March 22, 1938. L. A. PHILIPP 2,111,675

AIR CONDITIONING SYSTEM

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Fig. 1.

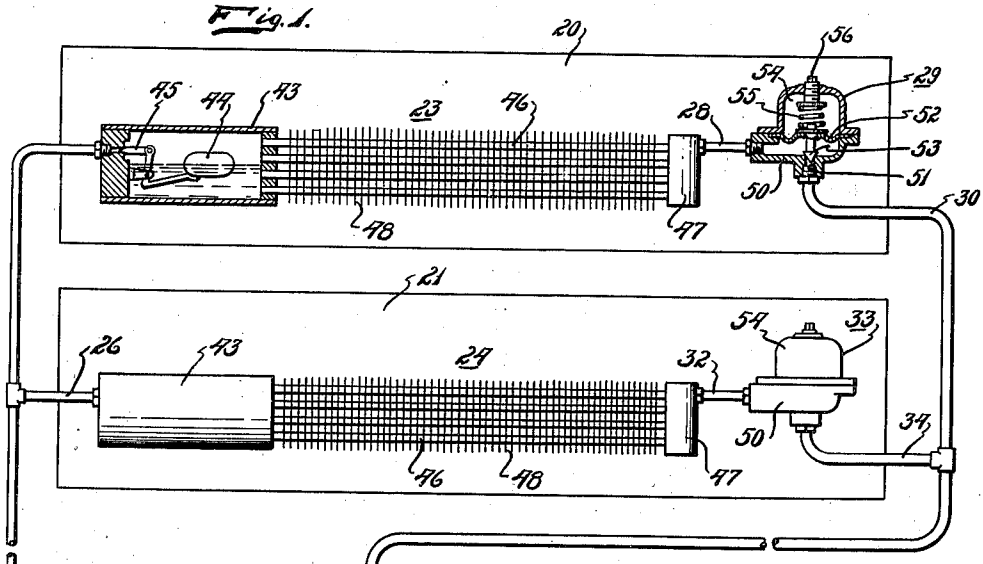
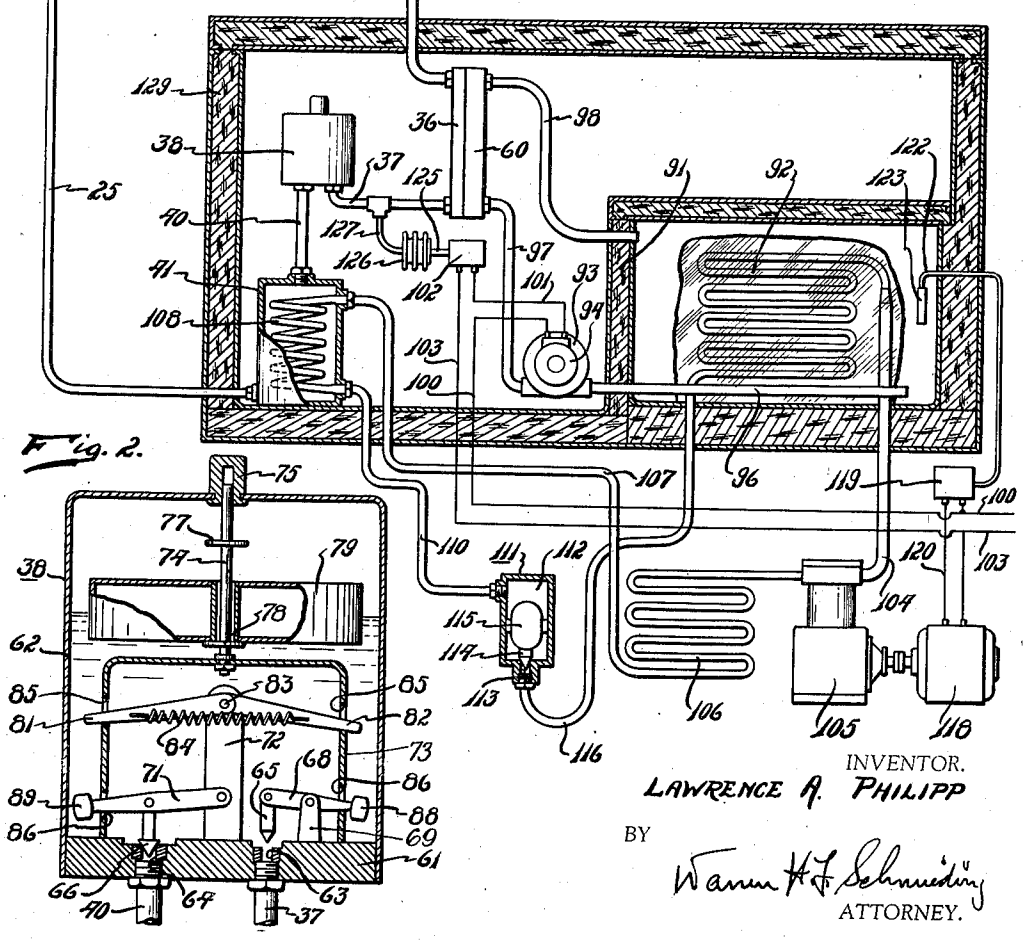


Fig. 2.



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AIR CONDITIONING SYSTEM

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20 Claims. (Cl. 62—4)

The present invention relates to refrigeration, and particularly to refrigerating systems which are automatic in operation.

One of the objects of the present invention is to provide a refrigerating apparatus including a heat absorber and a heat dissipator, operatively connected with one another, and to provide an ice making apparatus for cooling the heat dissipator.

In carrying out the foregoing object, it is another object of the present invention to control the heat exchange between the heat dissipator and the ice making apparatus in accordance with the temperature of the heat absorber; to control the operation of the ice making apparatus in accordance with the temperature of the heat absorber.

A further object of the present invention is to interpose a receiver for liquid refrigerant, which refrigerant is condensed in a heat dissipator, between such dissipator and the heat absorber, and cause the liquid refrigerant to flow from the dissipator to the receiver intermittently; to provide for the escape of gaseous refrigerant intermittently from the receiver toward the dissipator; to utilize heat, created by the refrigerating apparatus which cools the heat dissipator, for heating the receiver; to cool the heated refrigerant, of the refrigerating apparatus which cools the heat dissipator, by the refrigerant contained within the receiver.

A still further object of the invention is to provide a refrigerating system of the type in which the heat dissipator thereof is maintained at a lower temperature than the heat absorber and control the heat exchange between the heat dissipator and a cooling medium therefor in accordance with the temperature of the dissipator.

Further objects and advantages will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of embodiment of the present invention is clearly shown.

In the drawing:

Fig. 1 is a diagrammatic view of my improved refrigerating system; and

Fig. 2 is a longitudinal sectional view of one of the valves employed therein.

The present invention may be employed for cooling any type of chamber or chambers and is herein shown as employed for cooling a plurality of rooms in which 20 designates diagrammatically one room and 21 another room. In each of these rooms there is provided a heat absorber herein shown as evaporators 23 and 24. Liquid refrigerant is conducted by the pipe 25 to the evaporator 23 and by the pipe 25 and branch pipe 26 to the evaporator 24. Vaporized refrigerant is conducted from the evaporator 23 through a pipe 28, a valve 29 and a pipe 30 and, from evaporator 24 through a pipe 32, valve 33, branch pipe 34 and pipe 30 to a heat dissipator herein shown as a condenser 36. The condensed refrigerant is conducted by a pipe 37 to an intermittent accumulator or dump valve 38, whence the refrigerant flows intermittently through a pipe 40 to a receiver 41 which feeds the liquid refrigerant pipe 25.

Any suitable type of expansion valve may be employed between the pipe 25 and the evaporators 23 and 24, and in the present illustration I have shown flooded evaporators each comprising a header 43 inclosing a float 44 which float actuates a needle valve 45 and normally maintains the refrigerant level constant within the header 43. A plurality of tubes 46 extend longitudinally of the header and are connected at one end to the header 43 and at the other end to a header 47. The pipe 28 of evaporator 23 and the pipe 32 of evaporator 24 are connected above the liquid refrigerant level in the headers 47 so that only gaseous refrigerant will be withdrawn through these outlet pipes. Fins 48 are intimately connected with the tubes 46 for the purpose of increasing the heat absorbing surface of the tubes 46. The flow of gaseous refrigerant from the evaporators 23 and 24 is controlled respectively by valves 29 and 33. These valves are identical in construction and are responsive respectively to the pressure of the refrigerant within the evaporators. Valve 29 includes a casing 50 having an outlet 51 leading to pipe 30. One wall of the casing 50 is flexible and is herein shown as a flexible diaphragm 52 which carries a valve 53 for opening and closing the port 51. A second casing 54 covers the upper side of the diaphragm 52 and retains a spring 55 and a screw 56 by which tension of the spring may be adjusted. By adjusting the screw 56 any desirable temperature may be maintained within the respective evaporator. When the pressure within the evaporator rises above a certain setting of the valve 29, the diaphragm 52 will be flexed upwardly to open the valve 53 and permit the withdrawal of gaseous refrigerant from the evaporator and, when the pressure within the evaporator is reduced to the desired minimum, the diaphragm 52 will close the valve 53 so as to prevent the further flow of gaseous refrigerant from the evaporator.

A condenser-cooler 60 is in intimate heat exchange relation with the condenser 36 to cool the latter for cooling and condensing the gaseous refrigerant flowing from the evaporators 23 and 24. The liquid refrigerant is delivered by pipe 37 to the accumulator or dump valve 38, and when a predetermined quantity of liquid refrigerant is accumulated within the accumulator or dump valve 38, the accumulator or dump valve 38 is opened to feed a quantity of the liquid to the receiver 41. The accumulator or dump valve 38 is shown in detail in Fig. 2 and comprises a main base 61 and a casing 62. Pipe 37 is connected to the inlet opening 63 of accumulator or dump valve 38 and the outlet opening 64 thereof is connected to pipe 40. The inlet 63 and outlet 64 are controlled respectively by valves 65 and 66. Valve 65 is carried by a lever 68 pivoted to a post 69 and valve 66 is carried by a lever 71 pivoted to a post 72. The levers 68 and 71 are actuated by a yoke 73 and are so arranged that when valve 65 is open, valve 66 is closed and vice versa. A rod 74 is connected to the connecting portion of the yoke 73 and the upper end of the rod extends into a socket 75 carried by the casing 62. Rod 74 carries two abutments 77 and 78 and a float is slidably disposed on the rod 74 and between the abutments 77 and 78. The float 79 is shown in its lowermost position in the drawing and when more refrigerant is delivered to the valve 38 through the pipe 37, the float 79 will rise and finally engage abutment 77 whereby to raise the rod 74 and yoke 73 and reverse the positions of the valves 65 and 66; namely, close the valve 65 and open the valve 66.

It is desirable to move the valves 65 and 66 from their open or closed position to their closed or open position quickly and for this purpose there is provided a snap acting mechanism including two levers 81 and 82 which have their inner ends connected to a pin 83 and their outer ends connected to a coil spring 84. The outside ends of the levers 81 and 82 extend through openings 85 in the yoke 73 and are arranged to be raised and lowered by the yoke. The yoke 73 is shown in its lowermost position and when the float 79 engages the abutment 77, the yoke 73 will be raised and will cause the outside ends of the levers 81 and 82 to be raised. When the levers 81 and 82 are moved to beyond their dead center position with respect to the pin 83, the cross spring 84 will quickly raise the yoke 73 to quickly actuate levers 68 and 71. Levers 68 and 71 extend through slots 86 in the yoke 73 and the slits are of such length that the yoke will not engage the levers 68 and 71 until the levers 81 and 82 have been moved beyond their dead center position and in this manner the valves will remain in the position shown until they are quickly actuated by the yoke 73. Weights 88 and 89 are provided on the levers 68 and 71, respectively, for the purpose of holding the valves in the position shown while the yoke is being slowly moved upwardly so that it will be seen that liquid refrigerant which is condensed by the condenser 36 continuously flows into the accumulator or dump valve 38 until a predetermined quantity of liquid refrigerant is accumulated in the accumulator or dump valve 38 and then the liquid refrigerant is directed into the receiver 41. The outlet opening 64 of the accumulator or dump valve 38 is relatively large so as to permit the ready escape of gas from the receiver 41 to the accumulator or dump valve 38 when the valve 66 is open. When the valve 66 is open, the gas from the receiver 41 cannot enter the condenser 36 because at this time the inlet valve 65 is closed.

The condenser cooler 60 is maintained at a lower temperature than the condenser 36 and the gaseous refrigerant from the evaporators 23 and 24 is withdrawn therefrom by the cooling of the condenser 36 and the condensed refrigerant is intermittently fed by the accumulator or dump valve 38 to the receiver 41 and the gas generated within receiver 41 intermittently escapes to the dump valve 38 where it is cooled and condensed by the circulating liquid refrigerant remaining in accumulator or dump valve 38. The outlet valves 29 and 33 may be adjusted to maintain the same temperatures in the evaporators 23 and 24 or different temperatures, if desirable.

The condenser-cooler 60 is herein shown as being cooled by an artificial ice making apparatus. This apparatus includes a tank 91, containing, for example, water which is cooled by an evaporator 92. This water is circulated through the condenser cooler 60 by a pump 93 which is driven by a motor 94. The water is withdrawn from the bottom of the tank 91 by a pipe 96 and is delivered to the cooler 60 by a pipe 97. The water from the condenser cooler 60 is delivered by a pipe 98 to the upper end of the tank 91. The circuit for the motor 94 includes wire 100, motor 94, wire 101, controller 102 and wire 103. In this manner cold liquid is continuously circulated in heat exchange relation with the heat dissipator 36. Gaseous refrigerant is withdrawn from the evaporator 92 through a pipe 104 which is connected to the low pressure side of a compressor 105. The gaseous refrigerant is compressed by the compressor 105 and delivered to a condenser section 106 which may be cooled in any suitable manner so as to condense the compressed gas. From the section 106, the liquid refrigerant flows by way of pipe 107 to a section 108, which is in intimate heat exchange relation with the receiver 41, to cool the liquid refrigerant. The cooled liquid refrigerant is delivered by a pipe 110 to a high-side-type float 111. This float includes a chamber 112 having an outlet 113 in the bottom thereof which is controlled by a valve 114, and the valve in turn is actuated by a float 115. When a predetermined quantity of liquid accumulates within the chamber 112, the float 115 will open the valve 114 to permit the escape of liquid through the port 113 to a pipe 116 which leads to an inlet of the evaporator 92.

The compressor 105 is driven by a motor 118 which is controlled by a snap switch 119. The circuit for the motor is as follows: wire 100, snap switch 119, wire 120, motor 118 and wire 103. The snap switch 119 is of the pressure operated type and is responsive to variations in pressure in a pipe 122 and a bulb 123. The bulb 123 is disposed within the ice tank 91 and may be of the freezing thermostat type, that is, when the fluid therein freezes and expands it will cause the actuating of the switch 119 to open the motor circuit and, when the congealed fluid within the valve 123 melts, pressure therein and in the pipe 122 will be decreased and cause the switch 119 to close the motor circuit.

The operation of the compressor 105 will cause a lowering of temperature of the evaporator 92 and a consequent cooling of the liquid within the tank 91, and the circulation of the liquid by the pump 93 will cause a cooling of the condenser-cooler 60 to cool the condenser 36.

The quantity of water flowing through condenser-cooler 60 is controlled by varying the

speed of the pump 93 by varying the speed of the motor 94. For this purpose, there is provided a variable speed control 102 which is actuated by a rod 125, controlled by a pressure bellows 126. The pressure within the bellows 126 varies in response to the change in pressure within the condenser 36, it being connected by a pipe 127 to the outlet pipe 37 of the condenser 36. The arrangement is such that when the pressure is high in the condenser 36, the pressure is also high in the bellows 126, and the controller then causes the motor 94 to operate at full speed and as the pressure within the condenser 36 decreases, the speed of the motor 94 is decreased relatively. In this manner the pressure and, therefore, the temperature within the condenser, is maintained substantially constant. If both outlet valves 29 and 33 of evaporators 23 and 24 are wide open, thus permitting a large quantity of gas to escape therefrom, the pressure within the condenser will be increased and the motor 94 will operate at high speed so as to cause a large quantity of cooling medium to be circulated over the condenser 36. When one of the valves 29 closes or decreases the flow of refrigerant to the condenser 36, the flow of cooling medium through the condenser cooler 60 will be decreased.

When the demand for refrigeration by the evaporators 23 and 24 is relatively small, the compressor 105, nevertheless, continues to operate until a large quantity of ice is made within the tank 91 so that this reserve of ice may be utilized for cooling the condenser cooler 60 when the demand for refrigeration by evaporators 23 and 24 is in excess of the cooling capacity of the compressor 105. In this manner the refrigerating apparatus, including the compressor 105 need not be of a size sufficient to satisfy the peak demand of the evaporators 23 and 24. It will be understood that the pipe 96 is disposed beyond the ice zone in tank 91.

The refrigerant in the condenser 36 and in the accumulator or dump valve 38 is relatively cold and it is not desirable to deliver this cold refrigerant by way of pipe 25 to the evaporators 23 and 24 since if this refrigerant is cold, pipe 25 must be thoroughly insulated. By disposing the section 108 within the receiver 41, the liquid refrigerant within the receiver 41 will be heated. When the condenser 36 is located below the evaporators 23 and 24, as herein shown, the liquid refrigerant is lifted to the evaporators from the receiver 41 due to increasing of pressure of the refrigerant in the receiver. The increased pressure in the receiver 41 is caused by section 108. Preferably, the ice tank 91, the condenser cooler 60, the condenser 36, the accumulator or dump valve 38 and the receiver 41 are disposed within an insulated housing 129 which is usually disposed within the basement of the building.

From the foregoing, it will be seen that I have provided a refrigerating system in which a plurality of chambers to be cooled, such as rooms 20 and 21, may be maintained at the same temperatures or different temperatures, and I have provided an artificial refrigerating system in which the capacity thereof need be sufficient for taking care of normal demands only. When the demand for refrigeration is below normal, a reserve of ice is manufactured to take care of an abnormal demand for refrigeration. The thermostatic bulb 123 maintains the compressor 105 operative until ice forms thereabove at which time the thermostat will operate to stop the compressor motor and the compressor motor will remain inactive until the ice melts about the thermostat.

While the form of embodiment of the present invention as herein described constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow:

1. Refrigerating system comprising, in combination, an evaporator, a heat dissipator connected with the evaporator for receiving refrigerant therefrom and for liquefying vaporized refrigerant, means for causing cooling of the heat dissipator, a liquid refrigerant receiver connected with the heat dissipator for receiving refrigerant therefrom, and connected with the evaporator for delivering liquid refrigerant thereto, and means interposed between the dissipator and the receiver for causing intermittent flow of liquid from the dissipator to the receiver.

2. A refrigerating system comprising, in combination, an evaporator, a heat dissipator connected with the evaporator for receiving refrigerant therefrom and for liquefying vaporized refrigerant, means for cooling the heat dissipator, a liquid refrigerant receiver connected with the heat dissipator for receiving refrigerant therefrom, and connected with the evaporator for delivering liquid refrigerant thereto, means interposed between the dissipator and the receiver for causing intermittent flow of liquid from the dissipator to the receiver, and means for heating the refrigerant in said receiver.

3. A refrigerating system comprising, in combination, an evaporator, a heat dissipator connected with the evaporator for receiving refrigerant therefrom and for liquefying vaporized refrigerant, means for cooling the heat dissipator, means responsive to the condition of the evaporator for controlling the heat exchange between the heat dissipator and the cooling means, a liquid refrigerant receiver connected with the heat dissipator for receiving refrigerant therefrom and connected with the evaporator for delivering liquid refrigerant thereto, and means interposed between the dissipator and the receiver for causing intermittent flow of liquid from the dissipator to the receiver.

4. A refrigerating system comprising, in combination, an evaporator, a heat dissipator connected with the evaporator for receiving refrigerant therefrom and for liquefying vaporized refrigerant, means for circulating a cooling medium in heat exchange relation with the heat dissipator, means responsive to the condition of the evaporator for controlling the circulating means, a liquid refrigerant receiver connected with the heat dissipator for receiving refrigerant therefrom and connected with the evaporator for delivering liquid refrigerant thereto, and means interposed between the dissipator and the receiver for causing intermittent flow of liquid from the dissipator to the receiver.

5. A refrigerating system comprising, in combination, refrigerating apparatus, said apparatus including an evaporator, and means for withdrawing gaseous refrigerant from the evaporator and for compressing and condensing the same and for delivering the condensed refrigerant to the evaporator; a second refrigerating apparatus including an evporator, means in heat exchange relation with the first mentioned evaporator for withdrawing gaseous refrigerant from the second mentioned evaporator and for condensing the same, a receiver connected with the second mentioned means for receiving liquid refrigerant

therefrom and connected with the second mentioned evaporator for delivering liquid refrigerant thereto; and means for subjecting the liquid in the receiver to the heat of compression of the first refrigerating apparatus.

6. A refrigerating system comprising, in combination, refrigerating apparatus, said apparatus including an evaporator, and means for withdrawing gaseous refrigerant from the evaporator and for compressing and condensing the same and for delivering the condensed refrigerant to the evaporator; a second refrigerating apparatus including an evaporator and a condenser operatively connected with the second mentioned evaporator; and means providing for heat exchange between the means of the first refrigerating apparatus and the refrigerant condensed by said condenser.

7. A refrigerating system comprising, in combination, a refrigerating apparatus, said apparatus including an evaporator, and means for withdrawing gaseous refrigerant from the evaporator and for compressing and condensing the same and for delivering the condensed refrigerant to the evaporator; a second refrigerating apparatus including an evaporator and a condenser in heat exchange relation with the first mentioned evaporator, and operatively connected with the second mentioned evaporator; and means providing for heat exchange between the means of the first refrigerating apparatus and the refrigerant condensed by said condenser.

8. A refrigerating system comprising, in combination, a refrigerating apparatus including a plurality of evaporators, a condenser operatively connected with the evaporators, means for causing cooling of the condenser to a lower temperature than the evaporators, means responsive to the pressure of the refrigerant in one of said evaporators for controlling the flow of refrigerant from said evaporator to the condenser, means responsive to the pressure of refrigerant within the condenser for controlling the heat exchange between the condenser and the condenser cooling means, and means interposed between the condenser and the evaporator for causing intermittent unloading of liquid refrigerant from the condenser.

9. A refrigerating system comprising, in combination, a refrigerating apparatus including a plurality of evaporators, a condenser operatively connected with the evaporators, means responsive to the condition of one of said evaporators for controlling the flow of refrigerant therefrom to the condenser, means for causing cooling of said condenser to a temperature lower than the evaporators, means responsive to the temperature of the refrigerant for controlling the heat exchange between the condenser and the condenser cooling means, and means interposed between the condenser and the evaporator for causing intermittent unloading of liquid refrigerant from the condenser.

10. A refrigerating system comprising, in combination, a refrigerating apparatus including a plurality of evaporators, a condenser operatively connected with the evaporators, means for circulating a cooling medium in heat exchange relation with the condenser, the temperature of such medium being colder than that of the evaporators, means responsive to the condition of one of said evaporators for controlling the flow of refrigerant therefrom to the condenser, means responsive to the temperature of the condenser for controlling the cooling medium circulating means, and means interposed between the condenser and the evaporator for causing intermittent unloading of liquid refrigerant from the condenser.

11. A refrigerating system comprising, in combination, a heat absorber, a heat dissipator operatively connected therewith, means for cooling the heat dissipator to a temperature lower than that of the absorber, and means responsive to the temperature of the heat dissipator for controlling the heat exchange between the dissipator and the first mentioned means, and means interposed between the condenser and the evaporator for causing intermittent unloading of liquid refrigerant from the condenser.

12. A refrigerating system comprising, in combination, a heat absorber, a heat dissipator operatively connected therewith, means for circulating a liquid cooling medium in heat exchange relation with the heat dissipator, an ice making apparatus for cooling said liquid cooling medium, and means responsive to the temperature of the heat dissipator for controlling the heat exchange between the heat dissipator and the liquid cooling medium.

13. A refrigerating system comprising, in combination, an evaporator, a condenser operatively connected therewith, means for circulating a liquid cooling medium in heat exchange relation with the condenser, an ice making apparatus for cooling said liquid cooling medium, and means responsive to the pressure of refrigerant in the evaporator for controlling the heat exchange between the condenser and the liquid cooling medium.

14. A refrigerating system comprising in combination, an evaporator, a heat dissipator connected with the evaporator for receiving refrigerant therefrom, means for causing cooling of the heat dissipator, a liquid refrigerant receiver connected with the evaporator for delivering liquid refrigerant to the evaporator, and means interposed between the heat dissipator and receiver and responsive to an accumulation of liquid refrigerant received from the heat dissipator for delivering to the receiver, at one period of time, the liquid accumulated.

15. A refrigerating system comprising in combination, an evaporator, a heat dissipator connected with the evaporator for receiving refrigerant therefrom, means for causing cooling of the heat dissipator, a liquid refrigerant receiver connected with the evaporator for delivering liquid refrigerant to the evaporator, an accumulator interposed between the heat dissipator and the receiver and means for alternately connecting the accumulator with the heat dissipator and with the receiver.

16. A refrigerating system comprising in combination, an evaporator, a heat dissipator connected with the evaporator for receiving refrigerant therefrom, means for causing cooling of the heat dissipator, a liquid refrigerant receiver connected with the evaporator for delivering liquid refrigerant to the evaporator, an accumulator interposed between the heat dissipator and the receiver, valve mechanism for alternately connecting the accumulator with the heat dissipator and with the receiver, and means responsive to the quantity of liquid refrigerant in the accumulator for actuating the valve mechanism.

17. A refrigerating system comprising, in combination, an evaporator, a heat dissipator connected with the evaporator for receiving refriger-

ant therefrom, means for causing cooling of the heat dissipator, a liquid refrigerant receiver connected with the evaporator for delivering liquid refrigerant to the evaporator, means interposed between the heat dissipator and receiver and responsive to an accumulation of liquid refrigerant received from the heat dissipator for delivering to the receiver, at one period of time, the liquid accumulated and means for increasing the pressure of the refrigerant in the receiver while liquid refrigerant is accumulating in said accumulator.

18. A refrigerating system comprising, in combination, an evaporator, a heat dissipator connected with the evaporator for receiving refrigerant therefrom, means for causing cooling of the heat dissipator, a liquid refrigerant receiver connected with the heat dissipator for receiving refrigerant therefrom, and connected with the evaporator for delivering liquid refrigerant thereto, means responsive to an accumulation of liquid refrigerant condensed by the heat dissipator for delivering to the receiver, at one period of time, the liquid accumulated, and means operable while the condensed refrigerant is accumulating for increasing the pressure of the refrigerant in the receiver.

19. A refrigerating system comprising, in combination, refrigerating apparatus, said apparatus including an evaporator, and means for withdrawing gaseous refrigerant from the evaporator and for compressing and condensing the same and for delivering the condensed refrigerant to the evaporator; a second refrigerating apparatus including an evaporator, means in heat exchange relation with the first mentioned evaporator for withdrawing gaseous refrigerant from the second mentioned evaporator and for condensing the same, a receiver connected with the second mentioned evaporator for delivering liquid refrigerant to the same evaporator, means interposed between the second mentioned means and receiver and responsive to an accumulation of condensed refrigerant for delivering to the receiver, at one period of time, the liquid accumulated; and means for subjecting the liquid in the receiver to the heat of compression of the first refrigerating apparatus.

20. A refrigerating system comprising, in combination, refrigerating apparatus, said apparatus including an evaporator, and means for withdrawing gaseous refrigerant from the evaporator and for compressing and condensing the same and for delivering the condensed refrigerant to the evaporator; a second refrigerating apparatus including an evaporator, means in heat exchange relation with the first mentioned evaporator for withdrawing gaseous refrigerant from the second mentioned evaporator and for condensing the same, a receiver connected with the second mentioned means for receiving liquid refrigerant therefrom and connected with the second mentioned evaporator for delivering liquid refrigerant thereto; means responsive to an accumulation of liquid refrigerant condensed by the second mentioned means for delivering to the receiver, at one period of time, the liquid accumulated; and means for subjecting the liquid in the receiver to the heat of compression of the first refrigerating apparatus.

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