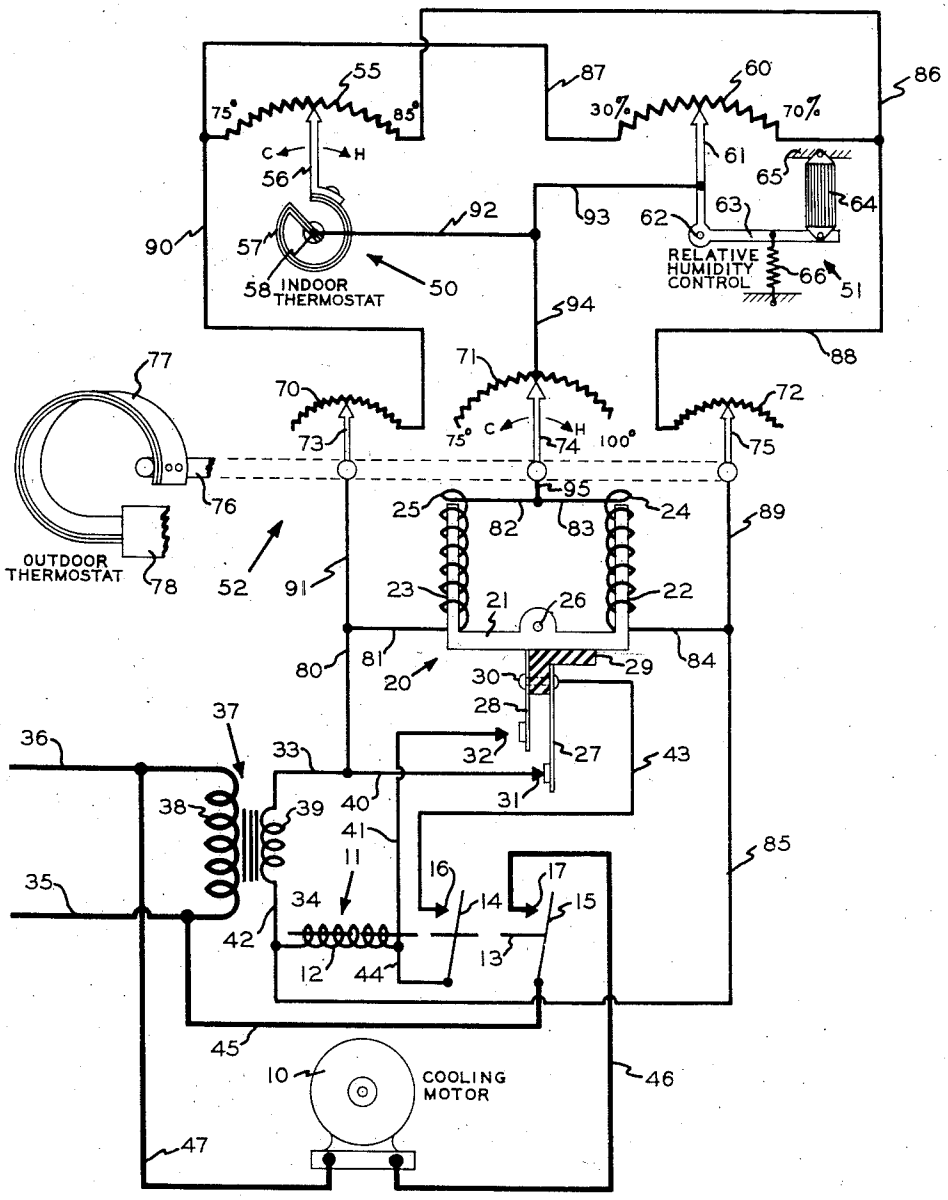
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AUTOMATIC AIR CONDITIONING SYSTEM

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AUTOMATIC AIR CONDITIONING SYSTEM

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The present invention relates to air conditioning systems by means of which the proper conditions are maintained within a space to be controlled and relates particularly to the air conditioning of a space during those periods that the space requires cooling by reason of high outdoor temperatures.

One of the objects of the present invention is the provision of an improved air conditioning system by means of which the effective temperature of the space is varied within predetermined limits upon variations in outdoor temperature, the arrangement preferably being such that the rate of increase of the effective temperature is less than the rate of increase of outdoor dry bulb temperature.

A further object of the invention is the provision of an improved system for cooling a space by means of which the dry bulb space temperature is allowed to increase as the outdoor temperature becomes progressively higher.

Another object of the invention is the provision of a control system for controlling a temperature changer in accordance with space temperature fluctuations and space relative humidity fluctuations so that a predetermined effective temperature, or a predetermined range of effective temperature, is maintained within the space, which system has utility either during warm weather when cooling is required or during cold weather when heating is required.

Other objects of the invention will be found in the drawing, the detailed description, and the appended claims.

For a more complete understanding of the invention, reference may be had to the following description and accompanying single drawing which is a diagrammatic representation of one form of the invention.

Referring to the drawing, a temperature changer is shown at 10 as comprising an electric motor which may control the heating or cooling of a space in any of the usual and well-known manners, the temperature changer 10 in the instant embodiment of the invention preferably being arranged to control the cooling of a space. The temperature changer or cooling motor 10 is controlled by a relay generally indicated at 11. This relay 11 includes a relay coil 12 which, when energized, attracts an armature 13 that in turn moves switch arms 14 and 15 into engagement with respective contacts 16 and 17. The relay 11 is in turn controlled by a balanced relay 20 which includes an armature 21 having a pair of legs 22 and 23. A pair of series connected electromagnetic coils 24 and 25 cooperate with the respective legs 22 and 23 of armature 21. The armature 21 is pivoted at a point indicated at 26 and operates a pair of contact blades 27 and 28. The contact blades 27 and 28 are secured to armature 21 through a block of electrical insulating material 29 by a rivet 30 which electrically connects contact blades 27 and 28. Contact blade 27 cooperates with a contact 31, and the contact blade 28 cooperates with a contact 32. The arrangement is such that when electromagnetic coils 24 and 25 are equally energized, the parts assume the position shown in the drawing wherein contact blade 27 is engaged with contact 31, but contact blade 28 is disengaged from contact 32. If the electromagnetic coil 24 becomes more highly energized than the electromagnetic coil 25, the contact blade 27 is moved from engagement with contact 31. On the other hand, if the electromagnetic coil 25 becomes more highly energized than the electromagnetic coil 24 by a predetermined amount, then contact blade 28 moves into engagement with contact 32.

High voltage power is supplied to the cooling motor 10 by means of line wires 35 and 36. Low voltage power is supplied to relay 11 by means of a step-down transformer 37 which is provided with a high voltage primary 38 that is connected to line wires 35 and 36. The step-down transformer 37 additionally includes a low voltage secondary 39. Whenever electromagnetic coil 25 becomes energized to a sufficiently greater extent than electromagnetic coil 24 so as to bring contact blade 28 into engagement with contact 32, electromagnetic coil 12 is energized as follows: secondary 39 of transformer 37, wire 33, wire 40, contact 31, contact blades 27 and 28, contact 32, wire 41, relay coil 12, wire 34, and wire 42 to the other side of secondary 39. Switch arms 14 and 15 are thereby moved into engagement with contacts 16 and 17. Engagement of switch arm 14 with contact 16 establishes a holding circuit for relay coil 12 which is independent of the contact blade 28 and contact 32. This holding circuit is as follows: secondary 39, wire 33, wire 40, contact 31, contact blade 27, wire 43, contact 16, switch arm 14, wire 44, relay coil 12, wire 34, and wire 42 to the other side of secondary 39. Engagement of switch arm 15 with contact 17 energizes the cooling motor 10 as follows: line wire 35, wire 45, switch arm 15, contact 17, wire 46, cooling motor 10, and wire 47 to line wire 36. When the energization of electromagnetic coils 24 and 25 is again equalized so as to move contact blade 28 from engagement with contact 32, the

initial energizing circuit for relay coil 12 is interrupted but the relay coil 12 remains energized by the holding circuit described above. However, when the electromagnetic coil 24 becomes more highly energized than the electromagnetic coil 25, then contact blade 27 disengages contact 31 and the holding circuit for relay coil 12 is interrupted, whereupon armature 13 and switch arms 14 and 15 return to the position shown in the drawing wherein the cooling motor 10 is deenergized.

It is to be understood that while a particular type of control system by means of which the balanced relay 20 controls the temperature changer 10 has been disclosed herein, that any other system or means of suitable character could be employed for this purpose.

The balanced relay 20 is adapted to be controlled by a space temperature variable resistance thermostat generally indicated at 50 which responds to the dry bulb temperature of the space, a space relative humidity responsive variable resistance controller 51, and an outdoor temperature variable resistance thermostat or controller 52.

The space temperature variable resistance controller or thermostat 50 is herein shown as comprising a potentiometer thermostat which includes a space or indoor resistance 55 that is adapted to be traversed by a movable contact arm 56. The movable contact arm 56 is controlled by a space temperature responsive thermal element 57 shown as comprising a bimetallic element having one of its ends secured as at 58 and its other end carrying the contact arm 56. The arrangement is preferably such that thermal element 57 causes the contact arm 56 to move from the cold or left-hand end of indoor resistance 55 to the hot or right-hand end thereof upon a predetermined variation in space temperature which is herein indicated as comprising a variation of from 75° F. to 85° F. It will be understood that this range of the space temperature responsive thermostat 50 should be selected to correspond with the desired or permissible fluctuations in the dry bulb temperature of the space.

The relative humidity responsive controller 51 is also shown in the form of a potentiometer which includes a humidity resistance 60 that is adapted to be traversed by a contact arm 61. The contact arm 61 forms one arm of a bell crank pivoted at 62 and which includes a second arm 63. The arm 63 is connected to one end of a humidity responsive element 64 herein shown as comprising a plurality of strands of hair, the other ends of which are fixed as indicated at 65. The proper tension is placed upon the humidity responsive element 64 by a coiled spring 66. The arrangement of humidity responsive controller is such that contact arm 61 moves from the left-hand end of the humidity resistance 60 to the right-hand end thereof upon predetermined variations in the space relative humidity which, for the purposes of this explanation, have been selected as ranging from 30% to 70%.

The outdoor thermostat or controller includes three resistances 70, 71, and 72 which are respectively traversed by contact arms 73, 74, and 75, all of which are mounted upon and secured to a common controlling shaft 76. The shaft 76 is adapted to be rotated by an outdoor responsive thermal element 77 which is shown as comprising a coiled bimetallic strip. One end of this thermal element 77 is fixed as indicated at 78, whereas its other end is connected to the shaft 76. The contact arms 73, 74, and 75 are adapted to traverse completely the resistances 70, 71, and 72 upon outdoor temperature changes throughout a range corresponding to the range of outdoor temperature within which it is desired to vary the indoor or space effective temperature. In this particular embodiment of the invention, this range has been selected to start at 75° F. and end at 100° F., the left-hand ends of resistances 70, 71, and 72 being the cold or 75° F. ends, whereas the right-hand ends thereof are the hot or 100° F. ends.

Low voltage power is supplied to the balanced relay control system by the secondary 39 of the step-down transformer 37. The relay coils 24 and 25 of the balanced relay 20 are connected in series across the secondary 39 by wires 33, 80, 81, 82, 83, 84, 85, and 42. The indoor resistance 55 and the humidity resistance 60 of the indoor thermostat 50 and the relative humidity control 51, respectively, are connected in parallel with each other and are connected in parallel with the series connected relay coils 24 and 25 through the resistances 72 and 70 by wires 86, 87, 88, 89, 90, and 91. The contact arms 56 and 61 are connected to each other and to the center of resistance 71 by wires 92, 93, and 94, and the contact arm 74 is connected to the junction of, or in between, the relay coils 24 and 25 by means of a wire 95 which is connected to the wires 82 and 83.

With the parts in the position shown, the space relative humidity, the space dry bulb temperature, and the outdoor temperature are all intermediate the ranges of their respective controllers. Contact arm 56 is therefore engaging the center portion of indoor resistance 55, and the contact arm 61 is engaging the center portion of the humidity resistance 60. Likewise, the contact arms 73, 74, and 75 are engaging the center portions of resistances 70, 71, and 72. Equal portions of resistances 70 and 72 are therefore connected to their respective electromagnetic coils 25 and 24, and none of the resistance 71 is in circuit with the wires 94 and 95. The electromagnetic coils 24 and 25 are therefore equally energized so that contact blade 26 is engaging contact 31 as heretofore explained.

Assuming that the outdoor temperature remains constant, a rise in the space temperature accompanied by movement of contact arm 56 along indoor resistance 55 towards the right-hand end thereof will increase the voltage drop across electromagnetic coil 25 and decrease the voltage drop across electromagnetic coil 24. When the space temperature has risen sufficiently to cause a large enough difference in the voltage drops across electromagnetic coils 25 and 24, contact blade 28 will move into engagement with contact 32, whereupon the cooling motor 10 will be energized through relay 11 as heretofore explained. The space will therefore be subjected to a cooling effect which will cause a lowering in the space temperature and movement of contact arm 56 along indoor resistance 55 towards the left-hand end thereof. This action will cause a gradual decrease in the voltage drop across the electromagnetic coil 25 and a gradual increase in the voltage drop across electromagnetic coil 24. When the space temperature has thus been lowered sufficiently, electromagnetic coil 24 will become more highly energized than electromagnetic coil 25, and both contact blades 27 and 28 will move from engagement with their respective contacts 31 and 32 whereupon the cooling motor 10 will be deener-

gized as heretofore explained. In this manner, as long as the outdoor temperature and space relative humidity remain constant, the space dry bulb temperature responsive thermostat will maintain the space temperature within a predetermined range which is dependent upon the prevailing outdoor temperature and space relative humidity.

Assuming that the outdoor temperature still remains constant but that there is an increase in the space relative himidity, then the contact arm 61 will move along humidity resistance 60 towards the right-hand end thereof. This action will increase the voltage drop across electromagnetic coil 25 and reduce the voltage drop across electromagnetic coil 24 so that the space temperature need not become quite so high before contact blade 28 will engage contact 32 to place the cooling means in operation. Similarly, if the relative humidity of the space decreases so that contact arm 61 moves along humidity resistance 60 towards the left-hand end thereof, the space temperature must become higher than before in order to cause a sufficient difference in the voltage drops across electromagnetic coils 24 and 25 to result in engagement of contact blade 28 with contact 32.

In this manner, the prevailing temperature which is maintained by the controller 50 is respectively decreased and increased as the space relative humidity increases and decreases. By properly proportioning the response and resistance values of the space temperature controller 50 and relative humidity controller 51, the effective temperature may be maintained within a substantially constant range for any particular outdoor temperature. This phase of the invention has utility for heating as well as for cooling.

If the outdoor temperature should increase, a smaller amount of resistance 70 will be connected between the electromagnetic coil 25 and the left ends of resistances 55 and 60, and a larger amount of resistance 72 will be connected between the electromagnetic coil 24 and the right ends of resistances 55 and 60. This causes a decrease in the voltage drop across electromagnetic coil 25 and an increase in the voltage drop across electromagnetic coil 24. The space temperature must therefore increase to a greater extent before the voltage drop across electromagnetic coil 25 will become greater than the voltage drop across electromagnetic coil 24 by the amount necessary to bring contact blade 28 into engagement with contact 32. As a result, the effective temperature maintained within the space is increased as the outdoor temperature increases. Similarly, upon a reduction in the outdoor temperature a larger amount of resistance 70 is placed in circuit with the electromagnetic coil 25, whereas a smaller amount of the resistance 72 is placed in circuit with electromagnetic coil 24 whereby the control of the space temperature controller 50 and the space humidity controller 51 will be modified in an opposite manner to lower the effective temperature maintained within the space. By properly proportioning the resistance values of resistances 70 and 72 the magnitude of the effect of the outdoor controller 52 upon the control system for the balanced relay 20 may be varied as desired. In the preferred embodiment of the invention, the value of these resistances is so selected that the space effective temperature rises at a lower rate than the outdoor temperature. Suitable resistance values for resistances 70 and 72 are 70 ohms in a system wherein the resistance values of indoor and humidity resistances 55 and 60 are 135 ohms.

Whenever the outdoor temperature rises above or falls below a value intermediate its total effective range, the contact arm 74 places a variable amount of resistance 71 in circuit with the wires 93 and 94. This placing of resistance 71 in this circuit prevents a complete short-circuiting of either of the electromagnetic coils 24 and 25 when the outdoor temperature, the space, and the space relative humidity reach the proper extremes whereby some current always flows through the electromagnetic coils 24 and 25 so that the system remains operative under all conditions.

It will be readily apparent that the resistance 71 could comprise a pair of separate resistances instead of being a single resistance having a connection intermediate its ends.

While a specific embodiment of the invention has been disclosed herein, many changes may be made by those skilled in the art without departing from the invention, and I therefore intend to be limited only by the scope of the appended claims.

I claim:

1. In combination, means in control of the conditioning of the air in a space, a pair of series connected electromagnetic coils in control thereof, a space temperature responsive potentiometer having a wide range equal to the desired limits of space temperature variation in warm weather, a space relative humidity responsive potentiometer having a wide range equal to the range of relative humidity within which it is desired to make corrections of the space temperature in order to maintain the effective temperature within predetermined limits, three variable resistances and associated contacts, electrical conductors connecting the low value ends of both the potentiometer resistances to one end of one of said three resistances, electrical conductors connecting the associated contact of said resistance to one end of one of said electromagnetic coils, electrical conductors connecting the high value ends of both the potentiometer resistances to one end of another of said three resistances, electrical conductors connecting the associated contact of said resistance to one end of the other of said electromagnetic coils, conductors connecting the contacts of said potentiometers to the center of said third resistance, conductors connecting the contact of said third resistance to the junction of said electromagnetic coils, means responsive to changes in outdoor temperature in control of the contacts for said three resistances and arranged to insert less of said first resistance in series with the low value ends of said potentiometers upon outdoor temperature rise, and a source of power connected directly across said series connected electromagnetic coils.

2. In combination, means in control of the conditioning of air in a space, a pair of series connected electrically energizable means in control thereof, a pair of potentiometers including potentiometer resistances and associated contacts, three variable resistances and an associated contact for each of said resistances, conductors connecting one end of a first of said resistances to one end of each of said potentiometer resistances, conductors connecting one end of a second of said resistances to the other end of each of said potentiometer resistances, conductors connecting one of the contacts of said first and second resistances to one end of one of said electrically energizable means and the other of said

contacts to one end of the other of said electrically energizable means whereby the two potentiometer resistances, in parallel, are connected in parallel with the series connected electrically energizable means through two of said variable resistances, conductors connecting the contacts of said potentiometers to the center of the third variable resistance and the contact thereof to the junction of the series connected electrically energizable means, three air condition responsive devices including a temperature responsive device and a moisture responsive device, separate connections between two of said devices and the two potentiometer contacts, connections between the third of said devices and the three variable resistance contacts, said last-named connections being arranged to increase the effective portion of the first of said variable resistances while decreasing the effective portion of the second of said variable resistances, and a source of power connected across said series connected electrically energizable means.

3. In combination, means in control of the cooling of a space, a pair of series connected electromagnetic coils in control thereof, a space temperature responsive potentiometer having a wide range equal to the desired limits of space temperature variation in warm weather, a space relative humidity responsive potentiometer having a wide range equal to the range of relative humidity within which it is desired to make corrections of the space temperature in order to maintain the effective temperature within predetermined limits, electrical conductors connecting both of the resistances of the potentiometers in parallel with the series connected coils and the movable contacts of the potentiometers to the junction of said coils, and outdoor temperature actuated variable resistance means associated with said coils for modifying the effect of said potentiometers thereon in such manner as to increase the effective temperature of the space as the outdoor temperature rises.

4. In combination, means in control of the condition of the air in a space, a pair of series connected electrically energizable means in control thereof, a pair of potentiometers including potentiometer resistances and potentiometer contacts, electrical conductors connecting both of the potentiometer resistances in parallel with the series connected electrically energizable means and the contacts of the potentiometers to the junction of the series connected electrically energizable means, variable resistance means associated with said electrically energizable means to modify the effect of the potentiometers thereon, a source of electrical power connected to said electrically energizable means, three air condition responsive devices including a moisture responsive device, and separate connections between said three devices and the potentiometer contacts and variable resistance means.

5. In combination, a temperature changer, series connected oppositely acting electrical means in control thereof, a space temperature responsive potentiometer having a range equal to the permissible space temperature fluctuations, a space relative humidity responsive potentiometer having a range equal to the permissible relative humidity fluctuations, conductors connecting both potentiometers in parallel with the series connected electrical means and outdoor temperature responsive variable resistance means associated with the electrical means for modifying the action of said potentiometers thereon.

6. A system of the class described, comprising, in combination, means in control of the cooling of a space, a pair of series connected oppositely acting electromagnetic coils in control of said means, a pair of variable resistances controlled by fluctuations in outdoor temperature connected one to each of the free ends of said coils, a pair of potentiometers connected across said series connected coils through the variable resistances, a space temperature responsive thermal element in control of one of the potentiometers, and a space relative humidity responsive element in control of the other of the potentiometers.

7. A system of the class described, comprising, in combination, means for controlling the condition of a space, oppositely acting electrical means in control thereof, a space temperature responsive potentiometer in control of the electrical means, a space relative humidity responsive potentiometer for additionally controlling the electrical means, and variable resistance means responsive to outdoor temperatures for modifying the action of said potentiometers on the electrical means.

8. In an air conditioning system, in combination, means in control of the condition of air in a space, a pair of series connected electrically energizable means in control thereof, a pair of potentiometers in control of said electrically energizable means, variable resistance means to modify the action of said potentiometers on the electrically energizable means, three air condition responsive devices including a moisture responsive device, connections between one of said devices and one of the potentiometers, connections between another of said devices and the other potentiometer, and connections between the third of said devices and the variable resistance means.

9. In combination, means in control of the condition of a space, electrical means in control thereof, a variable resistance space temperature actuated controller, a variable resistance outdoor temperature responsive controller, a variable resistance space relative humidity responsive controller, and electrical connections connecting all of said variable resistance controllers to the electrical means.

10. In combination, means in control of the cooling of a space, a pair of series connected oppositely acting electromagnetic coils in control thereof, a space temperature responsive potentiometer having a wide range equal to the permissible limits of space temperature variation in warm weather, a space relative humidity responsive potentiometer having a wide range equal to the range of relative humidity within which it is desired to make corrections of the space temperature in order to maintain the effective temperature within predetermined limits, and electrical conductors connecting both of the resistances of the potentiometers in parallel with the series connected coils and the movable contacts of the potentiometers to the junction of said coils.

11. In combination, a temperature changer, series connected oppositely acting electrical means in control thereof, a space temperature responsive potentiometer having a range equal to the permissible space temperature fluctuations, a space relative humidity responsive potentiometer having a range equal to the permissible relative humidity fluctuations and which responds to relative humidity regardless of temperature fluctuations, and conductors connect-

ing both potentiometers to the series connected electrical means including conductors connecting both potentiometer reactance members in parallel with the series connected electrical means.

12. In an air conditioning system, in combination, means to change the condition of air in a space, series connected oppositely acting electrically energizable means in control thereof, a pair of potentiometers having their resistance elements connected in parallel therewith and their contacts connected to the junction of the series connected electrically energizable means, temperature responsive means in control of one of said potentiometers, and moisture responsive means controlling the other of said potentiometers.

13. In an air conditioning system, in combination, means to change the condition of air in a space, oppositely acting electrical means in control thereof and connected in series across a source of power, a pair of variable resistances including movable contact means connected one to each end of the series connected electrical means, a single resistance connecting said variable resistances, a movable contact adapted to traverse the single resistance and connected to the junction of the series connected electrical means, an outdoor condition responsive device in control of the contact means, and a space moisture responsive device in control of said contact.

14. In an air conditioning system, in combination, means to change the condition of air in a space, oppositely acting electrical means in control thereof and connected in series across a source of power, a pair of variable resistances including movable contact means connected one to each end of the series connected electrical means, a single resistance connecting said variable resistances, a movable contact means adapted to traverse the single resistance and connected to the junction of the series connected electrical means, a moisture responsive device in control of one of said contact means, and a temperature responsive device in control of the other of said contact means.

15. In combination, means in control of the cooling of a space, electrical means in control thereof, a variable resistance space temperature actuated controller, a variable resistance outdoor temperature responsive controller, a variable resistance space relative humidity responsive controller, and electrical connections connecting all of said variable resistance controllers to said electrical means in a manner to cause an increase in the temperature maintained in said space upon either a lowering in the space relative humidity or a rise in the outdoor temperature.

16. In combination, means in control of the condition of a space, electrical means in control thereof, a space temperature responsive variable resistance controller having a relatively wide range of response in control thereof and requiring only a portion of its total range of movement to cause a complete change in the operation of said cooling means control, and a variable resistance controller responsive to the relative humidity of the space electrically associated with said first-named controller to vary the operating range thereof in respect to its total range in a manner to increase the temperature of the space upon a decrease in the relative humidity thereof.

17. In combination, means in control of the cooling of a space, electrical means in control thereof, a space temperature responsive variable resistance controller having a relatively wide range of response in control thereof and requiring only a portion of its total range of movement to cause a variation in the operation of said cooling means control, a variable resistance controller responsive to the relative humidity of the space electrically associated with said first-named controller to vary the operating range thereof in respect to its total range in a manner to increase the temperature of the space upon a decrease in the relative humidity thereof, and a variable resistance controller responsive to an outdoor temperature condition electrically associated with said first-named controller to vary the operating range thereof in respect to its total range in a manner to increase the temperature maintained in the space upon an increase in the outdoor temperature condition.

18. In an air conditioning system, in combination, means to change the condition of air in a space, electrical means in control thereof, a variable resistance space relative humidity responsive controller, a variable resistance outdoor temperature responsive controller, and electrical connections connecting both of said variable resistance controllers to the electrical means for controlling the condition of the air in the space in accordance with space relative humidity conditions and outside temperature conditions.

19. In an air conditioning system, in combination, means to change the condition of air in a space, electrical means in control thereof, a first variable control resistance means, means responsive to variations in space temperature for operating the first variable control resistance means, a second variable control resistance means, means responsive to variations in space relative humidity for operating the second variable control resistance means, and electrical connections connecting both of said variable control resistance means to the electrical means for controlling the condition of the air in the space in accordance with the space temperature and relative humidity conditions.

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