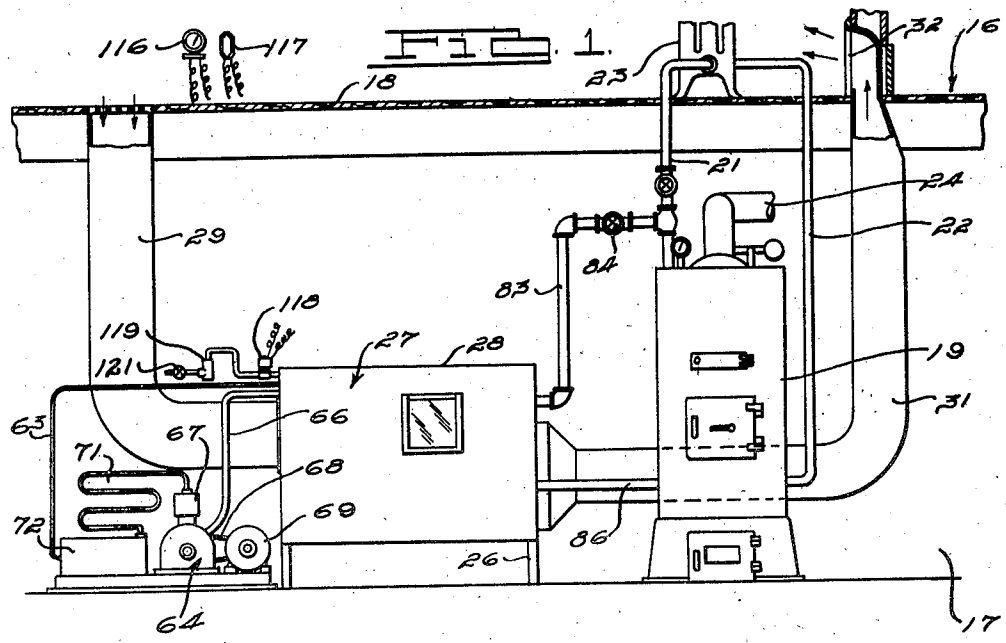
Jan. 19, 1937. G. L. SCHUYLER 2,068,080

AIR CONDITIONING APPARATUS

Original Filed April 12, 1932 3 Sheets-Sheet 1

FIG. 1.



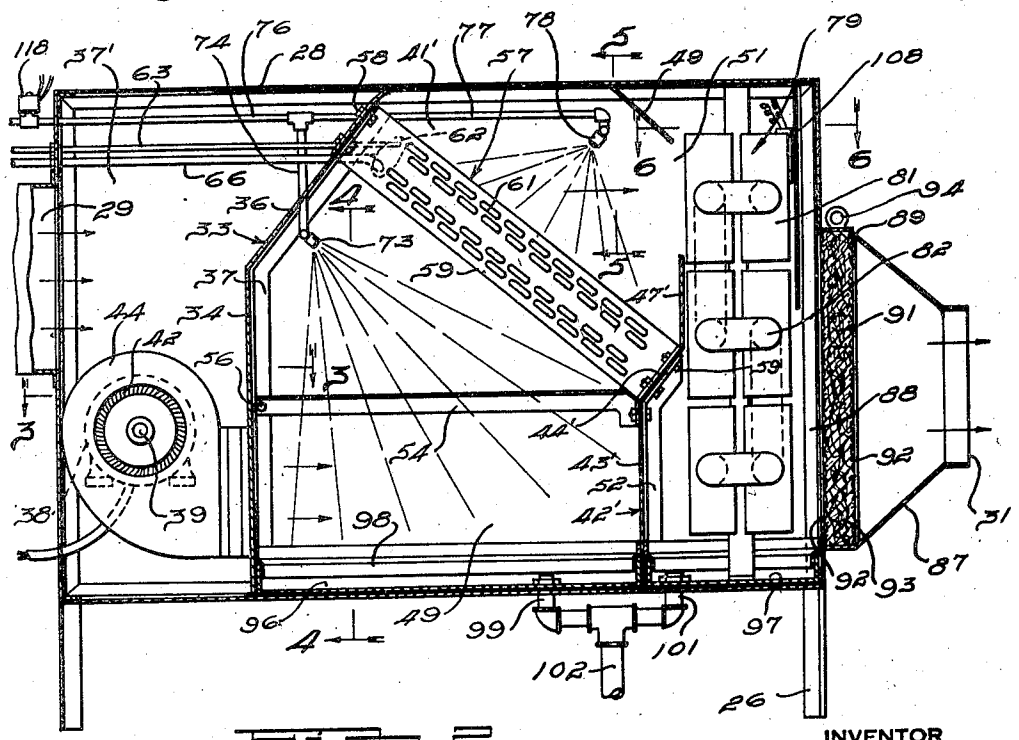




FIG. 2.

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AIR CONDITIONING APPARATUS

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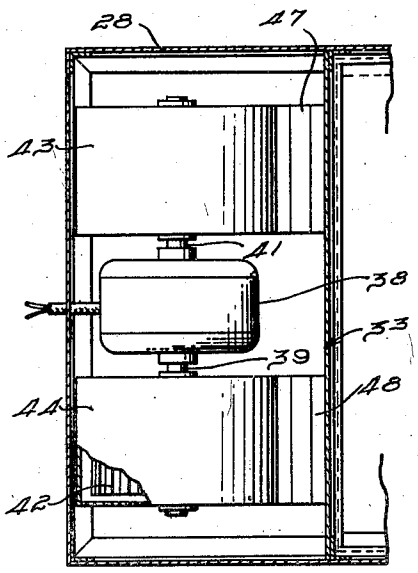


FIG. 3.

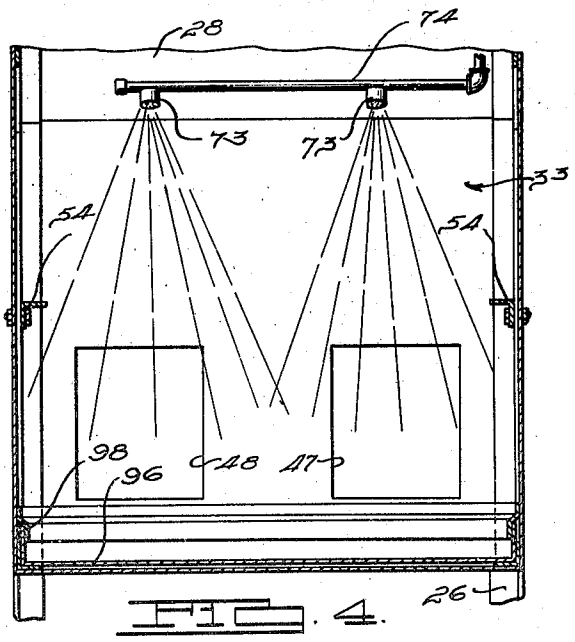


FIG. 4.

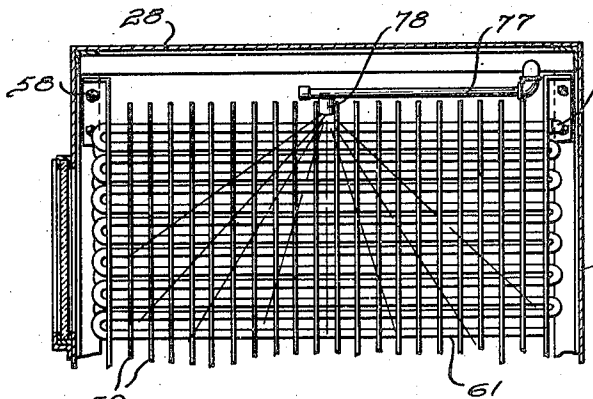


FIG. 5.

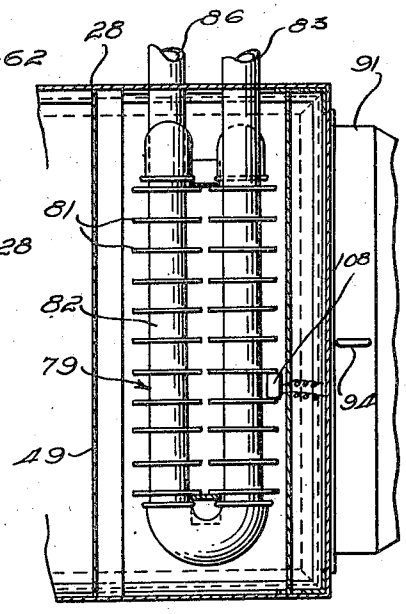


FIG. 6.

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AIR CONDITIONING APPARATUS

Original Filed April 12, 1932 3 Sheets-Sheet 3

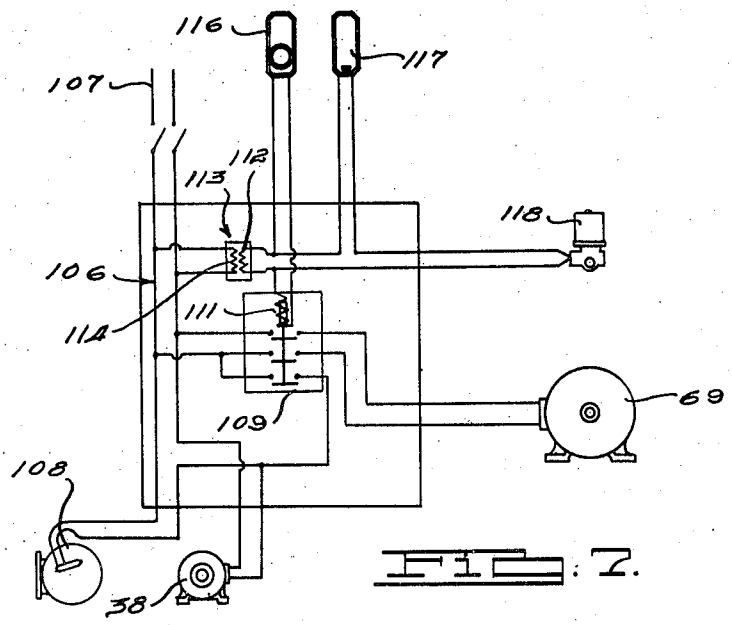


FIG. 7.

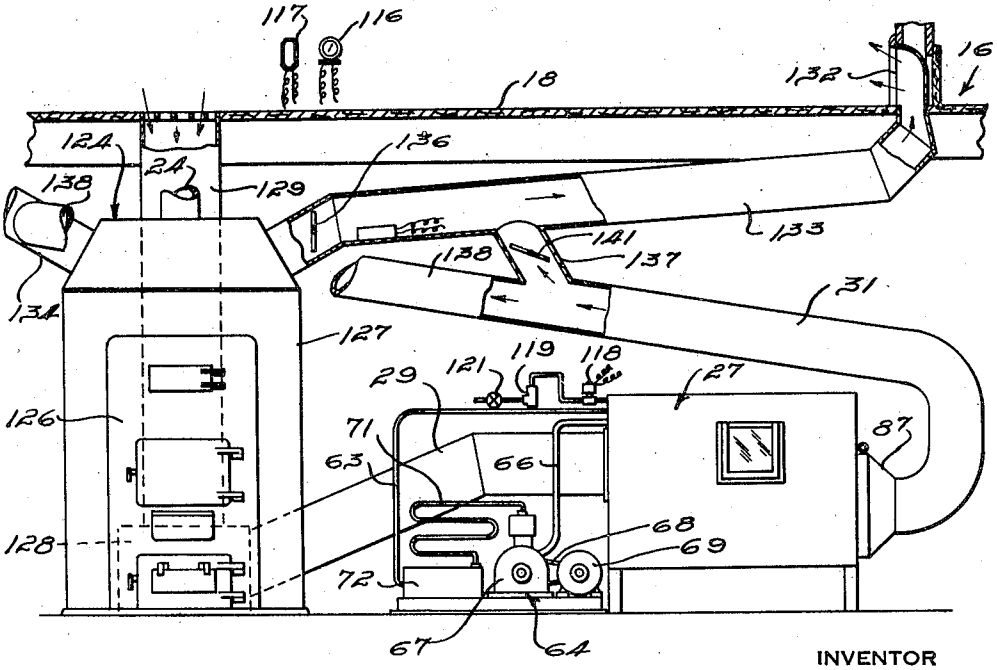


FIG. 8.

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Patented Jan. 19, 1937 2,068,080

# UNITED STATES PATENT OFFICE

2,068,080

## AIR CONDITIONING APPARATUS

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Application April 12, 1932, Serial No. 604,749
Renewed May 2, 1935

8 Claims. (Cl. 257—8)

The invention relates generally to air conditioning apparatus and has particular relation to apparatus for heating, cooling, humidifying and/or dehumidifying air in homes or elsewhere where it is desirable to maintain predetermined air conditions.

An object of the invention is to provide an apparatus which may be employed, in conjunction with a furnace and heating system already installed in a building, to cool and to dehumidify the air in summer and to heat and to humidify the air in winter.

Another object of the invention is to provide a simple and inexpensive refrigeration and air conditioning apparatus which is automatically controllable to maintain proper air temperature and humidity conditions.

Another object of the invention is to provide a system of controls for automatically operating a heating system, a refrigerating system and an air humidification apparatus in conjunction with one another and in such a manner as to maintain proper air conditions in a home or elsewhere where the apparatus is installed.

Another object of the invention is to provide an apparatus for humidifying the air in a building in the winter time and in which some of the steam or other heated fluid produced by a furnace employed in heating the building is employed in the humidifying apparatus for the purpose of increasing the temperature of the humidified air.

Another object of the invention is to provide a refrigerant evaporator having a large amount of heat exchange surface thereon which may be employed during the winter time when the evaporator is normally inoperative for cooling purposes, for supporting moisture or water sprayed thereon and for providing a large amount of wetted surface from which moisture is absorbed by the dry air passing therethrough for increasing the humidity of the air.

Another object is to provide a device of the type described having a novel arrangement of parts thereof whereby they may be contained in a casing of minimum dimensions, thus providing a device occupying a minimum amount of space for its installation.

The above being among the objects of the present invention, the same consists in certain novel features of construction and combinations of parts to be hereinafter described with reference to the accompanying drawings, and then claimed, having the above and other objects in view.

In the drawings:

Figure 1 illustrates a fragmentary cross-sectional view of a house with apparatus embracing the principles of the invention installed therein;

Fig. 2 is an enlarged longitudinal sectional view through a portion of the air conditioning apparatus embraced in the structure disclosed by Fig. 1;

Fig. 3 is a fragmentary horizontal sectional view of the air conditioning apparatus taken substantially on line 3—3 of Fig. 2 and looking in the direction of the arrows thereon;

Fig. 4 is a fragmentary vertical sectional view of the air conditioning apparatus taken substantially on line 4—4 of Fig. 2 and looking in the direction of the arrows thereon;

Fig. 5 is still another fragmentary sectional view taken in a vertical plane substantially upon line 5—5 of Fig. 2;

Fig. 6 is a fragmentary horizontal sectional view of the apparatus illustrated by Fig. 2 and is taken substantially in the plane of line 6—6 thereon;

Fig. 7 is a diagrammatical view of the mechanism controlling system embracing the principles of the invention;

Fig. 8 is a fragmentary vertical sectional view of a building employing a slightly different form of apparatus embracing the principles of the invention;

Referring particularly to the drawings, the numeral 16 indicates an ordinary dwelling house or other building in which it is desired to maintain predetermined air conditions. The building is provided with a room or basement 17 which is separated from the main room or rooms of the house by a horizontal partition or floor 18. In the basement is located a furnace 19 which is connected by conduits 21 and 22 with any number of radiators 23 for heating the rooms of the building with steam or hot water supplied by the furnace. The furnace 19 is provided with the usual smoke pipe 24 for delivering the products of combustion therefrom and may be fired either with coal, by an oil burner or in any other suitable manner.

Adjacent the furnace and supported on suitable legs, such as are indicated at 26, is an air conditioning apparatus 27 comprising a casing 28 having an air inlet 29 connected with one or more rooms of the building and an air outlet 31 and likewise connected with any number of rooms in the building by registers 32. Inside the casing 28 and disposed adjacent the inlet end

thereof is a partition 33 having a vertically disposed lower section 34 and an inclined upper section 36 each secured to the casing at the edges thereof by angle members 37. This partition provides an air inlet compartment 37' in which is centrally located an electrical motor 38 having shafts 39 and 41 projecting from opposite ends thereof and transversely of the casing. On these shafts are mounted fans 42 enclosed in casings 43 and 44 having axial openings therein through which air is drawn by the fans and discharged through outlets 47 and 48 into an air conditioning compartment 49 beyond the partition 33.

Disposed adjacent the outlet end of the casing 28 is a baffle 42' having a vertically disposed section 43' parallel to the section 34 of the baffle 33 and an angularly disposed portion 44' parallel to the angularly disposed portion 36. The sections 43' and 44' of the baffle 42' are much less extensive in height than the corresponding sections of the baffle 33 and a vertical baffle section 47' continuing from the upper edge of the baffle section 44' still terminates materially below the surface of the upper wall of the casing 28. Extending downwardly a short distance from the upper wall of the casing 28 is another baffle 49 between the lower edge of which and the upper edge of the baffle 47' an opening 51 is provided. The baffle sections 43' and 44' are secured rigidly to the casing 28 by angle members 52. In order to reinforce the baffle members and to give rigidity to the casing 28, horizontally disposed angle members 54 are bolted at opposite ends, as is indicated at 56, to the angle members 37 and 52 supporting the baffles.

Secured between the baffle sections 36 and 44 and extending entirely across the casing 28 is a refrigerant evaporating or cooling unit 57 which is secured by bolts 58 and 59 to the edges of the angle members 37 and 52, respectively, supporting the baffle. This evaporating unit may be of any well known construction but in the present instance consists of a plurality of spaced and parallel fins 59 through which a refrigerant circulating conduit 61 is sinuously wound. Connected with one end of the conduit is an expansion valve 62 in turn connected by a liquid line 63 to a refrigerant condensing unit 64, while the opposite end of the conduit is connected to the condensing unit by a suction line 66. The condensing unit 64 comprises a refrigerant compressor 67 driven through a belt 68 by an electrical motor 69 which discharges compressed refrigerant into a condenser 71 and from which condensed liquid flows to a storage tank or receiver 72.

In order to spray water for air humidification purposes throughout substantially the entire space beneath the evaporating unit 61 there is arranged within the compartment 49 a pair of spray nozzles 73 which are disposed just below the baffle section 36 and in a region substantially midway between the opposite ends thereof. These nozzles are supplied with water from the city mains or other suitable source by a conduit 74 connected to a main supply conduit 76 extending within the casing and connected at its opposite end with the aforesaid source of supply. Also connected with the conduit 76 is another conduit 77 for supplying water under pressure to a spray nozzle 78 arranged within the compartment 41' in such position as to spray water throughout substantially the entire extent of the evaporating unit 57 and upon the heat absorbing surfaces thereof.

Disposed beyond the baffle 43' and extending substantially from top to bottom of the casing is a vertically disposed radiator 79 consisting of a plurality of pairs of rows of fins 81 disposed one above another and having sections of a continuously wound conduit or steam pipe 82 thermally contacting with the central portions of the fins in each row. The fins 81 are formed of aluminum in the present instance although any suitable material may be employed in their construction. The upper end of this conduit is connected, by a supply conduit 83 having a control valve 84 therein, with the steam supply conduit 21 connected to the furnace 19. The lower end of the heating coil 82 is connected by an outlet conduit 86 with the water space in the lower portion of the furnace 19.

The air outlet conduit 31 has an enlarged portion 87 connected with an outlet opening 88 in the casing 28 and the upper wall of this enlarged portion has an elongated transversely disposed opening 89 formed therein in which is inserted across the opening 88 a water eliminator 91. This consists of a pair of parallel screens 92 between which is disposed a quantity of rock wool or other suitable material 93 through which air will flow readily but to which any free moisture in the humidified air will adhere. The entire eliminator is adapted to be removed from the opening 89 when desired and is provided for this purpose with a supporting ring 94.

Both sections of the compartment 41' inside the casing 28 are provided with water collecting pans 96 and 97 supported upon the lower surface of the casing and around the upper edges of which deflecting baffles 98 are employed for preventing the flow of water downwardly along the walls of the compartment and beneath the pans. Outlets 99 and 101 connected with the pans are in turn connected with an outlet conduit 102 which may be employed for carrying the waste water either to a pump or other device for recirculating the water through the supply conduit 76 or to a sewer or elsewhere where such water may be disposed of.

For operating the various mechanisms embraced in the apparatus there is employed a control system 106 embracing a power line 107 in which the fan motor 38 is connected in series with an electrical thermostat 108 which is secured in thermal contact with the fins of the heater 79 to control the motor 38 in response to temperature variations in the heater. The motor 38, however, is otherwise connected in the power line 107 in series with one of the contacting elements of a three pole relay switch 109. The remaining two poles of the relay switch are employed in controlling an electrical circuit from the power line 107 through the motor 69 by which the refrigerant condensing unit 64 is operated. The solenoid 111 for operating the relay switch 109 is connected to the secondary winding 112 of a transformer 113, the primary winding 114 of which is connected in the power line 107. Connected in series with the solenoid 111 is a thermostat 116 which is arranged inside a room of the building 16 in which it is desired to control the temperature. It is to be understood, of course, that any number of such thermostats may be employed in different rooms of the building and connected in parallel with one another so that any thermostat may provide an electrical circuit in the solenoid 111.

Also connected to the secondary winding 112 of the transformer 113 is an electrical switch or

humidistat 117 for opening and closing an electrical circuit through a solenoid operated valve 118 for controlling the flow of water through the supply line 76. In such supply line there is also arranged a strainer 119 for collecting dirt or other foreign matter in the water within the line and a manually controlled valve 121 for controlling the flow of water through the line otherwise than by the automatic operation of the valve 118. The humidistat 117 and the solenoid valve 118 are connected in series in a circuit in parallel relation to the circuit through the thermostat 116 and the solenoid 111.

In operating the apparatus in the summer time, for example, for cooling the air in the building, the furnace, of course, will not be fired and the valve 121 controlling the water supply line 76 should be closed to prevent the flow of water therethrough. The thermostat 116 is so adjusted as to close an electrical circuit through the solenoid 111 whenever the temperature within the room in which the thermostat is located increases beyond a predetermined value. When such event occurs and the induced electrical current from the secondary winding 112 flows through the solenoid 111, the relay switch 109 will close to provide an electrical circuit through the motors 69 and 38. Immediately thereafter air from the building 16 will be circulated downwardly through the inlet conduit 29, through the casing 28 and outwardly again into the room through the outlet conduit 31. Such circulation of air will be caused by the operation of the fan 42 in response to the operation of the motor 38.

As a result of the operation of the motor 69 the condensing unit 64 will cause expansion of liquid refrigerants through the expansion valve 62 and this in turn will result in a reduction in the temperature of the evaporating unit 56, the surface of which cools the air received from the building through the supply or inlet conduit 29 and supplied again therethrough through the outlet conduit 31. Not only is this air cooled in traversing the surface of the evaporating surface 57 but it will also be dehumidified to an appreciable extent by the condensation of moisture in the air upon the cold surfaces thereof. When the air is thus dehumidified and cooled to the desired extent, the thermostat 116 will open the electrical circuit to the solenoid 111 and the operations of the fan 38 and condensing unit motor 69 will be discontinued. Thereafter such cycle of operation will be repeated when the temperature in the room becomes high enough to again operate the thermostat 116 for closing the electrical circuit to the solenoid 111.

In the winter time it is not desirable to circulate air to and from the rooms of the building 16, unless the air is sufficiently heated, because the humidification of the air materially decreases its temperature and as a consequence thereof cold drafts would result. In order to circulate only heated air through the building, the thermostat 108 is so adjusted as to close an electrical circuit to the fan motor 38 only in the event the temperature of the heating coil 79 is high enough to heat the air to the proper temperature. There is no danger of the circuit through the motor 38 being closed by the operation of the relay 109 because the building will not be hot enough to operate the thermostat 116 during the winter time, under ordinary circumstances and certainly not when the heating coil 79 is too cold to cause the closing of an electrical cricuit by the thermostat 108 through the motor.

The humidistat 117 is so adjusted as to close an electrical circuit through the solenoid valve 118 whenever the humidity in the building, or the amount of moisture in the air therein is less than is desirable. Under such circumstances, and assuming the valve 121 to have been opened, the electrical energy induced in the secondary winding 112 will cause operation of the solenoid valve 118 to permit the flow of water through the nozzles 73 and 78. If there is a good fire in the furnace 19, or in the event an oil burner is employed, if it has cycled recently, the heating coil 79 will be heated by the steam of the furnace to such an extent that the thermostat 108 will close the electrical circuit to the fan motor 38 and a circulation of air from the room, through the water sprayed from the nozzles 73 and 78 and then to the room again, will result. The air contacting with the water from the nozzles 73 and 76 and with the wetted surface of the otherwise inoperative evaporating coil 76 will absorb moisture very rapidly and although the air will be cooled by such absorption of moisture it will be heated again in traversing the surface of the heating coil 76.

Any moisture in suspension in the air flowing from the heating coil will be collected by the eliminator 91 before the humidified air is again admitted to the room.

When the humidified air, thus applied, has diffused in the air in the room until there has been a sufficient increase in humidity to actuate the humidistat 117, the electrical circuit through the solenoid valve 118 will be opened to close the valve thereby cutting off the flow of water to the supply conduit 76 and the nozzles 73 and 78. The fans 42 thereafter will continue to operate and to circulate the air from the room across the heater 79 and will thus assist the main heating system for the building in heating the air therein until such time as the fire in the furnace 19 becomes low enough to cool the heater 79 to such an extent as to actuate the thermostat 108. Thereafter the operation of the fans 42 will be discontinued until such time as the heater 79 becomes hot enough again to cause the closing of an electrical circuit through the thermostatic switch 108. Such closing of the circuit through the thermostat 108 may occur at a time during which the humidity in the room containing the humidistat 117 is high enough to prevent closing of an electrical circuit therethrough and under such circumstances the fans will merely be employed for assisting in heating the building by circulation of air across the heater 79.

In the event the furnace 19 becomes hot enough to heat the building 16 to a temperature which would cause the operation of the cooling system in the summer time, the thermostat 116 will close to cause operation of the motors 38 and 69 and the resultant refrigeration of the hot air will continue until the temperature thereof is reduced sufficiently to cause the opening of the circuit through the thermostat. It is not desirable to have the refrigerating system thus operating in the winter time, such operation may be prevented merely by disconnecting the thermostat 116 during such periods.

In the form of the invention disclosed by Fig. 8 the air conditioning apparatus 27 is employed in conjunction with what is commonly known as a hot air circulating heating system 124 which comprises a furnace 126 surrounded by an air jacket 127 having an inlet 128 at the bottom thereof which is supplied with air from a room

of the building through an inlet conduit 129. The upper portion of the jacket 127 is connected to registers 132 in the rooms of the building 16 by hot air conduits such as those indicated at 133 and 134. The relative amounts of air delivered by each of these conduits is controlled by butterfly valves or dampers as indicated at 136. In the air conditioning apparatus 27 employed in conjunction with a furnace of this type the heater 79 either is not employed or is provided with heat from a source auxiliary to the furnace 126 or independent thereof. If the heater is not employed the humidified air delivered by the apparatus is not supplied directly to the room but instead the outlet conduit therefrom is connected to one or more of the hot air conduits leading from the air jacket 127 as is indicated at 137 and 138. The cool and humidified air thus supplied to the hot air conduits is mixed with the hot air therein prior to the delivery thereof to the rooms of the building and is heated therein to a temperature substantially equal to that of the hot air when delivered. The flow of air from the air conditioning apparatus may be controlled in its delivery to the hot air conduits by dampers 141 arranged in the pipes by which the outlet conduit 31 is connected to the various ducts for distributing hot air from the furnace.

The inlet conduit 29 to the air conditioning apparatus in this instance is connected directly to the inlet 128 for the air jacket 127 and receives therefrom a part of the air delivered by the duct 129. When the heater 79 is not employed in the air humidification apparatus 27 the thermostat 108 is employed in one of the hot air pipes leading from the furnace 126 or elsewhere thereabout where it will be responsive to the temperature of the air delivered by the furnace. When located in the conduit 133, as is illustrated by Fig. 8, the thermostat 108 will close an electrical circuit through the fan 38 only when there is a sufficient amount of hot air being delivered by the conduit 133 to increase to the desired extent the temperature of humidified air delivered by the outlet conduit 31.

Except as hereinbefore specified the humidification apparatus disclosed by Fig. 8 is substantially identical to that disclosed by the preceding figures and the reference numerals employed elsewhere herein are therefore applied thereto. The control systems for the structure disclosed by Fig. 8 also is substantially identical to the control system previously described and the structure is likewise similarly operable.

It is desired to call attention to the fact that because of the particular arrangement of parts disposed within the casing 28, the casing is of minimum external dimensions which is advantageous not only from the standpoint of economy in production, but from the standpoint of occupying a minimum of otherwise usable space in a residence or other building.

While the structures herein disclosed constitute preferred forms and applications of the invention, it is to be understood that there are numerous modified and equivalent structures within the scope of the invention as defined by the appended claims.

What is claimed is:

1. An air conditioning apparatus for buildings comprising a casing having a cooling unit arranged therein, means for circulating air throughout said casing and across said cooling unit, means comprising a refrigerating system for operating said cooling unit under predetermined temperature conditions, and means responsive to the humidity changes in the air for spraying water upon said cooling unit, the last mentioned means being controllable whereby to permit its use only when said refrigerating system is inoperative.

2. An air conditioning apparatus for buildings comprising a casing having end walls provided with inlet and outlet openings, a pair of baffles extending across said casing intermediately of said end walls and having a cooling unit secured therebetween, means adjacent the inlet end of said casing for discharging a blast of air through the baffle adjacent thereto and on one side of said cooling unit, the other baffle of said casing having an opening therethrough on the opposite side of said cooling unit for conveying the air thus discharged beyond said baffle and toward the outlet end of said casing, an air heater in said casing beyond said last mentioned baffle and adjacent said casing outlet opening, and means within said casing for spraying water therein between said baffles and on opposite sides of said cooling unit.

3. An air conditioning apparatus for buildings comprising a casing having means for circulating air therethrough, a plurality of finned tubes arranged in rows across said casing and disposed in parallel relation to the flow of air therein, a conduit for circulating cooling fluid through some of said rows of finned tubes, a conduit for circulating heating fluid through other of said rows of finned tubes, and means for spraying water only on those fins through which said conduit for cooling fluid extends.

4. In a building having a plurality of rooms, a hot air heating system associated therewith, said hot air heating system embracing a furnace having an air jacket thereabout, an inlet and an outlet conduit to and from said jacket and the rooms of said building, an air conditioning apparatus having an inlet connected to said jacket adjacent the inlet thereof, and an outlet connected with said outlet conduit from said jacket, and means for circulating air throughout said casing.

5. The combination with a building having a plurality of rooms and a heating system therein, an air conditioning apparatus for said building, a fan for circulating air through said air conditioning apparatus, a power line for supplying electrical energy to said fan, a transformer having the primary winding thereof connected to said power line and the secondary winding connected in series with a thermostat in said building and with a solenoid for controlling the operation of a relay switch, one of the poles of said relay switch being arranged to open and close an electrical circuit through said motor, and a thermostat in said air conditioning apparatus and connected in parallel with the aforesaid relay switch for additionally controlling the circuit through said motor.

6. The combination with a building having a plurality of rooms and an air conditioning apparatus therein, said air conditioning apparatus embracing a refrigerating system and a fan for circulating air therethrough, means for electrically operating said refrigerating system and said fan, a relay switch for controlling said means, a transformer for operating said relay switch and a thermostat arranged in said building for controlling the flow of current through said transformer.

7. Air conditioning apparatus including means

for conducting a stream of air from a room, means for heating a portion of said stream of air and supplying it to said room, means for humidifying a different portion of said stream of air and combining it with said heated air stream portion before delivery to said room, means for forcing said humidified air stream portion into said heated air stream portion and ultimately into said room, and mechanism for controlling said humidified air forcing means in response to temperature changes of said heated air stream portion and adapted to render said forcing means inoperative when heated air of a predetermined minimum temperature is not available for supply to the room.

8. Air conditioning apparatus including means for conducting a stream of air from a room, means for heating a portion of said stream of air, means for humidifying a different portion of said stream of air, means for converging and conducting said heated and humidified air stream portions to a room having a common outlet for discharging both heated and humidified air thereto, means for forcing said humidified air stream portion through said humidifying means and conducting means, and mechanism for controlling said humidified air forcing means, said mechanism being directly responsive to temperature changes of said air heating means and adapted to render said air forcing means inoperative when a supply of heated air of a predetermined minimum temperature is not available for mixing with said humidified air stream.

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