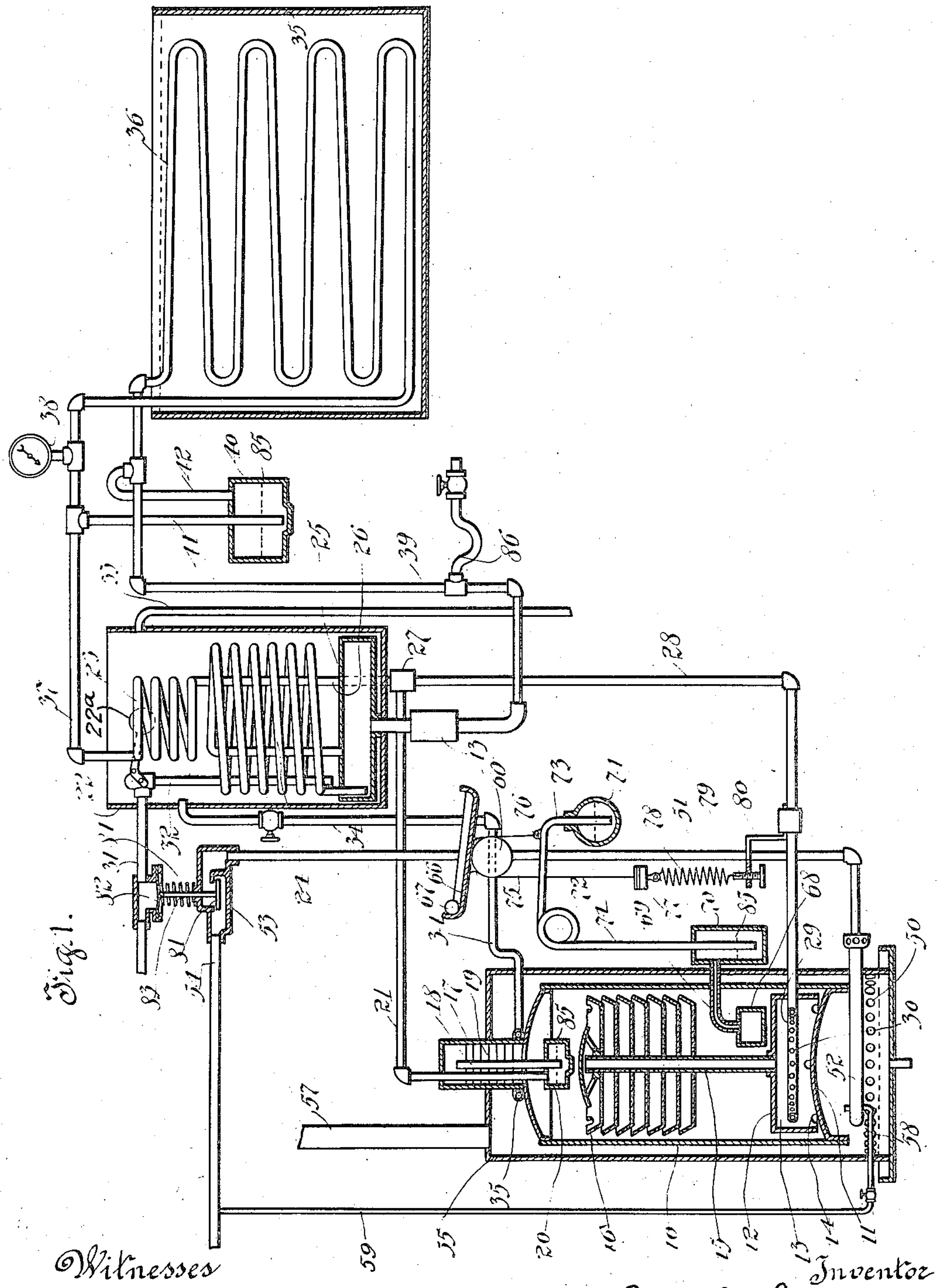
E. C. LOETSCHER.

REFRIGERATING APPARATUS.

APPLICATION FILED JULY 10, 1913.

1,151,202. Patented Aug. 24, 1915.

2 SHEETS—SHEET 1.



Witnesses

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Fig. 2.

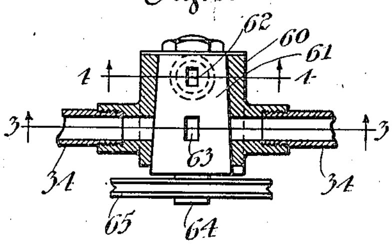


Fig. 3.

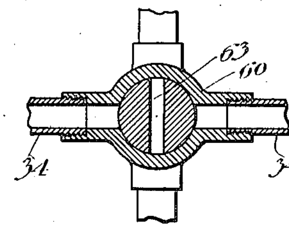


Fig. 4.

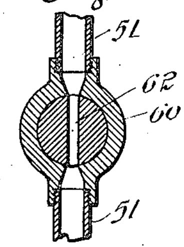


Fig. 5.

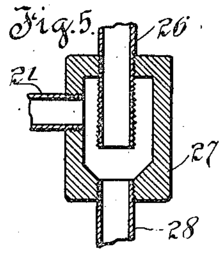


Fig. 6.

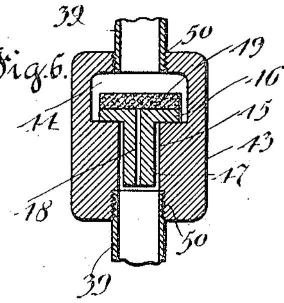


Fig. 7.

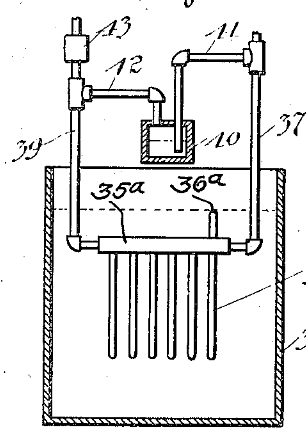


Fig. 9.

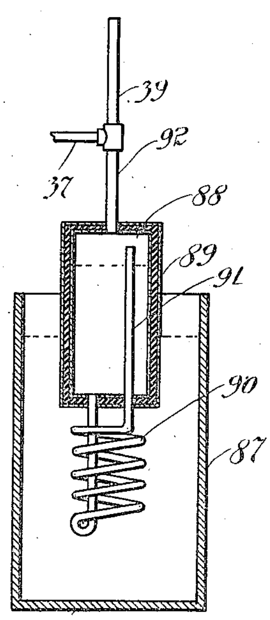
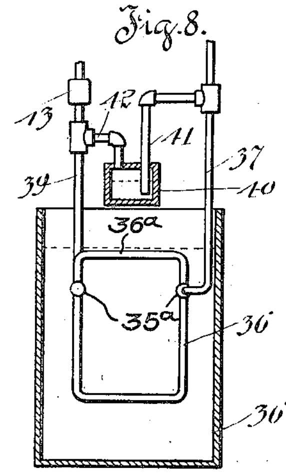


Fig. 8.



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UNITED STATES PATENT OFFICE.

EMIL C. LOETSCHER, OF DUBUQUE, IOWA.

REFRIGERATING APPARATUS.

1,151,202. Specification of Letters Patent. Patented Aug. 24, 1915.

Application filed July 10, 1913. Serial No. 778,247.

To all whom it may concern:

Be it known that I, EMIL C. LOETSCHER, a citizen of the United States, residing at Dubuque, in the county of Dubuque and State of Iowa, have invented certain new and useful Improvements in Refrigerating Apparatus, of which the following is a specification.

My invention relates to certain new and useful improvements in refrigerating apparatus and more particularly to a machine of the absorption type.

One of the principal objects of the invention is to provide a machine which shall be automatic in its operation and wherein the refrigerant is contained within an apparatus that is substantially seamless in that there are practically no moving parts in the path of the refrigerant.

A further object of my invention resides in the means for effecting a quick absorption of the expanded gas.

Still further objects of the invention reside in the automatic means for alternately introducing heat and applying a cooling medium to the generator-absorber and in means for rendering the machine inoperative in the event that the condenser fails to operate.

Minor details of construction will be hereinafter more fully described and are shown in the accompanying drawing, in which—

Figure 1 is a side elevational view in section of my complete refrigerating apparatus; Fig. 2 is a sectional view of a two-way control valve; Fig. 3 is a section on the line 3—3 of Fig. 2; Fig. 4 is a section on the line 4—4 of Fig. 2; Fig. 5 is a detail sectional view of the equalizing and separating fitting; Fig. 6 is a detail sectional view of the expansion valve; Fig. 7 is a side elevational view of the brine tank with the tank in section; Fig. 8 is an end view of Fig. 7; Fig. 9 is a detail sectional view of a modified form of receiver and refrigerating coil within the brine tank, the receiver and brine tank being shown in section.

Referring now more particularly to the drawings the apparatus as a whole consists essentially of three main sections, namely, the generator-absorber member, the rectifying and condensing member and the refrigerating member, which will be described in the order named and the relations of one to the other.

The generator-absorber.—Referring now to Fig. 1 the generator-absorber performs two functions, namely, the distillation of vapor from the refrigerant contained therein, such as pure aqua ammonia and the absorption of the vapor upon its return thereto. I preferably construct the generator-absorber 10 from metal that will withstand high pressure and which will not be affected by the action of the ammonia solution therein; said generator-absorber 10 is preferably provided with an arced bottom 11 upon which rests a shell 12 forming a supplementary generating chamber 13 in communication with the interior of the main generator by means of the opening 14. Secured to the shell 12 and communicating with the supplementary generating chamber is a vapor and liquid-conveying member 15, preferably extending vertically within the generator 10 and terminating below the top thereof, but above the liquid to be contained therein.

Upon the member 15 are mounted a plurality of distributing super-imposed members, each one of which has inwardly projecting sides so that the open upper edge of each member projects beyond the lower edge of the member above, whereby a liquid is caused to pass through the member 15 flowing from the open upper end thereof into the upper distributing member 16. When said distributing member is filled the liquid flows over the open upper edges thereof trickling down the inclined side edges into the distributing member below until all of the distributing members are filled, whereupon the liquid again passes into the gener- container.

Arranged preferably at the top of the container 10 is an analyzing chamber 17 into which a pipe 18 projects, which is open at both ends, and which may be supported by a series of perforated baffle plates 19. Mounted upon the lower end of the pipe 18 is a trap 20, the lower end of the pipe 18 communicating with the interior thereof. A pipe 21 extends through the upper end of the analyzing chamber 17 and also communicates with the interior of the trap 20.

The rectifier and condenser.—The rectifier and condenser comprises a receptacle 22 for containing water or any cooling medium, within which are mounted the rectifying coil 23 and the condensing coil 24, the latter having its two ends terminating within a liquid container 25, one end of said coil being disposed above the other end. One end of the rectifying coil 23 terminates in a downwardly extending arm 26 opening into the equalizing and separating chamber member 27, shown in detail in Fig. 5. The pipe 21 also opens into the interior of the equalizing and separating chamber 27 and preferably at a point above the open end of the pipe 26. A pipe 28 leads from the lower end of the separating chamber 27 to the auxiliary chamber 13 and having one or more openings terminating in a head 29 provided with perforations or other openings 30.

As a means for admitting and withdrawing the cooling medium from the rectifier and condenser I have provided a supply pipe 31, having an extension 32 terminating near the lower end of the member 22 and the over-flow pipe 33. A spray pipe 34 communicates with the member 22 at one end and preferably terminates at its other end in a perforated ring 35 surrounding the hood 17 to spray the generator absorber 10 with the liquid medium contained within the rectifier and condensing member 22.

The refrigerating member.—The refrigerating member comprises a refrigerating tank adapted to contain brine or any other non-freezing liquid, within which the refrigerating coil 36 is placed. The refrigerating coil has one end connected to one end of the rectifying member 23 by the pipe 37, coupled to which pipe a pressure gage 38 is herein shown and the other end of the refrigerating coil 36 is in communication with the interior of the liquid container 25 through the medium of the pipe 39. A trap 40 is in communication with the pipe 37 by means of the pipe 41 which preferably terminates near the bottom of the trap, while the pipe 39 is in communication with the trap 40 through the pipe 42 terminating near the upper wall of the trap 40. The expansion member 43 is secured to the pipe 39 at any convenient point between the refrigerating member 36 and the container 25, said expansion member being shown in detail in Fig. 6, comprising a valve chamber 44 having an extension to provide a valve opening 45. A valve 46 is movably mounted within the valve chamber 44 and carries the valve stem 47, said valve and valve stem being provided with an opening 48. A filtering material 49 covers one end of the opening 48 and is preferably carried by the valve head 46. Said expansion valve 43 is provided with two pipe-receiving openings 50 to receive two sections of the pipe 39.

As a means for applying heat to the generator-absorber member 10 I have herein shown the apparatus as intended to be used with a gas-heating medium, although any suitable heating medium may be employed, said apparatus consisting of a gas pipe 51 terminating in a heating coil 52 disposed beneath the curved bottom plate 11 of the member 10, said gas pipe 51 communicating with a valve 53, the function of which will be hereinafter more fully described, said valve having a pipe 54 leading into the same which communicates with the source of gas supply.

A shell 55 surrounds the generator-absorber member 10 and is provided with a plurality of air intake openings 50 near its lower bottom edge and a flue 57. As the heating fluid such as gas, passing through the pipe 51 is intermittently cut off and applied by mechanism hereinafter to be described, I provide a pilot burner 58 having its burner end terminating adjacent the heating coil 52 and connected to the pipe 54 by means of the pipe 59.

During the process of refrigeration it is necessary to automatically and alternately heat and cool the generator-absorber and to this end I provide automatic controlling means as follows: The fluid supply pipe 34 conveying the cooling medium to the generator-absorber is preferably so situated relative to the pipe 51 containing the heating fluid that both of said pipes are caused to pass through the compound valve 60 which embodies the plug 61 having a heating fluid opening 62 and a cooling fluid opening 63 so that when the long axis of the opening 63 is at right angles to the pipe 34 the valve is closed, and when the long axis of said opening is parallel with the axis of said pipe 34 where the same passes through the valve, said valve is in wide open position; it being equally true that when the long axis of the valve opening 62 is parallel with the vertical axis of the pipe 51 the valve is in open position and when at right angles to the vertical axis of the pipe 51 said heating-fluid valve is closed. A stud 64 is axially mounted on the valve plug 61 and carries a grooved wheel 65. Mounted upon the wheel 65 is an auxiliary operating means comprising a race-way within which a ball or other suitably shaped weighted member 67 is adapted to move or roll, and the function of which will be more particularly described.

A turning movement is imparted to the valve plug 61 by the novel mechanism now to be described: Within the generator-absorber 10 is placed a pressure chamber 68 supported by a pipe 69, one end of which communicates with the interior of the chamber 68 and which projects through the side walls of the members 10 and 55 and having its other end opening into the pressure chamber 70 near its upper end. A pipe 71 extends into the chamber 70 and having its end disposed below the point where the pipe 69 enters the same. Said pipe 71 is herein shown as formed with one or more convolutions 72 and terminating in a downwardly extending end 73, confined within a chamber 74. The pipe 71 is preferably made of spring metal so that the end carrying the chamber 74 yields relative to the vertical portion 71. A belt or cord 75 passes over the grooved wheel 65 and has one end secured to the lug 76 on the pipe 71 and its other end to a weighted block 77. A spring 78 is connected at one end to the weighted block 77 and at its other end to an adjusting screw 79, the latter being supported by a bracket 80 with which it has a screw-threaded engagement, said bracket being supported by any suitable means.

A valve 81 is positioned within the valve casing 53 and connected to the diaphragm 82 by means of the valve stem 83. The diaphragm 82 spans an opening in the pipe 31 while the valve 81 is intended to seat so as to close the opening in the valve casing 53 to prevent the flow of the heating fluid through the pipe 51. The tension of the diaphragm is such that so long as the pressure of the fluid passing through the pipe 31 is sufficient to overcome the tension of the spring 84 and such slight pressure as there may be upon the valve 81, the valve 81 will remain unseated allowing the fluid heating medium to pass through the pipe 51, whereas if the source of supply of the fluid passing through the pipe 31 should be cut off, the spring 84 would immediately shut the valve thereby cutting off the fluid heating supply, which would remain shut off until the liquid was again caused to pass through the pipe 31. This valve mechanism is in the nature of a safety device for the sole purpose of preventing the operation of the machine in the event that one of the elements essential to its operation should inadvertently or otherwise be interrupted.

Assuming that there is a proper supply of aqua ammonia or other suitable medium in the generator-absorber 10, which under normal conditions would approximately cover the third distributing member 16 from the bottom, and with both the heating and cooling fluids supplied to their respective parts, and that the valve opening 62 was in a vertical position so that the heating fluid is being supplied to the burner and the burner lighted, and further assuming that there is a liquid in the chamber 70 and the traps 20 and 40 to the height of the liquid levels indicated at 85 and that the container 68 is partially filled with aqua ammonia of a predetermined degree of saturation, or any other volatile fluid capable of forming a vapor pressure, and still further assuming that substantially all of the air within the system has been exhausted by means of an exhaust pump being applied to any convenient point, such as the joint 86 which may be thereafter sealed, the operation of the machine is as follows: Heat being applied to the curved bottom wall 11 of the generator-absorber, the aqua ammonia confined within the chamber 13 is heated and as such ammonia has a very low boiling point a gaseous vapor is instantly formed which, of course, tends to rise and the only outlet therefor is through the pipe 15. The rising of the vapor will trap portions of the liquid within said pipe 15, which will be carried upward and flow over the upper end of the pipe into the top distributing member 16, the vapor, however, continuing to rise through the baffle plates 19 to the highest point within the generator-absorber. As the heating process continues the distributing members 16 become successively filled, causing the liquid to flow over their outer edges and thereby affording a very great evaporating surface which tends to cause more perfect distillation of the fluid and as the distillation progresses and more vapor is produced, the level of the liquid within the generator-absorber becomes less in height, thereby exposing more distributing members.

In the meantime the vaporization of the liquid is creating a pressure in the upper part of the generator-absorber causing the gaseous vapor to pass through the pipe 18 and when the pressure of the liquid, such as mercury, within the trap 20 is less than the vapor pressure within the generator-absorber, the gaseous vapor will thereupon pass through the liquid trap into the pipe 21 to the separating member shown more in detail in Fig. 5. The gaseous vapor entering the chamber of the separating member 27 will thereupon rise through the pipe 26 into the rectifier, whereupon the condensed vapor which reaches the separating member 27 will gravitate through the pipe 28 back to the chamber 13 to be vaporized. The gaseous vapor thereupon enters the rectifier 23 which is submerged in a cooling medium contained in the receptacle 22, the function of the rectifier being to condense all of the water vapor within the gaseous vapor entering the same but to leave the ammonia gas unaffected, whereupon the ammonia gas passes into the pipe 37. The ammonia gas in passing through the pipe 37 has the choice of two ways, namely, either directly into the refrigerating coil 36 or through the pipe 41 into the trap 40 and up through the liquid seal therein into the pipe 42 and thence into the refrigerating member 36, or back through the pipe 39. As the ammonia vapor passes into the refrigerating member 36 the ammonia gas is condensed until the refrigerating member is full of the condensed gas unless the refrigerating member is already full of condensed gas due to the previous operation of the machine. When the refrigerating member is full of condensed gas and, therefore, no more gas can enter the same the gas in the pipe 37 now enters the pipe 41 passing through the liquid sealed in the trap 40 into the pipe 42, and since it cannot pass into the refrigerating member, it flows through the pipe 39 into the receiver 25 constituting part of the condensing member. The flow of the gas into the receiver 25 is practically unobstructed in passing through the expansion member 43 since the valve 46 in said expansion member will readily rise under slight pressure.

The receiver 25 and the condensing coil 24 being both submerged in a cooling medium, gas entering said condensing member will thereupon rise through the opening of the condensing coil at the top of the receiver 25 and will gradually be condensed in the condensing coil, thereby filling the receiver 25 with condensed gas. When the receiver 25 is filled or substantially filled with condensed gas the heating of the ammonia within the generator-absorber is automatically discontinued and the absorption process then automatically started by the following novel means: There being aqua ammonia in the chamber 68, or any other suitable liquid, and as the temperature of the fluid within the generator-absorber has risen to a high degree, the aqua ammonia in the chamber 68 will form a vapor pressure which will be transmitted through the pipe 69 to the interior of the chamber 70 and exert pressure upon the top surface of the liquid within said chamber 70, which liquid is preferably mercury. The mercury will thereupon rise through the pipe 71 passing through the convolution or convolutions 72 into the ball chamber 74 and as the ball chamber gradually receives the liquid the weight of the ball will consequently be increased and at the same time the air within the ball will be compressed. As the weight of the ball increases, the end 73 will begin to fall against the action of the spring pipe 72 and through the cord 75 imparts a turning movement to the valve plug 61. It is desirable that the turning movement given to this valve at this point be rapid and to this end I have mounted the ball guide 66 upon the pulley wheel 65 so that a partial rotation of said pulley wheel tilts the ball guide, causing the ball therein to roll or move toward one end and thereby impart a speedy rotative movement to the valve plug 61. The rotation of the valve plug either shuts off the flow of the heating medium and opens the valve to permit the flow of the cooling medium or shuts off the valve to stop the flow of the cooling medium and opens the valve to permit the flow of the heating medium.

In the process so far described it is essential that the heating medium be shut off and the parts are shown in Fig. 1 with the ball guide in such position that the ball is about to roll to the other end, thereby shutting off the heating fluid and opening the valve in the cooling fluid pipe. An adjustment of this valve mechanism may be effected by suspending a weight 77 from one end of the cord 75 and interposing a tension spring 78 between the weight 77 and the adjustable set-screw 79.

The source of heat being now cut off a cooling medium, such as water, flows from the receptacle 22 through the pipe 34 into the perforated ring 35, the cooling fluid thereupon being sprayed over the edge of the generator-absorber cooling the same, as well as the vapor and liquid therein. The condensation of the vapor gases in the generator-absorber reduces the pressure within said generator-absorber and as the remaining fluid therein begins to cool, it gradually absorbs the ammonia gas throughout the entire apparatus. Unless the ammonia gas throughout the apparatus is absorbed in a rapid manner, the temperature of the condensed gas in the refrigerating member 36 will remain at substantially the same temperature as the liquid medium in which said refrigerating member is submerged and the heat units in the surrounding liquid will not be absorbed to produce refrigeration. To obtain a rapid absorption and low degree of temperature in the fluid surrounding the refrigerating member 36 I utilize the distributing member 16 in the generator-absorber as a means for exposing a large liquid surface to the absorbing action of the ammonia gas flowing into the generator-absorber through the pipe 28. As the ammonia gas from the refrigerating member 36 is absorbed, the liquid ammonia in said refrigerating member boils, thereby absorbing the heat units in the brine surrounding the refrigerating member and contained in the receptacle 35, thus producing refrigeration. In the absorption process, the gas entering the generator-absorber through the pipe 28 in combining with the liquid in the generator-absorber produces heat, causing the vapor and liquid to rise in the pipe 15, said liquid flowing into the top distributing member 16 and successively into the distributing members below, thus exposing a large liquid surface to aid the absorption of the gas.

During the absorption process the condensed gas in the condensing coil 24 and container 25 is under pressure due to the temperature of the liquid within the container 22, with the result that the liquefied gas therein is forced into the expansion member 43. The valve 46 being seated the liquefied gas thereupon passes through the filtering material 49 into the restricted passage 48 and thereby gradually escapes through the restricted passage 48 into the pipe 39, whereupon said liquefied gas returns through the refrigerating member 36, pipe 37, rectifier 23 and pipe 28 into the generator-absorber.

In the return flow of the liquefied gas from the container 25, such gas as will pass into the pipe 42 will cause the non-volatile liquid in the trap 40 to rise in the pipe 41 until the pressure of the liquid in the pipe 41 is equal to the pressure of the gas in the pipe 42; consequently, the liquefied gas will flow into the refrigerating member 36, whereupon it absorbs heat units, having been reconverted into a gas on account of the temperature of the brine and returns to the generator-absorber as above indicated. Such gas in its return flow through the rectifier 23 into the pipe 28 as may be diverted into the pipe 21 will create a pressure in the trap 20 thereby causing the non-volatile liquid therein to rise in the pipe 18 until the pressure of said liquid equals the pressure of the gas in the trap 20 so that the gas must necessarily pass back through the equalizing or separating member 27 into the pipe 28.

In an apparatus of this character it is most desirable to eliminate as far as possible any moving or mechanical valves which might become gummed or clogged and thereby prevent the successful operation of the apparatus. In my system of piping as herein shown, any pressure that may be created in the pipe 28 during the heating process is equalized by the pressure in the pipe 21, since these two pipes open into a common chamber with the result that only the gaseous vapor can pass into the rectifier.

I wish to direct particular attention to the novel arrangement of the combined rectifier and condenser. In the construction shown, the condenser and rectifier are mounted within the container 22, to which container the cooling liquid supply pipe 31 is connected with its discharge end terminating near the bottom of the container. A liquid cooling medium of a comparatively low degree of temperature is necessary to liquefy the ammonia gas so that I arrange the condenser and the receptacle 25 near the bottom of the container 22 whereby the cooling medium will surround the coil 24 and container 25 when in its coolest state; whereas, the rectifier is so constructed that its superficial area is appreciably less than the superficial area of both the coil 24 and the container 25, but with a certain definite area relation. By means of such construction I am enabled to place both the condenser and the rectifier within the same container and to surround them by the same cooling medium, provided a definite area relation is maintained between these parts and the rectifier is positioned a predetermined distance above the condensing coil where the warmed cooling medium rising to the surface will surround the same.

The overflow pipe 33 is merely for the purpose of maintaining a proper level of cooling medium in the container 22. The float valve 22^a maintains the level of the liquid in the tank 22.

Assuming now, that refrigeration has taken place in the container 35 and that the liquefied ammonia and the ammonia gases have been absorbed and returned to the generator-absorber, with the exception of the liquefied gas in the refrigerating member 36, it is then desirable to discontinue the absorption of such liquefied gas as remains in the apparatus and to begin the generation of ammonia gas in order that refrigeration may continue. The controlling mechanism is so designed that as the liquid within the generator-absorber cools, the aqua ammonia within the receptacle 68 absorbs the compressed vapor in the receptacle 70 and the pressure in the ball chamber 74 created by the inflow of the non-volatile fluid therein, causes said non-volatile fluid to return through the pipe 71 into the receptacle 70. The gradual returning of said non-volatile fluid causes a rotation of the valve 61 in a direction reverse to that previously described through the medium of the spring 78, the inherent spring tension in the pipe 71 and, ultimately, by the movement of the ball 67 in the guide 66, thereby closing the valve opening 63 so as to shut off the cooling liquid supply and moving the valve opening 62 so as to permit the fluid heating medium in the pipe 34 to pass into the coil 52, whereupon the fluid heating medium will be ignited by the flame from the pilot burner 58 and the generation of the vapor gas will then proceed as heretofore described.

It is extremely desirable in a machine of the character described, to provide some means for rendering the machine inoperative in the event that any of the working parts become disarranged, or the source of supply of any of the elements necessary for the perfect operation of the machine be cut off. Since there are substantially no moving parts of my apparatus which can become defective through wear and as no injury could be done the machine by the fluid heating medium being cut off there is, consequently, only one contingency that might happen which would result in injury to the apparatus, namely, the shutting off of the cooling medium supply while the generation of the gas is in process. To guard against such contingency I interpose the valve 81 in the valve chamber 53, which valve controls the admission of the fluid heating medium to the pipe 51, and in the event that the fluid cooling medium should fail to flow through the pipe 31 and in the absence of pressure upon the diaphragm 82, said pressure being the normal pressure of the fluid cooling medium passing therethrough, the tension of the spring 84 is such that it would cause the valve 81 to seat, thereby shutting off the fluid heating medium supply and rendering the machine inoperative.

In the apparatus as heretofore described there is only one valve in the system through which the refrigerant passes, namely, the valve 43 and if desirable, this valve can be done away with without altering the principle of operation of the apparatus. Instead of employing the refrigerating member 36, and brine tank 35 as herein shown, I may use a brine tank 87 (Fig. 9) in which a receptacle 88 is suspended that is provided with an insulated outer wall 89. The refrigerating member 90 is connected at one end to the lower bottom wall of the receptacle 88 and opening thereinto, while one end of the refrigerating member is provided with a vertical extension 91 terminating within the interior of said receptacle 88 near the top wall thereof. The pipe 37 is connected directly with the pipe 92, the latter being in communication with the pipe 39. When this form of refrigerating member is substituted for the refrigerating member 36 and brine tank 35, the trap 40, pipes 41 and 42 and valve 43 are eliminated. In this modified form of construction the liquefied gas from the receptacle 25 will pass through the pipe 39 and will be trapped in the receptacle 88 and refrigerating coil 90 and during the absorption process the liquid in the refrigerating coil 90 is converted into gas and returns to the generator-absorber through the pipe 37, the insulation surrounding the receptacle 88 preventing said receptacle from acting as a condenser during the generating stage by preventing the gas therein from dissipating heat to the colder atmosphere and brine surrounding the receptacle 88. The gradual reflow of the liquefied gas from the receptacle 25 is accomplished by means of the restricted orifice 48, whereas, when said valve member 43 is omitted the gradual reflow of the liquefied gas in the receptacle 88 is accomplished, due to the cooling medium surrounding the refrigerating member 90 being of a much lower temperature than the cooling medium surrounding the container 25, with the result that the liquefied gas within the receptacle 88 is boiled much more slowly than the liquefied gas within the container 25, thereby causing a gradual return flow of the liquefied gas therein through the pipe 37 to the generator-absorber.

Figs. 7 and 8 show a modified arrangement of the refrigerating member together with the expansion member 43 and trap 40. Under certain conditions more especially when the machine is cooling the brine for the first time and, the latter is very warm, due to the temperature of the surrounding air, I have found that the construction shown in Fig. 1 may cause the liquid in trap 40 to be forced up into pipe 41 so rapidly that most of it is forced into pipe 37, and thence into the generator-absorber through pipe 28. Such action would make the machine inoperative, as the expanding vapor in pipe 39 could then pass through the trap 40 directly into pipe 37 without meeting the usual resistance. Thus the cold gas would not enter the coil 36 at all and no cooling of the brine could take place except that which could be accomplished by the evaporation of the refrigerant contained in said coil at the time absorption begins but all of the liquid in container 25 would by-pass through the trap instead of being forced through coil 36. Another cause for such action is found in the excessive friction of the numerous bends in coil 36 to the passage of the vaporized refrigerant, which may cause so high a back pressure in coil 36 that it may overcome the resistance of the liquid in pipe 41 which would cause the same result. In order to prevent such action, I provide a plurality of coils connected to headers 35^a at both ends thereof, as shown in Figs. 7 and 8. The pipe 39 connecting to one of the headers in one side and the pipe 37 connecting to the other header at the opposite side. An equalizing pipe 36^a is connected above the headers as shown. Said pipe serves the purpose of equalizing the pressures in the pipes 39 and 37 at all times, thus preventing the action described. Furthermore the multi-coil construction reduces the back pressure in the coil 36 because it provides numerous passages for the coils to free themselves of gas as compared with the construction shown in Fig. 1.

Having now described my invention, I claim:

1. In a refrigerating apparatus of the absorption type, the combination of a combined generator-absorber, a rectifier, a refrigerating member, a condenser, intercommunicating means between said members for directing the refrigerant from said generator-absorber through said members and to return said refrigerant to said generator-absorber, means for heating said generator-absorber and means within said generator-absorber for causing the vapor produced by said heat together with liquid to rise in a fixed path, and means interposed in the return path of the liquid for holding part thereof above the normal level of the liquid in said generator-absorber.

2. In a refrigerating apparatus of the absorption type, the combination of a combined generator-absorber, a rectifier, a refrigerating member, a condenser and inter-

communicating means between said members to cause a refrigerant to flow in a predetermined path through said members and return to said generator-absorber, said generator-absorber having one of the communicating means opening thereinto at its top for the outlet of the refrigerant and another communicating means opening thereinto near its bottom for the return of said refrigerant, and means adjacent the latter communicating means for heating said generator-absorber.

3. In a refrigerating apparatus of the absorption type, the combination of a combined generator-absorber, a rectifier, a refrigerating member, a condenser and intercommunicating means between said members causing a refrigerant to flow in a predetermined path from one point in said generator-absorber through said members to another point in said generator-absorber, an auxiliary chamber in said generator-absorber within which said refrigerant is caused to flow on its return, means for heating said generator-absorber adjacent said auxiliary chamber, a conduit secured to said auxiliary chamber to guide the refrigerant in its upward travel and means adjacent said conduit for causing the refrigerant passing therethrough to spread out and present a large evaporating or absorbing surface.

4. In a refrigerating apparatus of the absorption type, the combination of a combined generator-absorber, a rectifier, outlet communicating means between said generator-absorber and rectifier, a refrigerating member, communicating means between said refrigerating member and said rectifier, a condenser, communicating means between said condenser and said refrigerating member, communicating means between said generator-absorber and rectifier, return communicating means between said rectifier and generator-absorber, said outlet and return communicating means being in communication with each other.

5. In a refrigerating apparatus of the absorption type, the combination of a combined generator-absorber, a rectifier, outlet communicating means between said generator-absorber and said rectifier, a refrigerating member, communicating means between said rectifier and refrigerating member, a condenser, communicating means between said condenser and refrigerating member, a return communicating means between said rectifier and said generator-absorber, said outlet and return communicating means being in communication with each other and a pressure equalizing member at the juncture of said outlet and return communicating means and positioned above the level of the liquid in said generator-absorber.

6. In a refrigerating apparatus of the absorption type, the combination of a generator-absorber, a rectifier, communicating means between said generator-absorber and said rectifier, a refrigerating member, communicating means between said refrigerating member and said rectifier, a condenser, communicating means between said condenser and said refrigerating member and return communicating means between said rectifier and said generator-absorber and a receptacle adapted to contain a cooling medium and in which said rectifier and condenser are contained.

7. In a refrigerating apparatus of the absorption type, the combination of a generator-absorber, a rectifier, communicating means between said generator-absorber and said rectifier, a refrigerating member, communicating means between said refrigerating member and said rectifier, a condenser, communicating means between said condenser and said refrigerating member and return communicating means between said rectifier and said generator-absorber and a receptacle adapted to contain a cooling medium and in which said rectifier and condenser are contained and means for introducing a cooling medium into said receptacle adjacent the condensing member.

8. In a refrigerating apparatus of the absorption type, the combination of a generator-absorber, a rectifier, communicating means between said generator-absorber and said rectifier, a condenser positioned below said rectifier and of greater superficial area than said rectifier, a common receptacle for said rectifier and condenser adapted to contain a cooling medium, means for introducing a cooling medium into said container near the bottom thereof, a refrigerating member, communicating means between said rectifier and refrigerating member, communicating means between said condenser and refrigerating member and a return communicating means between said rectifier and said generator-absorber.

9. In a refrigerating apparatus of the absorption type, the combination of a combined generator-absorber, a rectifier, a refrigerating member, a condenser, communicating means between said generator-absorber and said rectifier, communicating means between said rectifier and refrigerating member, communicating means between said refrigerating member and said condenser, return communicating means between said rectifier and generator-absorber and means between the communicating means between said rectifier and refrigerating member and the communicating means between said condenser and refrigerating member for causing the refrigerant to flow from said rectifier into said condenser when said refrigerating member is substantiallv full of the refrigerant.

10. In a refrigerating apparatus of the absorption type, the combination of a generator-absorber, a rectifier, a refrigerating member, a condenser, communicating means between said rectifier and refrigerating member, communicating means between said condenser and refrigerating member, return communicating means between said generator-absorber and said rectifier, outlet communicating means between said generator-absorber communicating with the return communicating means between said rectifier and generator-absorber and fluid control valves for preventing the return of a refrigerant through said outlet communicating means into the said generator-absorber.

11. In a refrigerating apparatus of the absorption type, the combination of a generator-absorber, a rectifier, communicating means between said generator-absorber and said rectifier, a refrigerating member, communicating means between said rectifier and said refrigerating member, a condenser, communicating means between said condenser and said refrigerating member, means between said rectifier and refrigerating member for permitting the flow of a refrigerant from said rectifier into said condenser and preventing the flow of the refrigerant from said refrigerating member to said condenser and means in the path of travel of the refrigerant from said rectifier to said condenser permitting an unobstructed passage to the flow of said refrigerant into said condenser and restricting the flow of the refrigerant from said condenser to said refrigerating member.

12. In a refrigerating apparatus of the absorption type the combination of a generator-absorber, a rectifier, communicating means between said generator-absorber and said rectifier, a refrigerating member, communicating means between said rectifier and said refrigerating member, a condenser, communicating means between said condenser and said refrigerating member, means between said rectifier and refrigerating member for permitting the flow of a refrigerant from said rectifier into said condenser and preventing the flow of the refrigerant from said refrigerating member to said condenser and means in the path of travel of the fluid between said condensing member and said refrigerating member for varying the flow of the refrigerant between said members in opposite directions.

13. In a refrigerating apparatus of the absorption type, the combination of a generator-absorber, a rectifier, a refrigerating member, a condenser, inter-communicating means between said members, return communicating means between said rectifier and said generator-absorber, a heat conveying member terminating in a burner for heating said generator-absorber, a cooling fluid conveying member having a discharge end adjacent said generator-absorber for discharging a cooling fluid thereon, controlling means for said heat conveying and cooling fluid conveying members, a chamber within the generator-absorber adapted to contain a volatile liquid, a chamber outside of said generator-absorber, a communicating passageway between said chambers and means between said controlling means and the chamber outside of said generator-absorber for effecting the movement of said controlling means by pressure created in said last named chamber by the volatilization of the liquid in said first named chamber.

14. In an apparatus of the character described embodying an absorber-generator, automatic controlling mechanism for alternately heating and cooling the absorber-generator, comprising controlling means, a chamber within the generator-absorber adapted to contain a volatile liquid, a chamber outside of said generator-absorber, a communicating passageway between said chambers and means between said controlling means and the chamber outside of said generator-absorber for effecting the movement of said controlling means by pressure created in said last named chamber by the volatilization of the liquid in said first named chamber.

15. In an apparatus of the character described, a controlling means for controlling the flow of heating and cooling agents along two different channels and means for effecting the movement of said controlling means in opposite directions comprising a tubular spring member, a pressure chamber at each end thereof into which the ends of said tubular spring members open, a liquid containing chamber in communication with one of said pressure chambers and adapted to contain a volatile fluid, a non-volatile fluid in the compression chamber that has a communicating passageway with said volatile fluid containing chamber, a flexible connection between said tubular spring member and said controlling means and means for heating said chamber containing the volatile fluid whereby a pressure is created in the pressure chamber containing said non-volatile fluid to force said non-volatile fluid through said tubular spring member into the other pressure chamber, whereby the weight of said last named pressure chamber is increased and causing movement of said controlling means in one direction through the medium of said flexible member, said fluid in said last named pressure member being returned to the other pressure chamber by air pressure upon the cooling of the volatile fluid effecting a reverse movement of the controlling means through the medium of the tubular spring and flexible member.

16. In an apparatus of the character described, valve-controlling means comprising a two-way valve, a resilient tubular member flexibly connected to said valve, auxiliary pressure chambers at each end of said resilient tubular member, a main pressure chamber, a passageway between said main pressure chamber and one of said auxiliary pressure chambers, fluids in the main and auxiliary chambers that are in direct communication with each other, whereby the heating of the fluid in said main pressure chamber causes the fluid in said auxiliary chamber to flow through said resilient member into the other auxiliary pressure chamber, thereby increasing the weight of said chamber, a flexible connection between said resilient tubular member and said valve, whereby the deflection of said tubular member causes the rotation of said valve in one direction and a cooling of the fluid in said main pressure chamber causes the fluid in one of said auxiliary chambers to flow back to the auxiliary chamber in direct communication with the main chamber, thereby effecting the rotation of the valve in an opposite direction.

17. In an apparatus of the character described, valve-controlling means comprising a two-way valve, a resilient tubular member flexibly connected to said valve, auxiliary pressure chambers at each end of said resilient tubular member, a main pressure chamber, a passageway between said main pressure chamber and one of said auxiliary pressure chambers, fluids in the main and auxiliary chambers that are in direct communication with each other, whereby the heating of the fluid in said main pressure chamber causes the fluid in said auxiliary chamber to flow through said resilient member into the other auxiliary pressure chamber, thereby increasing the weight of said chamber, a flexible connection between said resilient tubular member and said valve, whereby the deflection of said tubular member causes the rotation of said valve in one direction and a cooling of the fluid in said main pressure chamber causes the fluid in one of said auxiliary chambers to flow back to the auxiliary chamber in direct communication with the main chamber, thereby effecting the rotation of the valve in an opposite direction and means carried by said valve and operated by the turning movement thereof for aiding its rotation in either direction.

18. In an apparatus of the character described, a generator-absorber comprising main and auxiliary chambers, an outlet pipe leading from said main chamber, a return flow pipe leading into said auxiliary chamber, a conduit in communication with said auxiliary chamber and extending upwardly within said main chamber, a plurality of distributing members super-imposed upon said conduit, the lower bottom edge of each distributing member extending within the circumference of the upper edge of the distributing member below the same, means for applying heat to said auxiliary chamber whereby the liquid within said main and auxiliary chambers will rise through said conduit and overflow upon the top distributing member and thence into the succeeding distributing members.

19. In a refrigerating apparatus of the absorption type, the combination of a combined generator-absorber, a rectifier, outlet communicating means between said generator-absorber and rectifier, a refrigerating member, communicating means between said refrigerating member and said rectifier, a condenser, a condensing chamber within said condenser, a single communicating member between said condensing chamber and said refrigerating member, communicating means between said generator-absorber, return communicating means between said rectifier and generator-absorber, said outlet and return communicating means being in communication with each other.

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