

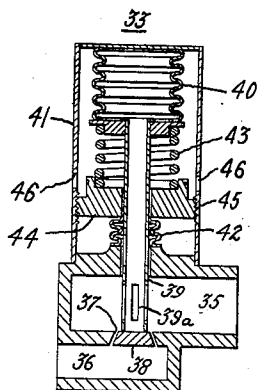
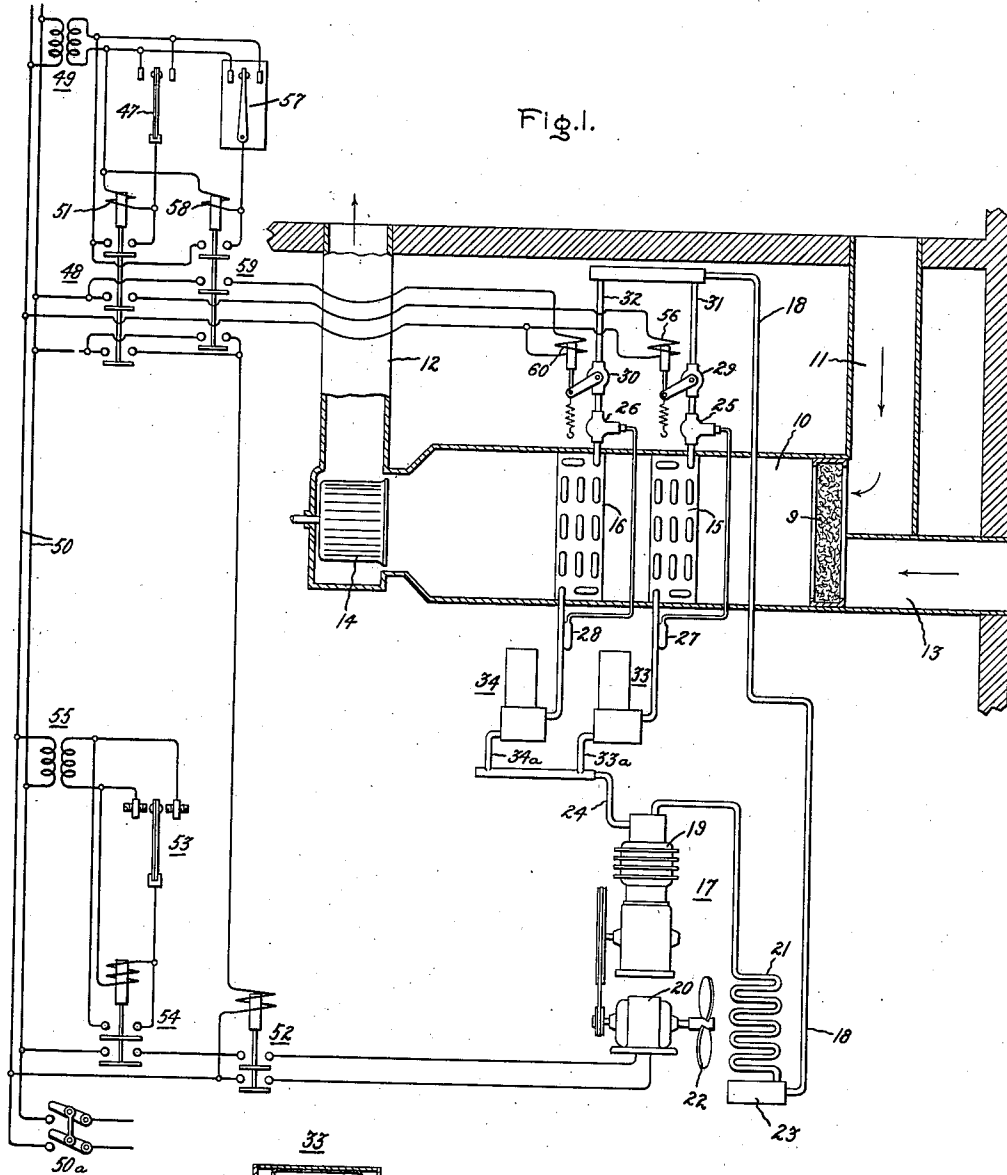
Sept. 17, 1940.

W. F. R. KARSTEN
AIR CONDITIONING SYSTEM

2,215,327

Filed Dec. 9, 1937

2 Sheets-Sheet 1



Inventor:
Walter F. R. Karsten,
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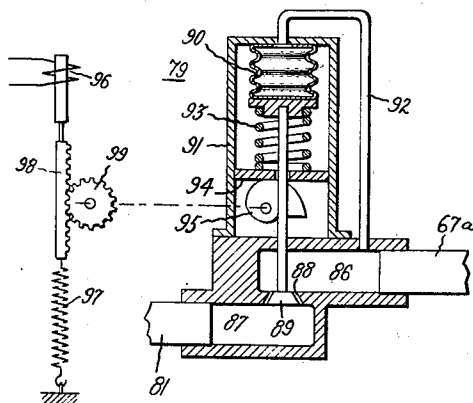
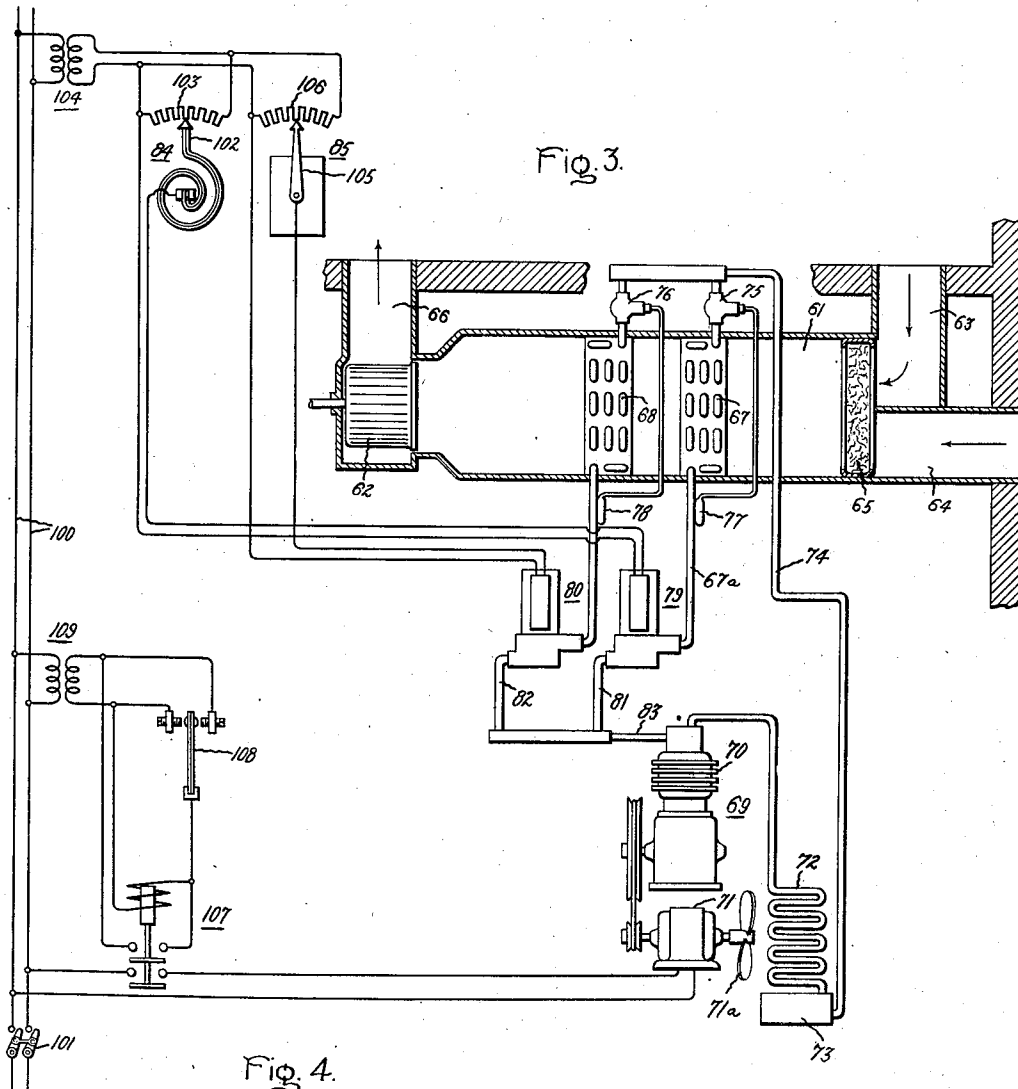
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AIR CONDITIONING SYSTEM

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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AIR CONDITIONING SYSTEM

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11 Claims. (Cl. 62—6)

My invention relates to air cooling systems and particularly to such systems arranged to control both temperature and humidity of the air within an enclosure.

5 Air conditioning systems for providing comfort cooling in hot weather commonly utilize cooling coils or units through which refrigerant is circulated in order to cool the air admitted to the enclosure. Reduction of the relative humidity of the air in the enclosure is also effected by main-
10 taining the outer surfaces of the cooling coils at a temperature below the dew point temperature of the air passing over the cooling coils to reduce the moisture content of the air. Various
15 arrangements have been proposed to control the cooling units in order to provide predetermined desired dry bulb temperature and relative humidity of the air in the room to be conditioned. Accordingly, it is an object of my invention to provide
20 an air conditioning system including an improved arrangement for controlling the temperature and relative humidity of the air within the enclosure to be conditioned.

Another object of my invention is to provide
25 an air conditioning system including cooling coils for lowering the temperature and the relative humidity of the air within an enclosure and an arrangement for varying the operation of the coils in accordance with the variations in temperature and relative humidity of the air within
30 the enclosure to be conditioned.

Further objects and advantages of my invention will become apparent as the following description proceeds, and the features of novelty which characterize my invention will be pointed
35 out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention, reference may be had to the accompanying drawings in which Fig. 1 is a diagrammatic illustration
40 of an air conditioning system embodying my invention; Fig. 2 is an enlarged diagrammatic sectional view of one of the pressure controlling valves shown in Fig. 1; Fig. 3 is a diagrammatic
45 illustration of a modified form of my invention; and Fig. 4 is an enlarged sectional view of one of the pressure controlling valves shown in Fig. 3 illustrating diagrammatically the automatic adjusting mechanism.

50 Referring now to the drawings, in Fig. 1 I have shown an air conditioning system including a duct or conditioning chamber 10 communicating with an enclosure through a return air duct 11 and a supply air duct 12 and arranged to receive
55 fresh air from outside the enclosure through a

duct 13. A fan 14 driven by a motor (not shown) is provided to draw air through the ducts 11 and 13 and a filter 9 and to circulate air through the duct 10 and into the enclosure through the supply duct 12, the fan being preferably operated continuously during operation of the system. In order to cool the air passing through the duct 10, I provide finned tube cooling elements or evaporator coils 15 and 16 which are arranged in series with respect to the path of the air circulating through the duct 10, the air flowing first over the coil 15 and then over the coil 16 before being circulated into the room through the duct 12. The coils 15 and 16 comprise evaporators of a refrigerating machine 17 and are connected to receive refrigerant in parallel from a liquid refrigerant line 18. The refrigerating machine 17 includes a compressor 19 driven by an electric motor 20. The compressor 19 discharges compressed refrigerant into a condenser 21 cooled by a fan 22 also driven by the motor 20. The refrigerant is cooled and liquefied in the condenser 21 and flows into a liquid receiver 23 from which it flows in regulated quantities through the liquid line 18 to the evaporators 15 and 16. The liquid refrigerant cools the air passing through the duct 10 and is thereby vaporized, and the vaporized refrigerant is returned to the compressor through a suction conduit 24.

The coils 15 and 16 are provided with expansion valves of the thermostatic expansion type to control the flow of refrigerant through the coils. Thermostatic expansion valves are constructed so that the quantity of liquid refrigerant admitted to the evaporator depends upon the saturated refrigerant pressure in the evaporator and upon the superheat temperature of the vaporized refrigerant leaving the evaporator. The expansion valves for the coils 15 and 16 are indicated at 25 and 26 respectively, the valves being provided with thermostatic elements or bulbs 27 and 28 respectively secured to the coils adjacent the outlets thereof. An increase in the superheat temperature of the refrigerant leaving the evaporators tends to open the valves and the opening is opposed by a pressure element responsive to the saturated pressure within the evaporators. The degree of opening of the valves thus in turn depends upon the difference of the saturated temperature within the evaporators and the superheat temperature at the thermostatic elements. This difference in temperature corresponds to the superheat of the refrigerant gas in the suction line, and the valve is therefore arranged to provide a substantially uniform degree of superheat regardless of the range

of pressure in the refrigerating system. Normally closed solenoid valves 29 and 30 are provided in liquid refrigerant lines 31 and 32 connecting the evaporators to the common liquid refrigerant line 18.

Evaporator 15 is maintained at a higher refrigerant pressure and temperature than evaporator 16, the temperatures of the two evaporators being selected so that the surface temperature of evaporator 15 is maintained normally above the dew point temperature of the air in the duct 10 and removes substantially only sensible heat from the air passing thereover while the evaporator 16 operating normally at a surface temperature substantially below the dew point temperature removes sensible heat and a large proportion of latent heat. In order to maintain the evaporators 15 and 16 at different pressures, I provide suction pressure control valves 33 and 34 respectively which control the flow of refrigerant through the evaporators. Both valves are of the same construction, but are adjusted to maintain different refrigerant pressures in the evaporators. Valve 33 which is shown in Fig. 2, comprises an inlet chamber 35 and an outlet chamber 36 separated by a valve opening 37 in which is located a valve 38 mounted on a hollow stem 39. The inlet chamber 35 communicates with the outlet conduit of coil 15 and the outlet chamber communicates with the suction line 24 of the compressor through a connection 33a. An expansible bellows 40 is mounted within a casing 41 of the valve and the interior of the bellows is in communication with the chamber 35 through the hollow stem 39 and openings 39a in the stem. A flexible seal 42 is provided to seal the valve stem 39 and the casing of the chamber 35 and thereby prevent leakage of refrigerant. The pressure within the bellows 40 is opposed by a spring 43 mounted within the casing 41 between the bellows and an adjustable collar 44. The collar 44 is provided with threads 45 engaging corresponding threads on the casing 41 and may therefore be raised or lowered by turning, openings 46 being provided in the casing to afford access for turning the collar 44. As long as refrigerant is being removed from the evaporator 15, the valve 33 will maintain a pressure within the evaporator corresponding to the setting selected by adjustment of the collar 44 of the valve. It is, therefore, evident that during operation of the compressor 19 the valve 33 will maintain a predetermined pressure and a corresponding temperature in the evaporator 15.

The valve 34, which is of the same construction as the valve 33, is connected between the outlet of the evaporator 16 and a connection 34a communicating with the suction line 24 and operates to maintain any desired pressure in the evaporator 16 during operation of the refrigerating machine.

Energy for driving the motor 20 and for energizing the control circuits of the system is supplied by power lines 50 upon closing a switch 50a to connect the lines to a source of alternating current (not shown). The control of the refrigerating machine is effected by a thermostat 47 and a humidostat 57, which are dependent upon the dry bulb temperature and relative humidity respectively of the air in the room or other enclosure to be conditioned. The thermostat controls a relay 48 and the humidostat controls a relay 59, energy being supplied by a transformer 49 connected across lines 50.

On a demand for cooling, that is, a demand

for a reduction of the dry bulb temperature of the air within the enclosure, the thermostat 47 moves to the right and completes a circuit of an operating coil 51 of the relay 48. The relay is therefore picked up and is maintained picked up by a holding circuit closed by the top one of three arms of the relay. The bottom arm of the relay closes the circuit of the operating coil of a motor switch 52. The motor 20 is thereby connected across the lines 50 and the refrigerating machine is started. Operation of the relay 48 also closes a circuit through its middle arm to a solenoid 56 of the valve 29 and opens the valve 29 to admit refrigerant to the evaporator 15. Coil 15 is then supplied with refrigerant by the refrigerating machine 17 and operates to remove sensible heat from the air circulating through the duct 10.

Should the relative humidity of the air within the enclosure to be conditioned be too great, the humidostat 57 will operate to engage its right-hand contact and energize a coil 58 thereby picking up the relay 59. The top one of three arms of the relay closes a holding circuit for the coil 58 while the middle arm closes a circuit of a solenoid 60 of the valve 30. The valve 30 is thereby opened and liquid refrigerant is supplied to the coil 16. Coil 16 which operates at a temperature below the dew point of the air removes a substantial quantity of latent heat from the air passing through the duct 10 and thereby reduces the moisture content of the air before it is returned to the enclosure. The bottom arm of the relay 59 closes a circuit to the coil of switch 52 in parallel with the bottom arm of the relay 48. It is, therefore, evident that the refrigerating machine 17 may be started by either the thermostat 47 or the humidostat 57.

A thermostat 53 is placed in the enclosure to be conditioned to stop the refrigerating machine in the event the temperature of the air within the enclosure should be reduced for any reason until it reaches a predetermined permissible minimum. Under normal room temperatures, the thermostat 53 will remain in engagement with its right-hand contact to pick up and hold closed a switch 54 in the motor circuit, and maintain a connection from the lines 50 to the switch 52. The switch 54 has two arms, the upper arm of which closes a holding circuit for the coil of the switch while the lower arm maintains the motor connection. Energy for the operation of switch 54 is supplied by a transformer 55 connected across the lines 50.

When the dry bulb temperature of the air within the enclosure has been reduced to the desired value, the thermostat 47 will move to the left and short circuit the coil 51 thereby causing the relay 48 to drop out. This opens the circuit of the coil 56 and allows valve 29 to close and prevent the further supply of refrigerant to the evaporator 15. The refrigerating machine 17, however, continues in operation as long as the relay 59 is in its pick up position. Relay 59 will remain in its pick up position until the relative humidity of the air in the enclosure has been reduced sufficiently to satisfy the humidostat 57 which will then engage its left-hand contact and short circuit the coil 58 and cause the relay 59 to drop out thereby opening the circuit of the coil of switch 52 and stopping the operation of the refrigerating machine. The dropping out of the relay 59 also opens the circuit of coil 60 and closes valve 30.

During normal operation of the air condition-

ing system shown in Fig. 1, the evaporator coil 15 under control of the thermostat 47 will satisfactorily maintain the desired dry bulb temperature within the enclosure and the coil 16 will satisfactorily maintain the relative humidity within the desired range. It is to be noted that the air circulates first over the coil 15 which removes a considerable amount of sensible heat from the air circulating in the duct to lower the dry bulb temperature thereof and, consequently, a relatively greater amount of dehumidification can be effected by the coil 16 for a relatively small lowering of the dry bulb temperature of the circulating air.

The temperatures of the coils 15 and 16, as shown in Fig. 1, remain substantially constant at the values determined by the pressure settings of the valves 33 and 34. It will be readily understood that when relatively great changes of dry bulb temperature or humidity are desired, a substantial period of time may be required to meet the desired conditions when the coils maintain the same temperatures. In Fig. 3, I have shown an air conditioning system having a control which varies the temperatures of the coils in proportion to the demand for changes of dry bulb temperature and relative humidity.

Referring now to Fig. 3, I have shown an air conditioning system including a duct 61 and a fan 62 for drawing into the duct room air and fresh air through the inlets 63 and 64 respectively, a filter 65 being provided to remove dust particles and other foreign matter from the air. The fan 62 is driven by a motor (not shown) and circulates air through the duct 61 and back into the room through a duct 66. In order to cool the air circulating through the duct, I provide finned cooling elements or evaporator coils 67 and 68 arranged in series in the duct and connected in parallel in the refrigerant circuit of a refrigerating machine 69 which includes a compressor 70 driven by a motor 71, a condenser 72 and a liquid receiver 73. Gaseous refrigerant is compressed by the compressor 70 and discharged into the condenser 72 where it is cooled by a fan 71a and liquefied, the liquid refrigerant collecting in the receiver 73. Liquid refrigerant is supplied to the evaporators 67 and 68 through a liquid line 74, the flow of refrigerant to the evaporators 67 and 68 being controlled by expansion valves 75 and 76 respectively, the valves being provided with thermostatic elements 77 and 78. The liquid refrigerant within the evaporators cools the air passing through the duct 61 and is thereby vaporized, the vaporized refrigerant returning to the compressor 70 through pressure controlled valves 79 and 80 connected by outlets 81 and 82 respectively to a suction line 83 of the compressor. The pressures within the evaporators 67 and 68 are controlled by the valves 79 and 80, which vary the pressures progressively in accordance with the demands for changes of temperature and humidity determined respectively by a thermostat 84 and a humidostat 85 dependent upon the temperature and humidity conditions in the room. The greater the demand for temperature or humidity change of the air within the enclosure, the lower will be the pressure maintained by the valves.

The valve 79 is illustrated in Fig. 4 and the valve 80 is of the same construction. The valve 79 comprises an inlet chamber 86 and an outlet chamber 87 communicating therewith through a valve opening 88. A valve 89 is provided to control the opening 88 in response to the pressure

within the evaporator 67 which is in communication with the chamber 86 through its outlet conduit indicated at 67a. In order to actuate the valve 89, I provide a sealed bellows 90 mounted in a casing 91 and maintained in communication with the chamber 86 through a tube 92. Pressure within the bellows is opposed by a spring 93 mounted between the bellows and a movable disk 94, the disk 94 being vertically slidable within the casing 91. The setting of the spring 93 may be varied by raising or lowering the disk 94. By varying or modifying the setting of the valve in accordance with the temperature in the room, a so-called "modulated" operation of the cooling coil is obtained, the pressure within the coil being varied continuously with the temperature in the room. Any suitable mechanism may be provided for moving the disk 94 in accordance with the room temperature. Motors of the modulating type are known in the art and may be employed for this purpose. In the drawings, I have shown a suitable modulating arrangement diagrammatically. This arrangement includes a cam 95 mounted below the disk 94 and actuated by a solenoid 96 in opposition to a spring 97 so that the energization of the solenoid is opposed by the spring and determines the position of a rack 98 arranged to drive the cam 95 through a pinion 99. The coil of the solenoid 96 is energized in proportion to the demand for a change of temperature of the air within the enclosure as determined by the thermostat 84, the greater the demand for a change, the greater the pull of the solenoid and hence the greater the upward movement of the rack 98. It will be noted that an upward movement of the rack rotates the pinion 99 and cam 95 in a clockwise direction thereby lowering the position of the disk 94 which bears on the surface of the cam. The lowering of the disk 94 decreases the effect of the spring 93 and consequently a lesser pressure within the bellows 90 is required to open the valve 89. The valve, therefore, remains open at lower evaporator pressures and permits a greater reduction of the pressure within the evaporator 67 thereby maintaining the lower pressure and, consequently, a lower temperature of the evaporator 67 on an increased demand for cooling.

Alternating current for driving the motor 71 and for energizing the control circuits of the system is supplied by power lines 100 upon closing of a manual switch 101. The thermostat 84 comprises a coiled bimetallic member 102 arranged throughout its range of movement to contact a resistor 103 which is connected directly across the secondary of a transformer 104, the primary of the transformer being connected across the lines 100. The member 102 moves from left to right in proportion to the difference between the room temperature and the desired room temperature. The energy supplied to the solenoid 96 is thus varied from zero at the extreme left-hand portion of the member 102 to a maximum at the extreme right-hand portion thereof. The zero energy portion of the solenoid may be selected so that the cam 95 is raised sufficiently to hold the valve 89 closed at evaporator pressures corresponding to the temperature of the air flowing to the evaporator and prevent the removal of refrigerant from the coil 67, so that the air passing through the duct 61 is not cooled. The humidostat 85 controls the valve 80 in the same manner as the thermostat 84 controls the valve 79. The humidostat comprises a movable member 105 arranged throughout its range of move-

ment to engage a resistor 106 connected across the secondary of the transformer 104 in the same manner as the resistor 103. The member 105 is arranged to move from left to right along the resistor 106 as the demand increases for a change of relative humidity, the left-hand portion representing a minimum or zero demand for humidity change and the right-hand representing a maximum demand.

The motor 71 is operated continuously under normal conditions, since it is connected to the lines 100 through a switch 107, which is held in its pick-up position under all normal room conditions as long as the switch 101 is closed. It is, therefore, evident that the refrigerating machine operates continuously under control of the thermostat 84 and the humidostat 85 so that there is a continuous control of the temperature and humidity of the air circulating through the duct 61 dependent upon room conditions. The temperature and relative humidity of the air within the enclosure are, therefore, controlled continuously rather than intermittently as in the system shown in Fig. 1, and the cooling coils start to correct an undesired change in room conditions substantially at the time the change occurs and the delay necessitated by a thermostat or humidostat working between limits is avoided.

Should the relative humidity of the air within the enclosure to be conditioned be unusually high so that even with the maximum opening of the valve 80 the coil 68 is unable to dehumidify to the desired degree the air passing through the duct 61, the continued operation of the coil may reduce the sensible heat in the air sufficiently to lower the dry bulb temperature below the comfort range. I, therefore, provide a limit thermostat 108 for opening the circuit of the motor 71 when the temperature within the enclosure is reduced to a predetermined permissible minimum consistent with comfort. Under normal room conditions, when the temperature is above the permissible minimum, the thermostat 108 remains in engagement with its right-hand contact thereby energizing the coil of switch 107 and holding the switch in its pick-up position, a holding circuit being closed through the upper arm of the switch. Should the dry bulb temperature be reduced to the minimum, the thermostat will engage its left-hand contact, short-circuit the coil of the switch 107, and allow the switch to drop out, thereby opening the motor circuit and preventing the further supply of refrigerant to the cooling coils. Energy for actuating the switch 107 is supplied from a suitable source, such as the secondary of a transformer 109, the primary of which is connected across the lines 100.

During the normal operation of the refrigerating system shown in Fig. 3, the thermostat 84 will control the operation of the coil 67 to maintain the dry bulb temperature of the air within the enclosure at the predetermined desired value. During normal operation, the coil 67 will operate at temperatures above the dew point of the air circulated through the duct 61. It is obvious, however, that when it is necessary to reduce the temperature of the room, a considerable amount, the temperature of the coil 67 may be required to fall below the dew point of the circulated air. The humidostat 85 will control the operation of the coil 68 to maintain the humidity of the air within the enclosure at the desired value. The coil 68 must obviously operate below the dew point of the air circulating through the duct in order to remove moisture therefrom. The range

of temperatures and pressures within the evaporator 68 during the operation thereof is, therefore, lower than the range of temperatures of the coil 67 during its operation and the average temperature of the coil 67 is greater than that of the coil 68. In this case, the term "lower range" is applied as designating a range of temperatures, the maximum temperature of which is below the maximum temperature of the range being compared. The coils 67 and 68 are arranged in the duct in the same order as the coils 15 and 16 of Fig. 1. Consequently, the coil 67 which controls the dry bulb temperature, lowers the temperature of the circulating air prior to its passage over coil 68 which controls the humidity. The coil 68, therefore, removes a relatively small amount of sensible heat in the same manner as was explained in connection with the coil 16.

From the foregoing, it is apparent that I have provided an air conditioning system including a simple and efficient arrangement for controlling both the dry bulb temperature and the relative humidity of the air within an enclosure to be conditioned.

While I have described particular embodiments of my invention in connection with an air conditioning system utilizing a compression refrigerating machine, various modifications will occur to those skilled in the art. I do not, therefore, desire my invention to be limited to the embodiments shown and described, and I intend in the appended claims, to cover all modifications thereof which do not depart from the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A system for conditioning the air within an enclosure including a duct, means for circulating air through said duct and into said enclosure, means including a plurality of cooling elements arranged in series with respect to the path of the air circulating through said duct for cooling the air circulating through said duct, common means for supplying refrigerant to said elements, means for maintaining a higher average temperature in one of said elements than in another of said elements, means dependent upon the temperature of the air within said enclosure for controlling the flow of refrigerant through said one element, and means dependent upon the relative humidity of the air within said enclosure for controlling the flow of refrigerant through said other element, both of said last two mentioned means being arranged to effect operation of said means for supplying refrigerant to said elements.

2. A system for conditioning the air within an enclosure including a duct, means for circulating air through said duct and into said enclosure, means including a plurality of refrigerant evaporators arranged in series with respect to the path of the air circulating through said duct for cooling the air circulating through said duct, means including a refrigerating machine having a refrigerant circuit for supplying liquid refrigerant to said evaporators and for removing gaseous refrigerant therefrom, means for maintaining a higher pressure in one of said evaporators than in another of said evaporators, means dependent upon the temperature of the air within said enclosure for controlling the flow of refrigerant through said one evaporator, and means dependent upon the relative humidity of the air within said enclosure for controlling the flow of refrigerant through said other evaporator,

both of said last two mentioned means being arranged to effect operation of said refrigerating machine.

3. A system for conditioning the air within an enclosure including a duct, means for circulating air through said duct and into said enclosure, means including a plurality of refrigerant evaporators arranged in series with respect to the path of the air circulating through said duct for cooling the air circulating through said duct, means including a refrigerating machine having a refrigerant circuit for supplying liquid refrigerant to said evaporators and for removing gaseous refrigerant therefrom, means for maintaining a higher pressure in one of said evaporators than in another of said evaporators, means dependent upon the temperature of the air within said enclosure and including a solenoid valve arranged on the supply side of said one evaporator for controlling the flow of refrigerant through said one evaporator, and means dependent upon the relative humidity of the air within said enclosure and including a solenoid valve arranged on the supply side of said other evaporator for controlling the flow of refrigerant through said other evaporator.

4. A system for conditioning the air within an enclosure including a duct, means for circulating air through said duct and into said enclosure, means including a plurality of cooling elements arranged in series with respect to the path of the air circulating through said duct for cooling the air circulating through said duct, means for supplying refrigerant to said elements, means for maintaining a higher average temperature in one of said elements than in another of said elements, means dependent upon the temperature of the air within said enclosure for controlling the flow of refrigerant through said one element, means dependent upon the relative humidity of the air within said enclosure for controlling the flow of refrigerant through said other element, and means dependent upon a predetermined minimum temperature of the air within said enclosure for stopping the supply of refrigerant to said elements.

5. A system for conditioning the air within an enclosure including a duct, means for circulating air through said duct and into said enclosure, means including a plurality of refrigerant evaporators arranged within said duct for cooling air circulating through said duct, means for supplying liquid refrigerant to said evaporators and for withdrawing gaseous refrigerant therefrom, means arranged on the outlet side of one of said evaporators for maintaining a predetermined range of pressures within said one evaporator, means arranged on the outlet side of another of said evaporators for maintaining a predetermined higher range of pressures in said other evaporator, means dependent upon the temperature of the air within said enclosure and cooperating with the first-mentioned pressure maintaining means for varying the pressure within said one evaporator within said predetermined range of pressures in accordance with changes in temperature of the air within said enclosure, and means dependent upon the relative humidity of the air within said enclosure and cooperating with the second-mentioned pressure maintaining means for varying the pressure within said other evaporator within said higher range of pressures in accordance with changes in the relative humidity of the air within said enclosure.

6. A system for conditioning the air within an enclosure including a duct, means for circulating air through said duct and into said enclosure, means including a plurality of refrigerant evaporators arranged within said duct for cooling air circulating through said duct, means for supplying liquid refrigerant to said evaporators and for withdrawing gaseous refrigerant therefrom, means arranged on the outlet side of one of said evaporators for maintaining a predetermined range of pressures within said one evaporator, means arranged on the outlet side of another of said evaporators for maintaining a predetermined higher range of pressures in said other evaporator, means associated with said evaporators for maintaining substantially constant the number of degrees of superheat of the gaseous refrigerant withdrawn from said evaporators, means dependent upon the temperature of the air within said enclosure and cooperating with the first-mentioned pressure maintaining means for varying the pressure within said one evaporator within said predetermined range of pressures in accordance with changes in temperature of the air within said enclosure, and means dependent upon the relative humidity of the air within said enclosure and cooperating with the second-mentioned pressure maintaining means for varying the pressure within said other evaporator within said higher range of pressures in accordance with changes in the relative humidity of the air within said enclosure.

7. A system for conditioning the air within an enclosure including a duct, means for circulating air through said duct and into said enclosure, means including a plurality of refrigerant evaporators arranged in series with respect to the path of the air circulating through said duct for cooling the air circulating through said duct, means for supplying liquid refrigerant to said evaporators and for withdrawing gaseous refrigerant therefrom, means arranged on the outlet side of one of said evaporators for maintaining a predetermined range of pressures within said one evaporator, means arranged on the outlet side of another of said evaporators for maintaining a predetermined higher range of pressures in said other evaporator, means dependent upon the temperature of the air within said enclosure and cooperating with the first-mentioned pressure maintaining means for varying the pressure within said one evaporator within said predetermined range of pressures in accordance with changes in temperature of the air within said enclosure, and means dependent upon the relative humidity of the air within said enclosure and cooperating with the second-mentioned pressure maintaining means for varying the pressure within said other evaporator within said higher range of pressures in accordance with changes in the relative humidity of the air within said enclosure.

8. A system for conditioning the air within an enclosure including a duct, means for circulating air through said duct and into said enclosure, means including a plurality of refrigerant evaporators arranged within said duct for cooling air circulating through said duct, means for supplying liquid refrigerant to said evaporators and for withdrawing gaseous refrigerant therefrom, each of said evaporators having a liquid line and a suction line, means including a plurality of pressure responsive valves arranged in said suction lines for maintaining predetermined pressures within said evaporators, means dependent

upon the temperature of the air within said enclosure for modifying the operation of the pressure valve of one of said evaporators to maintain different pressures in said one evaporator in accordance with changes of temperature of the air within said enclosure, means dependent upon the relative humidity of the air within said enclosure for modifying the operation of the pressure valve of another of said evaporators to maintain different pressures in said other evaporator in accordance with changes in the relative humidity of the air within said enclosure, and means dependent upon a predetermined minimum temperature of the air within said enclosure for stopping operation of said supply means.

9. A system for conditioning the air within an enclosure including a duct, means for circulating air through said duct and into said enclosure, means including a plurality of refrigerant evaporators arranged within said duct for cooling air circulating through said duct, means for supplying liquid refrigerant to said evaporators and for withdrawing gaseous refrigerant therefrom, each of said evaporators having a liquid line and a suction line, means including a plurality of pressure responsive valves arranged in said suction lines for maintaining predetermined pressures within said evaporators, each of said valves having a spring for determining the pressure to be maintained by said valve, means dependent upon the temperature of the air within said enclosure and including a cam arranged to change the setting of the spring of one of said valves for modifying the operation of said one valve to maintain different pressures in one of said evaporators in accordance with changes of temperature of the air within said enclosure, and means dependent upon the relative humidity of the air within said enclosure and including a cam arranged to change the setting of the spring of another one of said valves for modifying the operation of said other valve to maintain different pressures in another of said evaporators in accordance with changes of relative humidity of the air within said enclosure.

10. A system for conditioning the air within an enclosure including a duct, means for circulating air through said duct and into said enclosure, means including a plurality of refrigerant evaporators arranged within said duct for cooling air circulating through said duct, means for supplying liquid refrigerant to said evaporators and for withdrawing gaseous refrigerant therefrom, each of said evaporators having a liquid line and a suction line, means associated with said evaporators for maintaining substantially constant the number of degrees of superheat of the gaseous refrigerant withdrawn from said evaporators, means including a plurality of

pressure responsive valves arranged in said suction lines for maintaining predetermined pressures within said evaporators, each of said valves having a spring for determining the pressure to be maintained by said valve, means dependent upon the temperature of the air within said enclosure and including a cam arranged to change the setting of the spring of one of said valves for modifying the operation of said one valve to maintain different pressures in one of said evaporators in accordance with changes of temperature of the air within said enclosure, and means dependent upon the relative humidity of the air within said enclosure and including a cam arranged to change the setting of the spring of another one of said valves for modifying the operation of said other valve to maintain different pressures in another of said evaporators in accordance with changes of relative humidity of the air within said enclosure.

11. A system for conditioning the air within an enclosure including a duct, means for circulating air through said duct and into said enclosure, means including a plurality of refrigerant evaporators arranged in series with respect to the path of the air circulating through said duct for cooling the air circulating through said duct, means for supplying liquid refrigerant to said evaporators and for withdrawing gaseous refrigerant therefrom, each of said evaporators having a liquid line and a suction line, means associated with said evaporators for maintaining substantially constant the number of degrees of superheat of the gaseous refrigerant withdrawn from said evaporators, means including a plurality of pressure responsive valves arranged in said suction lines for maintaining predetermined pressures within said evaporators, each of said valves having a spring for determining the pressure to be maintained by said valve, means dependent upon the temperature of the air within said enclosure and including a cam arranged to change the setting of the spring of one of said valves for modifying the operation of said one valve to maintain different pressures in one of said evaporators in accordance with changes of temperature of the air within said enclosure, means dependent upon the relative humidity of the air within said enclosure and including a cam arranged to change the setting of the spring of another one of said valves for modifying the operation of said other valve to maintain different pressures in another of said evaporators in accordance with changes of relative humidity of the air within said enclosure, and means dependent upon a predetermined minimum temperature of the air within said enclosure for stopping operation of said supply means.

WALTER F. R. KARSTEN. 60