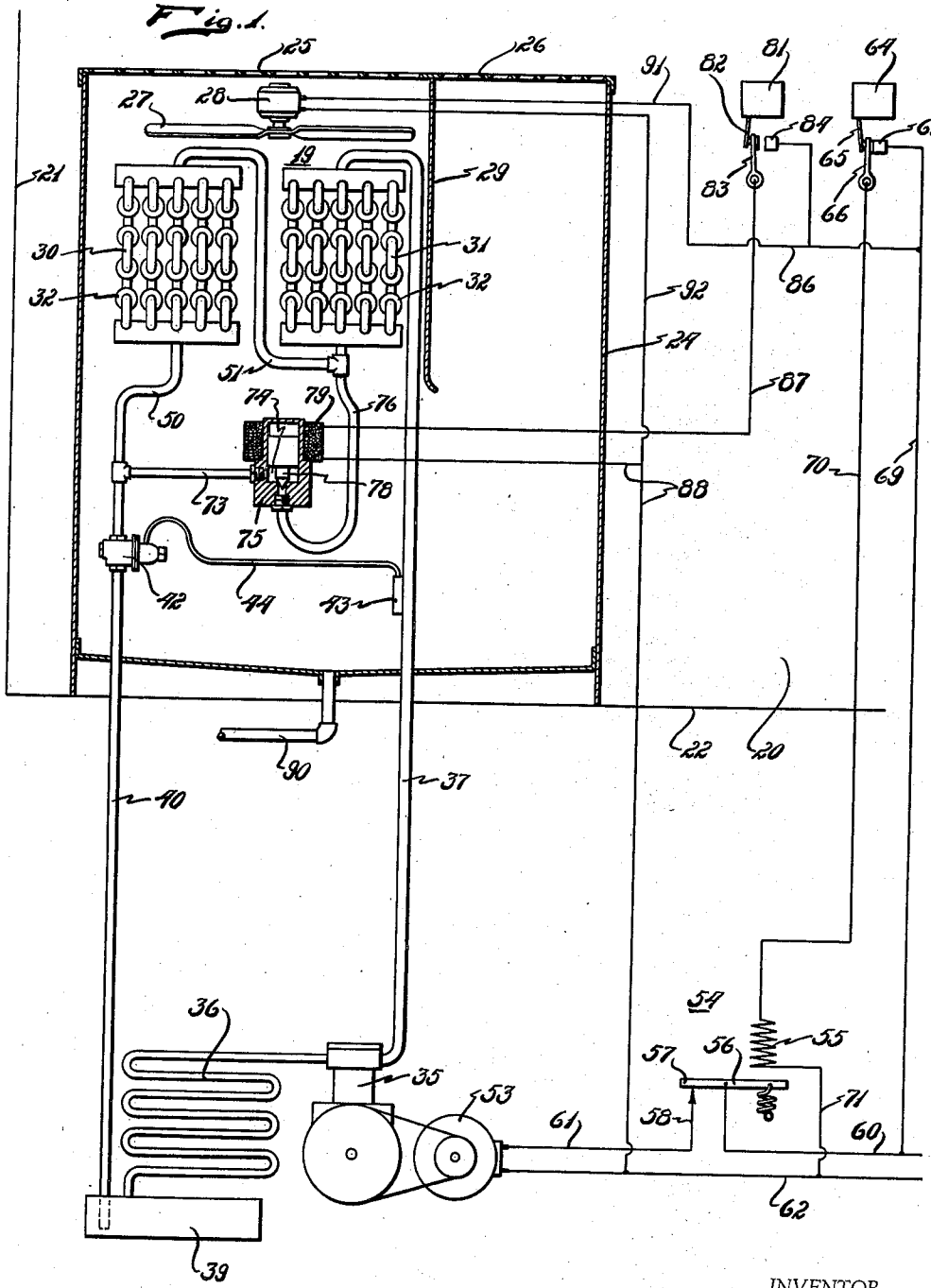
Aug. 15, 1939. L. A. PHILIPP 2,169,899

AIR CONDITIONING SYSTEM

Original Filed Nov. 14, 1933 2 Sheets-Sheet 1

Fig. 1.



INVENTOR.
LAWRENCE A. PHILIPP

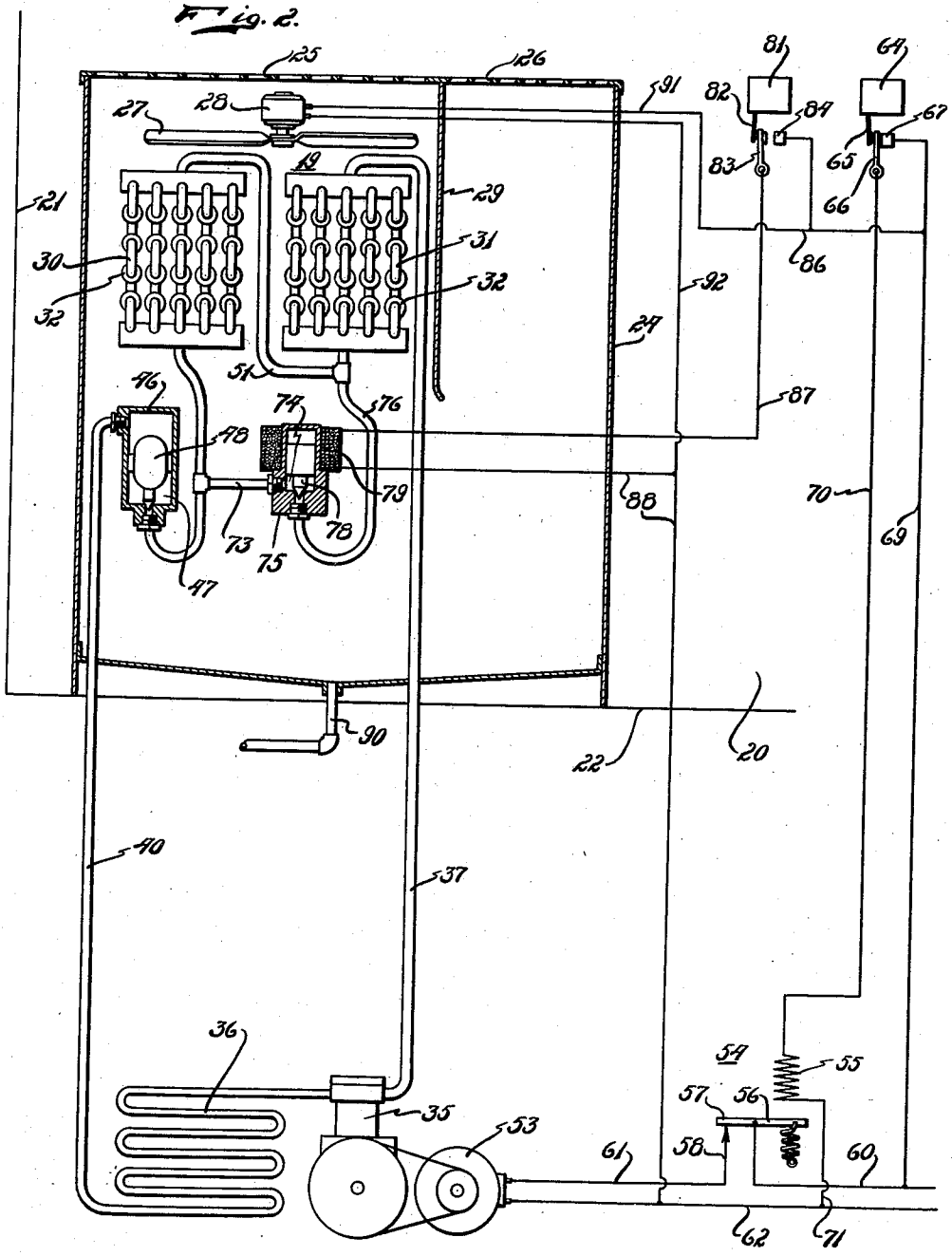
BY
Warren H. F. Schmeidler,
ATTORNEY.

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Fig. 2.



INVENTOR.
LAWRENCE A. PHILIPP

BY
Warren H. L. Schmieding
ATTORNEY.

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UNITED STATES PATENT OFFICE

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AIR CONDITIONING SYSTEM

Lawrence A. Philipp, Detroit, Mich., assignor, by mesne assignments, to Nash-Kelvinator Corporation, Detroit, Mich., a corporation of Maryland

Application November 14, 1933, Serial No. 697,940
Renewed January 11, 1939

11 Claims. (Cl. 62—6)

The present invention relates to the art of refrigeration and particularly to refrigeration for conditioning air, and is based upon the subject matter disclosed and claimed in my copending applications, Serial Nos. 697,169, 697,170, 697,171 and 697,172.

One of the objects of the present invention is to provide a refrigerating apparatus employing a heat absorber, for example an evaporator, having a plurality of sections connected in such fashion that refrigerant flows first through one section and then another and to provide a conduit paralleling the first section and controlling the flow of refrigerant through the paralleling conduit so as to vary the temperature of the sections respectively.

The present invention is particularly applicable for air condition system in which, at times, it is desirable to vary the amount of moisture removed from the air and in this respect, it is a further object of the present invention to control the amount of heat absorbed by different sections of the heat absorber in accordance with the relative humidity of the air to be conditioned by varying the flow of refrigerant through the paralleling conduit in accordance with the condition of the air.

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

Fig. 1 is a diagrammatic view of my improved refrigerating apparatus applied in an air conditioning system; and

Fig. 2 is a view similar to Fig. 1 but showing another form of the invention.

Referring to the drawings, I have illustrated the air conditioning system for cooling a room such as an office or a room in a dwelling. The room is indicated at 20 and a wall 21 and a floor 22 of the room are shown. A cabinet 24 is disposed within the room 20 and is provided at the top with an air inlet opening 25 and an air outlet opening 26. A fan 27 driven by a motor 28 causes air to circulate through the cabinet 24. A partition 29 depends from the top wall and extends from the front to the rear of the cabinet for directing air.

Any form of heat absorbing means may be employed and I have herein illustrated a heat absorber having two heat absorbing sections. In the present embodiment the absorber comprises an evaporator 19 having evaporator sections 30 and 31, each including a plurality of parallel coils provided with fins 32 for increasing the heat absorbing surface 30. The evaporator 31 has approximately as much heat absorbing surface as evaporator 30. Air from the room 20 enters the cabinet 24 through the inlet 25 and approximately one half of the air is forced over the section 30 and the other half thereof is forced over the section 31 and then out of the cabinet through the opening 26.

The means for dispelling the heat absorbed by the heat absorber comprises a compressor 35 and a condenser 36. Vaporized refrigerant is withdrawn from the evaporator sections 30 and 31 through a pipe 37 and the vaporized refrigerant is compressed by compressor 35 and discharged into a condenser 36 where it is cooled. The condensed refrigerant first flows into a receiver 39 (Fig. 1) and is conducted by a pipe 40 to the evaporator 19.

Any suitable type expansion valve may be interposed between the condenser 36 and the evaporator and two forms are herein shown. The expansion valve 42 shown in Fig. 1 is the well known pressure operated type expansion valve which is responsive to the pressure within the evaporator and responsive to the temperature of the outlet of the evaporator and is known in the art as a thermostatic expansion valve. A reduction in pressure within the evaporator tends to open the valve to admit liquid refrigerant to the evaporator but this opening of the valve is modified by a thermostat 43. The thermostat 43 is bonded to the outlet pipe 37 of evaporator section 31 and is connected to the back side of the expansion valve 42 by a tube 44. The thermostat 43 and tube 44 contain a volatile fluid and therefore this system varies the pressure on the back side of the valve 44 and is adjusted to operate the valve to prevent or substantially prevent the flow of refrigerant to the evaporator when vaporization of refrigerant is taking place at the point where thermostat 43 is connected to pipe 37; namely, at the outlet of the evaporator 19.

In accordance with Fig. 2 there is shown what is known in the art as a high-side-type float valve. In this system the usual receiver is omitted and the lower part of the condenser is connected directly to the pipe 40. This high-side-type float 46 includes a receiving chamber 47 for liquid refrigerant and liquid refrigerant is conducted thereto by the pipe 40. A float valve 48 is disposed within chamber 47 and controls the lower outlet of chamber 47. When a predetermined quantity of liquid refrigerant accumulates in receiving chamber 47, the float

valve 48 will raise to permit the flow of refrigerant therethrough.

Refrigerant is delivered to the evaporator 19 from either expansion valve 42 or expansion valve 46 by a pipe 50. Under certain conditions, refrigerant first flows to section 30 and part of the refrigerant is vaporized therein. Liquid and vaporized refrigerant then passes from the top of section 30 by a pipe 51 to the lower part of section 31. In section 31 all of the liquid refrigerant vaporizes and leaves the top of section 31 through the pipe 37 whence it is delivered by pipe 37 to the compressor 35. If vaporization takes place within the pipe 37 the fluid in thermostat 43 will contract to cause a complete closing of the expansion valve 42 or a further metering thereof.

When the sections 30 and 31 are connected in series as above set forth and all of the refrigerant passes first through section 30 and then through section 31 both sections will be maintained at substantially the same temperature. The quantity of refrigerant circulated in the refrigerating apparatus is controlled by starting and stopping the compressor 35. The compressor 35 is driven by a motor 53 and the motor is controlled by a switch 54. This switch comprises a magnetic coil 56, an armature 56, movable contact 57, and a stationary contact 58. When the coil 55 is energized a circuit to the motor 53 will be established by current flowing through main 60, contacts 57 and 58, wire 61, motor 53 and main 62. The energization and deenergization of the magnet coil 55 is controlled by a thermostat 64. This thermostat is provided with an operating arm 65 which is arranged to cause a contact 66 to engage a contact 67 when the temperature of the air in the room attains a predetermined high value and to cause contact 66 to separate from contact 67 when the temperature of the air in the room attains a predetermined low value. When contact 66 engages contact 67, a circuit is completed to the magnet coil 55 over main 60, wire 69, contact 67 and 66, wire 70, coil 55, wire 71 and main 62. Thus it is apparent that the desired temperature of the air may be maintained in the room 20.

It is also desirable to control the relative humidity of the air in the room 20. The humidity of the air in the room changes due to changes in the environment and due to the direct addition of moisture to the air and, if the relative humidity of the air is high, although the temperature of the air is satisfactory, the condition of the air would still be uncomfortable. In order to rectify this condition, I provide for cooling a part of the air, flowing through the cabinet 24 to a low temperature to cause precipitation or an increased precipitation of the moisture out of the air. In order to lower the temperature of part of the air passing through cabinet 24, I provide a conduit which parallels section 30 and this conduit includes a pipe 73, chamber 74 of valve 75 and pipe 76. Pipes 73 and 76 are connected to pipes 50 and 51 respectively. The flow of refrigerant through this paralleling conduit is controlled by a valve 78 in the form of a solenoid core. This valve opens and closes an outlet port in the lower part of chamber 74. The core is actuated by a magnet coil 79 which, when energized, opens the valve 78 and permits the flow of refrigerant direct from either the expansion valve 42 or 46 to the section 31 and, when the coil 79 is deenergized, the valve 78 is closed and all of the refrigerant flowing to section 31 first must pass through section 30. The opening and closing of the valve 78 is controlled by a humidostat 81. This humidostat is provided with an actuating arm 82 for controlling the engagement and disengagement of contacts 83 and 84. When the relative humidity of the air in the room 20 is proper, contact 83 is separated from contact 84 and therefore valve 78 is closed and consequently sections 30 and 31 operate at substantially the same temperature. If however the relative humidity of the air is too high, humidostat 81 will cause its arm 82 to move contact 83 into engagement with contact 84 to complete a circuit to magnet coil 79 over the following circuit: main 60, wires 69 and 86, contacts 84 and 83, wire 87, coil 79, wire 88 and main 62. The valve 75 will then be open and liquid refrigerant can then flow direct from the expansion valve 42 (Fig. 1) or expansion valve 46 (Fig. 2) to the evaporator section 31. The capacity of the compressor being substantially constant, it will now materially reduce the pressure within section 31 because the suction action of the compressor is now substantially concentrated on reducing the pressure within section 31. This reduction in pressure within section 31 will cause a material lowering of the temperature thereof. The conduit paralleling section 30 offers less resistance to the flow of refrigerant than the section 30 and it has been found in actual practice that, by feeding the liquid refrigerant through the paralleling conduit to section 31, the temperature of section 31 was decreased and the temperature of section 30 was increased. Due to the relatively small heat absorbing surface of section 31, the pressure and likewise the temperature thereof will be decreased materially to remove a large quantity of moisture from the air. The water collected in the cabinet 24 will fall to the bottom thereof and will be drained from the cabinet through a pipe 90.

In the preferred embodiment of the invention the fan 27 operates continuously and the motor circuit therefor comprises main 60, wires 69, 86, 91, motor 28, wires 92 and 88 and main 62.

From the foregoing it will be seen that I have provided an improved refrigerating system which, when employed in an air conditioning system, not only maintains the desired temperature but also the desired relative humidity. As an example, the thermostat 64 may be set to start the compressor when the mean temperature of the room is 84° F. and stop the compressor when the mean temperature is lowered to 82° F. The humidostat 81 may be set to open the valve 75 when the relative humidity of the air increases for example above 50%. The temperature of section 31 will then decrease and the temperature of section 30 will increase. The temperature of section 31 will be considerably below the dew point of the air and, due to the fact that more latent heat and less specific heat is removed when the relative humidity is high, the refrigerating apparatus will operate over a longer period of time in order to reduce the temperature of the air and during this longer period the section 31 will be operating continuously to remove a relatively large amount of moisture from the air. When the relative humidity of the air attains a predetermined low value the humidostat 81 will operate to close the valve 75 and to thereby cause the sections 30 and 31 to operate at substantially the same temperature.

While the forms of embodiment of the present invention as herein described constitute preferred forms, 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, heat dissipating means, a heat absorber having a plurality of sections for cooling a common medium, one of said sections having its inlet connected with the outlet of the dissipating means for receiving refrigerant therefrom, a second heat absorbing section having its inlet connected with the outlet of the first absorber section and having its outlet connected with the inlet of the heat dissipating means, a conduit paralleling the first heat absorber section, and means responsive to a psychrometric condition of the medium cooled by the sections for controlling the flow of refrigerant through said conduit to vary the temperature differential between said sections.

2. In an air conditioning system, a refrigerating apparatus comprising in combination, heat dissipating means, a heat absorber having a plurality of sections for cooling a common medium, one of said sections having its inlet connected with the outlet of the dissipating means for receiving refrigerant therefrom, a second heat absorber section having its inlet connected with the outlet of the first absorber section and having its outlet connected with the inlet of the heat dissipating means, a conduit paralleling the first heat absorber section, temperature responsive means for controlling the operation of the heat dissipating means and means responsive to a psychrometric condition of the medium cooled by the sections for controlling the flow of refrigerant through said conduit to vary the temperature differential between said sections.

3. In an air conditioning system, a refrigerating apparatus comprising in combination, heat dissipating means, a heat absorber having a plurality of sections, one of said sections having its inlet connected with the outlet of the dissipating means for receiving refrigerant therefrom, a second heat absorber section having its inlet connected with the outlet of the first absorber section and having its outlet connected with the inlet of the heat dissipating means, a conduit paralleling the first heat absorber section, and a single means responsive to the psychrometric condition of the medium cooled by the heat absorber for causing one of said sections to increase in temperature and another section to decrease in temperature, said last means including a valve for controlling the flow of refrigerant through said conduit.

4. In an air conditioning system, a refrigerating apparatus comprising in combination, an evaporator having sections connected in series circuit relation, an expansion valve connected with the inlet of the evaporator, a conduit paralleling the first section of the evaporator for delivering refrigerant directly from the expansion valve to the second section of the evaporator, means for withdrawing gaseous refrigerant from the evaporator and for compressing and condensing said refrigerant and for delivering the same to the expansion valve, and a single means responsive to the psychrometric condition of the medium cooled by the heat absorber for causing one of said sections to increase in temperature and another section to decrease in temperature, said last means including a valve for controlling the flow of refrigerant through said conduit.

5. In an air conditioning system, a refrigerating apparatus comprising in combination, an evaporator having sections connected in series circuit relation and adapted to cool a common medium, an expansion valve connected with the inlet of the evaporator, a conduit paralleling the first section of the evaporator for delivering refrigerant directly from the expansion valve to the second section of the evaporator, means for withdrawing gaseous refrigerant from the evaporator and for compressing and condensing said refrigerant and for delivering the same to the expansion valve, means for controlling the flow of refrigerant through said conduit, and means responsive to a psychrometric condition of the medium cooled by the sections for actuating said control means to vary the temperature differential between said sections.

6. In an air conditioning system, a refrigerating apparatus comprising in combination, an evaporator having sections connected in series circuit relation and adapted to cool a common medium, an expansion valve connected with the inlet of the evaporator, a conduit paralleling the first section of the evaporator for delivering refrigerant directly from the expansion valve to the second section of the evaporator, means for withdrawing gaseous refrigerant from the evaporator and for compressing and condensing said refrigerant and for delivering the same to the expansion valve, means responsive to the temperature of the medium cooled by the sections for controlling the operation of the refrigerant circulating means, and means for controlling the flow of refrigerant through said conduit to vary the temperature differential between said sections.

7. In an air conditioning system, a refrigerating apparatus comprising in combination, an evaporator having sections connected in series circuit relation and adapted to cool a common medium, an expansion valve connected with the inlet of the evaporator, a conduit paralleling the first section of the evaporator for delivering refrigerant directly from the expansion valve to the second section of the evaporator, means for withdrawing gaseous refrigerant from the evaporator and for compressing and condensing said refrigerant and for delivering the same to the expansion valve, temperature responsive means for controlling the operation of the refrigerant circulating means, means for controlling the flow of refrigerant through said conduit, and means responsive to a psychrometric condition of the medium cooled by the sections for actuating said control means to vary the temperature differential between said sections.

8. An air conditioning system comprising in combination, refrigerating apparatus including heat dissipating means, a heat absorber having a plurality of sections for cooling air, one of said sections having its inlet connected with the outlet of the dissipating means for receiving refrigerant therefrom, a second heat absorber section having its inlet connected with the outlet of the first absorber section and having its outlet connected with the dissipating means, a conduit paralleling the first heat absorber section, and means responsive to the relative humidity of the air to be conditioned for controlling the flow of refrigerant through said conduit.

9. An air conditioning system comprising in combination, refrigerating apparatus including heat dissipating means, a heat absorber having a plurality of sections for cooling air, one of said sections having its inlet connected with the outlet of the dissipating means for receiving refrig-

erant therefrom, a second heat absorber section having its inlet connected with the outlet of the first absorber section and having its outlet connected with the dissipating means, a conduit paralleling the first heat absorber section, means responsive to the temperature of the air to be conditioned for controlling the operation of the refrigerating apparatus and means responsive to the relative humidity of the air to be conditioned for controlling the flow of refrigerant through said conduit.

10. An air conditioning system comprising in combination, refrigerating apparatus including an evaporator having sections connected in series circuit relation and arranged for cooling air, an expansion valve connected with the inlet of the evaporator, a conduit paralleling the first section of the evaporator for delivering refrigerant directly from the expansion valve to the second section of the evaporator, means for withdrawing gaseous refrigerant from the evaporator and for compressing and condensing said refrigerant and for deliverying the same to the expansion valve, and means responsive to the relative humidity of the air to be conditioned for controlling the flow of refrigerant through said conduit.

11. An air conditioning system comprising in combination, refrigerating apparatus including an evaporator having sections connected in series circuit relation and arranged for cooling air, an expansion valve connected with the inlet of the evaporator, a conduit paralleling the first section of the evaporator for delivering refrigerant directly from the expansion valve to the second section of the evaporator, means for withdrawing gaseous refrigerant from the evaporator and for compressing and condensing said refrigerant and for delivering the same to the expansion valve, means responsive to the temperature of the air to be conditioned for controlling the operation of the refrigerating apparatus, and means responsive to the relative humidity of the air to be conditioned for controlling the flow of refrigerant through said conduit.

LAWRENCE A. PHILIPP.