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CONTROL SYSTEM FOR AIR CONDITIONING APPARATUS

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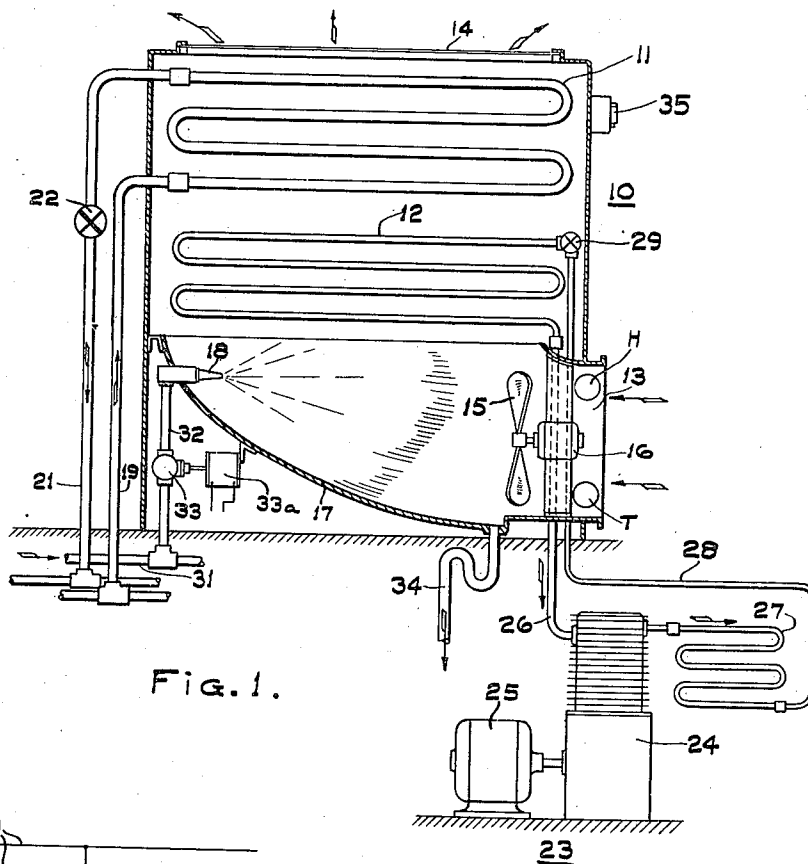


Fig. 1.

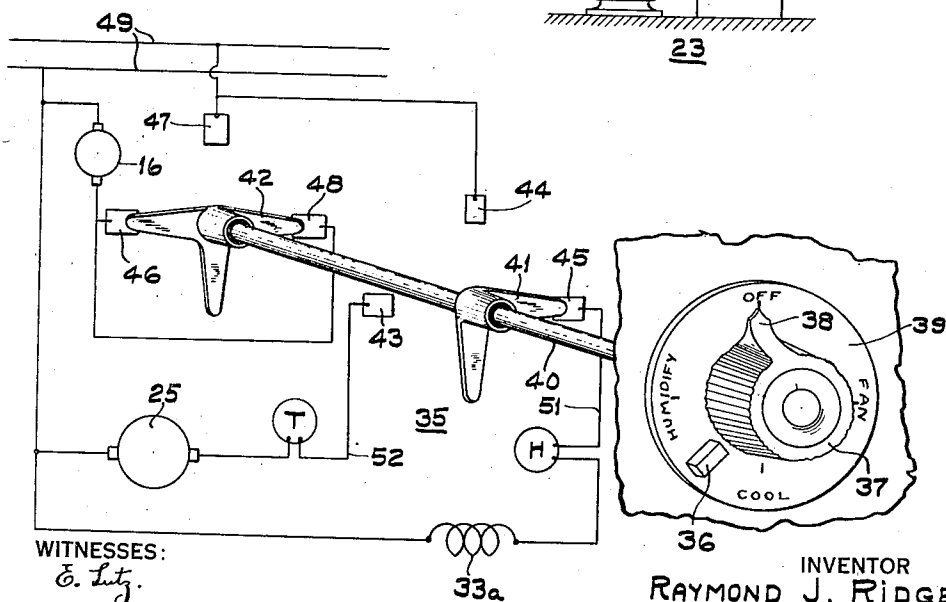


Fig. 2.

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CONTROL SYSTEM FOR AIR CONDITIONING
APPARATUS

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18 Claims. (Cl. 236—44)

My invention relates to control systems for air conditioning apparatus and it has for its purpose to provide an improved system wherein the particular elements of the apparatus to be operated may be easily selected at will.

While the application of my invention is not limited to any specific air conditioning system, it is particularly adaptable to small unitary systems which are usually operated under manual control. The elements incorporated in a system of this character usually include a fan for translating air and a plurality of air treating devices such as, for example, a heater, humidifying devices and air cooling means. These elements are connected to the building service lines for service at call; the fan being connected to the electric system, the heater to the hot water or steam lines, the humidifying devices to the water service and the cooling means to a refrigerant source, usually a refrigerating machine. In the operation of these systems, the conditioning element or elements to be operated are selected at will, depending upon the season of the year or weather conditions, usually by an electrical control system.

It is an object of my invention to provide a control system having a single switching device for effecting operation of various air conditioning elements.

A further object of my invention is to provide a control system for a plurality of air treating devices, having a switching device which may be moved from any other position to a position where one air treating device is operative, without passing through a position where a second air treating device would be operative.

In accordance with my invention, I propose to use an electric switching device movable to a plurality of positions for energizing the circuits leading to the elements to be operated. While the operation of a conditioner of this type may be effected by manual control entirely, it may be desirable to control the operation of the elements, manually selected, by instruments responding to atmospheric conditions in the room. To this end, thermostats may be placed in the controlling circuits of the heater and the cooler to regulate the same in accordance with temperature conditions, during periods when either of these elements are operative. Likewise, a humidostat may be connected in the humidifier circuit to regulate the same during its operative periods.

When manually adjusting the switching device to a position where one of the air treating elements will be operative, it is desirable that

this position be attained without passing through another position where a second air treating element would be operative. Therefore, the second air treating element will not be momentarily energized when the adjustment is made to place the first air treating means in an operative condition. I accomplish this feature by my arrangement of the operative positions of the switching device with respect to the inoperative or "off" position thereof and by a stop device which limits the movement of the switch.

It will be understood that the fan is operated during periods of operation of either the humidifying device or the cooling means, so that the treated air will be rapidly conveyed to the room. There may be times when it is desirable to circulate air to the room without treating the same and, in order that this may be accomplished, I provide a switch position in which the fan alone is operative. Preferably this position is adjacent the position wherein the cooling means is operative, so that in adjusting the switch to this latter position the fan will be started somewhat previous to the starting of the motor of the cooling means. Sequential starting of the fan and refrigerant compressor motor is thereby accomplished and the maximum current in the circuit feeding these motors is thereby reduced with respect to the combined starting currents of the motors, if started simultaneously.

A further object of my invention is, therefore, to provide a control system for an air conditioner having a plurality of motors, so arranged that sequential starting of the conditioner motors is obtained.

These and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is a view, somewhat diagrammatic, of apparatus for conditioning air; and,

Fig. 2 is a diagram of the electrical connections of my improved control system.

The conditioning apparatus shown in Fig. 1 preferably includes a cabinet 10 within which a radiator 11 and a cooling coil or evaporator 12 are disposed. Air to be treated enters the cabinet 10 through an inlet opening 13 and is passed over the radiator 11 and cooling coils 12 before being discharged through an opening 14 to the space to be air conditioned. A fan 15 driven by a motor 16 is preferably arranged adjacent the inlet opening 13 for translating the air to be treated. The cabinet may further include a duct

structure 17 for conveying air therethrough, and a humidifying device, preferably a spray nozzle 18, is disposed within the duct structure 17 in the path of the moving air.

5 The radiator 11 may be supplied with heating medium such as, for example, hot water through conduit 19 from a suitable source (not shown), and a return pipe 21 conveys the water back to the source. The supply of heating medium to
10 the radiator 11 is controlled by the valve 22.

The cooling coil or evaporator 12 is supplied with refrigerant from any convenient source such as, for example, a refrigerating machine 23 of the compressor-expander type. The latter includes a refrigerant compressor 24, driven by an
15 electric motor 25, and arranged to withdraw refrigerant vapor from the cooling coil 12 through a conduit 26. Refrigerant vapor is compressed in the compressor 24 and discharged into a condenser 27 in which it is cooled and condensed. The liquefied refrigerant is conveyed through conduit 28 to an expansion device 29, where it is expanded into the cooling coil or evaporator 12, abstracting heat therefrom in a well known manner.

25 The humidifying spray nozzle 18, disposed within the duct structure 17, is preferably supplied with water from the building service line 31 through a pipe 32. An electrically-operated valve 33, preferably of the solenoid type, is connected
30 in the pipe 32 and controls the supply of water conveyed thereby. Excess water, discharged by the spray and not vaporized, which may collect in the bottom of the duct 17 is drained away by conduit 34. This conduit 34 will also drain away
35 water precipitated from the air when the cooling coil effects dehumidification.

It will be apparent that all of the foregoing elements are not operated at any one time and that conditions of the air in the room will dictate which of the elements should be operated.
40 During cold weather, the operator will select the radiator 11, the humidifier 18 and the fan 15 for operation, while, in the warm seasons, the fan 15 and the cooling coil 12 will be placed in operation.
45 In order that the various elements may be selected for operation at will, I provide a control system having a switching device 35 conveniently disposed on the cabinet 10. The fan motor 16, the compressor motor 25 and a coil 33a for operating the solenoid valve 33 are electrically
50 connected to the switching device 35, as shown diagrammatically in Fig. 2.

The switching device 35 is preferably of the reversible rotary type, similar to the conventional reversible snap switches marketed by the electrical trade, but including a stop 36 which prevents complete rotation of the movable members. The switching device 35 includes a handle 37 having a pointer 38 which cooperates with a dial 39
60 for indicating the effective positions of the switch. The pointer 38 may also engage the stop 36, so that the switch movement is somewhat less than 360°.

The switching device 35 also includes the shaft
65 40, fixed to the handle 37, and carrying a two-arm switch blade 41 and a three-arm blade 42, which are insulated therefrom. The switch blade 41 cooperates with contacts 43, 44, and 45, while the switch blade 42 cooperates with contacts 46,
70 47, and 48. Contacts 44 and 47 are connected to one line of the power source 49 and the other line of the power source 49 is connected to the fan motor 16, the coil 33a of the solenoid valve 33 and the compressor motor 25. The fan motor 16
75 is also connected to contacts 46 and 48 and the

solenoid valve coil 33a connects with the contact 45 by means of a conductor 51. If automatic control is desired, an instrument responding to a humidity condition, such as the humidostat H, may be inserted in the conductor 51.

5 The compressor motor 25 is connected by conductor 52 to the contact 43 and, if temperature control is to be employed, a thermostat T is inserted in the conductor 52. The thermostat T and humidostat H are preferably disposed within the
10 space to be air conditioned so that changes in atmospheric conditions are reflected therein.

It may be desirable to construct automatically controlled conditioners with instruments built in and, in this event, the humidostat H and thermostat T are preferably disposed in the path of
15 air withdrawn from the enclosure, so that changes in air conditions will be readily reflected therein. As shown in Fig. 1, the thermostat T and humidostat H are carried by the cabinet 10 and are disposed in the inlet opening 13 in the path of air
20 withdrawn from the enclosure.

The switch 35 as shown in Fig. 2 is in its "off" position and all circuits are open as neither contact 44 or 47 is engaged by switch blade 41 or 42
25 at this time.

Movement of the switch handle 37 counterclockwise to the "humidify" position causes switch blade 42 to bridge contacts 47 and 48 and switch
30 blade 41 to bridge contacts 44 and 45. In this position, the fan motor 16 and valve coil 33a are energized through switch blades 42 and 41, respectively. Water under pressure will now flow from the service pipe 31 to the spray nozzle 18 and vaporize in the duct 17. Air to be treated
35 will now be conveyed by the fan 15 through the spray and passed over the coil 12 and radiator 11 before being discharged through the outlet opening 14. As this is a cool weather operation, it will be understood that the valve 22 will be open
40 and the radiator 11 heated.

In the event that circulation of heated air without humidification is desired, the switch handle 37 may be rotated clockwise to the "fan" position in which the fan will be energized
45 through blade 42 now bridging contacts 46 and 47. As contacts 44 and 45 are not bridged by blade 41 in this position, the coil 33a will be deenergized and valve 33 closed, so that the water supply to the nozzles 18 is discontinued.

50 During warm weather, the valve 22 will be closed to render the radiator 11 inactive. With the control handle 37 in the "fan" position, circulation of untreated air is obtained for ventilation as both the radiator 11 and cooling coil 12 are inactive. If cooling is desired, the handle 37 is moved to the "cool" position, in which the
55 blade 41 bridges contacts 43 and 44 to energize the compressor motor 25. The blade 42 bridges contacts 46, 47, and 48 and the fan motor 16 is also energized. Refrigerant will now be circulated through the cooling coil 12 by the compressor 24 for abstracting heat therefrom. Air to be treated will now be drawn through opening
60 13 by the fan 15, and translated in heat exchange relation with the cooling coil 12, before being delivered through the opening 14. If dehumidification of the air being conveyed occurs, the water precipitated therefrom will fall to the bottom of the duct 17 and flow through the drain
70 pipe 34 to a point of discharge.

The thermostat T responds to the temperature of the space to be cooled and will start and stop the compressor motor 24 in accordance with its temperature setting. A desirable air condition
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may, therefore, be maintained automatically as long as the control is in its "cool" position. However, in this position, it will be seen that the fan 15 operates continuously to provide air circulation, and is independent of the thermostat.

The arrangement of the stop 36 between the "humidity" and "cool" positions, prevents movement of the control from one to the other, directly. Therefore, when the control is adjusted from any other position to either of these positions, the desired position will be attained without passing through the other. This prevents momentary energization of one of the air treating devices when adjustment is made to effect operation of the other.

As apparatus of this character is frequently installed on electric circuits of limited capacity, it is desirable that motor starting currents be maintained as low as possible. The arrangement of the "fan" and "cool" positions, as disclosed, causes the fan motor 16 to be energized before the compressor motor 25 when the control is adjusted to the "cool" position, so that sequential starting of these motors is effected. A reduction in maximum current demand is thereby obtained over an arrangement wherein both motors would be connected to the line simultaneously.

While I have shown a manually operated valve 22 in the radiator supply pipe 19, it is within the scope of my invention to provide an electrically operated valve, and an additional position of the switch to control the valve. It will be understood that air conditioning apparatus, other than air cooling and humidifying apparatus, may be controlled by my system and that these have been disclosed by way of example.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In air conditioning apparatus, the combination of means for translating air to be treated, first and second means for treating said air and means for controlling the operation of said air translating and said air treating means including a switching device having a control element movable to a plurality of selective positions, in one position of which it renders the air translating means alone operable, in another position of which it renders the air translating means and the first air treating means operable, and in another position of which it renders the air translating means and said second air treating means operable.

2. In air conditioning apparatus, the combination of means for translating air to be treated, first and second means for treating said air and means for controlling the operation of said air translating and said air treating means including a switching device having a control element movable to a plurality of selective positions, in one position of which it renders the air translating means alone operable, in another position of which it renders the air translating means and said first air treating means operable, and in another position of which it renders the air translating means and said second air treating means operable, and means for indicating the

selective position of the control element which is effective.

3. In air conditioning apparatus, the combination of means for translating air to be treated, first and second means for treating said air, and means for controlling the operation of said air translating and said air treating means including a switching device having a control element movable to a plurality of selective portions in one position of which it renders said air translating means alone operable, in another position of which it renders the air translating and the first air treating means operable, in another position of which it renders the air translating and said second air treating means operable and in another position of which it renders said air translating and said air treating means inoperable.

4. In apparatus for air conditioning an enclosure, the combination of means for translating air to the enclosure, first and second means for treating said air, means for controlling the operation of said air translating and said air treating means including a control element, movable to a plurality of selective positions, in one position of which it renders the air translating means alone operable in another position of which it renders the air translating means and said first air treating means operable and in another position of which it renders the air translating means and said second air treating means operable, means responsive to a condition of the air in the enclosure for controlling the operation of the first air treating means when operable, and second means responsive to a condition of the air in the enclosure for controlling the second air treating means when operable.

5. In apparatus for air conditioning an enclosure, the combination of a fan for conveying air to the enclosure, means for humidifying said air, means for cooling said air, and manually operated means for controlling the operation of said fan, humidifying and air cooling means including a control element movable to a plurality of selective positions, in one position of which it renders the fan alone operable, in another position of which it renders the fan and the humidifying means operable and in another position of which it renders the fan and the air cooling means operable.

6. In apparatus for air conditioning an enclosure, the combination of a fan for conveying air to the enclosure, means for humidifying said air, means for cooling said air, manually operated means for controlling the operation of said fan, humidifying and air cooling means including a control element movable to a plurality of selective positions, in one position of which it renders the fan alone operable, in another position of which it renders the fan and the humidifying means operable and in another position of which it renders the fan and the air cooling means operable, means responsive to the temperature of the air in the enclosure for controlling the operation of the cooling means, when operable, and means responsive to the humidity of the air in the enclosure for controlling the operation of the humidifying means, when operable.

7. In air conditioning apparatus, the combination of means for translating air to be treated, first and second means for treating said air and means for controlling the operation of said air translating and said air treating means including a switching device having a control element movable to a plurality of selective positions, in

one position of which it renders the air translating means alone operable, in another position of which it renders the air translating means and said first air treating means operable, and in another position of which it renders the air translating means and said second air treating means operable, said device being so arranged that movement of the control element from any other position to a position where one of the air treating means is operable may be effected without passing through a position where the other air treating means is operable.

8. In air conditioning apparatus, the combination of means for translating air to be treated, means for humidifying said air, means for cooling said air and means for controlling the operation of the aforesaid means including a switch, having an element movable to a plurality of selective positions, in one position of which it renders said air translating means operable, in another position of which it renders the air translating and humidifying means operable, and in another position of which it renders the air translating and air cooling means operable, said switch being so arranged that movement of said element from any other position to the position where the air cooling means is operable may be effected without passing through the position where the air humidifying means is operable and vice versa.

9. In apparatus for air conditioning an enclosure, the combination of a fan for conveying air to the enclosure, means for humidifying said air, means for cooling said air, manually operated means for controlling the operation of said fan, humidifying and air cooling means including a control element movable to a plurality of selective positions, in one position of which it renders the fan alone operable, in another position of which it renders the fan and the humidifying means operable and in another position of which it renders the fan and the air cooling means operable, means responsive to the temperature of the air in the enclosure for controlling the operation of the cooling means, when operable, and means responsive to the humidity of the air in the enclosure for controlling the operation of the humidifying means, when operable, said manually operated controlling means being so arranged that movement of the control element from any other position to the position where the air cooling means is operable may be affected, without passing through the position where the air humidifying means is operable and vice versa.

10. In a control system for air conditioning apparatus, the combination of a fan for translating air to be treated; means for cooling said air; means for humidifying said air; a switching device for controlling the operation of the fan, humidifying means and air cooling means; said switching device being movable to a plurality of selective positions including in order, a terminal position in which said fan and humidifying means are operative, an intermediate position in which the fan, the humidifying means, and the air cooling means are inoperative, a second intermediate position in which the fan is operative, and a second terminal position in which the fan and the air cooling means are operative; and means for preventing movement of said switching device beyond said terminal positions.

11. A control system for air conditioning apparatus including air translating means, air

treating means, and motors for driving said air translating means and said air treating means, respectively, said control system comprising electrical circuits for the motor of said air translating means and the motor of said air treating means, respectively; and a switching device for said circuits including a control element movable to a first position, a second position, and movable through a third position upon movement from said first to said second position, means operable automatically in response to positioning of said control element to said first position for opening both circuits, means operable automatically in response to positioning of said control element to said second position for energizing one of said circuits and for placing the other circuit in condition for energization, and means operable automatically in response to positioning of said control element to said third position for energizing said one circuit and for opening said other circuit; whereby, energization of one of said motors precedes energization of the other motor when said element is moved from said first to said second position.

12. A control system for air conditioning apparatus including a fan for translating air, refrigerating apparatus for cooling air, and motors for driving said fan and said refrigerating apparatus, respectively, said control system comprising electrical circuits for said fan motor and the motor of said refrigerating apparatus, respectively, a switching device for said circuits including a control element movable to a first position, a second position, and movable through a third position upon movement from said first to said second position, means operable automatically in response to positioning of said control element to said first position for opening both circuits, means operable automatically in response to positioning of said control element to said second position for energizing said fan motor circuit and for placing said refrigerating apparatus circuit in condition for energization, and means operable automatically in response to positioning of said control element to said third position for energizing said fan motor circuit and for opening said refrigerating apparatus circuit; whereby, energization of said fan motor precedes energization of the refrigerating apparatus motor when said element is moved from said first to said second position.

13. In a control system for apparatus for air conditioning an enclosure, the combination of means for withdrawing air from the enclosure, first and second means for treating the withdrawn air, means for delivering the treated air to the enclosure, a switch for controlling the operation of the air withdrawing and the air treating means, and being movable to a plurality of selective positions, in one position of which the air withdrawing means is operable, in another position of which the air withdrawing and said first air treating means are operable and in another position of which the air withdrawing and said second air treating means are operable, means responsive to a condition of the withdrawn air for controlling the operation of the first air treating means when operable, and means responsive to a second condition of the withdrawn air for controlling the operation of the second air treating means when operable.

14. In a control system for apparatus for air conditioning an enclosure, the combination of a fan for withdrawing air from the enclosure, means for cooling said air, means for humidifying

ing said air, means for delivering the air to the enclosure after treatment by either of the two last mentioned means, a switch for controlling the operation of the fan, air cooling and air humidifying means, said switch being movable to a plurality of selective positions, in one position of which it renders the fan operable, in another position of which it renders the fan and air cooling means operable, and in another position of which it renders the fan and humidifying means operable, means responsive to the temperature of the air withdrawn from the enclosure for controlling the operation of the air cooling means when operable and means responsive to the humidity of the withdrawn air for controlling the operation of the humidifying means when operable.

15. In apparatus for air conditioning an enclosure, the combination of a fan for conveying air to the enclosure, means for cooling said air, and manually operated means for controlling the operation of said fan and air cooling means including a control element movable to at least three selective positions, in one position of which it renders the fan and the air cooling means inoperable, in a second position of which it renders the fan alone operable, and in another position of which it renders the fan and the air cooling means operable.

16. In apparatus for air conditioning an enclosure, the combination of a fan for conveying air to the enclosure, means for cooling said air, manually operated means for controlling the operation of said fan and air cooling means including a control element movable to at least three selective positions, in one position of which it renders the fan and the air cooling means inoperable, in a second position of which it renders the fan alone operable, and in another position of which it renders the fan and the air cooling means operable, and means responsive to the temperature of the air in the enclosure for controlling the operation of the cooling means, when operable.

17. A control system for air conditioning apparatus including air translating means and air treating means, said control system comprising electrical circuits for said air translating means and said air treating means, respectively; a switching device for said circuits including a control element movable to a plurality of selective positions, means operable automatically in response to positioning of said control element to a first of said selective positions for opening both of said circuits, means operable automatically in response to positioning of said control element to

a second of said selective positions for opening the air treating means circuit and for effecting continuous energization of said air translating means circuit, means operable automatically in response to positioning of said control element to a third of said selective positions for placing the air treating means circuit in condition for energization and for effecting continuous energization of said air translating means circuit; and means connected in a portion of the air treating means circuit that is independent of the air translating means circuit and operable automatically, upon positioning of said control element in said third position, for effecting energization of the air treating means in response to a condition of the air; whereby either continuous operation of the air translating means without operation of the air treating means, or continuous operation of the air translating means during intermittent operation of the air treating means may be obtained.

18. A control system for air conditioning apparatus including air translating means and air cooling means, said control system comprising electrical circuits for said air translating means and said air cooling means, respectively; a switching device for said circuits including a control element movable to a plurality of selective positions, means operable automatically in response to positioning of said control element to a first of said selective positions for opening both of said circuits, means operable automatically in response to positioning of said control element to a second of said selective positions for opening the air cooling means circuit and for effecting continuous energization of said air translating means circuit, means operable automatically in response to positioning of said control element to a third of said selective positions for placing the air cooling means circuit in condition for energization and for effecting continuous energization of said air translating means circuit, and a thermostat connected in a portion of the air cooling means circuit that is independent of the air translating means circuit and operable automatically, upon positioning of said control element in said third position, for effecting energization of the air cooling means in response to a predetermined maximum temperature of the air; whereby either continuous operation of the air translating means without operation of the air cooling means, or continuous operation of the air translating means during intermittent operation of the air cooling means may be obtained.

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