March 30, 1937. M. M. SUPPES 2,075,314

AIR CONDITIONING APPARATUS

Filed April 26, 1933 2 Sheets-Sheet 1

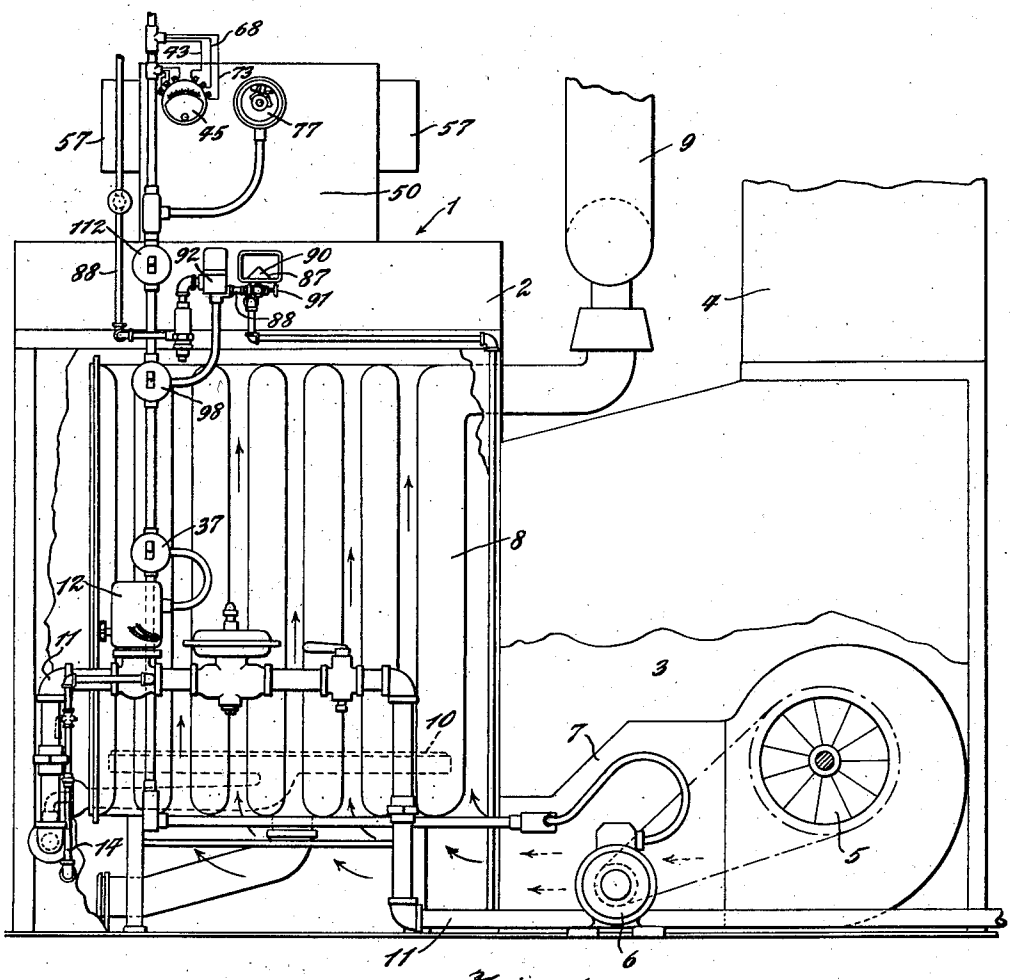

Fig. 1.

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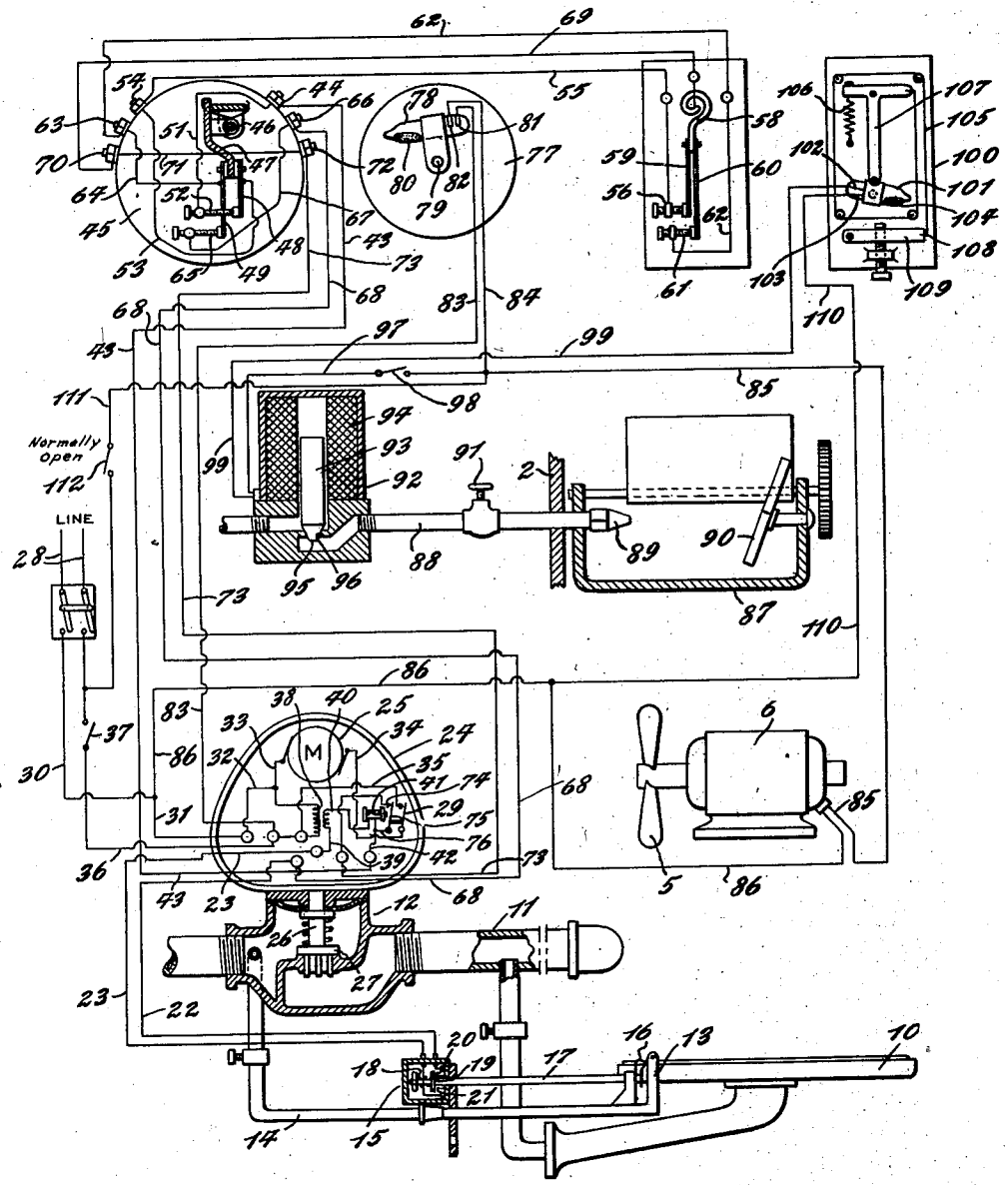

Fig. 2.

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UNITED STATES PATENT OFFICE

2,075,314

AIR CONDITIONING APPARATUS

Max M. Suppes, Elyria, Ohio, assignor to Fox Furnace Company, Elyria, Ohio, a corporation of Ohio

Application April 26, 1933, Serial No. 667,981

7 Claims. (Cl. 236—44)

My invention relates to new and useful improvements in air conditioning apparatus, and more particularly to apparatus for heating and humidifying air to be supplied to a room or other space.

An object of my invention is to provide means responsive to the temperature of an air heating element and means responsive to the humidity in a space to be heated, which means operate conjointly to prevent supply of water to the air to be heated until the temperature of the air heating element reaches a predetermined degree.

Another object is to provide a fan controlled by the means responsive to the temperature of the air heating element for supplying air to the element and for discharge into the room or space to be heated.

Another object is to provide means to control the supply of fuel to a burner for the heating element in accordance with the temperature requirements of the room or space to be heated.

Another object is to provide means to stop the operation of the burner upon the occurrence of a maximum predetermined desired temperature of the air heated by the element.

The invention consists in the cooperative relation between the elements comprising the apparatus, and the novelty of which will be particularly pointed out and distinctly claimed.

Referring to the accompanying drawings, to be taken as a part of this specification, I have fully and clearly illustrated a preferred embodiment of my invention, in which drawings—

Figure 1 is a view in side elevation of a heating apparatus, having certain portions broken away to show the internal construction, and

Fig. 2 is a diagrammatic view showing the cooperative relation between the parts of the apparatus embodying my invention.

Referring to the drawings by characters of reference, 1 designates generally a heating apparatus, such as a hot air furnace, having a casing or jacket 2 provided with an air inlet chamber 3 supplied by an air inlet conduit 4. Within the chamber 3 there is a fan 5 driven by a motor 6 preferably positioned outside of the furnace casing. The fan 5 discharges the air received from the chamber 3 through a duct 7 into the interior of the jacket or casing 2. Within the jacket 2 there is a heat radiating element 8 which is hollow and has an outlet flue 9. The element 8 is heated by a burner 10 positioned therein and supplied with fluid fuel, such as gas, by means of a conduit 11. The supply of gas through the conduit 11 is controlled by a motor operated valve 12, and the burner 10 is provided with a pilot burner 13 supplied by a conduit 14 connected into the conduit 11 on the inlet side of the valve 12. The burner 13 controls the valve 12 through a thermostatically operated switch 15 having a bimetal element 16 responsive to the flame of the pilot burner. The element 16 expands when heated by the flame of the burner 13 to permit the control rod 17 to be moved toward the right of Fig. 2 under the force of the coil spring 18 so that the switch member 19 will bridge the contacts 20, 21 and complete the circuit through the lead wires 22, 23 which are connected to terminal posts in the motor housing 24 of the valve 12. Within the housing 24 there is an electric motor 25 which may be operatively connected in any suitable manner to the stem 26 of the valve member 27 controlling flow through the conduit 11. The motor 25 is supplied with current directly from the main line 28 and is controlled by a relay operated switch having a switch blade 29. The circuit of the motor is as follows: From the line 28 through the lead wires 30, 31, 32, and 33 to the motor; and from the motor through lead wire 34, switch blade 29, and lead wires 35 and 36 back to the line. In the lead wire 36 there is a control switch 37 which is normally closed but which may be opened to break the valve motor circuit. Also in the motor casing 24 there is a transformer 38 having its primary side connected between the lead wires 32 and 36, and therefore in parallel with the motor. The transformer secondary is connected at one side by a lead wire 39 to the terminal which receives the pilot switch lead wire 23. The other side of the transformer secondary is connected by a lead wire 40 to the relay coil 41 of the motor controlling relay switch. From the relay coil 41 a lead wire 42 connects to a terminal post in the casing 24 from which a lead wire 43 leads to a terminal 44 of a thermostatically operated control switch 45. This switch 45 may be of any well-known type or construction having an operating shaft 46 actuated by a bimetal coil or element for rotating the lever arm 47 having switch blades 48, 49. The switch 45 is preferably carried by the furnace casing and has its thermostatic element positioned within the interior of the furnace bonnet 50 so as to respond to the temperature of the air adjacent the heating element 8. The terminal 44 is connected within the switch housing by a wire 51 to a contact 52 cooperable with the blade 48 which is connected by a wire 53 to a terminal post 54. The terminal 54 is connected by a lead wire 55 to one contact 56 of a double bladed room thermostat positioned in the space or room to be heated. The air heated by the element 8 is forced by the fan 5 through the bonnet 50 and thence through the outlet discharge ducts or conduits 57 which are connected in the usual manner to the room or space to be supplied with the heated air. The room thermostat has a bimetal coil 58 responsive to the temperature of the room air and carry-

ing switch blades 59, 60 of which the blade 59 cooperates with the contact 56. The blade 60 cooperates with a contact 61 connected by a lead wire 62 to a terminal 63 on the switch 45. The terminal 63 is connected within the switch housing by a wire 64 to the blade 49 which cooperates with a contact 65 connected to a switch terminal 66 by a lead wire 67. The terminal 66 is connected by a lead wire 68 to the pilot switch lead wire 22 at its terminal within the motor housing 24. The room thermostat also provides a holding circuit for the motor relay to maintain the motor energized and the valve member 27 in open position. This holding circuit comprises a lead wire 69 connected to the bimetal element 58 of the room thermostat and to a terminal 70 on the switch housing 45. The terminal 70 is connected by a lead wire 71 to a housing terminal 72 from which a lead wire 73 extends into the motor housing 24. The lead wire 73 terminates in a switch contact 74 cooperable with a switch blade 75 operable by the relay coil 41 and preferably connected to the blade 29 for movement therewith. The blade 75 is connected by a lead wire 76 to the lead wire 42.

The fan 5 is controlled by a thermostatic switch 77 which may be of any well-known type or construction and which is carried by the furnace jacket with the thermostatic switch operating element positioned within the furnace bonnet in the path of the air heated by the element 8. The switch 77 may have a mercury tube switch element 78 carried by a shaft 79 rotated by the thermostatic operating element such as a bimetal coil, or the like, responsive to the temperature of the gases heated by the element 8. The element 78 contains a globule of mercury 80 operable to make contact between the terminals 81 and 82 within the element 78 upon the temperature of the air within the bonnet 50 reaching a predetermined desired minimum degree. The terminals 81, 82 are connected respectively to leads 83, 84 of which the lead 83 is connected within the housing 24 to the lead wire 36 which connects with the line. The lead wire 84 is connected by a wire 85 to one of the terminals of the motor 6. The other terminal of the motor is connected by the lead wire 86 to the lead wire 30 which connects with the line.

The heating apparatus is provided with a water spray humidifier 87 which is supplied with water from a supply line or pipe 88 which extends through the wall of the jacket 2 above the element 8. The end of the pipe 88 within the jacket is provided with a nozzle 89 directed toward a splash plate 90. The supply line may be provided with a manual regulating valve 91 and is controlled by an automatically operated valve 92. The valve 92 is preferably electrically operated and of the solenoid type having a valve plunger 93 which is lifted by a solenoid coil 94 upon energization thereof. The plunger 93 has a valve head 95 which seats to close the valve port 96 when the coil 94 is deenergized. One terminal of the coil 94 is connected by a lead wire 97 to the lead wire 84 of the switch 77. A manual switch 98 is preferably provided in the lead wire 97. The other end of the coil 94 is connected by a lead wire 99 to a humidity responsive control means 100 positioned within the room or space to be heated and humidified. The control means 100 comprises a mercury tube switch element 101 mounted for tilting or rocking movement and containing contacts 102 and 103 adapted to be bridged by a globule of mercury 104 when the humidity within the room or space is below the desired degree. The element 101 is tilted by an expansible-contractible medium 105, such as a strip of paper held under tension by a spring 106 and connected at one end to a lever 107 having engagement with the switch element 101. The other end of the strip 105 is anchored, as at 108, to an adjustable support 109. The switch contact 102 is connected to the lead 99 from the valve 92, and the contact 103 is connected by a lead wire 110 to the motor lead 86.

In order that the fan 5 may be utilized for supplying fresh air to the room or space during that period of the year when heating is not desired, a lead wire 111 is connected to the fan motor lead 85 and to the lead wire 36 between switch 37 and the main line. A switch 112, normally open, controls current flow through the wire 111. The motor 6 can therefore be independently controlled by the switch 112 which when closed establishes a circuit from the line through leads 30 and 86 to the motor 6 and thence via leads 85 and 111 and switch 112 back to the line.

The operation of my apparatus is as follows: The pilot burner 13 is lighted, which will heat the thermostat 16 and close the switch 15 at the contacts 20, 21. The main line switch and the manual switches 37 and 98 are, of course, closed so that the operating circuits can be completed. The closing of these switches will energize the primary side of the transformer 38 through the following circuit: From the main line through leads 30, 31 and 32 to the transformer primary; and thence through lead 36 and switch 37 back to the line. As long as the temperature of the air in the bonnet of the heating apparatus is below the high temperature safety limit, the switch blades 48 and 49 within the switch 45 will be making circuit with the contacts 52 and 65 respectively. If the room thermostat now calls for heat, the bimetal element 58 will move the blades 59 and 60 to make contact at the contacts 56 and 61 respectively. When the circuit is completed at the room thermostat, the pilot switch 15 being closed, the relay coil 41 will be energized to make circuit through the valve motor 25 to open the main gas valve 27. The relay circuit is as follows: From the secondary of the transformer 38 through the leads 39 and 23 to the pilot switch 15; and thence through leads 22 and 68 to the terminal 66 of the switch 45, through the switch lead 67, contact 65, blade 49, and lead 64 to terminal 63; thence through lead 62, room thermostat contact 61, blade 60, blade 59, and contact 56 to lead wire 55 and contact 54 on the switch housing 45, through lead 53, switch blade 48, contact 52 and lead 51 to terminal post 44; thence via leads 43 and 42 to the relay coil 41 and back to the other side of the transformer secondary through lead 40, thus completing the relay circuit. Energization of the relay 41 attracts the switch blades 75 and 29 closing the relay holding circuit and the valve motor circuit respectively. Contact of blade 29 with the terminal of lead wire 35 permits current flow from the line through the leads 32 and 33 to the motor 25 and from the motor through lead 34, switch blade 29, and lead 35 to the lead 36, which energizes the motor 25 to open the valve 27 so that gas will flow to the main burner 10 and be ignited by the pilot burner 13. The burner 10 serves to heat

the radiating element 8 and when the air within the furnace casing reaches a predetermined minimum temperature of, say, about 150 degrees F., the thermostatic switch 77 will be actuated to make circuit to start the fan motor 6 through the following circuit: From lead wire 30 through lead 86 to the motor 6; and thence through leads 85 and 84 to the switch 77; and from the switch 77 through lead 83 to the lead 36. Operation of the fan 5 by the motor 6 will draw air into the chamber 3 through the inlet 4 and discharge the indrawn air through the furnace jacket 2 in intimate heat exchange relation with the heat radiating element 8, and thence through the bonnet 50 and discharge ducts 57 to the room or space to be heated. Should the temperature within the jacket 2 and bonnet 50 rise above a predetermined desired maximum for which the switch 45 is set, the switch 45 will be actuated to move the blades 48 and 49 out of engagement with their contacts 52 and 65 respectively to break the circuit through the relay coil 41, which will deenergize the motor 25 and close the valve 27, thereby stopping the burner 10. If the humidity in the room or space to be heated is below the desired degree, the switch element 101 of the control means 100 will have completed circuit between the leads 110 and 99 so as to energize the solenoid coil 94 by the following circuit: From fan motor lead 86 through lead 110, control means 100, lead 99, coil 94, lead 97, and switch 98 to lead 84; and thence through switch 77 to the line. Current flow through the coil 94 will lift the plunger 93 and open the port 96 so that water will flow through the supply line 88 and be discharged from the nozzle 89 within the furnace casing. The water discharged from the nozzle 89 will strike against the plate 90 and be fanned out thereby into the heated air stream leaving the heat radiating element 8, so that the heated air leaving the bonnet 50 through the discharge ducts 57 will be humidified. When the moisture content of the air within the room or space containing the control means 100 reaches the desired degree, the switch element 101 will be actuated to break the circuit through the coil 94 so that the valve head 95 will close the port 96 in the water supply line to stop further humidification of the air supplied to the room or space. It will be noted that the control means 100 and the switch 77 are in series circuit with the valve solenoid coil 94, so that even though the control means 100 is unsatisfied and calling for an increase in moisture content of the air, the valve 95 will not be opened unless the switch 77 is closed in response to a minimum temperature of the air in the furnace casing. This serves to prevent discharge of water into the furnace jacket when the temperature of the air is too low to take up the supplied water which would result in a rusting of the parts within the furnace casing. It will also be noted that the valve 95 is only operable to open the water supply line when the fan 5 is discharging air through the furnace casing so as to further insure that the water supply will be picked up by the air stream and not be permitted to fall upon the heat radiating element and the other parts within the furnace casing. The switch 45 also serves as a safety means to close the valve 27 in the event that the fan 5 should cease to operate because in such an event the temperature within the bonnet would rise rapidly above the predetermined desired degree or safe limit at which the switch 45 will open. The room thermostat is also operable through its control of the main burner 10 to control the operation of the fan motor 6 and the valve 92. When the room thermostat becomes satisfied, the burner 10 will be stopped so that the temperature in the bonnet 50 will drop. When the temperature in the bonnet falls below the minimum desired temperature, the switch 77 will be opened to thereby break the fan motor and water valve circuits, thus stopping the fan and the further humidification of the air.

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

1. An air conditioning apparatus of the character described, comprising an air heating furnace adapted to heat air for supply to a space to be heated, a heat radiating element in said furnace, an electrically controlled burner for heating said element, a thermostat responsive to air temperature in the space to be heated and controlling the circuit of said burner, a fan including an electric motor operable to discharge air over said element and into the space to be heated, switch means responsive to temperature of the air adjacent said element and controlling the motor circuit of said fan, the circuits of said thermostat and said temperature responsive means being in parallel relation, water spray means in said furnace to humidify the air passed over said element, a valve controlling the water supply to said humidifying means, means responsive to the humidity of the air in the space to be heated and controlling said valve, and said temperature responsive means controlling operation of said valve by said humidity responsive means.

2. An air conditioning apparatus of the character described, comprising an air heating furnace having a bonnet and adapted to supply heated air to a space to be heated, a heat radiating element in said furnace, a fluid fuel burner for heating said element, a valve controlling flow of fuel to said burner, a thermostat responsive to air temperature in the space to be heated and controlling said valve, a fan operable to discharge air over said element and into the space to be heated, means responsive to the temperature of the air in said bonnet and controlling said fan, water spray means in said furnace to humidify the air passed over said element, a valve controlling the water supply to said humidifying means, means responsive to the humidity of the air in the space to be heated and controlling said second-named valve, and said temperature responsive means controlling operation of said second-named valve by said humidity responsive means and said thermostat controlling operation of said fan and said second-named valve indirectly by control of the burner valve and the temperature in said bonnet.

3. An air conditioning apparatus of the character described, comprising an air heating furnace having a bonnet and adapted to heat air for supply to a space to be heated, a heat radiating element in said furnace, a fluid fuel burner for heating said element, a valve controlling flow of fuel to said burner, a thermostat responsive to air temperature in the space to be heated and controlling said valve, a fan operable to discharge air over said element and into the space to be heated, means responsive to the temperature of the air adjacent said element and controlling said fan, water spray means in said furnace to humidify the air passed over said element, a valve controlling the water supply to said humidifying

means, means responsive to the humidity of the air in the space to be heated and controlling said second-named valve, said temperature responsive means controlling operation of said second-named valve by said humidity responsive means, and means responsive to temperature of the air in said bonnet and controlling said first-named valve, said last-named means upon failure of the fan operating to reduce the temperature in said bonnet and cause operation of said first-named temperature responsive means to close said second-named valve.

4. An air conditioning apparatus of the character described, comprising an air heating furnace having a heat radiating element, a fluid fuel burner for heating said element, a valve controlling flow of fuel to said burner, a motor for actuating said valve, a thermostatic switch responsive to temperature in a space to be heated by said furnace and controlling said motor, means responsive to temperature adjacent said element and controlling said motor, water spray means to humidify the air heated by said element, a valve controlling the supply of water to said spray means, a solenoid for actuating said second-named valve, a fan operable to supply air to said heating element for discharge into the space to be heated, a motor for driving said fan, a switch responsive to air temperature adjacent said element and in series circuit with said fan motor and said solenoid and in parallel circuit with said thermostatic switch, and a switch responsive to the humidity in the space to be heated and in series circuit with said last-named switch and said solenoid.

5. An air conditioning apparatus of the character described, comprising an air heating furnace, electrically controlled heating means therefor, a thermostat responsive to air temperature in the space to be heated for controlling the circuit of the heating means for said furnace, an electrically driven fan operable to discharge air through said furnace and into the space to be heated, electrically controlled means for introducing water into said furnace into the air passing therethrough, circuits therefor operatively independent of the circuit of the heating means and without the direct control of said thermostat, plural means responsive to the temperature of the air within said furnace, the first of said last-named means operating at a predetermined minimum temperature within the furnace to control the circuits of the fan and the water introducing means, and the second of said last-named means controlling the circuit of said heating means at a predetermined maximum temperature to reduce the heat supplied to the furnace, said thermostat and said second heat responsive means controlling the operation of said fan and said water introducing means indirectly through said first heat responsive means in response to variation of the heat supplied to the furnace, and means under control of said means operating at a minimum temperature and responsive to the humidity of the air within the space to be heated for controlling the water introducing means.

6. An air conditioning apparatus of the character described, comprising an air heating furnace for supply to a space to be heated, electrically operated means for controlling the heat supplied to said furnace, a thermostat switch responsive to air temperature in the space to be heated for controlling the circuit of said electrically operated means, a switch responsive to the temperature within said furnace and disposed in the circuit of said electrically operated means for controlling said electrically operated means to reduce the heat supplied when a predetermined maximum temperature is attained, a motor driven fan for forcing air through the furnace and into the space to be heated, electrically operated means for introducing water into said air in the furnace, a switch responsive to a predetermined minimum temperature within said furnace in series circuit with the fan motor and the water introducing means, the last-mentioned circuit being operatively separate from the circuit of said thermostat switch and said first-named furnace temperature responsive switch and without the direct control thereof, said several temperature responsive switches for controlling the supply of heat causing operation of the fan and the water introducing means indirectly by variation of the heat supplied to the furnace to cause actuation of the last-named furnace temperature responsive means, and serving to reduce the heat supplied upon failure of the fan for any reason, and means responsive to the humidity of the air in the space to be heated and in series circuit with said water introducing means and the temperature responsive switch therefor.

7. An air conditioning apparatus of the character described, comprising an air heating furnace adapted to heat air for supply to a space to be heated, electrically operated means for controlling the heat supplied to said furnace, thermostat switches responsive to air temperature within the space to be heated and within the furnace respectively and in series circuit with said electrically operated means, a motor operated fan for discharging air into the furnace and into the space to be heated, electrically operated means for introducing water into the air within said furnace, a switch responsive to the humidity within the space to be heated for maintaining a predetermined degree of humidity within said space, and controlling the circuit of said water introducing means, and switch means responsive to temperature within said furnace in circuit with said motor and in series circuit with said humidity responsive switch and water introducing means, said last-mentioned circuits being operatively independent of the circuit of said thermostatic switches and without the direct control thereof, said last-named furnace temperature responsive means and said thermostatic switch within the space to be heated and humidity responsive switch being coordinated in operation to control the starting of said fan and the opening of the water introducing means at a minimum temperature insuring effective absorption of the maximum quantity of water required for humidification of the air and adequate supply of heat to the space to be heated, and said first-named furnace temperature responsive switch being coordinated in operation with said last-named furnace temperature responsive switch means to operate when a maximum temperature is attained and reduce the heat supplied to the furnace and indirectly cause operation of the second-named furnace temperature responsive switch to stop the fan and close the water introducing means as a minimum temperature is attained.

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