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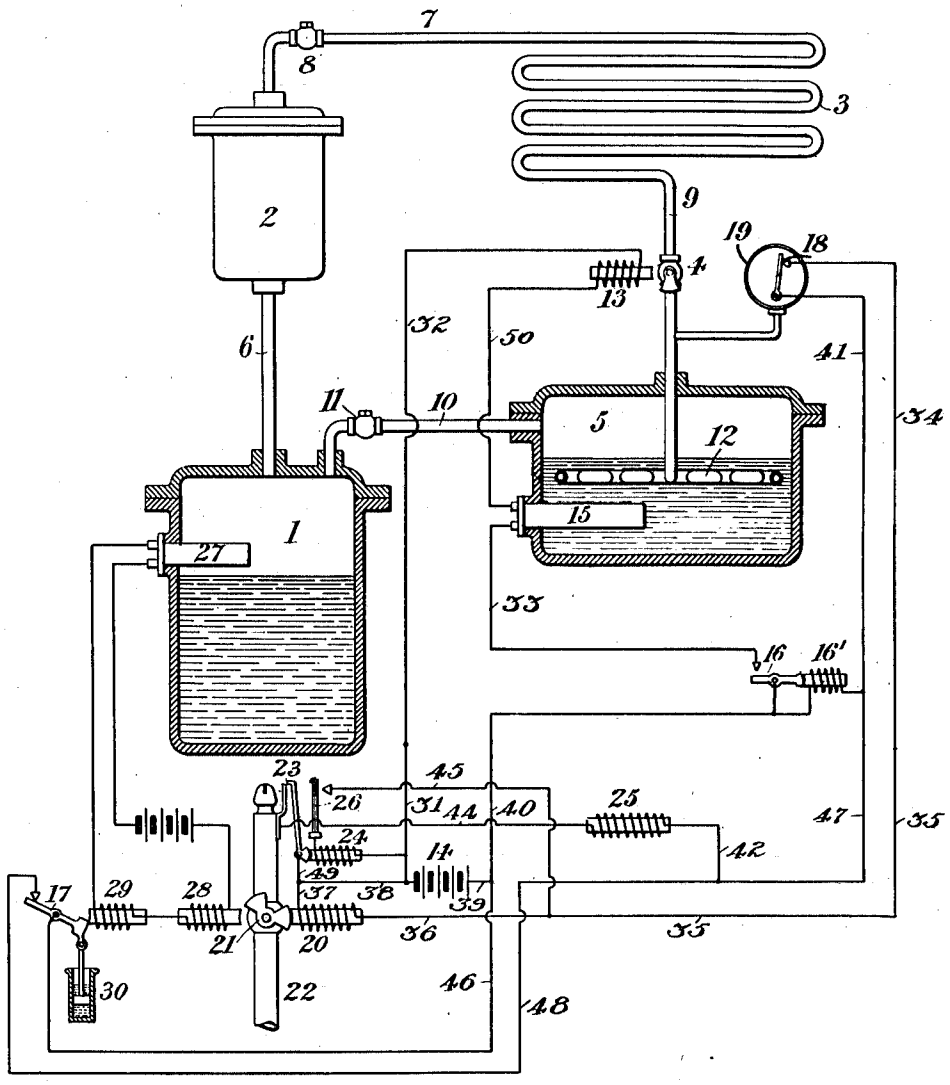
REFRIGERATING APPARATUS.

APPLICATION FILED OCT. 1, 1902.

1,054,507. Patented Feb. 25, 1913.



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REFRIGERATING APPARATUS

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Application filed October 1, 1902. Serial No. 125,545.

To all whom it may concern:

Be it known that I, CLYDE J. COLEMAN, a citizen of the United States, residing at the borough of Manhattan, in the city of New York, county of New York, and State of New York, have invented certain new and useful Improvements in Refrigerating Apparatus, of which the following is a specification, reference being had therein to the accompanying drawing.

The present invention relates to that type of refrigeration apparatus, in which the different operations of the system, automatically succeed each other in recurring cycles.

And the present improvement has for its object to provide a simple and efficient electrically controlled refrigeration apparatus, in which the different operations or steps of the process, to wit:—the vaporizing or distilling, the condensing or liquefying, the expanding, and the absorbing of the ammonia or other gaseous medium employed, are automatically caused to succeed each other in recurring cycles, and in which as any one step or operation in the process nears its end the next succeeding step or operation will be automatically commenced, and so on through the series of operations and the recurring cycles thereof, all as will hereinafter more fully appear and be more particularly pointed out in the claims.

In the accompanying drawing, illustrative of the present invention is shown an elevation partly sectional and partly diagrammatic of an automatic refrigerating apparatus embodying the present invention.

Similar numerals of reference indicate like parts in the different views.

Referring to the drawing: 1, represents the combined absorbing and generating vessel or distilling chamber; 2, the rectifier or water separator; 3, the storage or condensing chamber or coils, in which the liquefication of the ammonia gas is effected; 4, the expansion valve; and 5, the expansion chamber or coils, in which the liquefied ammonia is expanded to effect the cooling operation of the system.

The above described members of the refrigerating apparatus are usual to the present type of refrigeration systems, and may be of any well known and approved construction, and may be connected together in the usual manner; the generator 1, by pipe connection 6, with the rectifier 2, which in turn is connected by pipe 7, with the condensing chamber 3, such pipe connection being provided with a check valve 8, to prevent back flow into the rectifier and generator.

The condensing chamber 3, is connected to the expansion or cooling chamber 5, by a pipe connection 9, in which is arranged the expansion valve 4; and the expansion or cooling chamber is in turn connected to the generator 1, by the return pipe connection 10, provided with a check valve 11, to prevent back flow from the generator into the expansion or cooling chamber.

In the distillation and absorption system of refrigeration to which the present invention more particularly relates and as heretofore practised, a very serious obstacle to the successful and continued operation of the process was met with in the fact that water or aqueous vapor in a greater or less quantity, was carried over into the condensing or liquefying chamber, with the subsequent results of a clogging up of the expansion valve, and the expansion coils or chamber, by the congelation of such water therein, and so producing a material reduction in the efficient and economical action of such portions of the system, and which reduction in efficiency was further augmented by a reduction in the volatility of the ammonia due to the presence of such water. With a view to avoiding such defects in the present system of refrigeration as heretofore practised, my invention includes means for removing from the ammonia gas, after it leaves the generating chamber, any water or aqueous vapor which may be carried over with the ammonia gas from such generator.

My invention consists in the provision in connection with an intermittent distillation and absorption system of refrigeration, of a brine or cold storage tank connected to or forming a part of the cooling coils or chamber of such system, and mechanism, hereinafter more fully described, for effecting a closed condition of the expansion valve of the system, the conjoint action of which new features or elements of this part of the present invention, is to continue and maintain the cooling operation during the period in which the ammonia gas is being redistilled in the combined generator and absorber of the system.

In the construction shown in the drawing, as illustrative of this part of the present invention, the main cooling chamber or tank

5 is enlarged to form a combined expansion chamber and a brine tank; the auxiliary expansion coil 12, being arranged within said chamber, in an immersed condition in the brine, and in my preferred construction as shown, the ammonia gas will discharge from such coil directly through the brine, to effect the abstraction of any aqueous vapor that may be present in such gas.

The above mentioned mechanism for automatically controlling the expansion valve, is in turn automatically controlled by the mechanism that admits fuel gas beneath the generator, and which last mentioned mechanism is in turn controlled by the degree of absorption in the generator, as will hereinafter more fully appear in the description of the operation of the present invention.

Another part of the present invention consists in a series of automatic electrically actuated mechanisms and connections between the different portions or members of the present refrigerating system, so that the operations of such different members are caused to automatically succeed each other in recurring cycles, and in which as one step or operation in the process nears its end the next succeeding operation will be automatically caused to commence. To this end, the construction and arrangement of parts will be as follows:

13, is an electro-magnet adapted to open the expansion valve 4, which is normally held in the closed position by any suitable means; the operating electrical circuit of this magnet may be traced as follows: from the battery 14 through wires 39, 40, contacts of switch 16, wire 33, thermostat 15, wire 50, coil of electro-magnet 13, wires 32 and 31 back to the battery 14. The thermostat is located within the expansion chamber 5 of the system and is adapted to close the circuit when the temperature in the expansion chamber rises above a predetermined point.

A pressure gage 19 is located in that portion of the system between the expansion valve 4 and the combined generator and absorber 1, to indicate the pressure within the expansion chamber 5, but more particularly to operate the electrical switch device 18, through back pressure in such expansion chamber. Such switch device is adapted, firstly, to close the circuit of the operating electro-magnet 20 which operates the valve 21 in the fuel gas supply pipe 22 to an open condition, such circuit being traceable as follows: from the battery 14 through wires 39, 46, switch 17, wires 48, 47, 41, switch 18, wires 34, 35, 36, coil of electro-magnet 20, wires 37, 38, back to the battery; secondly, the switch device 18 is adapted to control the electro-magnet 16′ of the switch device 16 that controls the circuit of the operating electro-magnet 13 of the expansion valve mechanism 4, and by opening said circuit permits the expansion valve to assume its closed condition to arrest further expansion of the refrigerant. The resistance of the coil of the electro-magnet 16′ is so determined relative to the potential of the battery and other elements with which it is included in series that the closing of the switch 17 will produce a short-circuit whereby the current, instead of flowing through the switch 18 by way of the wire 41 and coil of the electro-magnet 16′, will flow through such switch by way of wires 46, switch 17 and wires 48 and 47.

The automatic igniting mechanism for the fuel gas burner beneath the ammonia still or generator of the present system is in the present invention automatically controlled by the back pressure in the expansion chamber 5 of the system, and simultaneous with the opening of the valve 21 which supplies fuel gas to the burner of the main generator 1. Such igniting mechanism will comprise an electric spark producing mechanism 23, the fixed member of which is attached adjacent to the gas burner, while the movable member thereof is under control of the operating electro-magnet 24, by which such members are operated to produce an igniting electrical spark; and such members of the spark-producing mechanism will be arranged in a branch circuit of the main battery 14, which may be traced as follows: from the battery 14, through wires 39, 46, switch 17, wires 48, 42, spark coil 25, wire 44, contacts 23, and wires 49, 38, back to the battery.

The thermostat 26 is arranged in the branch circuit, which may be traced as follows: from the battery 14 through wires 39, 46, switch 17, wires 48, 47, 41, switch 18, wires 34, 35, 45, thermostat 26, coil of electro-magnet 24, back to battery. The thermostat under the influence of the heat from the burner is adapted to control the operating circuit of the electro-magnet 24, so that after the gas has been ignited the heat from the burner will operate such thermostat to open the circuit thereby deënergizing the electro-magnet and causing the movable member of the igniting device to be cut out of the circuit in which it is included. Upon the accidental extinguishment of the flame, the thermostat will reclose the operating circuit of the electro-magnet 24 to again bring the igniting mechanism into action to effect a relighting of the gas.

The thermostat 27 is located within the combined absorbing and generating tank 1 of the system and adapted by a rise in temperature to complete the circuit through the battery to control the circuit of the electro-magnet 28 by which the valve 21 of the fuel supply is shut off. Such circuit may be traced as follows: from the battery through

coils of electro-magnet 28 and 29, respectively, thermostat 27 back to the battery. The switch 17, which is opened by the energization of the electro-magnet 29, controls the circuit, which may be traced as follows: from the battery 14, through wires 39, 46, contact of switch 17, wires 48, 47, 41, contact of switch 18, wires 34, 36, coil of electro-magnet 20, wires 37, 38, and back to the battery.

An important feature of the present invention, in this connection, comprises means for retarding the closing of the switch 17 after it has been opened, so as to provide a predetermined period of time in which the absorbing and generating tank 1 can cool down to the proper temperature for absorption, before the expansion coil 12 is brought into active service to perform its periodic cooling function.

In the drawing I have shown as a means for accomplishing such retarding result, a dash pot 30, the plunger of which has connection with the moving member of the switch 17; any other equivalent retarding mechanism may, however, be substituted without departing from the spirit of this part of the present invention.

The operation of the present apparatus is as follows: Starting with the combined generator and absorber 1, charged with a saturated solution of aqua ammonia and the burner beneath the same in a lighted condition to effect distillation. The ammonia gas arising from the solution passes through pipe connection 6, into the rectifier 2, where the greater part of the aqueous vapor is separated, from thence the ammonia gas passes into the liquefying chamber or coils 3 to assume a highly compressed or liquid condition. At a degree of temperature within the generator corresponding with the approximate completion of the distillation, the thermostat 27 closes the circuit of the electro-magnet 28 and operates the fuel supply valve 21 to a closed condition; such action of the thermostat also closes the circuit of the electro-magnet 29 to open, for a predetermined period of time, in which the absorbing and generating tank 1 can cool down to the proper temperature for absorption, the circuit of the switch 17 and thus prevent any premature and automatic relighting of such fuel gas. With the expiration of such predetermined period of time in which the generator has cooled down so as to be capable of re-absorbing the ammonia gas, a re-absorption of such gas from the expansion chamber will take place and the pressure in such expansion chamber will be gradually reduced, allowing the back pressure switch 18 to open to break the circuit of the electro-magnet 16′ and permit the switch 16 in the expansion valve circuit to reclose, whereby the thermostat 15 is brought into action to open the expansion valve 4 through the electro-magnet 13 to commence the cooling operations of the system. The switch 17 prevents premature and automatic relighting of the gas in the following manner: until such switch is closed, no current can flow through either the fuel-gas operating magnet 20, the igniter actuating magnet or the spark coil 25 and the sparking gap 23. No current can flow through these elements by way of wire 40 and coil 16′ because of the resistance of the latter. This resistance is so determined relative to the battery potential and to the resistance of the fuel-gas operating magnet, the igniter actuating magnet and the spark coil and sparking gap with which it is included in series when not short-circuited by the switch 17, that when not short-circuited, it will prevent the passage of sufficient current to operate the ignition controlling apparatus. The closing of the switch 17, which is the first effectual closure of the circuits of the fuel-gas operating magnet, the igniter actuating magnet or the spark coil amounts to an initial closure of such circuits so far as their operation is concerned, so that the switch 17 virtually controls the ignition circuits. Unless such switch is closed no gas will be fed to the burner, no current will flow through the ignition circuits and no sparking will take place.

With the continued expansion of the gas within the cooling chamber 5, and the continued absorption of such gas within the combined absorber and generator 1, a back pressure is finally established in such cooling chamber, which through the instrumentality of the back pressure gage 19, and switch device 18, closes, first, the circuit of the electro-magnet 16′, to operate the switch device 16, to open the circuit of the operating electro-magnet 13, of the expansion valve 4, to permit the same to assume a closed condition and arrest any further expansion of the refrigerant; and second, to close the circuit of the electro-magnet 20, to open the supply valve 21, and admit fuel gas to the burner of the generator 1. Simultaneously therewith the electro-magnet 24, is energized to operate the spark producing mechanism 23, to relight the fuel gas, when a new cycle of the operations just described, will again commence.

Having thus fully described my said invention what I claim as new and desire to secure by Letters Patent, is:—

1. In an automatic absorption system of refrigeration, the combination of a generating and absorbing chamber and means for heating said chamber, a liquefying chamber, a combined expansion chamber and storage brine tank, an expansion valve arranged between the liquefying chamber and the combined expansion chamber and cold storage

brine tank and normally held in the closed position, and means automatically controlled by the pressure within the combined expansion chamber and the storage brine tank for controlling the operation of the expansion valve and the generating and absorbing chamber heating means.

2. In an automatic absorption system of refrigeration, the combination of a generating and absorbing chamber, a liquefying chamber, an expansion chamber, an expansion valve arranged between the liquefying and expansion chambers and normally held in the closed position during the distilling period, means automatically controlled by conditions within the expansion chamber for controlling the expansion valve whereby a difference in pressure is preserved between the liquefying chamber and the expansion chamber, and thermal means for controlling the expansion valve controlling means, substantially as set forth.

3. In an automatic absorption system of refrigeration, the combination of a generating and absorbing chamber and heating means therefor, a liquefying chamber, an expansion chamber, thermal means for controlling the duration of the distilling period, means automatically operated by back pressure in the expansion chamber for controlling the heating means, and means for retarding the operation of such back pressure mechanism, substantially as set forth.

4. In an automatic absorption system of refrigeration, the combination of a generating and absorbing chamber, a liquefying chamber, an expansion chamber, means automatically operated by back pressure in the expansion chamber for starting redistillation and means for retarding the operation of such back pressure mechanism.

5. In an automatic system of refrigeration, the combination of a generating and absorbing chamber, a liquefying chamber, an expansion chamber, means automatically operated by back pressure in the expansion chamber for starting redistillation, means for retarding the operation of such back pressure mechanism and a thermostat connected with the generator for controlling the operation of the retarding device.

6. In an electrical system of automatic control for refrigerating apparatus, the combination of a generating and absorbing chamber, a liquefying chamber, an expansion chamber, a pressure gage connected to the expansion chamber, an electrical circuit controlled by said pressure gage, an electro-dynamic mechanism, arranged in said circuit, and adapted to control the heating of the main generator, substantially as set forth.

7. In an electrical system of automatic control for refrigerating apparatus, the combination of a generating and absorbing chamber, a liquefying chamber, an expansion chamber, a pressure gage connected to the expansion chamber, an electrical circuit controlled by said pressure gage, an electro-dynamic mechanism arranged in said circuit and controlled thereby, a thermostat in the generating chamber, an electrical circuit controlled by said thermostat, an electro-dynamic mechanism arranged in such circuit and controlled thereby, such electro-dynamic mechanism being adapted to automatically control the heating of the main generator, substantially as set forth.

8. In an electrical system of automatic control for refrigerating apparatus, the combination of a generating and absorbing chamber, a liquefying chamber, an expansion chamber, a pressure gage connected to the expansion chamber, an electrical circuit controlled by said pressure gage, an electro-magnet in said circuit, a thermostat in the generating chamber, an electrical circuit controlled by said thermostat, an electro-magnet in said circuit and a valve in the fuel supply adapted to be closed thereby, substantially as set forth.

9. In an electrical system of automatic control for refrigerating apparatus, the combination of a generating and absorbing chamber, a liquefying chamber, an expansion chamber, a pressure gage connected to the expansion chamber, an electrical circuit controlled by said pressure gage, an electro-magnet in said circuit, a valve in the fuel supply adapted to be opened by said electro-magnet, and an electrical gas lighting mechanism controlled by such circuit, substantially as set forth.

10. In an electrical system of automatic control for refrigerating apparatus, the combination of a generating and absorbing chamber, a liquefying chamber, an expansion chamber, a pressure gage connected to the expansion chamber, an electrical circuit controlled by said pressure gage, an electro-magnet in said circuit, a valve in the fuel supply adapted to be opened by said electro-magnet, an electric gas lighting mechanism controlled by such circuit, and a thermostat controlling said gas lighting mechanism, substantially as set forth.

11. In an electrical system of automatic control for refrigerating apparatus, the combination of a generating and absorbing chamber, a liquefying chamber, an expansion chamber, an expansion valve arranged between the liquefying and expansion chambers, an electro-dynamic mechanism and circuit controlling said valve, a thermostat in the expansion chamber controlling said circuit, and a switch device adapted to be operated by back pressure in the expansion chamber to render said valve operating mechanism inoperative, substantially as set forth.

12. In an electrical system of automatic control for refrigerating apparatus, the combination of a generating and absorbing chamber, a liquefying chamber, an expansion chamber, an expansion valve arranged between the liquefying and expansion chambers, an electro-dynamic mechanism and circuit controlling said valve, a thermostat in the expansion chamber controlling said circuit, and a pressure actuated switch to open and close said circuit and adapted to be controlled by back pressure in the expansion chamber, substantially as set forth.

13. In a system of automatic control for refrigerating apparatus, the combination of a generating and absorbing chamber, a liquefying chamber, an expansion chamber, an expansion valve arranged between the liquefying and expansion chambers, and mechanism controlling said valve, a thermostat in the expansion chamber controlling said valve mechanism and a device operated by back pressure in the expansion chamber to render said valve operating mechanism inoperative.

14. In an electrical system, of automatic control for refrigerating apparatus, the combination of a generating and absorbing chamber, a liquefying chamber, an expansion chamber, a pressure gage connected to the expansion chamber, means controlled by said pressure gage, mechanism arranged in connection with said means and adapted to control the heating of the generating chamber, a thermostat associated with the generating chamber, mechanism controlled by said thermostat and adapted to render the back pressure mechanism inoperative.

15. In an electrical system of automatic control for refrigerating apparatus, the combination of a generating and absorbing chamber, a liquefying chamber, an expansion chamber, a pressure gage connected to the expension chamber, an electrical circuit controlled by said pressure gage, an electro-dynamic mechanism arranged in said circuit and adapted to control the heating of the main generator, a thermostat in the generating chamber, an electrical circuit controlled by said thermostat and adapted to control the opening of the back pressure circuit, substantially as set forth.

16. In an electrical system of automatic control for refrigerating apparatus, the combination of a generating and absorbing chamber, a liquefying chamber, an expansion chamber, a pressure gage connected to the expansion chamber, an electrical circuit controlled by said pressure gage, an electro-dynamic mechanism arranged in said circuit and adapted to control, the heating of the main generator, a thermostat in the generating chamber, an electrical circuit controlled by said thermostat and adapted to control the opening of the back pressure circuit, and means for holding said circuit open for a predetermined period of time, substantially as set forth.

17. In a system of automatic control of refrigerating apparatus, the combination of a generating and absorbing chamber, a liquefying chamber, an expansion chamber, a pressure gage connected to the expansion chamber, a heater, means controlled by the pressure gage to control the supply of fuel to the heater, electric gas lighting mechanism controlled by said means and a thermostat controlling said lighting mechanism.

In testimony whereof I have affixed my signature in presence of two witnesses.

CLYDE J. COLEMAN.

Witnesses:

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