

April 14, 1942.

L. G. HUGGINS

2,279,787

AIR CONDITIONING APPARATUS

Filed Aug. 6, 1937

2 Sheets-Sheet 1

FIG. 1.

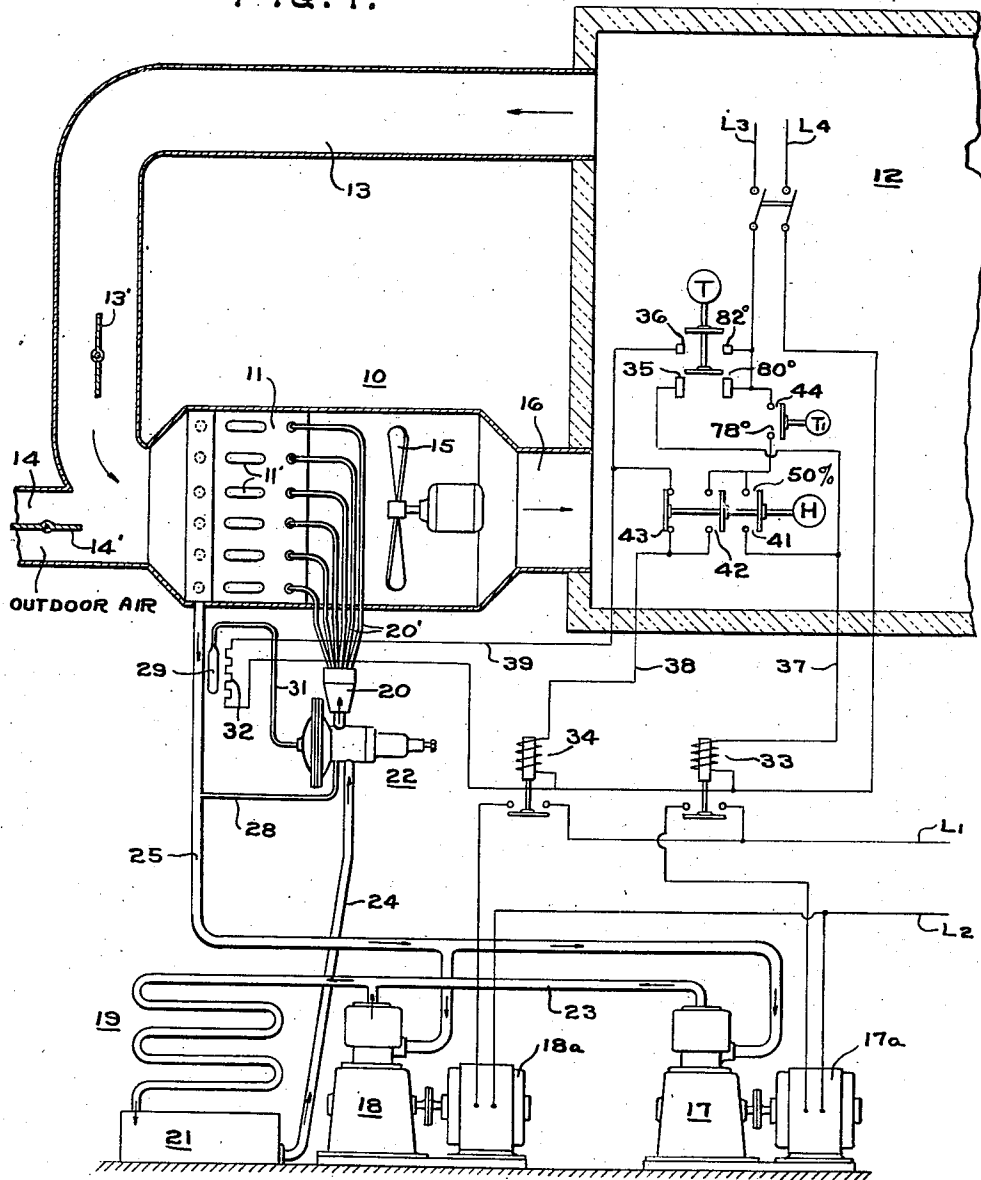
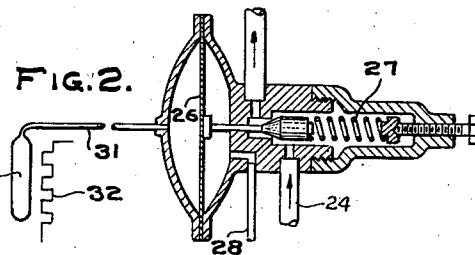


FIG. 2.

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2 Sheets-Sheet 2

FIG. 3.

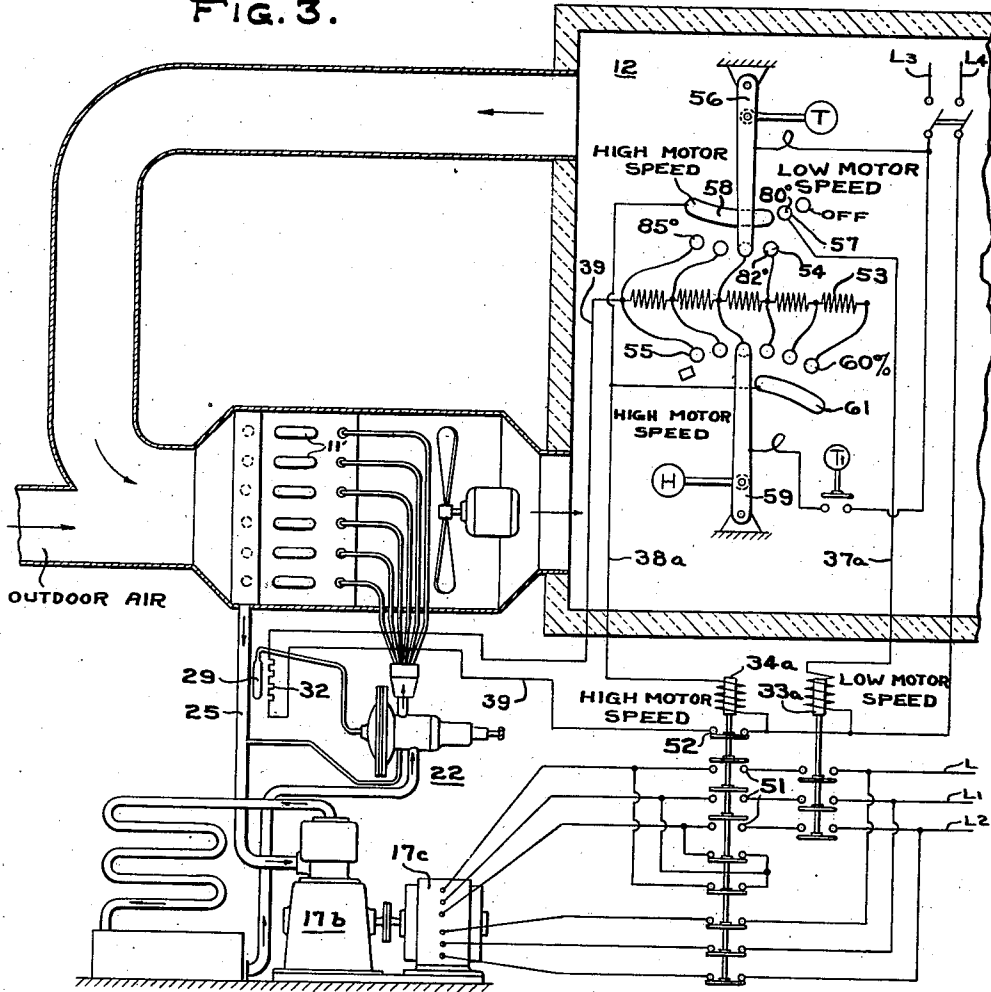
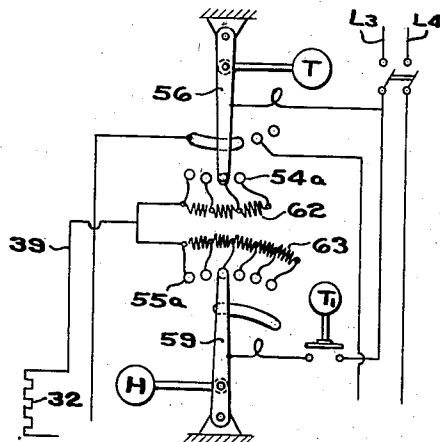


FIG. 4.



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AIR CONDITIONING APPARATUS

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Application August 6, 1937, Serial No. 157,681

9 Claims. (Cl. 62—6)

My invention relates to apparatus for cooling and dehumidifying air for an enclosure, and it has for an object to provide improved means for varying the operation thereof.

Another object is to provide air cooling and dehumidifying apparatus including a variable speed compressor and an air cooling evaporator, and to maintain the refrigerant pressure in the evaporator sufficiently low for dehumidifying the air when the compressor is operating at low speed.

A further object is to vary the operation of the apparatus so as to maintain both the temperature and the humidity of the air in the enclosure within desired limits.

Still another object is to vary the sensible heat and the latent heat removal from an enclosure, and the ratio of sensible to latent heat, to maintain both the temperature and the humidity of the air in the enclosure within desired limits.

The above and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a diagrammatic view of one embodiment of air conditioning apparatus embodying my invention;

Fig. 2 is an enlarged detail sectional view showing the thermostatic expansion valve;

Fig. 3 is a diagrammatic view of a second embodiment; and,

Fig. 4 is a diagrammatic view of another modification of the control.

Referring to the drawings in detail, I show an air conditioning chamber 10 containing a refrigerant evaporator 11 for cooling and dehumidifying air for an enclosure 12. Air withdrawn from the enclosure is conveyed to the chamber 10 through a duct 13, and outdoor air is conveyed thereto through a duct 14. A fan 15 controlled in any suitable manner, operates to draw the air through the ducts 13 and 14, across the evaporator 11, and through a duct 16 into the enclosure 12. Suitable dampers may be provided in the several ducts as is well understood in the art. A damper 13' in the duct 13 and a damper 14' in the duct 14 are shown by way of example.

The evaporator 11, shown diagrammatically on the drawings, is of a suitable commercial form and of the type known as a dry evaporator; that is, the refrigerant flows at substantial velocity through several tubes or turns in series. The

illustrated evaporator comprises a plurality of coils 11' arranged in parallel with respect to the flow of air; each coil comprising a plurality of tubes disposed in a horizontal plane and connected for flow of refrigerant successively through the several tubes from the right-hand side to the left-hand side of the evaporator as shown in the drawing. The evaporator 11 is part of a mechanical refrigerating system comprising compressors 17 and 18, assumed for convenience to be of equal capacity and driven by electric motors 17a and 18a, respectively, a condenser 19, a liquid receiver 21 and a thermostatic expansion valve 22, for controlling the admission of liquid refrigerant to the evaporator. A conduit 23 conveys the compressed refrigerant from the compressors to the condenser, and a conduit 24 conveys the condensed refrigerant from the liquid receiver to the valve 22. A distributor fitting 20 and distributor tubes 20' serve to distribute the refrigerant from the valve 22 to the several coils of the evaporator 11, in this case in equal proportions. A suction conduit 25 returns the refrigerant vaporized in the evaporator 11 to the compressors. Any suitable refrigerant may be used, such as dichlorodifluoromethane.

The thermostatic expansion valve 22 is responsive to the superheat of the vaporized refrigerant leaving the evaporator and regulates the admission of liquid refrigerant to the evaporator to maintain said superheat substantially constant. The valve 22, shown in detail in Fig. 2, has a pressure-responsive diaphragm 26 for actuating the same and a spring 27 biasing the same in closing direction. The pressure of the vaporized refrigerant in the suction conduit 25 is conveyed through a tube 28 and imposed on the diaphragm in valve closing direction. A thermostatic bulb 29 is disposed in contact with the suction conduit 25 or in any suitable heat transfer relation to the vaporized refrigerant therein. The bulb 29 contains a suitable volatile fluid, preferably the same liquid as used for refrigerant, and its pressure is conveyed through a tube 31 and imposed on the expansion valve 22 in valve opening direction. Since the pressure in the bulb 29 is a function of the temperature of the vaporized refrigerant and the pressure conveyed through the tube 28 is a function of its saturation temperature, the difference is a measure of the superheat and acts on the diaphragm 26 in valve opening direction to maintain the superheat substantially constant. The setting of the spring 27 controls the superheat that the

valve maintains and in conventional practice it is usually set for 10° F.

Such a valve operates automatically to maintain liquid refrigerant throughout most of the evaporator coils, that is, all but the small portion at the outlet end in which there is effected the degree of superheating called for by the expansion valve.

In the present case, however, the spring is set to maintain a higher degree of superheat dependent upon the relative capacities of the compressors and chosen so that the portion of the evaporator containing liquid refrigerant is reduced in the same proportion that the compressor capacity is reduced when the compressor 18 is shut down. For the present case, a setting of 40° F. superheat is assumed.

A small electric heating element 32 is disposed adjacent the thermostatic bulb 29 for the purpose of selectively raising the temperature of the liquid in the bulb above the temperature of the refrigerant in the suction conduit to such an extent that the superheat of the latter will be reduced to the usual 10° F. and a greater portion of the evaporator will contain liquid refrigerant.

Control mechanism

The control mechanism includes a thermostat T for controlling the cooling action to maintain substantially the desired temperature in the enclosure, a humidostat H exercising a degree of control over the dehumidifying action so as to maintain substantially the desired humidity of the air in the enclosure, and a second thermostat T₁ for discontinuing dehumidification before such action reduces the temperature to an undesirable extent. These control instruments are made responsive to the condition of the air in the enclosure, as by disposing them within the enclosure. I desire it to be understood that these instruments, which are represented only diagrammatically on the drawings, may be of any suitable form and construction known in the art of instruments and that they may embody any and all features known in the art. For example, they are preferably provided with suitable adjustment for varying the values to which they respond. Also, suitable provision may be made for causing them to operate with a snap action. Relays 33 and 34 are provided for controlling the supply of electric current from line conductors L₁ and L₂ to the motors 17a and 18a, respectively.

The control mechanism may be supplied with current from line conductors L₃ and L₄, which may be connected to the same source as the line conductors L₁ and L₂. The thermostat T has a set of contacts 35 adapted to be closed upon increase in temperature of the air in the enclosure 12 to a first predetermined maximum temperature, such as 80° F., and a second set of contacts 36, adapted to be closed upon increase to a slightly higher predetermined maximum temperature, such as 82° F., these temperatures representing substantially the temperatures desired to be maintained within the enclosure 12. The contacts 35 control a circuit 37 for the winding of the relay 33. The contacts 36 control a circuit 38 for the winding of the relay 34 and a circuit 39 for the heating element 32. The humidostat H has contacts 41 and 42 which are adapted to be closed simultaneously by the humidostat upon increase in the humidity of the air in the enclosure 12 to a predetermined maximum value desired to be maintained thereby,

such as 50% relative humidity. The contacts 41 and 42 are arranged in parallel with the contacts 35 and 36, respectively, and are adapted to supply current to the circuits 37 and 38, respectively. The humidostat H is further provided with a back contact 43 adapted to break the connection between the contacts 36 and the circuit 38 when the contacts 41 and 42 are closed. The purpose of these contacts is to permit the contacts 42 to close the circuit 38 without closing the circuit 39. The thermostat T₁ is adapted to open its contacts 44 when the temperature of the air in the enclosure is reduced to a value, for example 78° F., such that further reduction in temperature would cause discomfort, or such that further cooling action would not be desired. These contacts are connected between the line conductor L₃ and the contacts 41 and 42, so that they are adapted to prevent dehumidifying action under control of the humidostat H.

Fig. 1—Operation

Assume first that the thermostat T closes its contacts 35 in response to increase in temperature to 80° F. The circuit 37 is completed and energizes the relay 33 to start operation of the motor 17a and the compressor 17. No current is supplied to the heating element 32, so that the thermostatic bulb 29 responds to the actual temperature of the refrigerant leaving the evaporator 11.

The air conditioning apparatus now operates in the usual manner of such apparatus, but at one half of full capacity. Vaporized refrigerant is compressed by the compressor 17, conveyed through the conduit 23 to the condenser 19, condensed therein, collected in the liquid receiver 21, and conveyed through the conduit 24 to the thermostatic expansion valve 22. From the latter, it is distributed by the distributor fitting 20 and the distributor tubes 20' to the several coils of the evaporator, in which it serves to cool the air flowing over the evaporator. The vaporized refrigerant leaving the evaporator coils is returned to the compressor through the suction conduit 25.

The thermostatic expansion valve 22 operates, as explained above under the description of this valve, so as to maintain a predetermined degree of superheat of the refrigerant vapor leaving the evaporator, which is assumed to be 40° F., since no current is supplied to the heating element 32. The setting of the thermostatic expansion valve to such a high degree of superheat causes the same to restrict the flow of refrigerant to the evaporator coils, so that a reduced portion of the length of each coil contains liquid refrigerant, the remainder containing vaporized refrigerant which is being superheated to the high degree called for by the thermostatic expansion valve.

The reason for this is as follows: The evaporator coil 11 is designed so that, when both compressors 17 and 18 are operated, it will cool and dehumidify the air to the usual extent with the thermostatic expansion valve maintaining 10° superheat of the discharged refrigerant vapor. If the same degree of superheat were maintained when only one compressor is operating, then the one compressor in operation would not be able to remove vapor at a sufficiently high rate to provide a sufficiently low refrigerant temperature in the evaporator for dehumidification. By providing the high superheat, so that only half

as much of the evaporator contains liquid refrigerant, there is maintained a proper relation of compressor capacity to effective evaporator surface, so that a sufficiently low refrigerant pressure and temperature may be maintained. The operation is substantially the same as in conventional practice, except that only half of the compressor capacity and half of the evaporator surface are effective. In other words, the evaporator is operating at half capacity.

Upon increase in temperature above 82° F., the thermostat T closes its contacts 36, thereby closing circuits 38 and 39. The relay 34 energizes the motor 18a for operating the compressor 18, and the circuit 39 supplies electric current to the heating element 32. Both compressors are now in operation. At this time, the heat supplied by the heating element 32 to the thermostatic bulb 29, raises the pressure in the latter to such an extent as to indicate a temperature thirty degrees higher than it would indicate if such heat were not supplied, or thirty degrees higher than the temperature of the vaporized refrigerant. The net result is that the thermostatic expansion valve operates to maintain ten degrees of superheat of the refrigerant leaving the evaporator, since the remaining thirty of the forty degrees required by the thermostatic expansion valve is supplied by the heating element.

The evaporator 11 now operates in the conventional manner of such apparatus, such quantity of liquid refrigerant being supplied thereto as can be completely evaporated and superheated 10° F.

Now assume that the relative humidity of the air in the enclosure 12 rises to 50%. The humidostat H closes its contacts 41 and 42 and opens its contacts 43. Also assume that the dry bulb temperature of the air is below 82° F., the temperature at which the contacts 36 are closed. The contacts 35 may be either open or closed. The contacts 41 and 42 energize the circuits 37 and 38 to cause operation of both compressors, while the open contacts 43 prevent energization of the heating element 32 by the contacts 42. Since the heating element 32 is not energized, the thermostatic expansion valve operates to maintain a high degree of superheat with the result that a reduced portion of the evaporator is supplied with liquid refrigerant while, at the same time, both compressors 17 and 18 are operating. It will be seen that the ratio of compressor capacity to effective evaporator surface is greatly increased, so that a lower pressure and a lower temperature of the refrigerant in the evaporator are provided. The reduced temperature of the effective evaporator surface cools the air in contact therewith to a considerably lower dew point and therefore effects a considerably greater degree of dehumidification thereof. The amount of sensible heat removal or temperature reduction is greater than when only one compressor is operating, but it is less than when both compressors are operating and a maximum portion of the evaporator surface is effective. If the thermostat T closes its contacts 36 while the apparatus is so operating, then the heating element 32 is energized to supply liquid refrigerant to the maximum portion of the evaporator, thereby rendering the humidity responsive control ineffective. In other words, maximum demand for dry bulb temperature reduction supercedes humidity control.

Fig. 3

In Fig. 3, I show another embodiment of my invention in which modulating control of the heating element 32 is provided and in which variable compressor capacity is provided by a two-speed compressor 17b driven by a two-speed motor 17c. The control for the motor includes relays 33a and 34a which are controlled by circuits 37a and 38a, respectively, and which are adapted to effect such connections between the terminals of the motor 17c and the line conductors L, L₁ and L₂, as to effect operation of the motor at low speed and at high speed, respectively. Inasmuch as such connections, specifically, form no part of the present invention, and depend upon the particular motor and type of electric current used, they are not described herein, the particular connections shown on the drawing being known in the art as suitable for three phase alternating current motors.

The relay 34a has contacts 51 adapted to open the connection made by the relay 33 whenever both relays are energized at the same time, so that high speed operation is effected at such time. The relay 34a also has contacts 52 in the circuit 39 arranged so that the circuit 39 may be closed only when the relay 34a is energized to effect high speed operation.

The circuit 39 for the heating element is provided with a rheostat 53 having two sets of contacts, 54 and 55, as shown on the drawing. The thermostat T actuates a contactor arm 56, which is connected to the line conductor L₂ and which is adapted to engage a contact 57 connected to the circuit 37a upon increase in temperature to 80° F. and to engage a contact segment 58, connected to the circuit 38a, upon increase to 82° F., these temperatures being used again as examples of first and second predetermined maximum temperatures. The contactor is also adapted to successively engage the several rheostat contacts 54, to decrease the resistance in the circuit 39, upon successive increases in temperature. For example, the first to the fourth contacts (from left to right) may be engaged in response to values of 85°, 84°, 83° and 82° F., respectively.

The humidostat H actuates a contactor arm 59, which is connected to the line conductor L₃ and adapted to engage a contact segment 61 connected to the circuit 38a upon increase in relative humidity above a predetermined value, for example, 55%. The contactor 59 is also adapted to successively engage the first to the sixth rheostat contacts 55 (from left to right), for increasing the resistance in the circuit, upon increase in relative humidity, to 50, 52, 54, 56, 58 and 60%, respectively.

Fig. 3—Operation

Assume first that the relative humidity in the enclosure 12 is 50%, so that the contactor 59 engages the first contact 55. If the temperature is below 80°, the cooling apparatus is shut down. As the temperature increases to 80°, the thermostat T moves the contactor 56 into engagement with the contact 57, thereby closing the circuit 37a and energizing the relay 33a. The motor compressor unit then operates at low speed, which speed may be one-half the full or high speed. As the circuit 39 is opened by the contacts 52 of the deenergized high speed relay 34a, the bulb 29 is not heated, and the effective evaporator surface is reduced to the minimum value, for ex-

ample, by one half. The apparatus thus operates in the same manner as the apparatus of Fig. 1 when the contacts 35 alone are closed, the only difference being that the reduction in compressor capacity is provided by reduced speed of the compressor instead of reducing the number of compressors.

Next assume that the temperature increases to 82°, the humidity remaining at 50%. The contactor 56 engages the contact 58, completing the circuit 38a to energize the high speed relay 34a. It also engages the fourth contact 54. The relay 34a effects high speed operation of the motor compressor and its contacts 52 close the circuit 39. The maximum amount of current is supplied to the heating element 32 due to the engagement of the contactor 59 with the first contact 55, so that the effective portion of the evaporator is at a maximum. The apparatus now operates in the same manner as that of Fig. 1, when the contacts 36 are closed, the only difference being that the full compressor capacity is provided by full or high speed of the multi-speed compressor instead of by two compressors.

Next assume that the temperature is below 82°, the compressor either being shut down or operating at low speed. As the humidity increases to 52% and 54%, the contactor 59 moves to the second and third contacts 55, but this has no effect since the circuit 39 is opened by the contacts 52. As the humidity reaches 55%, however, the contactor 59 engages the high speed contact 61 to close the circuit 38a. The energized relay 34a effects high-speed operation of the compressor and also closes the circuit 39. The heating element 32 is now energized, but by a reduced amount of current, due to the fact that two resistance sections are interposed in the circuit, the contact 59 being in engagement with the third contact 55. Thus, a reduced amount of heat is supplied to the thermostatic bulb 29 so that it operates to maintain an intermediate value of superheat of the vaporized refrigerant discharged through the suction conduit 25. In this case, the refrigerating apparatus operates in the usual manner of such apparatus but the pressure and temperature of the refrigerant in the evaporator are only partially reduced, so that the degree of dehumidification is increased to a limited extent. As the contactor 59 moves toward the right and engages the several contacts 55, the resistance is gradually increased and the amount of current supplied to the heating element 32 is gradually decreased. Thus, the thermostatic expansion valve 22 gradually increases the amount of superheat of the vaporized refrigerant, resulting in gradual reduction in temperature and pressure of the refrigerant in the evaporator, and gradual increase of the degree of dehumidification in accordance with the increase in humidity and demand for dehumidification.

When the temperature is 82° and the contactor 56 engages the high speed contact 58 and the fourth contact 54, there is indicated a demand for cooling greater than that supplied by half speed operation, but yet sufficiently moderate to permit some of the cooling effect to be utilized for a greater degree of dehumidification. In this case, the effective portion of the evaporator is controlled by the humidostat to a limited extent. If the humidity is 50%, then the effective portion of the evaporator is at a maximum, since there is no demand for an increased degree of dehumidification. As the relative humidity increases to 52, 54 and 56%, however, additional

resistance is interposed in the circuit and the effective evaporator surface is reduced to increase the degree of dehumidification. Further increase in relative humidity to 58 or 60 percent has no effect, however, since the contactor 56 engages the fourth contact 54, thereby shunting the fourth and fifth resistance sections. The reason for this is that the temperature indicates a demand for sensible heat removal greater than that obtained when the fourth and fifth resistance sections are in a circuit.

As the temperature increases further to 83°, 84°, 85°, the additional resistance sections are successively shunted to gradually increase the effective surface, and also gradually reduce the range of control that may be effected by the humidostat. At 85°, for example, the greatest possible amount of sensible heat removal is desired, so that all the resistance sections are shunted to provide maximum effective evaporator surface.

It will thus be seen that in this embodiment there is provided modulating control of the effective evaporator surface in response to a humidity condition, together with modulating control in response to temperature adapted to supersede the humidity responsive control to the extent that the temperature may call for greater effective evaporator surface than that provided by the humidity responsive control.

Fig. 4

The control scheme shown in Fig. 4 is similar to that shown in Fig. 3 except that two separate rheostats controlled by the thermostat and the humidostat, respectively, are provided for controlling the circuit 39 and these rheostats are connected in parallel so that the circuit is influenced by both temperature and humidity except when one or the other causes maximum current to be supplied thereto. In this embodiment, the contactor 56 engages contacts 54a of a rheostat 62 and the contactor 59 engages contacts 55a of a rheostat 63. When each contactor engages a contact other than the first, then each resistance supplies a reduced amount of current to the circuit 39, so that variation in either temperature or humidity varies the amount of current supplied to the heating element 32 and the portion of the evaporator surface that is effective. However, if either contactor engages the first contact, then full line voltage is supplied to the circuit 39 so that the maximum portion of the evaporator surface is effective. In this case, the other rheostat is ineffective. The operation of this embodiment is in other respects the same as that of Fig. 3.

While I have shown my invention in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In air cooling and dehumidifying apparatus, the combination of evaporator means comprising a plurality of refrigerant passages arranged in parallel, means for effecting flow of a stream of air over said evaporator means, a variable speed compressor, condensing means, means operable automatically to effect operation of the compressor at low speed and to restrict the flow of refrigerant to said evaporator means so that

liquid refrigerant extends through a relatively small portion of each of said passages in response to a predetermined temperature and to effect operation of said compressor at high speed and to increase the flow of refrigerant to said evaporator means so that liquid refrigerant extends through a greater portion of each of said passages in response to a higher predetermined temperature.

2. In air cooling and dehumidifying apparatus, the combination of evaporator means, means for effecting flow of a stream of air over said evaporator means, compressor means of variable capacity, condensing means, and means operable automatically to effect operation of the compressor means at full capacity and to supply a maximum portion of the evaporator means with liquid refrigerant in response to a predetermined maximum temperature and independently of humidity, to effect operation of the compressor means at reduced capacity and to supply a reduced portion of the evaporator means with liquid refrigerant in response to a relatively low humidity and a temperature intermediate said predetermined maximum temperature and a predetermined minimum temperature, and to effect operation of the compressor means at full capacity and to supply a reduced portion of the evaporator means with liquid refrigerant in response to a relatively high humidity and a temperature intermediate said predetermined maximum temperature and a predetermined minimum temperature.

3. In air cooling and dehumidifying apparatus, the combination of evaporator means, means for effecting flow of a stream of air over said evaporator means, a multi-speed compressor, condensing means, and means operable automatically to effect operation of the compressor at low speed and to supply a relatively small portion of the evaporator means with liquid refrigerant in response to a relatively low humidity and a temperature intermediate a predetermined maximum temperature and a predetermined minimum temperature, to effect operation of the compressor at high speed and to supply a greater portion of the evaporator means with liquid refrigerant in response to said predetermined maximum temperature and independently of humidity, and to effect operation of the compressor at high speed and to supply a relatively small portion of the evaporator means with liquid refrigerant in response to a relatively high humidity and a temperature intermediate said predetermined maximum temperature and to a predetermined minimum temperature.

4. In air cooling and dehumidifying apparatus, the combination of evaporator means, means for effecting flow of a stream of air over said evaporator means, compressor means of variable capacity, condensing means, means operable automatically to effect operation of the compressor means at reduced capacity and to supply a reduced portion of the evaporator means with liquid in response to a low humidity condition, to effect operation of the compressor means at increased capacity in response to a predetermined maximum value of a humidity condition, and to vary the portion of the evaporator means supplied with liquid refrigerant gradually in response to gradual variations in the value of said humidity condition while said compressor means is operating at increased capacity.

5. In air cooling and dehumidifying apparatus,

the combination of evaporator means, means for effecting flow of a stream of air over said evaporator means, compressor means of variable capacity, condensing means, and means operable automatically to effect operation of the compressor means at reduced capacity and to supply a reduced portion of the evaporator means with liquid refrigerant in response to a relatively low humidity and a temperature intermediate predetermined maximum and minimum values, to effect operation of the compressor means at full capacity in response to either a temperature above said predetermined maximum value or a relatively high humidity, and to vary the portion of the evaporator means supplied with liquid refrigerant gradually in response to gradual variations in humidity while said compressor means is operating at full capacity.

6. In air cooling and dehumidifying apparatus, the combination of evaporator means, variable capacity compressor means and a condenser connected in a refrigerant circuit, means operable automatically to increase and decrease both the portion of the evaporator means containing liquid refrigerant and the rate of fluid translation (by volume) of the compressor means in response to increase and decrease, respectively, in temperature of air, and means operable automatically to increase said rate of fluid translation and thereby also the ratio of said rate of fluid translation to the portion of the evaporator means containing liquid refrigerant in response to increase in humidity of air.

7. In air cooling and dehumidifying apparatus, the combination of evaporator means, means for effecting flow of a stream of air over said evaporator means, variable capacity compressor means, means operable automatically to initiate and terminate operation of the compressor in response to increase above and decrease below a predetermined temperature of air, means for automatically increasing and decreasing both the portion of the evaporator means containing liquid refrigerant and the rate of fluid translation (by volume) of said compressor means in response to increase and decrease, respectively, in temperature of air, and means operating automatically to increase and decrease the rate of fluid translation (by volume) and thereby also the ratio of said rate of fluid translation to the liquid-containing portion of the evaporator means in response to increase and decrease, respectively, in humidity of air.

8. In air cooling and dehumidifying apparatus, the combination of evaporator means, variable capacity compressor means and a condenser connected in a refrigerant circuit, means operable in response to increase in temperature of air above a first predetermined value for effecting operation of the apparatus with a reduced portion of the evaporator means containing liquid refrigerant and the compressor operating at reduced rate of fluid translation (by volume), means operable in response to increase in humidity of air for increasing the rate of fluid translation (by volume) of said compressor means and thereby also the ratio of said rate of fluid translation to the liquid-containing portion of the evaporator means, and means operable in response to increase in temperature of air above a second and higher predetermined value for increasing the liquid containing portion of the evaporator means independently of humidity.

9. In an air cooling and dehumidifying apparatus the combination of evaporator means,

means for effecting flow of a stream of air over said evaporator means, compressor means of variable capacity, condensing means, and means operable automatically to effect operation of the compressor means at reduced capacity and to supply a reduced portion of the evaporator means with liquid refrigerant in response to a relatively low humidity and temperatures intermediate predetermined maximum and minimum values, to effect normally operation of the compressor 10

means at sufficiently high capacity to lower the pressure in the evaporator to a minimum when the temperature rises above a predetermined high value or the humidity becomes relatively high, and to vary the portion of the evaporator means supplied with liquid refrigerant gradually in response to gradual variations in humidity while the compressor means is operating to maintain the pressure in the evaporator at a minimum.

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