

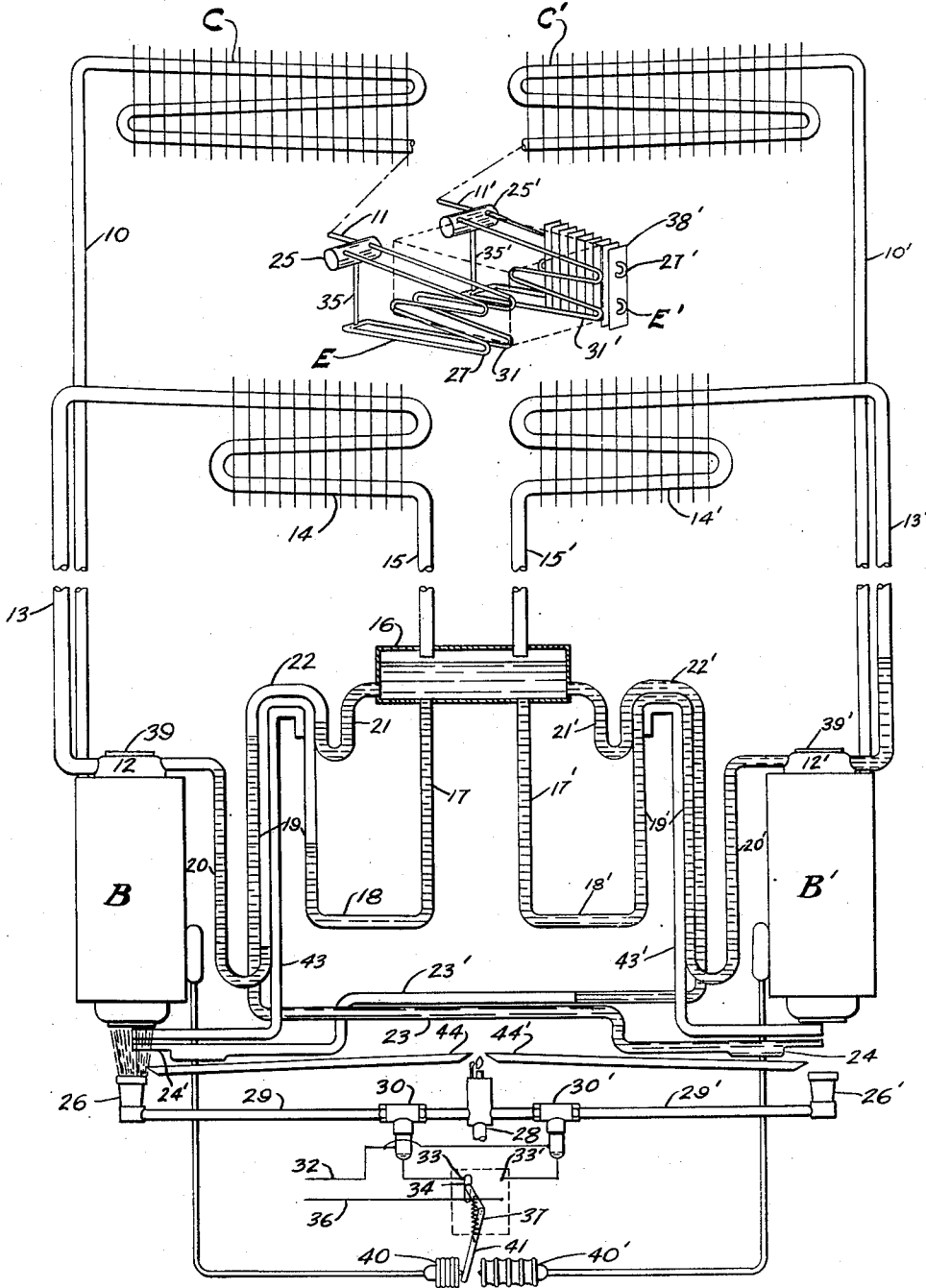
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COOLING SYSTEM FOR REFRIGERATORS

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COOLING SYSTEM FOR REFRIGERATORS

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This invention relates to the art of refrigeration and more particularly to a cooling system for rejecting waste heat from said system efficiently and controllably.

It is a particular object of the present invention to provide a cooling system especially adapted to the need of refrigerating systems having portions thereof which are alternately subjected to heating and cooling actions to operate the system.

It is a further object of the present invention to provide a refrigerating system in which the generator-absorber of an intermittent refrigerating apparatus is cooled by a cooling system having a heat responsive part which interrupts the flow of cooling medium to the generator-absorber when heated and a heat operated mechanism which quickly cools the heat responsive control mechanism to provide for rapid initiation of cooling action at the end of a heating period of the generator-absorber.

Other objects and advantages of the invention will become apparent as the description proceeds when taken in connection with the accompanying drawings.

The invention is diagrammatically and schematically illustrated in the accompanying drawings as applied to an intermittent absorption refrigerating apparatus of the dual unit type. The right and left hand refrigerating systems shown in the drawings are identical with each other, hence only the left hand system will be specifically described. Corresponding parts of the right hand system will be identified with identical reference characters distinguished by the addition of a prime.

The refrigerating system per se comprises an annular generator-absorber vessel B which may contain a liquid absorbent such as water or a solid absorbent such as strontium chloride or the like. The absorbent is adapted to absorb a refrigerant such as ammonia. When heated the refrigerant is liberated from the absorbent as a vapor. Vapor liberated from the absorbent in the generator-absorber B flows through a conduit 10 to a tubular air cooled condenser C. The vapor is liquefied in the condenser C and the liquid flows therefrom through a conduit 11 to the evaporator structure E. Any desired specific construction of evaporator may be utilized. As illustrated herein the evaporator comprises a liquid receiver 25 to which the conduit 11 is connected. A pair of cooling coils 27 and 31 open at their upper ends into the reservoir 25. The lower ends of the coils 27 and 31 receive liquid re-

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frigerant from the reservoir 25 through the conduit 35. In the preferred arrangement of this type evaporator the coil sections 31-31' will be arranged to refrigerate the interior of a freezing compartment. The coils 27-27' will be provided with air cooling fins 38-38' positioned laterally on opposite sides of the freezing chamber (in the interest of clarity only the fins 38' are shown in the drawing).

In the operation of the device heat is applied to the generator-absorber B to evolve refrigerant vapor. After the absorbent contained in the generator-absorber is exhausted to some predetermined degree the heating action is stopped and the generator-absorber B is cooled. This causes the absorbent therein to reabsorb vapor which lowers the vapor pressure sufficiently in the line comprising conduits 11, 10, condenser C and the evaporator E so that the refrigerant evaporates at a low temperature in the evaporator E to produce a useful refrigerating effect. The heat of absorption so developed is conveyed away by a cooling system to be described hereinafter.

The cooling system for dissipating the heat of absorption from the generator-absorber B is charged with a volatile cooling medium such as methyl chloride and includes an annular cooling jacket 12 which is in heat transfer relationship with the interior wall of the annular generator-absorber B. Cooling medium vapor produced in the annular jacket 12 flows through a conduit 13 into a tubular air cooled condenser 14 wherein it is liquefied. Liquid cooling medium discharges from the condenser 14 through a pipe 15 into a cooling medium reservoir 16. Cooling medium is conveyed from the lower portion of the reservoir 16 into the upper portion of the jacket 12 through a conduit system which comprises the downwardly extending conduit 17, horizontal conduit 18, a U-shaped vapor lock conduit 19 and a vertically extending conduit 20 which opens into the upper part of the jacket 12. An additional conduit system is connected with the reservoir 16 and comprises a downwardly extending conduit 21 which joins an inverted U-shaped vapor trap conduit 22 arranged in heat exchange relation with the bight portion of the vapor lock conduit 19. The conduit 22 connects to an elongated horizontal conduit 23 which terminates in a dead ended bulb 24 positioned underneath the generator-absorber assembly B' of the associated system and positioned to be heated in a manner to be described hereinafter.

The generator-absorber B is heated by a combustible fuel burner such as the gas burner 26 positioned therebeneath and arranged to discharge its products of combustion through a flue 39 which is positioned interiorly of the annular cooling jacket 12. The burner 26 receives fuel from a supply conduit 28 through a conduit 29 which contains a solenoid control valve 30.

The apparatus is controlled solely by regulating the supply of fuel to the burners 26—26' by controlling the solenoid valves 30—30'. The solenoid valves are each connected to an electrical supply line 32 and to switch contacts 33—33', respectively. A bridge contact 34 is adapted to connect the contacts 33—33' alternately to the other side of the electric supply line 36. As illustrated herein the bridge contact 34 is actuated by an over-center snap acting mechanism 37 which in the position shown is energizing the solenoid valve 30 to supply fuel to the burner 26. In its other position the valve 30 will be de-energized and will close itself by spring action whereas the valve 30' will be energized through the contact 33' to supply fuel to the burner 26'. The snap acting mechanism is arranged to be actuated by a pair of thermostats 40—40' which are responsive to the temperatures of the generator-absorbers B and B' respectively. The thermostat 40 responsive to the generator-absorber B, is positioned to operate the actuating link 41 of the snap acting mechanism 37. The thermostat mechanism 40', responsive to the temperature of the generator-absorber B', is positioned to operate the actuating link 41 but in the opposite sense with respect to the thermostat 40. In the position shown the thermostat 40 is in collapsed, cold position, indicating that the generator-absorber B has just completed an absorbing cycle of operation. The thermostat 40' is in its fully expanded position indicating that the generator-absorber B' has just completed a generating phase of operation, hence the link 41 has been actuated to energize the solenoid valve 33 through the contact 33 to supply fuel to the burner 26.

When the generator-absorber B has completed its generating phase of operation its temperature will rise and the thermostat 40 will expand to actuate the snap acting mechanism 37 in a manner to de-energize the solenoid valve 30 and to energize the solenoid valve 30'. At this time the thermostat 40' will be in collapsed position because the generator-absorber B' will be cold having substantially completed its absorbing period of operation.

The inverted U-shaped conduit 19 which is in the path of flow of cooling medium from the reservoir 16 to the cooling jacket 12 is adapted to form a fluid flow blocking vapor lock in order to control the operation of the cooling system. The bight and left hand leg portions of the vapor lock conduit 19 are heated by conduction through a metallic heat conducting element 43 which is in heat exchange relation with the bight and left hand leg portions of conduit 19. The lower end of element 43 is positioned to be heated by burner 26. When fuel is supplied to the burner 26 it is ignited by the flash pilot structure 44 and immediately begins to heat the heat conductor 43 as well as the generator-absorber B. Heat conducted through the element 43 quickly vaporizes cooling medium in the bight portion of the conduit 19 which forms a vapor lock and prevents further flow of cooling medium from reservoir 16 into the cooling jacket 12. As long as heat

is applied to the burner 26 the vapor lock is maintained and all of the cooling medium in circulation then flows through the generator-absorber B' to remove the heat of absorption therefrom.

When the generating period of the generator-absorber B is completed and the burner 26 is extinguished, the vapor lock in the conduit 19 will eventually collapse by condensation to restore cooling medium circulation to the cooling jacket 12. This action however has been found to require a prohibitive time lag which it is a principal object of this invention to eliminate.

The inverted U-shaped portion of the conduit 22, which is in thermal exchange with the bight portion of the inverted U-shaped conduit 19, also has a comparatively shallow vapor lock formed therein due to heat conducted through the conduit 19 when it is heated by the heat conductor 43. However, due to the rather remote thermal relationship between conduit 22 and heat conductor 43 this vapor lock is shallow and in some circumstances may not be very substantial. A shallow vapor lock at this point is desirable to prevent vapor formed in conduit 22 from being displaced by cool liquid from reservoir 16 which might cause premature collapse of the vapor lock in conduit 19.

That portion of the conduit structure 21, 22 and 23 on the side of the U-shaped conduit 22 closest to the bulb 24 is filled with liquid. The major portions of the conduit 23 and the bulb 24 are exposed to atmospheric air and are therefore at substantially atmospheric temperature. When the control mechanism de-energizes burner 26 and energizes burner 26', heat is applied to bulb 24 and vaporizes a portion of the liquid therein contained. The vapor thus trapped in the dead end of the conduit system 23—24 forces cool liquid around the bight portion of conduit 22 into intimate thermal exchange relationship with the inverted U-shaped vapor lock 19 in the primary cooling system. When this occurs rapid condensation takes place within the bight portion of conduit 19 which disturbs the equilibrium of the vapor lock and causes it to collapse with great rapidity to restore cooling medium circulation to the jacket 12.

It is not essential that all the vapor in the vapor lock conduit 19 be condensed as any significant localized condensation therein will upset the rather delicate balance of the vapor lock and cause uncondensed vapor to be blown into the jacket 12 from which it escapes to the condenser. By this means the thermal controls which are responsive to the generator-absorber temperatures operate directly and solely upon the gas control. The cooling medium system is controlled entirely by the application of heat to the generator-absorbers.

As shown in the drawings the conduit 23' which is associated with the cooling system for the generator-absorber B' is being heated by the burner 26 and has displaced cold cooling medium into heat exchange with the vapor lock and the conduit 19' to remove the vapor lock. This leaves a considerable portion of the conduit 23 filled with vapor. This however is not objectionable as there will be ample time during the absorbing cycle of operation for the vapor in this portion of conduit 23 to condense and cool substantially to atmospheric temperature. The conduit system 21, 22, 23 and 24 operates by displacing cool liquid therein in the direction of the reservoir 16 under the propulsive

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pressure produced by vaporizing a small portion of the liquid in bulb 24. A substantially static condition then ensues throughout the remainder of the generating period of the other absorber-generator. Following this there is a period of condensation of vapor in bulb 24 during which liquid gradually flows back thereinto from the reservoir 16 so as to recharge it with liquid.

In the foregoing structure the heat applied to any generator-absorber automatically establishes and maintains a vapor lock in its cooling system throughout its generating period of operation. Additionally the application of heat to any particular generator-absorber simultaneously and automatically displaces cold liquid into heat exchange relationship with the pre-existing vapor lock in the cooling system of the associated generator-absorber to restore cooling medium circulation to that generator-absorber. In this manner rapid formation and collapse of the cooling system flow control vapor lock is established without requiring any action by the system control mechanism and without requiring moving parts in any way associated with the cooling system. The mere application of heat to either generator-absorber automatically shuts off the flow of cooling medium to the heated generator-absorber and initiates flow of cooling medium to the associated generator-absorber.

While I have illustrated and described the invention in considerable detail, it is to be understood that various changes may be made in the arrangement, proportion and construction of parts without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. Refrigerating apparatus comprising a pair of intermittent absorption refrigerating systems each including a generator-absorber and a cooling element in heat exchange relation with the generator-absorber, means for heating said generator-absorbers, means for controlling said heating means to heat said generator-absorbers alternately with respect to each other, a cooling system including a pair of conduits each having an inverted U-shaped part adapted to form a cooling medium flow preventing vapor lock when heated, each of said cooling elements being connected to a separate one of said conduits to receive cooling medium therefrom, means for heating the upper part of each of said U-shaped conduits when the generator-absorber to which it controls cooling medium flow is heated, and a pair of elongated dead ended conduits connected to receive liquid cooling medium from said cooling system, each of said conduits having a portion in heat exchange relation with a separate one of said U-shaped conduits and its dead ended portion positioned to be heated simultaneously with the generator-absorber to which cooling medium is supplied through the other of said U-shaped conduits.

2. In a refrigerator of the intermittent absorption type having a generator-absorber provided with a cooling means, a cooling system for the generator-absorber connected to circulate a cooling medium through said cooling means including heat operated flow control means operative when heated to stop flow of cooling medium to said cooling means, heat operated means operative when heated to render said heat operated flow control means operative to allow flow of cooling medium to said cooling means, means for heating said generator-absorber and said heat operated flow control means simultane-

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ously, means for heating said second mentioned heat operated means, and control means for successively activating said heating means.

3. In a refrigerator of the intermittent absorption type having a pair of generator-absorbers each provided with a cooling means, a cooling system for the generator-absorbers connected to circulate a cooling medium through said cooling means including a pair of heat operated flow control means each arranged when heated to stop the flow of cooling medium to a distinct one of said cooling means, a pair of heat operated structures each operative when heated to render a distinct one of said flow control means operative to allow flow of cooling medium to said cooling means, and means for heating said generator-absorbers alternately with respect to each other and for simultaneously heating the flow control means for controlling cooling medium flow to the heated generator-absorber and the heat operated structure for rendering the other flow control means operative to allow flow of cooling medium to the cooling means in heat exchange relation with the unheated generator-absorber.

4. In a refrigerating apparatus a pair of refrigerating systems each including a generator-absorber and a cooling element in heat exchange relation with the generator-absorber, a cooling system for passing a volatile cooling medium through said cooling elements comprising heat rejecting means connected to receive heated cooling medium from said cooling elements, separate means for conveying cooling medium from said heat rejecting means to said cooling elements each including an inverted U-shaped conduit adapted to form a cooling medium flow preventing vapor lock when heated, a pair of dead ended conduits each connected to receive liquid cooling medium from said heat rejecting means and each having a portion in heat exchange relation with the bight portion of a separate one of said U-shaped conduits, and means for heating said generator-absorbers successively and for heating the bight portion of the U-shaped conduit controlling cooling medium flow to the cooling element of the heated generator-absorber and the dead ended portion of the dead end conduit in heat exchange relation with the U-shaped conduit controlling the flow of cooling medium to the cooling element of the unheated generator-absorber simultaneously with the heated generator-absorber.

5. In a refrigerating apparatus a pair of refrigerating systems each including a generator-absorber and a cooling element in heat exchange relation with the generator-absorber, a cooling system for passing a volatile cooling medium through said cooling elements comprising heat rejecting means connected to receive heated cooling medium from said cooling elements, separate means for conveying cooling medium from said heat rejecting means to said cooling elements each including an inverted U-shaped conduit adapted to form a cooling medium flow preventing vapor lock when heated, a pair of cooling conduits each connected to receive liquid cooling medium from said heat rejecting means, each of said cooling conduits having a portion in heat exchange relation with the bight portion of a separate one of said U-shaped conduits and an elongated part more remote from said heat rejecting means than said heat exchange portion exposed to cooling air, and means for heating said generator-absorber successively and for

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heating the bight portion of the U-shaped conduit controlling cooling medium flow to the cooling element of the heated generator-absorber and a part of the elongated conduit in heat exchange relation with the unheated U-shaped conduit simultaneously with the unheated generator-absorber.

6. In an intermittent absorption refrigerating system having a generator-absorber, a cooling element in heat exchange relation with the generator-absorber, a cooling system for circulating a cooling medium through said cooling element including a part forming a cooling medium flow blocking vapor trap, means for intermittently heating said generator-absorber and said part to vaporize cooling medium and prevent cooling of said generator-absorber while it is being heated, and apparatus for cooling said part comprising a fluid filled structure having one portion thereof in heat exchange with said part, a vapor trap portion and a portion between said first mentioned portions exposed to cooling air whereby cool liquid is displaced from said vapor trap portion when vapor is formed therein into heat exchange relation with said part to condense vapor therein, and means for heating said vapor trap portion alternately with said generator-absorber.

7. Refrigerating apparatus having a pair of generators which are alternately heated and cooled in out of phase relationship with each other in operation, means for flowing a cooling medium in heat exchange relation with each of said generator-absorbers including a pair of heat responsive cooling medium flow control parts operative when heated to prevent flow of cooling medium therethrough, each of said heat responsive parts being connected to control the flow of cooling medium in heat exchange relation with a different one of said generator-absorbers, a pair of heat operated cooling means each arranged to cool a different one of said heat responsive flow control parts, heating means, and means for controlling said heating means to apply heat to each of said generator-absorbers intermittently in out of phase relation to each other and to apply heat simultaneously with the application of heat to each of said generator-absorbers to the heat responsive part controlling the flow of cooling medium to the generator-absorber being heated and to the heat operated means for cooling the other heat responsive part.

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8. In a heat operated refrigerating system having a pair of parts which are alternately heated and cooled in out of phase relation to each other; the combination therewith of a cooling system for said parts including a pair of heat absorbing elements each in heat exchange relation with a distinct one of said parts, a heat dissipating means, means providing for circulation of a cooling medium between said heat dissipating means and said heat absorbing elements including a pair of heat responsive cooling medium flow control means each connected to control cooling medium flow to a distinct one of said heat absorbing means and operative to interrupt cooling medium flow when heated; a pair of heat operated cooling means each having a section in heat exchange relation with a distinct one of said flow control means and operative when heated to cool said flow control means; heating means; and means for controlling said heating means to heat each of said parts intermittently and in out of phase relation to each other and simultaneously to heat the flow control means controlling cooling medium flow to the heated part and the heat operated cooling means for cooling the other flow control means.

9. In a refrigerating system having a part which is alternately heated and cooled in operation, a cooling means in heat exchange relation with said part, means for supplying a cooling medium to said cooling means including a heat responsive means operative when heated to interrupt the supply of cooling medium to said cooling means, a heat operated means for cooling said heat responsive means, and means for periodically applying heat to said part and said heat responsive means simultaneously and for applying heat to said heat operated cooling means alternately with respect to the application of heat to said part.

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