

Sept. 8, 1936.

C. P. ERSCHEN ET AL

2,053,771

AIR CONDITIONING SYSTEM

Filed March 26, 1934

2 Sheets-Sheet 1

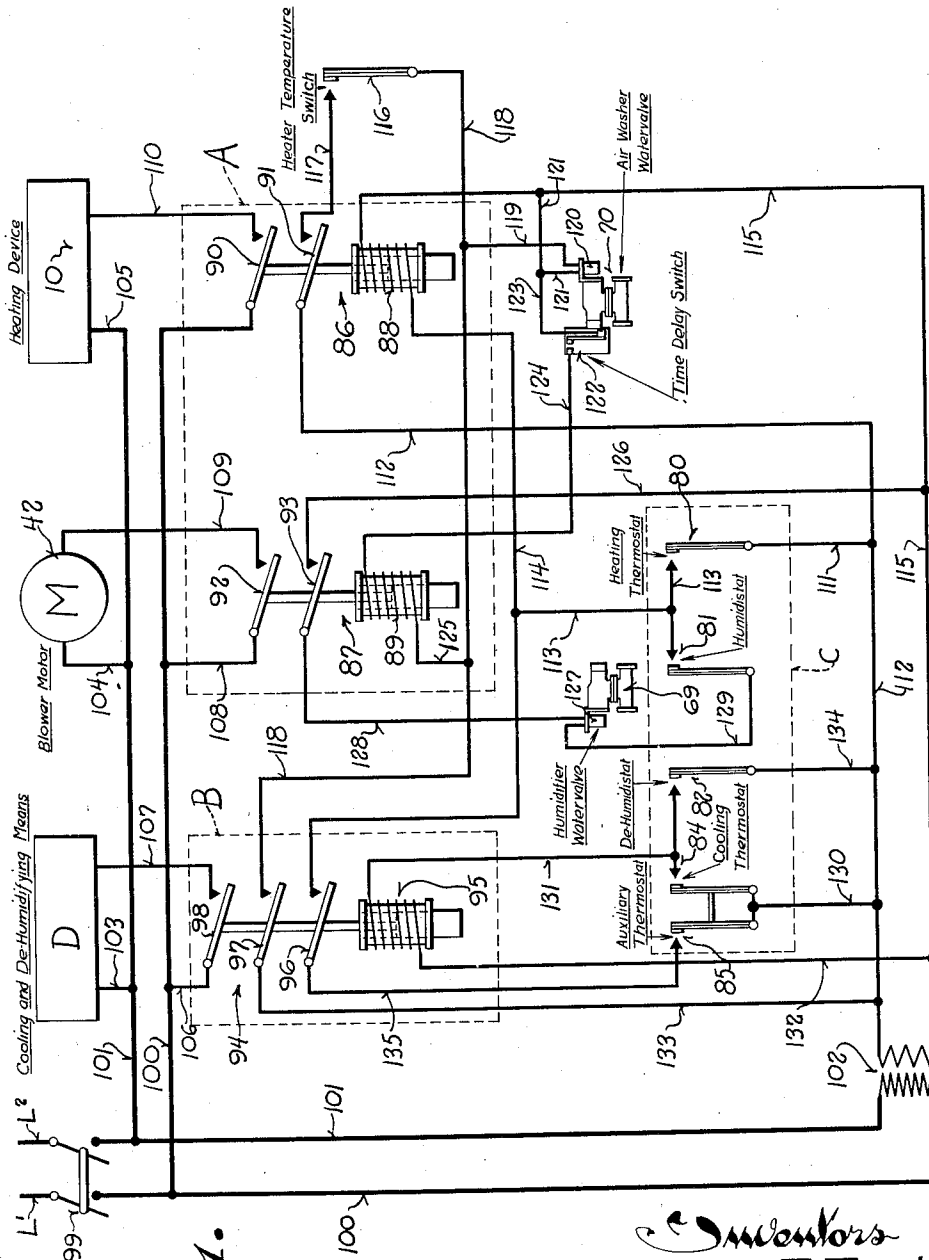


Fig. 1.

Inventors
Charles P. Erschen
Richard C. Jeperlinger
By Schmitt Jones
Attorney

Sept. 8, 1936.

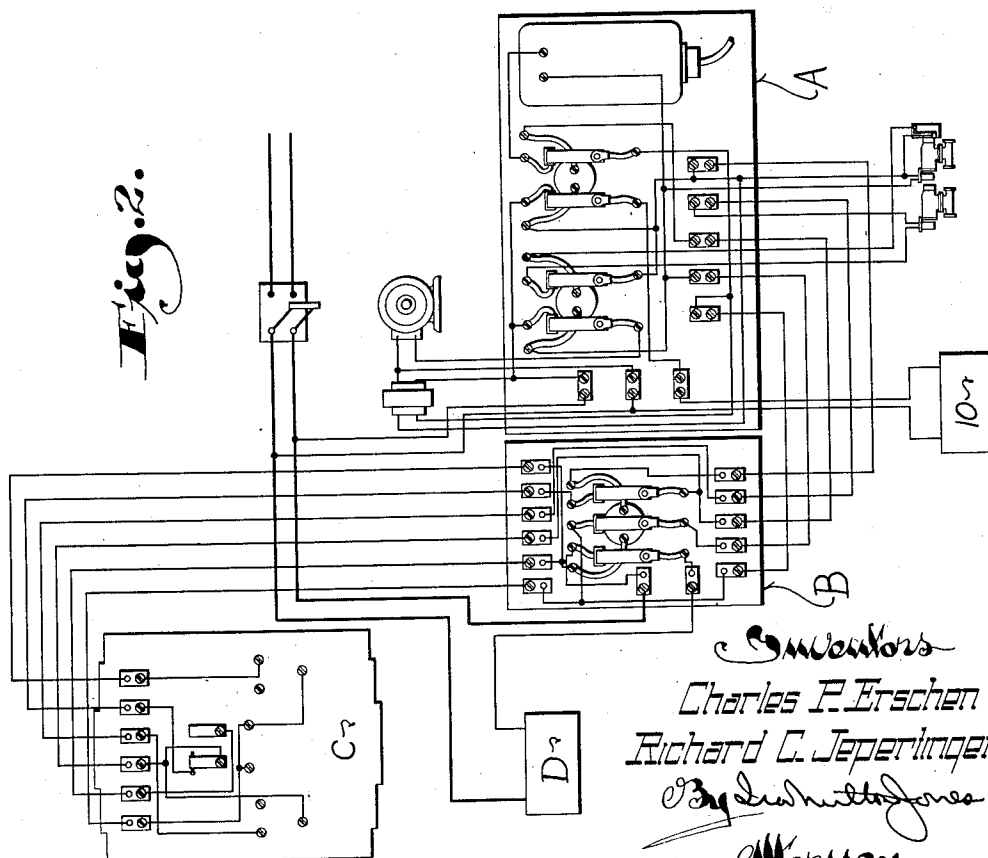
C. P. ERSCHEN ET AL

2,053,771

AIR CONDITIONING SYSTEM

Filed March 26, 1934

2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,053,771

AIR CONDITIONING SYSTEM

Charles P. Erschen and Richard C. Jepertinger,
Milwaukee, Wis., assignors to Air Conditioning
Equipment Corporation, Milwaukee, Wis., a
corporation of Wisconsin

Application March 26, 1934, Serial No. 717,326

10 Claims. (Cl. 236—44)

This invention relates to air conditioning systems and is a continuation as to all common subject matter of our application for Letters Patent for Heating and cooling system, Serial No. 544,910, filed June 16, 1931.

In its present embodiment, the invention refers more particularly to air conditioning equipment particularly intended for residence use, as distinguished from large commercial installations, although it is to be understood that the invention is susceptible to such use.

It is a general object of this invention to provide an air conditioning system of the character described, which provides positively controlled regulation of temperature, humidity, purity and motion of the air.

A further object of this invention is to provide an air conditioning system capable of rendering this service the year 'round and entirely automatically.

With the above and other objects in view which will appear as the description proceeds, the invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

In the accompanying drawings, we have illustrated one complete example of the physical embodiments of our invention constructed according to the best modes we have so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a wiring diagram of the system; and

Figure 2 is a diagrammatic view to illustrate particularly the manner in which the various control panels are actually hooked up.

Referring now particularly to the accompanying drawings in which like numerals indicate like parts, the letters A and B designate control equipment panels mounted within a suitable housing located generally in the basement of the home or in juxtaposition to the central conditioning unit, and the letter C represents a temperature and humidity control unit which is mounted on a wall of one of the rooms of the building and contains thermostats and humidistats by which all of the functions of the system are governed.

The panels A and B and control unit C are electrically connected by wires, as illustrated in Figure 2, and as a matter of convenience in installation, the terminals of the panels and the control unit are correspondingly numbered. The

terminals of the control panels A and B besides being connected to the various mechanisms of the apparatus are also electrically connected with the external elements of the system, an automatic firing or heating device 10, and a cooling unit in the form of any direct expansion type compressor or mechanical refrigerator or iced water supply D.

The electrical circuits, without restriction to the actual wiring, are shown in Figure 1, and reference is had to this diagram in the following description:

The temperature and humidity control panel C includes a heating thermostat 80, a humidistat 81, a dehumidistat 82, a cooling thermostat 84, and an auxiliary heating thermostat 85. The cooling and auxiliary heating thermostats may be combined in one unit if desired, but for convenience in description, they have been shown as separate elements, connected mechanically, however, so that if one is closed, the other will be held open.

The panel A mounts two electromagnetic switches 86 and 87, having electromagnets 88 and 89 respectively to effect their closure. The switch 86 has two switch contactors 90 and 91 and the switch 87 has two switch contactors 92 and 93.

The panel B mounted alongside the panel A mounts an electromagnetic switch 94 actuated by an electromagnet 95. This switch has three movable switch contactors 96, 97 and 98, all simultaneously closed upon energization of the electromagnet 95. The electromagnetic switch 94 functions only in conjunction with the dehumidistat, the cooling thermostat and the auxiliary heating thermostat.

Electrical energy may be supplied to the system from lines L¹ and L² connected through a master switch 99 to lines 100 and 101, respectively. These supply lines 100 and 101 lead to the primary of a step-down transformer 102. The line 101 also connects with one side of the power means of the cooling unit D, as at 103, to one side of a motor 42 which drives the usual blower of the system, as at 104 and to one side of the heating device 10, as at 105.

The cooling unit D is connected across the lines 101 and 100 upon the closure of the switch 94, specifically by the closure of the contactor 98, one side of which is connected to the line 100 through conductor 106 and the other side of which connects through conductor 107 with the cooling unit.

The blower motor 42 is connected across the lines 100 and 101 by the closure of the electromagnetic switch 87 and specifically the closure of

the switch contactor 92, one side of which is connected to line 100 through conductor 108 and the other side of which is connected to the motor through conductor 109.

5 The heating device 10 is similarly connected across the lines 100 and 101, but by the closure of the electromagnetic switch 86 and specifically its switch contactor 90, one side of which is shown directly connected to the line 100, and the other
10 side of which is connected through conductor 110 to the heating device.

The heating thermostat 80 may be set for winter temperature control within any desired two degree temperature range. When the tempera-
15 ture in the building drops to a point below that for which the heating thermostat 80 is set, it closes a circuit which initiates the functioning of the heating device through the closure of the electro-
magnetic switch 86 as follows:

20 The contactor of the heating thermostat is connected to one side of the secondary of the transformer 102 to be supplied with current therefrom through a conductor 111 and line 112. The station-
25 ary contact of the thermostat 80 is connected through conductors 113 and 114 to one side of the electromagnet 88. The other side of the electromagnet 88 is directly connected to line 115,
30 which leads back to the other side of the secondary of transformer 102. Consequently, upon closure of the heating thermostat 80, current traverses the electromagnet 88 energizing the same, and
closing the electromagnetic switch 86.

Closure of the switch 86 immediately initiates the functioning of the heating device 10 by reason
35 of the closure of its switch contactor 90. The contactor 91 is also closed, but its closure is ineffective until the closing of a heater temperature switch 116 having its temperature responsive element located adjacent the heat ex-
40 changer supplied or fed from the heating device.

Upon closure of the heater temperature switch 116, an air washer valve 70 opens to supply water to the spray nozzles of the system. For this
45 purpose, one side of the switch contactor 91 is directly connected to the line 112 and its other side is connected through conductor 117 to the station-
ary contactor of switch 116. The movable contactor of switch 116 is connected through con-
50 ductors 118 and 119 to one side of the electrical actuating device 120 of the water valve 70. The other side of the actuating device is connected through conductor 121 to the line 115. Conse-
quently, upon closure of the switch 116 (switch
55 contactor 91 being closed), the actuating device 120 becomes operative and opens the air washer valve 70.

The opening of the valve 70 to full capacity activates a time delay switch 122, which upon
60 closure, effects the closing of electromagnetic heating device; an air washer having a control side of the time delay switch 122 is connected to the line 115 through part of conductor 121,
and a conductor 123. The other side of the switch 122 is connected through a conductor 124
65 to one side of the electromagnet 89 of switch 87. The other side of electromagnet 89 is connected through conductor 125 to conductor 118,
which leads to the contactor of switch 116. Passing through the closed switch 116, conductor 117,
70 and closed switch contactor 91, the circuit for the electromagnet 89 is completed to the line 112, which leads back to the secondary of the step-down transformer 102.

Upon energization of the electromagnet 89, the
75 switch 87 closes and immediately starts the blower

motor 42 by reason of the closure of its switch contactor 92. Simultaneous with the closure of the switch contactor 92, the switch 93 also closes. This switch initiates the opening of a water valve
5 69 controlling the supply of water to the humidifier of the system but only in the event the humidistat 81 is calling for increased humidity. For this purpose, one side of the switch contactor 93 is connected to line 115 through conductor
10 126 and the other side thereof is connected to the electrical actuating device 127 of the valve 69 through conductor 128. The other side of the actuating device 127 is connected through
15 conductor 129 to the contactor of the humidistat 81. The stationary contact of the humidistat 81 is connected through the conductor 113 to the contact of the heating thermostat 80,
which, being closed and being connected through conductor 111, with the line 112, completes the
20 circuit for the actuator 127.

In this connection, it is to be noted that the circuit controlling the operation of the humidifier for winter humidity control, can be completed only when the heating device is in operation and when the temperature at the heat ex-
25 changer is sufficiently high to evaporate all of the moisture created by the humidifier.

Obviously, when the degree of humidity to which the humidistat is set, has been reached, the humidistat 81 opens the circuit for the ac-
30 tuator 127 and the valve 69 closes. In the event the required temperature has been attained before the humidity is brought to the set degree, the opening of the heating thermostat 80 will
35 shut down the operation of the humidifier as well as that of the heating device and air washer.

For summer ventilation and air cleaning and cooling, the cooling thermostat 84 may be set to the desired temperature range, and when the temperature rises beyond this setting, the cir-
40 cuits controlling the functioning of the cooling unit D, the air washer sprays, and the blower motor 42 are completed, so that washed and cooled air will be circulated through the duct system to all parts of the building.

This control is obtained as follows: The con-
45 tactor of the cooling thermostat 84 is connected through conductor 130 to the line 112. Its stationary contact is connected through a conductor 131 to one side of the electromagnet 95 of the
50 electromagnetic switch 94. The other side of the electromagnet 95 is directly connected through conductor 132 to the line 115. Consequently, upon closure of the cooling thermostat 84, the
55 switch 94 closes, closing all of its contactors 96, 97 and 98.

Immediately upon the closure of the switch contactor 98, the cooling unit D is set in operation, and upon the closure of the switch con-
60 tactor 97, the water valve 70 is opened. For this purpose, switch contactor 97 is connected to line 112, through conductor 133 and through conductors 118 and 119 to one side of the actuator 120;
the other side of the actuator 120 being connected to the line 115 through conductor 121. 65
As before, complete closure of the valve 70 activates the time delay switch 122, which in turn, closes the electromagnetic switch 87 to start the blower motor 42.

While the switch contactor 96 of switch 94
70 is also closed, the closure thereof is ineffective as it functions only in conjunction with the auxiliary heating thermostat 85.

By reason of the operation of the cooling unit D, a suitable cooling medium is circulated through
75

its evaporator coil to lower the temperature of the air passed therethrough and into the circulation system. Obviously, the control will function in this manner to reduce the temperature of the air until the cooling thermostat again opens when the system becomes inoperative.

Positive automatic summer temperature and humidity control is also provided, the control of these functions being governed by the dehumidistat 82 and the auxiliary heating thermostat 85.

It is to be noted that the dehumidistat 82 and the cooling thermostat 84 are connected in parallel so that when either the temperature or humidity rises beyond the setting of these controls, the resulting closure of either one initiates the functioning of the cooling unit, the air washer and the blower as just described; and being so connected between the conductor 131 and the line 112, by a conductor 134, the manner in which the closure of the dehumidistat 82 effects this function is readily apparent.

In the event the desired temperature drop is accomplished more quickly than the reduction of humidity during this cycle of operation, the auxiliary heating thermostat 85 initiates the operation of the heating device 10, to cause a small amount of the heating fluid to flow to the heat exchanger, tempering the air in the building to a point just above that for which the cooling thermostat is set.

The manner in which the auxiliary heating thermostat 85 initiates the functioning of the heating device 10 is as follows:

Upon closure of the auxiliary heating thermostat 85, current flows from line 112 through conductor 130 to the auxiliary heating thermostat, through conductor 135 to switch contactor 95, and then through conductor 114 to one side of electromagnet 88 of switch 86. The other side of the electromagnet 88 being connected directly to the line 115, the same will be immediately energized to close the switch 86. Closure of the switch 86 starts the heating device 10 in the manner hereinbefore brought out.

When the atmospheric conditions are such that there is no requirement for operation of the refrigerator equipment for cooling purposes, but where a reduction of humidity is necessary, the dehumidistat 82 will set in operation the refrigeration equipment to effect the necessary dehumidification and the auxiliary heating thermostat 85 will intermittently operate the firing device to maintain temperature.

Since the auxiliary heating thermostat is connected into the control system so that it can only operate the firing device when the dehumidistat is calling for a reduction of humidity, there can be no interference between the auxiliary heating thermostat 85 and the regular heating thermostat 80 during winter operation.

From the foregoing description taken in connection with the accompanying drawings, it will be readily apparent to those skilled in the art, that this invention provides a novel air conditioning system, particularly adaptable for residence purposes, although not limited thereto, and that the functioning of the entire system is completely automatic, requiring no manual attention whatever, except the usual adjustment of the room thermostats and humidistats.

What we claim as our invention is:

1. In an air conditioning system for buildings having heating and cooling means to determine the temperature of the air, means to determine the humidity of the air, and means to move the air; an electrical control system to regulate the

functioning of said aforementioned means comprising electro-responsive means associated with each of said aforementioned means to initiate the operation thereof; a control unit located within one of the rooms of the building to be subjected to the atmospheric conditions therein and having a heating thermostat to control the response of the electro-responsive means initiating the functioning of the heating means during cold weather, an auxiliary heating thermostat to control the response of said electro-responsive means initiating the functioning of the heating means during warm weather, a cooling thermostat to control the functioning of the electro-responsive means to initiate the functioning of the cooling means, a dehumidistat also operable to control the response of said electro-responsive means to initiate the functioning of the cooling means, and a humidistat operable to control the response of the electro-responsive means to initiate the operation of the humidifying means; and electric circuit means to connect the various elements of the control unit with said electro-responsive means, said circuit means so connecting the various elements that the auxiliary heating thermostat is effective to initiate the functioning of the heating means only when the dehumidistat is operative and calling for dehumidification of the air, whereby interference between the control of the heating means by the heating thermostat for cold weather and the auxiliary heating thermostat for warm weather is prevented.

2. In an air conditioning system having means to heat the air, means to wash the air, and means to induce air flow; an electrical control system to regulate the functioning of said aforementioned means including a control unit so located as to be affected by the atmospheric condition of the air to be treated, and having a thermostat; individual electro-responsive means to initiate the functioning of the heating means, the air washing means, and the air moving means; an electric circuit to connect the thermostat of the control unit with said electro-responsive means of the heating means, whereby closure of the thermostat in response to a temperature drop below a predetermined degree causes the response of said electro-responsive means and initiates the functioning of the heating means; electric circuit means operable upon the response of said electro-responsive means initiating the functioning of the heating means to cause said electro-responsive means for the air washing means and the air moving means to respond; and means in said circuit means to delay the response of the electro-responsive means initiating the functioning of the air moving means until the air washing means is in operation.

3. In an air conditioning system having means to heat the air, means to wash the air, and means to induce air flow; an electrical control system to regulate the functioning of said aforementioned means including a control unit so located as to be affected by the atmospheric condition of the air to be treated, and having a thermostat; individual electro-responsive means to initiate the functioning of the heating means, the air washing means, and the air moving means; an electric circuit to connect the thermostat of the control unit with said electro-responsive means of the heating means, whereby closure of the thermostat in response to a temperature drop below a predetermined degree causes the response of said electro-responsive means and initiates the functioning of the heating means; electric circuit

means operable upon the response of said electro-responsive means initiating the functioning of the heating means to cause said electro-responsive means for the air washing means and the air moving means to respond; means in said circuit means to delay the response of the electro-responsive means initiating the functioning of the air moving means until the air washing means is in operation; and means in said electric circuit means to delay the response of the electro-responsive means initiating the functioning of the air washing means and the air moving means until a predetermined temperature has been attained at a predetermined portion of the system.

4. In an air conditioning system including a heating device, an air washer having a control valve and an air blower operated by an electric motor; an electrical control to regulate the functioning of the system comprising, a control unit so located as to be responsive to the atmospheric conditions of the air being treated and having a thermostat which closes when the temperature of the air drops below a predetermined degree; a first electro-magnetic switch adapted when energized to initiate the operation of the heating device; a second electromagnetic switch adapted when energized to initiate the operation of the blower motor; electro-responsive means adapted when energized to open the control valve of the air washer; a source of E. M. F., a circuit to energize the first electromagnetic switch upon closure of the thermostat, and thereby initiate the operation of the heating device; electric circuit means controlled by the first electromagnetic switch to energize the second electromagnetic switch and the electro-responsive means of the air washer; and means to delay the energization of the second electromagnetic switch until the control valve of the air washer has been completely opened by its electro-responsive means.

5. In an air conditioning system including a heating device, an air washer having a control valve and an air blower operated by an electric motor; an electrical control to regulate the functioning of the system comprising, a control unit so located as to be responsive to the atmospheric conditions of the air being treated and having a thermostat which closes when the temperature of the air drops below a predetermined degree; a first electromagnetic switch adapted when energized to initiate the operation of the heating device; a second electromagnetic switch adapted when energized to initiate the operation of the blower motor; electro-responsive means adapted when energized to open the control valve of the air washer; a source of E. M. F.; a circuit to energize the first electromagnetic switch upon closure of the thermostat, and thereby initiate the operation of the heating device; electric circuit means controlled by the first electromagnetic switch to energize the second electromagnetic switch and the electro-responsive means of the air washer; and means to delay the energization of the second electromagnetic switch until the control valve of the air washer has been completely opened by its electro-responsive means, and thermally responsive means to delay the energization of the electro-responsive means controlling the opening of the air washer control valve until a predetermined temperature has been attained at a selected portion of the system.

6. In an air conditioning system including a heating device; an air washer having a control valve; a humidifier having a control valve, and

an air blower operated by an electric motor; an electrical control to regulate the functioning of the system comprising, a control unit so located as to be responsive to the atmospheric conditions of the air being treated, and having a thermostat which closes when the temperature of the air drops below a predetermined degree, and a humidistat which closes when the humidity of the air drops below a predetermined degree; a first electromagnetic switch adapted, when energized, to initiate the operation of the heating device; a second electromagnetic switch adapted, when energized, to initiate the operation of the blower motor; electro-responsive means adapted, when energized, to open the control valve of the air washer; electro-responsive means adapted, when energized, to open the control valve of the humidifier; a source of E. M. F.; a circuit adapted to be closed by the thermostat to energize the first electromagnetic switch and thereby initiate the operation of the heating device; electric circuit means controlled by the first electro-magnetic switch to energize the second electromagnetic switch and the electro-responsive means of the air washer; means to delay the energization of the second electromagnetic switch until the control valve of the air washer has been completely opened by its electro-responsive means; and electric circuit means governed by the humidistat and adapted to energize the electro-responsive means of the humidifier to initiate the operation of the humidifier when humidification is necessary; said last designated circuit means including a switch which closes with the energization of the second electromagnetic switch, whereby operation of the humidifier is possible only when the heating means and air washer are in operation.

7. In an air conditioning system including a heating device, a humidifier having a control valve and an air blower operated by an electric motor; an electrical control to regulate the functioning of the system comprising, a control unit so located as to be responsive to the atmospheric conditions of the air being treated and having a thermostat which closes when the temperature of the air drops below a predetermined degree, and a humidistat which closes when the humidity of the air drops below a predetermined degree; a first electromagnetic switch adapted, when energized, to initiate the operation of the heating device; a second electromagnetic switch adapted, when energized, to initiate the operation of the blower motor; electro-responsive means adapted, when energized, to open the control valve of the humidifier; a source of E. M. F.; a circuit governed by the thermostat to energize the first electromagnetic switch and thereby initiate the operation of the heating device; electric circuit means controlled by the first electromagnetic switch to energize the second electromagnetic switch; another circuit means governed by the humidistat to energize the electro-responsive means of the control valve for the humidifier, and a switch in said other circuit means connected with the second electromagnetic switch so as to be closed only when said second electromagnetic switch is closed and the blower motor is in operation, whereby the humidifier can function only when the heating device and blower motor are in operation.

8. In an air conditioning system including a heating device, a humidifier having a control valve and an air blower operated by an electric motor; an electrical control to regulate the functioning of the system comprising, a control unit so located as to be responsive to the atmospheric

conditions of the air being treated and having a thermostat which closes when the temperature of the air drops below a predetermined degree, and a humidistat which closes when the humidity of the air drops below a predetermined degree; a first electromagnetic switch adapted, when energized, to initiate the operation of the heating device; a second electromagnetic switch adapted, when energized, to initiate the operation of the blower motor; electro-responsive means adapted, when energized, to open the control valve of the humidifier; a source of E. M. F.; a circuit governed by the thermostat to energize the first electromagnetic switch and thereby initiate the operation of the heating device; electric circuit means controlled by the first electromagnetic switch to energize the second electro-magnetic switch; another circuit means governed by the humidistat to energize the electro-responsive means of the control valve for the humidifier, a switch in said other circuit means connected with the second electromagnetic switch so as to be closed only when said second electromagnetic switch is closed and the blower motor is in operation, whereby the humidifier can function only when the heating device and blower motor are in operation; and thermal means to delay the energization of the second electromagnetic switch until a predetermined temperature has been attained at a selected portion of the system, whereby the blower motor and the humidifier remain inoperative until said predetermined temperature has been attained at said selected portion of the system.

9. In an air conditioning system including a heating device, a humidifier having a control valve, cooling and dehumidifying means, and an air blower operated by an electric motor; an electrical control to regulate the functioning of the system, comprising a control unit so located as to be responsive to the atmospheric conditions of the air being treated and having a thermostat which closes when the temperature of the air drops below a predetermined degree, a humidistat which closes when the humidity of the air drops below a predetermined degree, a dehumidistat which closes when the humidity of the air exceeds a predetermined degree, a cooling thermostat which closes when the temperature of the air exceeds a predetermined degree and an auxiliary heating thermostat which closes when the temperature drops below a predetermined degree; a first electromagnetic switch adapted, when energized, to initiate the operation of the heating device; a second electromagnetic switch adapted, when energized, to initiate the operation of the blower motor; a third electromagnetic switch adapted, when energized, to initiate the operation of the cooling and dehumidifying means; electro-responsive means adapted when energized to open the control valve of the humidifier; a source of E. M. F.; a circuit governed by the thermostat

to energize the first electromagnetic switch and thereby initiate the operation of the heating device; a thermally responsive switch which closes upon the attainment of a predetermined temperature at a selected portion of the system; a second electric circuit including said thermally responsive switch, and controlled by the first magnetic switch to energize the second electromagnetic switch and thereby initiate the operation of the blower motor; electric circuit means governed by the humidistat and including the electro-responsive means of the humidifier and operable upon closure of the second electromagnetic switch to energize said electro-responsive means and activate the humidifier in the event the humidistat is closed; a third electric circuit to energize the third electromagnetic switch upon closure of either the dehumidistat or the cooling thermostat to initiate the operation of the cooling and dehumidifying means; and another electric circuit means including the auxiliary heating thermostat and a switch closed with the closure of the third electromagnetic switch to energize the first electromagnetic switch and initiate the functioning of the heating device; the cooling and auxiliary heating thermostats being so interconnected that when one is open, the other is closed, whereby operation of the heating device in response to the auxiliary heating thermostat is possible only when the dehumidistat is closed to maintain the third electromagnetic switch closed.

10. In an air conditioning system, including a heating device and cooling and dehumidifying means; an electrical control to regulate the functioning of the system comprising, electro-responsive means to initiate the operation of the heating device; electro-responsive means to initiate the operation of the cooling and dehumidifying means; a thermostat; an electric circuit governed by the thermostat to energize the first mentioned electro-responsive means to initiate the operation of the heating device; another electrical circuit to energize the second mentioned electro-responsive means and initiate the operation of the cooling and dehumidifying means; a dehumidistat and a cooling thermostat connected in parallel in said other circuit so that closure of either the dehumidistat or the cooling thermostat completes said other circuit; and an auxiliary heating thermostat operable to close the first mentioned circuit and energize the first mentioned electro-responsive means to initiate the operation of the heating device; said auxiliary heating thermostat being connected with the cooling thermostat, so that only one or the other can be closed at one time, and whereby closure of the auxiliary heating thermostat is ineffective except when the dehumidistat is closed.

CHARLES P. ERSCHEN.
RICHARD C. JEPERTINGER.