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AIR CONDITIONING MECHANISM

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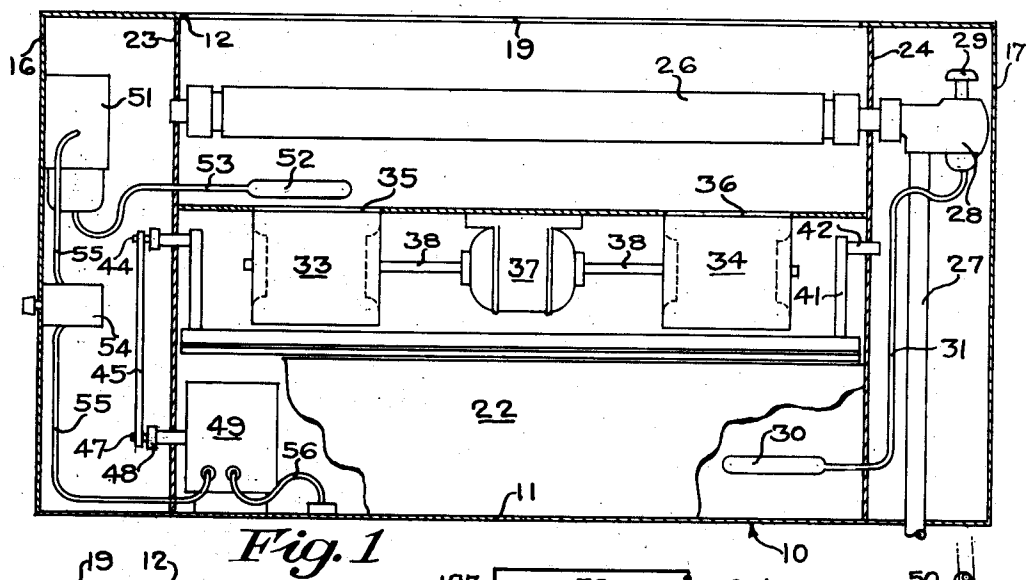


Fig. 1

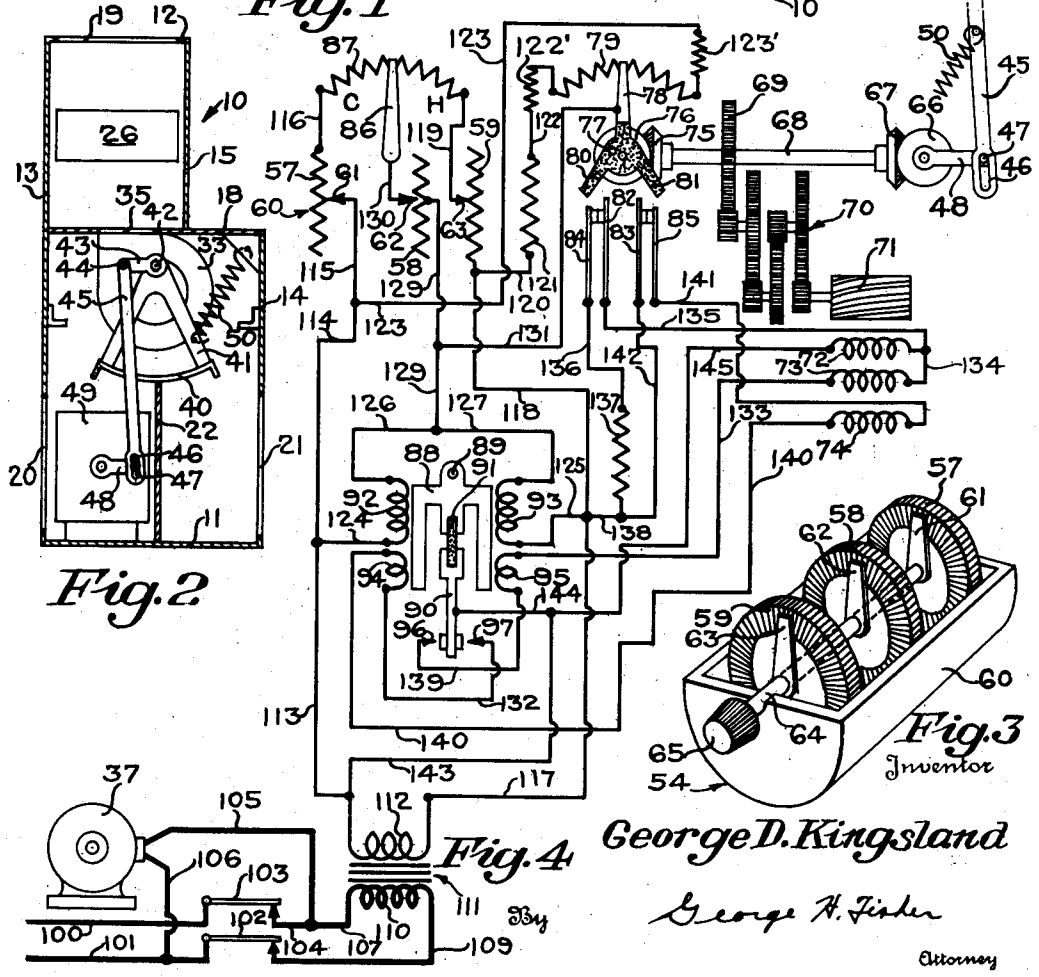


Fig. 2

Fig. 3

Fig. 4

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AIR CONDITIONING MECHANISM

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2 Claims. (Cl. 236—38)

This invention relates to air conditioning mechanism in general and more particularly to unit ventilators.

An object of this invention is to provide a control system for unit ventilators or plenary systems wherein the damper is controlled in accordance with the temperature of a mixture of fresh air and recirculated air and wherein the heating element or radiator is controlled in response to space or room temperature.

In many localities in this country heating and ventilating codes stipulate that a predetermined amount of fresh air must at all times be admitted by the air conditioning mechanism or unit ventilator to the space or room to be heated. The amount of fresh air so admitted varies according to different requirements in the various localities.

It is therefore another object of this invention to provide an adjusting means for a control system of a unit ventilator or plenary system whereby a predetermined amount of fresh air may at all times be admitted in accordance with the heating and ventilating regulations of the various localities and whereby this predetermined amount of air may be easily adjusted.

A further object is to provide a control system of the class described wherein a predetermined amount of fresh air may be provided when the system is in operation, but wherein no fresh air is provided when the system is rendered inoperative.

Other objects of this invention will become apparent to those skilled in the art upon reference to the accompanying specification, claims and drawing, in which drawing:

Figure 1 is an elevational sectional view of a unit ventilator disclosing my control system applied thereto.

Figure 2 is a sectional view of Figure 1.

Figure 3 is a perspective view with parts broken away showing the adjusting mechanism utilized in my invention.

Figure 4 is a schematic wiring diagram of the control system of my invention.

Although my invention may be applied to plenary systems it is shown in Figures 1 and 2 as being applied to a unit ventilator generally designated at 10. The unit ventilator 10 is shown to comprise a lower wall 11, an upper wall 12, a front wall 13 and rear walls 14 and 15. Side walls are also provided at 16 and 17 and the rear walls are connected together by a horizontally extending partition 18. The upper wall 12 is provided with a discharge opening 19, the front wall 13 is provided with a return air opening 20 and the rear wall 14 is provided with a fresh air opening 21. Located in the unit ventilator 10 is a longitudinally extending partition or baffle 22 dividing the lower portion of the unit ventilator into a return air chamber and a fresh air chamber. The unit ventilator 10 is also provided with vertically extending partitions 23 and 24 to form spaces in which the various control elements may be located.

Located in the upper portion of the unit ventilator 10 and above the horizontally extending partition 18 is a radiator or heat exchanger 26 receiving a supply of heating fluid such as steam from a pipe 27. The supply of steam to the radiator 26 is controlled by means of a valve herein shown as a thermostatic valve 28 of usual design. The valve 28 may be manually operated or adjusted by the handle 29 or automatically operated in response to temperature by means of a remotely located control bulb 30 connected thereto by a capillary tube 31. In the present invention the bulb 30 is located in the return air opening 20 so that the valve 28 is operated in response to return air temperature and consequently space temperature. Upon an increase in space temperature the valve 28 is moved towards a closed position and upon a decrease in space temperature the valve 28 is moved towards an open position. Conceivably, the valve 28 could be motor operated under the command of a thermostat located either in the room or in the return air opening and such a mode of operation is within the contemplation of this invention.

Also located in the unit ventilator 10 just below the horizontal partition 18 are fans 33 and 34 for forcing air from the lower portion of the unit ventilator through openings 35 and 36 in the partition 18 over the radiator or heat exchanger 26 and discharging the same through the opening 19 into the space or room to be heated. The fans 33 and 34 are operated by an electric motor 37 through any suitable connecting means such as a shaft 38.

The amount of fresh air or return air delivered to the fans 33 and 34 is determined by means of a damper 40 mounted on brackets 41 suitably supported by shafts 42. Mounted on one of the shafts 42 is a crank 43 which is pivotally connected by means of a pin 44 to one end of a link 45. The other end of the link 45 contains an elongated slot 46 receiving a pin 47 mounted on a crank 48. The crank 48 is suitably operated by means of a proportioning motor 49 which may be of the form shown and described in Patent No.

2,032,658 issued to Willis H. Gille on March 3, 1936.

The damper 40 is biased toward a fresh air restricting or closed position by means of a tension spring 50. Upon operation of the proportioning motor 49 the damper 40 is moved away from the fresh air restricting or closed position against the action of the spring 50. Therefore, the damper 40 may be positioned, in a manner to be pointed out more fully hereafter, to determine whether fresh air or return air is to be admitted to the radiator 26 or the amount of fresh air or return air to be admitted.

Located in the unit ventilator 10 is a temperature controller 51 of the potentiometer type and may take the form of the controller shown and described in Patent No. 2,041,050 issued to Lewis L. Cunningham on May 19, 1936. This temperature controller 51 is made responsive to the temperature of the mixture of fresh air and return air by placing a temperature control bulb 52 in the outlet opening of one of the fans 33 and 34, the control bulb 52 being connected to the temperature controller 51 by means of a capillary tube 53.

Also located in the unit ventilator 10 is a variable resistance 54 the structure of which is shown in Figure 3. The temperature controller 51 and the variable resistance 54 are suitably connected to the proportioning motor 49 by means of conduits 55. The proportioning motor 49 receives its power from some source not shown through a conduit 56.

Referring now to Figure 3, the variable resistance 60 is shown to comprise three coils 57, 58 and 59 suitably mounted in a casing 60. Sliders 61, 62 and 63 mounted on a shaft 64 and rotated by a knob 65 are adapted to slide across the resistances 57, 58 and 59, respectively.

Referring now to Figure 4, the crank 48 is shown to be operated by bevelled gears 66 and 67 which in turn are operated by a shaft 68. Mounted on the shaft 68 is a gear 69 which is driven through a reduction gear train 70 by a motor rotor 71. The motor rotor 71 is controlled by field windings 72, 73 and 74. Upon energization of the field winding 72 the motor rotor 71 and, consequently, the shaft 68 are maintained in predetermined positions against the tension of the spring 50 since the field winding 72 is not sufficiently strong to rotate the shaft 68 against the action of the tension spring 50, but is sufficiently strong to maintain the shaft 68 in a given position. Upon energization of the field winding 74 along with energization of the field winding 72 the shaft 68 is rotated against the tension of the spring 50. The field winding 74 is not sufficiently strong in itself to operate the shaft 68 against the tension of spring 50. Upon energization of the field winding 73, which field winding 73 acts in opposition to field winding 72, the action of the field winding 72 is neutralized and the spring 50 is allowed to move the shaft 68 in the opposite direction.

Also mounted on the shaft 68 is a bevelled gear 75 which engages a bevelled gear 76 carrying an abutment member 77. The abutment member 77 carries a slider 78 adapted to slide across a balancing potentiometer coil 79. The abutment member 77 also carries spaced fingers 80 and 81 which are adapted at extreme positions to engage contacts 82 and 83, contact 82 cooperating with a stationary contact 84 and contact 83 cooperating with a stationary contact 85.

For purposes of illustration the temperature controller 51 is shown to comprise a slider 86 adapted to slide across a potentiometer coil 87 so that upon an increase in temperature the slider 86 is moved to the right and upon a decrease in temperature it is moved to the left as shown by the characters H and C.

The proportioning motor 49 also includes a relay mechanism comprising an armature 88 pivoted at 89. The armature 88 carries a contact arm 90 which is insulated from the armature 88 by means of an insulating member 91. The armature 88 is moved about its pivot 89 by means of coils 92, 93, 94 and 95. The contact arm is adapted to engage spaced contacts 96 and 97 so that when the coil 92 is energized more than the coil 93 the contact arm 90 is moved into engagement with the contact 97 and when the coil 93 is energized more than the coil 92 the contact arm 90 is moved into engagement with the contact 96.

Line wires leading from some source of power not shown are designated at 100 and 101. The line wire 100 is connected to a switch 103. The switch 103 is in turn connected by wires 104 and 105 to the fan motor 37 and the fan motor 37 is in turn connected by a wire 106 to the other line wire 101. Therefore, when the switch 103 is closed the fan motor 37 is placed in operation.

The switch 103 is also connected by wires 104 and 107 to one end of a primary 110 of a step-down transformer 111 having a secondary 112. The other end of the primary 110 is connected by a wire 109 and a switch 102 to the other line wire 101. Therefore, when the switches 102 and 103 are closed the step-down transformer 111 is energized.

One end of the secondary 112 is connected by wires 113, 114 and 115 to the slider 61 of the variable resistance 60. The resistance 57 cooperating with the slider 61 is connected by a wire 116 to the left end of the potentiometer coil 87. The other end of the secondary 112 is connected by wires 117 and 118 to the resistance 59 of the variable resistance 60. The slider 63 cooperating with the resistance 59 is connected by a wire 119 to the right end of the potentiometer coil 87. The junction of the wire 118 and the resistance 59 is connected by a wire 120, a resistance 121, a wire 122 and a protective resistance 122' to the left end of the balancing potentiometer coil 79. The right end of the balancing potentiometer coil 79 is connected by a protective resistance 123' and wire 123 to the junction of wires 114 and 115. The lower end of the coil 92 is connected by a wire 124 to the junction of wires 113 and 114 and likewise the lower end of the coil 93 is connected by a wire 125 to the junction of wires 117 and 118. The upper ends of the coils 92 and 93 are connected together by wires 126 and 127 and by wires 128 and 129 to the resistance 58 of the variable resistance 60. The slider 62 cooperating with the resistance 58 is connected by a wire 130 to the slider 86. The slider 78 cooperating with the balancing potentiometer coil 79 is connected by a wire 131 to the junction of wires 128 and 129.

From the above it is seen that the left hand end of the secondary 112, the lower end of the coil 92, the left hand end of the potentiometer coil 87 and the right hand end of the balancing potentiometer coil 79 are connected together. Likewise, the right hand end of the secondary 112, the lower end of the coil 93, the right hand end of the potentiometer coil 87 and the left hand end of the balancing potentiometer coil 79 are

connected together. It is also seen that the sliders 78 and 86 and the upper ends of the coils 92 and 93 are connected together. It, therefore, can be stated that the secondary 112, the coils 92 and 93, and the potentiometers 87 and 79 are connected in parallel.

The contact 96 is connected by a wire 139 to one end of the coil 95, the other end thereof being connected by a wire 133 to one end of the field winding 73. The other end of the field winding 73 is connected by wires 134 and 135 to the contact 82. The contact 84 is connected by a wire 136, a resistance 137 and a wire 138 to the junction of wires 117 and 118. The contact 97 is connected by a wire 132 to one end of the coil 94, the other end of which is connected by a wire 140 to one end of the field winding 74. The other end of the field winding 74 is connected by a wire 141 to the contact 85. The contact 83 is connected by a wire 142 to the wire 138. The left end of the secondary 112 is connected by wires 143 and 144 to the contact arm 90 and by wires 143 and 145 to one end of the field winding 72, the other end of the field winding 72 being connected to the junction of wires 134 and 135.

With the parts in the position shown in the drawing, the temperature of the mixture of fresh and return air is normal and the slider 86 is in its mid position with respect to the potentiometer coil 87. By reason of this position of the slider 86 the damper 40 is likewise in a mid position and equal amounts of fresh air and return air are being delivered to the radiator 26. Referring specifically to Figure 4, it is seen that a circuit is completed from the secondary 112 through wires 143 and 145, field winding 72, wire 135, contacts 82 and 84, wire 136, resistance 137 and wires 138 and 117 back to the secondary 112. Completion of this circuit causes energization of the field winding 72 to maintain the shaft 68 and, consequently, the damper 40 in its adjusted position against the action of the tension spring 50.

Upon a decrease in temperature of the mixture of fresh and return air the slider 86 is moved towards the left with respect to the potentiometer coil 87. By reason of the parallel relationship pointed out above, such movement of the slider 86 causes partial short-circuiting or shunting of the coil 92 to decrease the energization thereof and to increase the energization of coil 93. This unequal energization of coils 92 and 93 causes movement of the contact arm 90 into engagement with the contact 96 to complete a circuit from the secondary 112 through wires 143 and 144, contact arm 90, contact 96, wire 139, coil 95, wire 133, field winding 73, wires 134 and 135, contacts 82 and 84, wire 136, resistance 137 and wires 138 and 117, back to the secondary 112. Completion of this circuit causes energization of the field winding 73 to neutralize the action of the field winding 72 to allow the spring 50 to move the damper 40 towards a fresh air restricting or closed position to increase the mixed air temperature. Movement of the motor 49 and the damper 40 towards a closed position causes left hand movement of the slider 78 with respect to the balancing potentiometer coil 79. This causes decreasing of the energization of coil 93 and increasing of the energization of coil 92. The coils 92 and 93 become equally energized when the damper 40 has been moved sufficiently far towards a fresh air restricting position. When the coils 92 and 93 are rebalanced in this manner the contact arm 90 is moved out of engagement with contact 96 to the mid position shown in the drawing to de-energize the field winding 73 to allow the field winding 72 to maintain the damper 40 in its newly adjusted position against the action of the tension spring 50.

If the temperature of the mixture of fresh and return air should become sufficiently low so as to move the slider 86 to the extreme left hand position the damper 40 will be moved to an extreme fresh air restricting or closed position. Movement of the damper 40 to its extreme closed position is insured by the resistance 121 connected in series with the left hand end of the balancing potentiometer coil 79 whereby the proportioning motor 49 is moved sufficiently far to cause breaking of the limit contacts 82 and 84 and to cause movement of the pin 47 downwardly in the slot 46. This breaks the circuit through field winding 72 to prevent overtravel of the proportioning motor.

Upon a rise in temperature of the mixture of fresh and return air so as to move the slider 86 out of its extreme left hand position the coil 93 is partially shunted or short-circuited to decrease the energization thereof and to increase the energization of the coil 92. This causes movement of the contact arm 90 into engagement with the contact 97 to complete a circuit from the secondary 112 through wires 143 and 144, contact arm 90, contact 97, wire 132, coil 94, wire 140, field winding 74, wire 141, contacts 85 and 83, and wires 142, 138 and 117, back to the secondary 112. Completion of this circuit causes energization of field winding 74 which is sufficient to move the pin 47 upwardly in the slot 46. When the pin 47 has proceeded to the upper extremity of the slot 46 the finger 80 permits the contact 82 to engage the contact 84 to cause energization of the field winding 72 in the manner pointed out above. Since the field windings 72 and 74 are both energized, counter-clockwise movement of the crank 48 and consequent movement of the damper 40 from the fresh air restricting position against the action of the tension spring 50 is brought about. Movement of the damper 40 towards an open position causes right hand movement of the slider 78 and when the damper 40 has been moved sufficiently far the slider 78 rebalances the coils 92 and 93 to move the contact arm 90 out of engagement with the contact 97 to the mid position shown in Figure 4. This causes de-energization of the field winding 74 and the damper 40 is maintained in its newly adjusted position by the energization of the field winding 72. If the damper 40 should be moved to an extreme open or return air restricting position, the finger 81 breaks contact between the limit contacts 83 and 85 to break the circuit through the field winding 74. In this manner overtravelling of the proportioning motor is prevented.

It is noted at this point that the circuits through the field windings 73 and 74 are completed through the coils 94 and 95 to increase the contact pressure of the contact arm 90 to prevent relay chatter. It is also noted that the circuits through field windings 72 and 73 are completed through the resistance 137 to add resistance to these circuits to compensate for the drop in resistance caused by the simultaneous energization of the oppositely acting windings 72 and 73.

In case of power failure or in case of opening of the switches 102 or 103 the step-down transformer 111 is de-energized and, consequently, the control system outlined above is rendered

inoperative. The spring 50 thereupon moves the damper 40 to an extreme closed or fresh air preventing position. The switch 102 is provided to prevent opening of the damper when it is desired to operate the fan alone for morning pick-up purposes.

In order to limit the closing movement of the damper 40 to comply with heating and ventilating regulations, I have provided the variable resistance 60 in the control circuit. Movement of the sliders 61, 62 and 63 downwardly in Figure 4 with respect to the associated resistances 57, 58 and 59 increases the resistance in the left hand end of the potentiometer coil 87 and decreases the resistance in the right hand end thereof. This downward movement of these sliders has the same effect as the right hand movement of the slider 86 with respect to its potentiometer coil 87. Therefore, with the slider 86 in the extreme left hand position the damper 40 is caused to be positioned in a partially open position. The farther the sliders 61, 62 and 63 are moved downwardly the farther open the damper 40 will be positioned. Therefore, provision is made whereby the closing movement of the damper 40 may be limited and means are provided for adjusting this minimum position to meet the various heating and ventilating regulations that exist throughout the country. However, in case of power failure or in case of opening of the switch 103 to shut down the control system, the damper 40 is moved to its extreme closed position regardless of the setting of the variable resistance 60. Movement of the sliders 61, 62 and 63 upwardly from the position shown has the opposite effect and limits movement of the damper 40 toward an open or return air restricting position. Such operation may be desirable in some instances and forms a part of this invention.

The above control system maintains the mixture of the fresh and return air at a constant temperature, this temperature preferably being about 65°. In order to heat the air above 65° and to maintain a constant temperature in the space or room to be heated, the valve 28 is controlled in response to room or space temperature. Preferably, the thermostatic valve is so adjusted that it will be fully opened at or below 70° and fully closed at or above 72° so that a large amount of heat will be delivered to the space when the temperature is below 70° and the amount of heat supplied will be decreased as the room temperature approaches 72° at which time the supply of heat to the space will be discontinued.

From the above it is seen that I have provided a control system for a unit ventilator or plenary system wherein the temperature of the air being delivered to the radiator is maintained constant by the proper positioning of a damper and wherein the temperature in the space to be heated is maintained constant by controlling the radiation in the unit ventilator in response to space temperature. Provision is also made in the control system for limiting the closing movement of the damper whereby a minimum amount of air will at all times be admitted to the space to be heated but preventing the admission of fresh air when the unit ventilator is placed out of operation. By reason of my control system the amount of fresh air may be adjusted to comply with the various heating and ventilating codes that exist throughout the country.

Although I have disclosed one form of my invention for purposes of illustration, other forms thereof may become apparent to those skilled in the art and, therefore, this invention is to be limited only by the scope of the appended claims and the prior art.

I claim as my invention:

1. In an air conditioning system, the combination of, a conditioning chamber having air conditioning apparatus therein, electrically operated fan means for circulating fresh and return air through the conditioning chamber to a space to be conditioned, an electric circuit for supplying power to the fan means, damper means for regulating the supply of fresh and return air circulated, means for biasing the damper means to fresh air preventing position, electric motor means acting against said biasing means for positioning said damper means, means for supplying power to the electric motor means from the electric circuit of the fan means, a three wire control circuit for said electric motor means, said three wire control circuit including a common wire, a first control wire which is adapted in cooperation with said common wire to cause said electric motor means to operate in one direction, and a second control wire which is adapted in cooperation with said common wire to cause said motor means to operate in the opposite direction, condition responsive electric current controlling means for controlling said motor means, said current controlling means including a movable member connected to said common wire and means contacted by said movable member and adapted to place said common and control wires in cooperation respectively, a minimum position electric current controlling means interposed in one of said control wires between said condition responsive electric current controlling means and said motor means for preventing said condition responsive electric current controlling means from causing said motor means to move said damper means to a position stopping the supply of fresh air, and means for opening the electric circuit of the fan means for stopping the fan means and for interrupting the supply of power to the electric motor means whereby the biasing means moves the damper means, regardless of the condition responsive electric current controlling means and the minimum position electric current controlling means, to a position for substantially stopping the supply of fresh air.

2. In an air conditioning system, the combination of, a conditioning chamber having air conditioning apparatus therein, electrically operated fan means for circulating fresh and return air through the conditioning chamber to a space to be conditioned, an electric circuit for supplying power to the fan means, damper means for regulating the supply of fresh and return air circulated, means for biasing the damper means to fresh air preventing position, electric motor means acting against said biasing means for positioning said damper means, means for supplying power to the electric motor means from the electric circuit of the fan means, a three wire control circuit for said electric motor means, said three wire control circuit including a common wire, a first control wire which is adapted in cooperation with said common wire to cause said electric motor means to operate in one direction, and a second control wire which is adapted in cooperation with said common wire to cause said motor means to operate in the opposite direction, condition responsive electric current controlling means for controlling said motor means, said cur-

rent controlling means comprising a potentiometer having a slider member connected to said common wire, and a resistance connected across said control wires, a minimum position variable resistance interposed in one of said control wires between said potentiometer and said motor means for preventing said potentiometer from causing said motor means to move the damper means to a position stopping the supply of fresh air, and means for opening the electric circuit of the fan means for stopping the fan means and for interrupting the supply of power to the electric motor means whereby the biasing means moves the damper means, regardless of the potentiometer and variable resistance to a substantially closed position.

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