooling fins 54 are preferably provided on the intermediate horizontal portion of this conduit.

A tubular mixing chamber 55 is mounted concentrically over the tube 53, the bottom of the chamber resting on the projection 39 while the top thereof is spaced above the upper outlet of the tube 53, as shown to advantage at Figure 3. A conduit 56 connects with the top of the chamber 55 and extends upwardly to connect with an upper projection 57 of the evaporator coil, as shown to advantage at Figure 1. A conduit 58 connects with the bottom portion of the mixing chamber 55 and extends downwardly and horizontally so as to project into the upper portion of the receiver 10 and to discharge therein. The bottom of the tubular member 23 communicates with the top of the heat exchanger 14 through the medium of a conduit 60 the upper end of which is connected to the lower end of the tube, while the bottom end connects with the upper chamber of the heat exchanger.

The operation of the apparatus is substantially as follows:—

The solution of refrigerant and absorption medium, as for instance ammonia and water, is conducted downwardly from the receiver 10 and discharges into the centre compartment of the

heat exchanger. It passes from the heat exchanger through the conduit 18 to the generating coil which is filled with the solution to the level of the liquid in the receiver. When the generating coil is heated by the electric heater 22 the ammonia, with a small percentage of water vapor, passes upwardly through the generator extension 20' and into the vaporizing chamber 24, a portion of the water vapor being removed by the baffles in the chamber. The unevaporated liquid, mainly water, flows back into the tube 23 and is conducted by the pipe 60 into the upper chamber of the heat exchanger, through the tubes 17 and outwardly and upwardly through the coil 51 and upwardly projecting conduit 50 to the top of the absorber 47. As this weak liquor is conducted through the tubes 17, it is in heat relation with the liquor supplied from the receiver and elevates the temperature thereof.

The vapor, mainly ammonia gas, is conducted from the chamber 24 through the conduit 26 and, while passing through the horizontal extension 27, is in heat exchange relation with the liquid in the vaporizing container 43. This vapor is carried upwardly through the pipe 29 into the rectifier 30 and enters the rectifier at a point above the level of liquid condensate therein. Any condensation occurring in the pipe 29 is carried downwardly into the receiver 10. After passage through the rectifier 30, the practically pure ammonia vapor is conducted through and, being cooled therein, is liquefied in the condenser coil 34. The liquefied ammonia passes from the outlet of the condenser into a very small extension loop 34' into the top of the evaporating coil in a liquid state. This extension loop 34' is purposely made small so as to minimize the transfer of heat from 34' to the brine of 36, as further explained later on. I prefer to introduce into the evaporating coil or into one of the conduits connected therewith an auxiliary agent lighter than and inert to the refrigerant, such as hydrogen, at a pressure approximately equal to the liquefying pressure of the refrigerant; said lighter agent is used as circulator and mixer in order to facilitate the circulation in certain parts of the system. The evaporation of the refrigerant proceeds rapidly in the coil in the presence of the auxiliary agent with consequent absorption of heat and refrigeration. The liquid ammonia flowing through the vaporizer coil passes downwardly through the conduit 40 and eventually into the container 43. The ammonia gas mixed with hydrogen is urged upwardly by the rising hydrogen and discharged upwardly through the mixer tube 53, the heavier excess being conducted from the mixing chamber downwardly through the pipe 59 and into the upper portion of the receiver 10. This gaseous mixture passes upwardly through conduit 49 into the absorber coil 47. The ammonia gas is absorbed by the weak liquor introduced into the top of the coil through the pipe 50 and flows into the receiver 10 while the liberated hydrogen escapes from the coil through the pipe 52. From the conduit 52, the hydrogen current discharges into the lower portion of the mixer tube 53 and mixes with the cold and heavy gases issuing from the lower portion of the evaporator coil and, acting as a circulator, is conducted upwardly as a mixture of hydrogen and cold ammonia vapor and passes into the top of the evaporating coil in the presence of the liquid refrigerant entering the coil. This admixture of the return liberated hydrogen auxiliary agent

with the cold gases in the mixing device enhances the cooling action in the evaporator.

As will be noted from Figure 1, the horizontal extension 27 of the vapor take-off conduit will raise the temperature of the solution of refrigerant and absorbing liquid maintained in the container 43 so that part of the refrigerant is vaporized and passes upwardly through the outlet branch 45 and conduit 29 to the rectifier. The vapor passes through the rectifier and the condenser, and the refrigerant, in a liquefied state, is fed into the top of the evaporator coil 37. This provides an auxiliary vaporizer which circulates a part of the refrigerant through a reduced circuit by-passing the absorber, the receiver and the main vaporizer or generator and increases the refrigerating efficiency of the system.

Even though the condenser 34 is of the air cooled type the apparatus can be efficiently operated under varying atmospheric temperatures, since said condenser is designed with a surface large enough for ordinary temperatures. But, whenever the atmospheric temperature rises too high, say above 90° F., only partial condensation may be effected in the air cooled condenser coil at the pressure prevalent in the system. If, however, the partly liquefied refrigerant is but slightly cooled below its critical temperature, liquefaction is easily obtained with very little absorption of heat therefrom. Consequently, the refrigerant from 34 is passed through the extension loop 34' disposed in the upper part of the evaporator casing, whereby the refrigerant is very effectively liquefied prior to introduction into the evaporating coil 37. This action can be explained as a "trigger" action, so to speak, and represents only slight absorption from the brine of casing 36, since, except in extreme cases, the refrigerant is liquefied and cooled in 34.

Therefore, the extension structure 34' provides a very important and advantageous element in refrigerating systems, enabling very efficient operation even at high atmospheric temperatures, without the necessity of employing exterior cooling means such as fans, cooling water or the like.

In the modification shown at Figure 6, the liquid in the auxiliary vaporizer shell 43 is partially heated by the vapor take-off conduit 28 and partially by the conduit 60' through which the liquid is conducted from the tubular receiver 23 to the heat exchanger 14. As shown in the drawings, the horizontally extending portion of the conduit 28 is vertically offset so that this section is disposed in heat exchange relation with the liquid in the container 43 and a remaining section 28' extends horizontally above the container.

The conduit 60 is arranged so that a portion 60' extends horizontally in the container 43 in heat exchange relation with the liquid therein. It is, therefore, apparent that both the vapor and liquid conduits connecting with the generator structure may be utilized to heat the liquid in the auxiliary vaporizer.

It is to be understood that the process and apparatus herein shown and described is to be taken as a preferred example of the same and that various changes as to the shape, size and arrangement of parts and steps of the process may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described my invention, I claim:—

1. The process of refrigerating which comprises heating a solution containing a refrigerant and

an absorbent medium in a main generator to vaporize the refrigerant, condensing the vapor and passing the liquefied refrigerant to an evaporator, collecting the liquid refrigerant passing from the evaporator in an auxiliary vaporizer and mixing some absorbent liquid therewith, heating the said solution in the auxiliary vaporizer by heat exchange with a fluid outlet from the main generator, condensing the vaporized refrigerant from the auxiliary vaporizer, and conducting the said condensed refrigerant to the evaporator.

2. In an absorption refrigerating process the steps of conducting a liquid refrigerant from the evaporator to an auxiliary vaporizer, mixing an absorbent medium with the said liquid refrigerant, heating the solution in the auxiliary vaporizer by a conduit conducting fluid from the main generator, condensing the refrigerant vapor passing from the auxiliary vaporizer, and conducting the condensed refrigerant from the condenser to the evaporator.

3. In an absorption refrigerating process which comprises heating of a solution of refrigerant and absorbing mediums to vaporize the refrigerant, condensing the vaporized refrigerant and conducting the same to an evaporator, the steps of collecting the liquid refrigerant passing from the outlet of the evaporator in an auxiliary evaporator, and mixing the same with an absorbing medium therein, heating the solution in the auxiliary evaporator by heat exchange with an outlet from the generator to vaporize liquid refrigerant in the auxiliary generator, condensing the vaporized refrigerant issuing from the auxiliary generator, and conducting the condensed refrigerant from the condenser to the evaporator.

4. In an absorption refrigerating process utilizing a refrigerant, an absorbing fluid and a light auxiliary gas, the steps of conducting the mixture of vaporized refrigerant and auxiliary gas through a mixer, passing the liberated auxiliary gas after separation from the refrigerant through the mixed gases in the mixer, and conducting the said gas from the mixer to the inlet portion of the evaporator.

5. In an absorption refrigerating apparatus, a generator, a condenser, a rectifier connected to said condenser, a downwardly extending vapor conduit connecting the generator with the rectifier, an evaporator adapted to receive liquid refrigerant from the condenser, an auxiliary vaporizer container communicating with the evaporator so that liquid refrigerant from the said evaporator flows to the said container, a conduit connecting with the vaporizer adapted to conduct therein condensate from the rectifier, the solution in the vaporizer container being heated by the vapor conduit extended from the generator so that refrigerant may be evaporated in the auxiliary vaporizer and passed through the condenser to the evaporator by-passing the generator, a receiver adapted to receive fluid from the auxiliary vaporizer and the evaporator, an absorber, and means for feeding fluid from the receiver through a heat exchanger to the generator.

6. In an absorption refrigerator apparatus of the type employing an auxiliary inert gas including a generator, a condenser, an evaporator, an absorber, a receiver, and means interconnecting the said members, a mixer through which the refrigerant and auxiliary agent gases pass on discharge from the evaporator, and a conduit connecting with the mixer so that the auxiliary gas is caused to pass through the mixed vapors

as it is conducted to the receiver and evaporator.

7. In an absorption refrigerating apparatus including a generator, a condenser, an evaporator, an absorber and means interconnecting the said members, an auxiliary vaporizing container connected so as to receive liquid refrigerant from the evaporator and absorbing fluid from the condenser, the said vaporizer having a conduit carry-

ing the vapor from the generator to the condenser passing therethrough so as to heat the liquid in the said vaporizer so that evaporated refrigerant will be conducted through the condenser to the evaporator and by-pass the absorber and generator.

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