

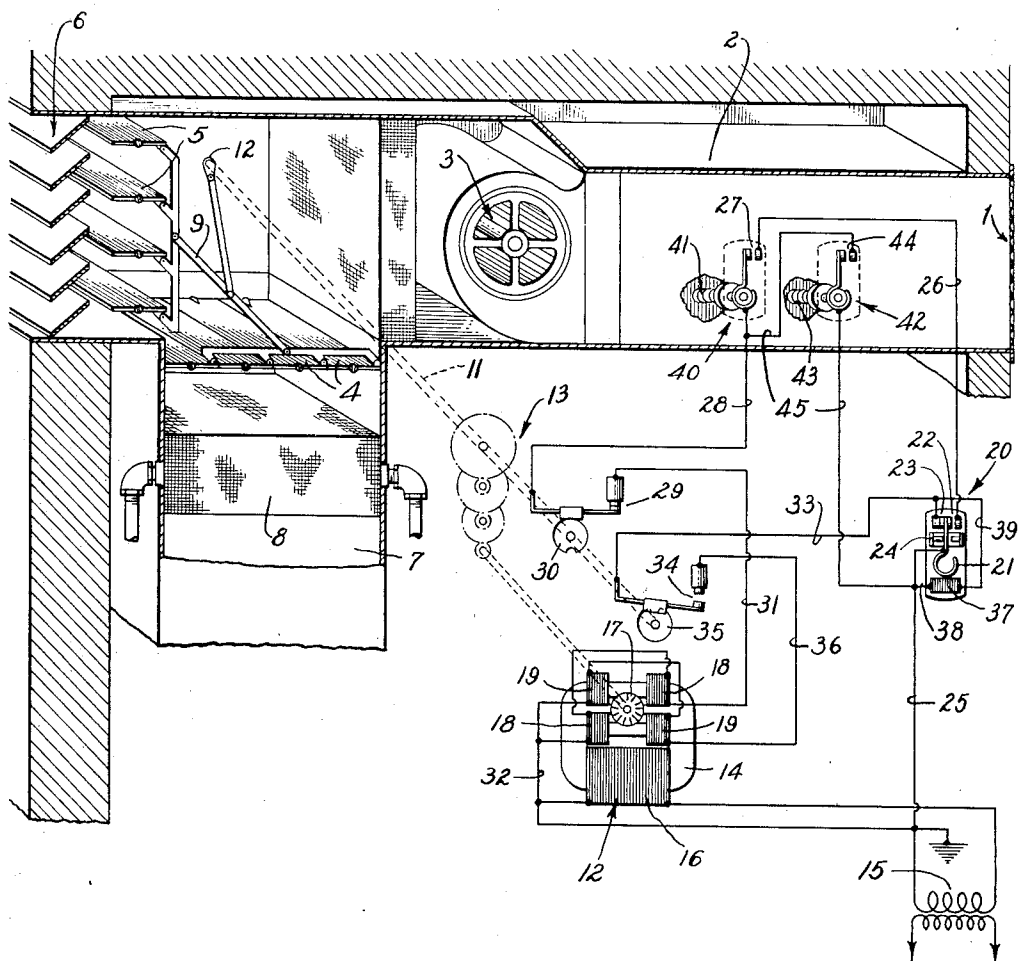
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CONTROL FOR AIR CONDITIONING SYSTEMS AND THE LIKE

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CONTROL FOR AIR CONDITIONING
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10 Claims. (Cl. 236—68)

This invention relates to the control of air conditioning and similar systems and more particularly to a temperature control system of the general character disclosed in my copending application Serial No. 717,732, filed March 28, 1934.

One object of the invention is to adapt the control system disclosed in said application to the control of air conditioning systems of the so-called blast type.

A more detailed object of the invention is to incorporate in a blast heating system a novel means for disabling the regulating device against further movement in a direction to decrease the heat supply when the temperature of the warm air current delivered to the space to be heated falls below a desired minimum value.

Another object is to provide, in a system in which the movement of a motor driven regulating member in one direction is controlled by a condition responsive device, a novel means for disabling said member against further movement without interrupting the motor circuit controlled by said device.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawing which shows the invention embodied in a so-called blast heating system wherein a current of warm air is discharged into the space to be heated from an outlet 1 of a duct 2 through which the flow of air is induced by a power driven blower 3. Herein the temperature of the delivered air is determined by the positions of dampers 4 and 5 which regulate the proportion of fresh air drawn through a duct 6 and of recirculated air drawn through a duct 7 and exposed to the action of a heater such as a steam coil 8. Preferably, the dampers are connected by a link 9 for operation in unison and are actuated by an electrically driven operator including a main operating shaft 11 having fast thereon a crank 12 connected to the link 9. As the shaft oscillates back and forth from the full cooling position shown in the drawing in which the damper 4 is fully closed and the fresh air damper 5 fully opened, to a full heating position in which the damper 4 is open and the damper 5 closed, the temperature of the air discharged from the outlet 1 will be varied progressively.

The operating shaft 11 is driven by an electric motor 12 through speed reduction gearing 13 constructed to produce movement of the dampers at the desired rate. The motor shown is of the induction type including a stator 14 constantly energized by the application of alternating cur-

rent from a source 15 to a main winding 16 and having two poles defining a cylindrical recess in which is disposed a squirrel cage rotor 17. Operation of the motor in one direction or the other is initiated by selective short-circuiting of shading coils 18 and 19 comprising a relatively large number of turns of wire. The coils 18 are connected in series and enclose corresponding side portions of the poles on diametrically opposite sides of the rotor while the coils 19 enclose similar sections of the poles on the other sides thereof.

When the coils 18 are short-circuited with the coils 19 open-circuited, the current induced in the short-circuited coils will act in a well-known manner to produce shifting of the magnetic field around the rotor in a counter-clockwise direction resulting in operation of the motor in a direction to move the operating shaft 11 toward full-heating position. Similarly, when the coils 19 are short-circuited, and the coils 18 ineffectual, the motor will run in a direction to decrease the temperature of the conditioned air.

Means is provided for controlling the motor 12 to effect continuous oscillation of the shaft 11 back and forth in a manner such as to establish a mean position of the dampers and therefore a mean temperature of the delivered air corresponding to the rate of heat loss from the space being heated. In the present instance, this means includes a thermostat 20 having an element 21 exposed to the air at a representative point in the space being heated and arranged to operate switches 22 and 23. The stationary contacts of these switches are spaced apart a distance sufficient to define an operating differential of several degrees with the result that the switch 22 will be closed when the temperature of the element 21 falls below the temperature range for which the thermostat is set, and the switch 23 will be closed when the element temperature rises above this range. A magnetic detent 24 is associated with the thermostat tongue and operates to effect movement of the tongue between the stationary contacts with a snap action. It is intended that the thermostat will be set so that its operating range will be several degrees, for example ten, above the temperature which it is desired to maintain in the space being heated. The switch 22 controls a short-circuit for the coils 18 extending from a grounded conductor 25 through the thermostat tongue, the switch 22, a conductor 26, a switch 27, a conductor 28, a limit switch 29 which is opened by a cam 30 when the shaft 11 is in full-heating position, a conductor 31, the coils 18 to a grounded conductor 32 com-

mon to all of the shaded coils. Similarly, the switch 23 controls a short-circuit for the coils 19 extending from the conductor 25 through the switch 23, a conductor 33, a limit switch 34 which is opened by a cam 35 when the shaft 11 is in full-cooling position, a conductor 36, the coils 19 to the conductor 32.

To utilize the thermostat for timing the alternate temperature increasing and decreasing cycles of the operating shaft 11, an electric resistance heater 37 is incorporated in the thermostat to produce false heating of the thermostatic element 21, the capacity of the heater being such that it will, upon prolonged energization, heat the element 21 to a temperature approximately twenty degrees above that of the surrounding air. The terminals of the resistance element are connected by conductors 38 and 39 to the terminals of the switch 23. As a result of this arrangement, the heater is permanently connected in series with the shading coils 19 but will be short-circuited and therefore maintained ineffectual while the switch 23 is closed. When this switch is opened, the short-circuit is broken whereupon the heater will be energized effectually by current derived from the shading coils 19. The heater 37 is of such high resistance that when it is energized, the current flow through the shading coils 19 is not sufficient to prevent effective operation of the motor under the predominating effect of the coils 18.

As a result of the arrangement above described, the temperature of the thermostatic element 21 will be maintained above that of the room air and will decrease while the heater is deenergized and the switch 23 closed until the lower limit of the thermostat operating range is obtained, whereupon the switch 22 will be closed and the heater 37 energized to increase the temperature of the element 21. As the element is thus heated and cooled, the motor 12 operates to oscillate the shaft 11 back and forth through distances determined by the lengths of the heating and cooling periods thereby establishing a mean effective position of the shaft and the corresponding temperature of the delivered air. In view of the fact that the thermostatic element 21 is exposed to the air being heated, the lengths of the heating and cooling cycles will be varied with changes in the room temperature, and these changes will be such as to effect a change in the mean operating position of the shaft 11 in a direction to correct for the rate of heat loss which caused such temperature change.

In systems of the above character, it is desirable to limit the temperature to which the delivered air may be increased to a predetermined maximum and also to limit the temperature to which the delivered air may fall to a predetermined minimum value which will be comfortable to the occupants of the room. A rise in the temperature of the delivered air above the desired maximum is prevented in the present instance through the provision of a thermostat 40 set to respond to the desired maximum limit temperature and having its element 41 arranged to maintain the switch 27 closed when the temperature within the duct 2 is below the desired maximum and to open this switch when the temperature rises above this maximum. When the switch 27 is opened, it will be observed that movement of the shaft 11 in a direction to increase the air temperature will be prevented with the result that when the switch 27 is open, the timing mechanism

above described will operate to establish a lower mean temperature of the delivered air.

To insure the maintenance of the desired low limit temperature without interfering in any way with the operation of the timing mechanism, the invention contemplates the provision of means which operates when the air temperature in the duct 2 falls below the low limit value to disable the motor driven operator and prevent movement of the shaft 11 toward temperature decreasing position during the cycle of the timing mechanism in which the switch 23 is closed. In the present instance, this means includes a thermostat 42 having an element 43 disposed within the duct 2 and arranged to maintain a switch 44 normally open but to close this switch when the temperature of the delivered air falls below the low limit value for which the thermostat 42 is set. Closure of the switch 44 is utilized to short-circuit the shading coils 18 independently of the switch 22. For this purpose, the switch 44 is interposed in a conductor 45 extending between the conductor 25 and the conductor 28.

With the switch 44 thus arranged, it will be observed that if this switch becomes closed during a temperature decreasing cycle caused by short-circuiting of the shading coils 19 by the switch 23, the coils 18 will then be short-circuited resulting in the production of a shading effect which is substantially equal to the shading effect of the then short-circuit windings 19. As a result, the coils 18 exert a braking action which effectually stops the motor without opening the circuit through the coils 19 or otherwise interfering with the normal operation of the timing mechanism. In this way, further movement of the shaft 11 in a direction to decrease the temperature of the delivered air is prevented during the remainder of the temperature-decreasing cycle. Accordingly, the effect of closure of the switch 42 during the continued operation of the timing mechanism is to produce a net drift of the mean position of the shaft 11 in the temperature-increasing direction. Thus, the control mechanism operates to correct for a fall in the temperature of the delivered air below the desired minimum value.

I claim:

1. A temperature regulating system having, in combination, a thermostat having first and second switches which are closed respectively when the thermostat temperature is below and above a predetermined value, a temperature regulating device, reversible electric motor driving means for said device having first and second windings energizable selectively by closure of said first and second switches, an electric heater adapted when energized to produce false heating of said thermostat and having its terminals connected to the terminals of said second switch whereby to be effectually energized when said second switch is open, a high limit thermostat by which said second winding may be rendered ineffectual, a low limit thermostat having a switch which is closed below a predetermined temperature and arranged to effect energization of said first winding independently of said first switch.

2. A temperature regulating system having, in combination, a thermostat having first and second switches which are closed respectively when the thermostat temperature is below and above a predetermined value, a temperature regulating device, reversible electric motor driving means for said device having first and second windings energizable selectively by closure of said first

and second switches, an electric heater adapted when energized to produce false heating of said thermostat and having its terminals connected to the terminals of said second switch whereby
 5 to be effectually energized when said second switch is open, a low limit thermostat having a switch which is closed below a predetermined temperature and arranged to effect energization
 10 of said first winding independently of said first switch whereby to maintain both of said windings energized when said low limit switch and said second switch are both closed.

3. A temperature regulating system having, in combination, a regulating device, an operator
 15 therefor including an electric motor driving means having first and second windings energizable selectively to cause movement of said device back and forth to increase and decrease the temperature of an air current delivered to
 20 a space to be heated, a thermostat in said space operating to energize said first and second windings respectively when the thermostat temperature falls below and rises above a predetermined value higher than the value to be main-
 25 tained in said space, an electric heater for producing false heating of said thermostat arranged to be effectually energized when said first winding is energized whereby to cause alternate closure of said switches, and a low limit thermostat
 30 responsive to the temperature of said air current and adapted to cause energization of said first winding independently of said thermostat when the temperature of the air current falls below a predetermined value.

35 4. A temperature regulating system having, in combination, a regulating device, an operator therefor including a shaded pole motor having first and second shading coils arranged to be short-circuited selectively to cause movement of
 40 said device back and forth to increase and decrease the temperature of an air current delivered to a space to be heated, a thermostat in said space operating to short-circuit said first and second coils respectively when the thermo-
 45 stat temperature falls below and rises above a predetermined value higher than the value to be maintained in said space, an electric heater for producing false heating of said thermostat and having its terminals connected to the termi-
 50 nals of said second switch, whereby to cause alternate closure of said switches, and a low limit thermostat responsive to the temperature of
 55 said air current and adapted to short-circuit said first winding independently of said thermostat when the temperature of the air current falls below a predetermined value.

5. A temperature regulating system having, in combination, a regulating device movable back
 60 and forth to increase and decrease the temperature of an air current delivered to a space to be heated, continuously operating means acting to cause movements of said device alternately in opposite directions, said means including a
 65 thermostat arranged to vary the relative lengths of said movements in accordance with temperature changes in said space, and a low limit thermostat which operates, when the temperature of
 70 said air current falls below a predetermined minimum value while said device is moving in a heat-decreasing direction, to interrupt the movement of said device during the remainder of the heat-decreasing interval determined by said means.

6. A temperature regulating system having, in

combination, a regulating device governing the temperature of an air current delivered to a space to be heated, an operator for said device including reversible electric motor driving means
 5 having first and second windings energizable selectively to cause movement of said device back and forth in directions to increase and decrease the temperature of said air current, means oper-
 10 ating to effect alternate energization of said windings for time intervals the lengths of which vary automatically in accordance with tempera-
 15 ture changes in said space, and a low limit thermostat responsive to the temperature of said air current and adapted to cause energization of said first winding independently of said means
 20 when the temperature of the air current falls below a predetermined value while said second winding is energized.

7. A temperature regulating system having, in combination, a regulating device movable back
 25 and forth to increase and decrease the temperature of an air current delivered to a space to be heated, continuously operating means acting to cause movements of said device alternately in
 30 opposite directions irrespective of temperature changes in said space, and a low limit thermostat which operates when the temperature of said air current falls below a predetermined mini-
 35 mum value while said device is moving in a heat-decreasing direction to interrupt the movement of said device during the remainder of the heat-
 40 decreasing interval determined by said means while permitting continued operation of said means.

8. A control system of the character described
 45 having, in combination, electric motor driving means having two windings selectively energizable to cause operation of the driving means in opposite directions, a condition responsive device
 50 controlling a circuit for one of said windings, and means for interrupting the operation of said driving means while said circuit remains closed comprising a circuit for said other winding and a
 55 second condition responsive device for controlling the latter circuit.

9. A control system of the character described
 60 having, in combination, a shaded pole induction motor having shading coils adapted when short-circuited to induce operation of the motor in opposite directions, a condition responsive device
 65 having a switch for short-circuiting one of said windings to cause operation of the motor in one direction, and means for disabling said condition responsive device against effective operation of
 70 said motor while said short-circuit remains closed comprising a second condition responsive device arranged to open and close a short-circuit for said other coil.

10. A regulating system having, in combina-
 75 tion, a device movable back and forth to vary a condition of a medium to be delivered to a space to be conditioned, timing mechanism operable continuously irrespective of the condition in said space, means controlled by said timing mecha-
 80 nism to cause movements of said device alternately in opposite directions, and a condition responsive instrument operable when the condition of said medium changes to a predetermined value during the movement of said device in one of
 85 said directions to interrupt such movement while permitting continued movement of said timing mechanism.

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