

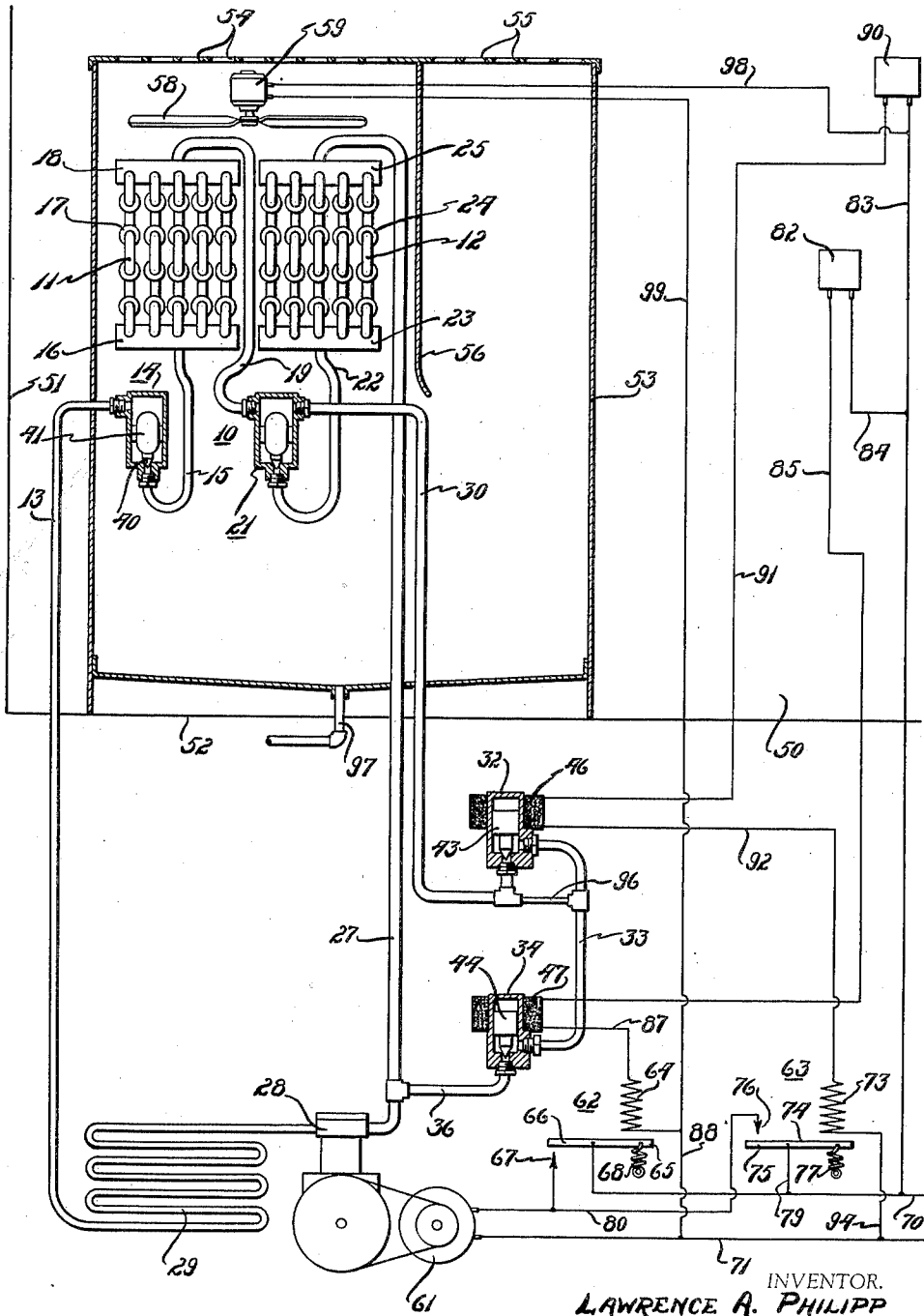
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AIR CONDITIONING SYSTEM

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AIR CONDITIONING SYSTEM

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The present invention relates to refrigeration and more particularly to refrigeration for conditioning air by cooling and dehumidifying the same.

One of the objects of the present invention is to provide an improved refrigerating system and an improved method of and apparatus for conditioning air, and in carrying out these objects, it is a further object to provide a refrigerating system utilizing a plurality of heat absorbers or absorber sections and increasing the temperature of one of the sections and decreasing the temperature of another of the sections by causing refrigerant to flow in a conduit paralleling one of the sections, and to vary the amounts of heat absorbed by the respective sections by controlling the flow of refrigerant through the paralleling conduit in accordance with the condition of the medium cooled by the heat absorbing sections and in the case of utilizing this process and apparatus for the purpose of conditioning air, in accordance with the relative humidity of the air to be conditioned.

Another object of the present invention is to control the flow of refrigerant through the paralleling conduit in accordance with the temperature of the air to be conditioned.

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

The figure in the drawing illustrates diagrammatically my improved system.

My invention contemplates the use of a heat absorber having at least two heat absorbing surfaces or sections and when used in connection with an air conditioning system, both sections are used under normal, or low, humidity conditions for removing principally sensible heat from the air. One of these sections is utilized principally, particularly when the air to be conditioned is high in relative humidity, for cooling the air to considerably below its dew point in order to cause precipitation and thereby removal of a large quantity of moisture from the air.

In the present embodiment an evaporator 10 of a mechanical refrigerator is employed as the heat absorber and the two heat absorbing surfaces are provided by dividing the evaporator into two sections or portions 11 and 12. Refrigerant is delivered to the evaporator 10 through a pipe 13. The refrigerant first flows through an expansion valve 14 and is conducted by a

pipe 15 to the lower header 16 of section 11. The refrigerant is conducted upwardly through a series of parallel coils 17 to an upper header 18. From the upper header 18 the refrigerant flows by way of pipe 19 to a second expansion valve 21 and then through a pipe 22 to the header 23, parallel pipes 24, header 25 of section 12. Gaseous refrigerant from section 12 passes through a pipe 27 to the low pressure side of a compressor 28. The refrigerant is compressed by compressor 28 and delivered to a condenser 29 wherein it is condensed and conducted to pipe 13. Gaseous refrigerant is also conducted from the upper part of expansion valve 21 by a pipe 30, valve 32, pipe 33, valve 34 and pipe 36 to the low pressure side of compressor 28. The expansion valves 14 and 21 are similar in construction and are known in the art as high-side-type float valves. Each of these valves comprises a liquid receiving chamber 40 and a float valve 41 which opens a lower port when a predetermined quantity of liquid refrigerant accumulates within the receiving chamber 40. Therefore only liquid refrigerant will flow into pipes 15 and 22. The pipe 30 is connected above the liquid level of the expansion valve 21 for conducting only gaseous refrigerant to the compressor 28.

The valves 32 and 34 which are disposed in the gaseous refrigerant line between expansion valve 21 and compressor 28 are similar in construction. The valve 32 is provided with a magnetic core 43 and the valve 31 is provided with a magnetic core 44. An electro magnet 46 is arranged, when energized to lift the core 43 from its seat to permit refrigerant to flow from pipe 30 to pipe 33. The valve 31 is provided with an electro magnet 47, which, when energized, causes the core 44 to be raised from its seat to permit the flow of refrigerant from pipe 33 into pipe 36.

The air conditioning system herein shown is utilized for cooling a room 50; one side of the room is shown at 51 and the floor is shown at 52. Evaporator 10 is disposed in a cabinet 53 having an air inlet opening 54 and an air outlet opening 55 and partition 56 depends from the top wall and extends from the front to the rear of the cabinet for directing air. Air is circulated about the evaporator 10 by a fan 58 driven by a continuously operating motor 59.

The compressor 28 is driven by a motor 61 which motor is controlled by two electro magnetic switches 62 and 63 which switches are connected in parallel. Switch 61 includes a magnet coil 64, an armature 65, contacts 66 and 67. A spring 68 holds the contacts 66 and 67 separated

when the coil is deenergized. When the coil 64 is energized a circuit to the motor is completed over main 70, contacts 66 and 67, motor 61 and main 71. Switch 63 includes a magnet coil 73, an armature 74, contacts 75 and 76. The spring 77 holds the contacts 75 and 76 together when the coil 73 is deenergized to complete the motor circuit over main 70, wire 79, contacts 75 and 76, wire 80, motor 61 and main 71. Therefore it is apparent that if coil 64 is energized or coil 73 is deenergized, a circuit is completed to the motor.

A thermostat 82 is arranged to control the energization of coil 47, of valve 34 and coil 64 of switch 62. When the temperature of the air in the room is above a predetermined desired maximum, the thermostat 82 closes a circuit through coils 47 and 64 as follows: main 70, wires 83 and 84, thermostat 82, wire 85, coil 47, wire 87, coil 64, wire 88 and main 71. Therefore, if the temperature of the air is above a predetermined maximum a circuit will be completed to the motor 61 and the valve 34 will be open. The thermostat 82 is arranged to open the circuit through coils 47 and 64 when the temperature of the air in the room is lowered to a predetermined minimum.

A humidostat 90 controls the energization and deenergization of coil 46 of valve 32 and coil 73 of switch 63. If the relative humidity of the air in the room is proper, the humidostat 90 will maintain coils 46 and 73 energized so that the flow of refrigerant from pipe 30 to pipe 33 is not restricted. The circuit for these coils is as follows: main 70, wire 83, humidostat 90, wire 91, coil 46, wire 92, coil 73, wire 94 and main 71. Therefore it will be apparent that if the relative humidity is proper the operation of the compressor motor 61 is governed entirely by the thermostat 82. If however the relative humidity of the air in the room is too high for comfort, the humidostat will interrupt the circuit through coil 46 and coil 73 causing the valve 32 to restrict the flow of refrigerant from pipe 30 to pipe 33 and permit the spring 77 of switch 63 to make contacts 75 and 76 whereby a motor circuit will be completed.

It is apparent therefore that although the temperature of the air is reduced to the desired minimum, the compressor motor will be maintained operating through the agency of humidostat 90. The compressor will continue to operate until the relative humidity of the air has been reduced to the desired minimum. When valves 32 and 34 are open wide, gaseous refrigerant which vaporizes in section 11 will be withdrawn through the pipes 30, 33 and 36 and gaseous refrigerant will be withdrawn from section 12 through the pipe 27. Under this condition both sections will operate at the same temperature or substantially so until the temperature of the room is reduced to a predetermined minimum. The thermostat 82 is set so as to start the compressor when the temperature of the air in the room reaches approximately 84° F. and stops the compressor when the temperature of the air decreases to 82° F. If the relative humidity of the air in the room is too high, the humidostat 90 will permit the valve 32 to close and the flow of refrigerant from pipe 30 to pipe 33 will be restricted to that which can flow through a small bypass 96. Since the flow of gaseous refrigerant from section 11 is now restricted, the pressure reducing action of compressor 28 will be concentrated primarily on sec-

tion 12 whereby the pressure within section 12 will be reduced with the consequent lowering of the temperature of this section and since less gas is withdrawn from section 11 its pressure and likewise its temperature will be increased. Under these conditions the temperature of section 12 is lowered considerably below the dew point of the air causing an increased precipitation of moisture from the air and a consequent lowering of the humidity thereof. The heat absorbing surfaces of sections 11 and 12 are approximately the same and therefore the temperature of section 12 will be reduced considerably when the suction action of the compressor is concentrated primarily upon this section. This in effect provides for removing a large quantity of the latent heat from the air being conditioned and only a relatively small quantity of specific heat.

In case the cooling effect of sections 11 and 12 is such as to cause the temperature of the air in the room to be reduced, for example to 82° F. while the relative humidity of the air is still too high, the thermostat 82 will cause the closing of valve 44 and prevent the flow of gaseous refrigerant from pipe 33 to 36. In this event, section 11 will merely function as a liquid feed line for section 12. The suction action of the compressor 28 will, in this case, be concentrated entirely upon reducing the pressure in section 12 which in effect will cause a further reduction of temperature in section 12 so as to cause a greater precipitation of moisture from the air. Under this condition a still larger quantity of latent heat will be removed from the air.

Thus it will be understood that this system functions differently under three different conditions of the air. When the humidity is substantially proper, sections 11 and 12 operate at substantially the same temperature. When the humidity of the air is relatively high and when the air should be cooled, valve 32 will cause the section 11 to be increased in temperature and the section 12 to be decreased in temperature to cause precipitation or increased precipitation of moisture from the air. And when the air is reduced to the desired low temperature but the humidity is still too high for comfort, the valve 34 causes a further increase in differential between sections 11 and 12 to cause a removal of a relatively large amount of moisture from the air.

The moisture condensed in a cabinet 53 is conducted therefrom through a pipe 97. The motor circuit of fan 58 includes main 70, wires 83 and 98, motor 59, wires 99 and 88 and main 71. Under certain conditions, it will be desirable to cause some precipitation of moisture at the sections 11 and 12 when the valves 32 and 34 are open, and it is to be understood that when said section 11 is referred to as functioning to remove principally sensible heat, such terms are used merely to define the main functional purposes of the section as distinguished from the functional purposes of section 12 when either of the valves 32 or 34 is closed.

While the form of embodiment of the present invention as herein disclosed 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.

I claim:

1. In an air conditioning system, a refrigerating apparatus comprising in combination, an evaporator having portions connected in series and an expansion valve for each portion, means

for withdrawing gaseous refrigerant from said portions, compressing and condensing the refrigerant and delivering the same to the evaporator, means for starting and stopping said first means, a refrigerant conduit paralleling one of said portions of the evaporator to by-pass refrigerant there-around to said first means, and means in said conduit responsive to the relative humidity of the air to be conditioned for controlling the flow of refrigerant through said conduit.

2. In an air conditioning system, a refrigerating apparatus comprising in combination, an evaporator having portions connected in series and an expansion valve for each portion, means for withdrawing gaseous refrigerant from said portions, compressing and condensing the refrigerant and delivering the same to the evaporator, a refrigerant conduit at the outlet of one of said portions to receive refrigerant therefrom and for conducting refrigerant to said circulating means, said conduit paralleling another of said portions of the evaporator, and means in said conduit responsive to the relative humidity of the air to be conditioned for controlling the flow of refrigerant through said conduit.

3. An air conditioning system comprising in combination a refrigerating apparatus including heat absorbing means for cooling circulating air, said heat absorbing means having a cooling surface, the main function of which is to remove principally specific heat from the air and having another cooling surface, the main function of which latter portion is to cool air to below the dew point thereof, means for circulating refrigerant through the heat absorbing means, a by-pass conduit paralleling one of said portions connected with the other of said portions to receive refrigerant therefrom, and means responsive to the relative humidity of the air to be conditioned for controlling the flow of refrigerant through said conduit.

4. An air conditioning system comprising in combination a refrigerating apparatus including heat absorbing means for cooling circulating air, said heat absorbing means having a cooling surface, the main function of which is to remove principally specific heat from the air and having another cooling surface, the main function of which latter portion is to cool air to below the dew point thereof, means for circulating refrigerant through the heat absorbing means, a conduit paralleling one of said portions, and means responsive to the relative humidity and to the temperature of the air to be conditioned for controlling the flow of refrigerant through said conduit.

5. The process of cooling and dehumidifying air which process comprises causing air which is to be conditioned to circulate in heat exchange relation with a heat absorber, circulating refrigerant through the heat absorber, causing different portions of the absorber to absorb different amounts of heat by by-passing the flow of refrigerant about one portion of the absorber, and varying the by-passing in accordance with the relative humidity of the air to be conditioned.

6. The process of cooling and dehumidifying air which process comprises causing air which is to be conditioned to circulate in heat exchange relation with a heat absorber, circulating refrigerant through the heat absorber, causing different portions of the absorber to absorb different amounts of heat by by-passing the flow

of refrigerant about one portion of the absorber, and varying the by-passing in accordance with the relative humidity and in accordance with the temperature of the air to be conditioned.

7. The process of cooling and dehumidifying air which process comprises, causing air which is to be conditioned to circulate in heat exchange relation with a portion of a heat absorber, the main function of which portion is to remove principally sensible heat from the air, and causing air to circulate in heat exchange relation with another portion of the absorber, the main function of which second portion is to cool the air to below the dew point thereof, circulating refrigerant through said portions, by-passing refrigerant about the second portion, and controlling the quantity of refrigerant by-passed in accordance with the relative humidity of the air to be conditioned.

8. The process of cooling and dehumidifying air which process comprises, causing air which is to be conditioned to circulate in heat exchange relation with a portion of a heat absorber, the main function of which portion is to remove principally sensible heat from the air, and causing air to circulate in heat exchange relation with another portion of the absorber, the main function of which second portion is to cool the air to below the dew point thereof, circulating refrigerant through said portions, by-passing refrigerant about the second portion, and controlling the quantity of refrigerant by-passed in accordance with the relative humidity and in accordance with the temperature of the air to be conditioned.

9. In an air conditioning system, a refrigerating apparatus comprising in combination, heat absorbing means having a plurality of portions adapted to cool a common medium, means for circulating refrigerant through the heat absorbing means, one of the portions of the heat absorbing means being arranged to receive refrigerant from another portion, a conduit paralleling the first mentioned portion to by-pass refrigerant from said second mentioned portion to said circulating means and valve means responsive to the relative humidity and the temperature of the air to be conditioned to control the quantity of refrigerant by-passed through the conduit.

10. In an air conditioning system, a refrigerating apparatus comprising in combination, an evaporator, means for withdrawing gaseous refrigerant from the evaporator, compressing and condensing the refrigerant and delivering the same to the evaporator, one portion of the evaporator being arranged to receive refrigerant from another portion, means for controlling the flow of refrigerant from the second mentioned portion to the first mentioned portion, a conduit paralleling one of said portions to conduct refrigerant from the other of said portions to said first means, and valve means operating independently of said controlling means and responsive to the relative humidity of the air to be conditioned for controlling the flow of refrigerant through the conduit.

11. In an air conditioning system, a refrigerating apparatus comprising in combination, an evaporator, means for withdrawing gaseous refrigerant from the evaporator, compressing and condensing the refrigerant and delivering the same to the evaporator, one portion of the evaporator being arranged to receive refrigerant from another portion, means for controlling the flow

- of refrigerant from the second mentioned portion to the first mentioned portion, a conduit paralleling the first mentioned portion to conduct refrigerant from the second mentioned portion to said first mentioned means, and valve means operating independently of said controlling means and responsive to the relative humidity of the air to be conditioned for controlling the flow of refrigerant through the conduit.
- 10 12. An air conditioning system comprising in combination, refrigerating apparatus, including heat absorbing means for cooling circulating air, one portion of said heat absorbing means being arranged to receive refrigerant from another portion, the main function of one of said portions being to remove principally specific heat from the air and the main function of another of said portions being to cool air to below the dew point thereof, means for circulating refrigerant through said heat absorber, a conduit paralleling the portion second to receive refrigerant to conduct refrigerant from the other portion to the circulating means, means to start and stop said circulating means, means to start and stop said circulating means, and valve means responsive to the relative humidity of the air to be conditioned for controlling the flow of refrigerant through said conduit.

lating means, and valve means responsive to the relative humidity of the air to be conditioned for controlling the flow of refrigerant through said conduit.

13. An air conditioning system comprising in combination, refrigerating apparatus including heat absorbing means for cooling circulating air, one portion of said heat absorbing means being arranged to receive refrigerant from another portion, the main function of one of said portions being to remove principally specific heat from the air and the main function of another of said portions being to cool air to below the dew point thereof, means for circulating refrigerant through said heat absorber, a conduit paralleling the portion second to receive refrigerant to conduct refrigerant from the other portion to the circulating means, means to start and stop said circulating means, and valve means directly responsive to the temperature of the air to be conditioned for varying the flow of refrigerant through said conduit.

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