

Dec. 10, 1935.

J. H. TEXTORIUS ET AL

2,023,622

AIR CONDITIONING APPARATUS

Filed April 18, 1933

5 Sheets-Sheet 1

Fig. 1.

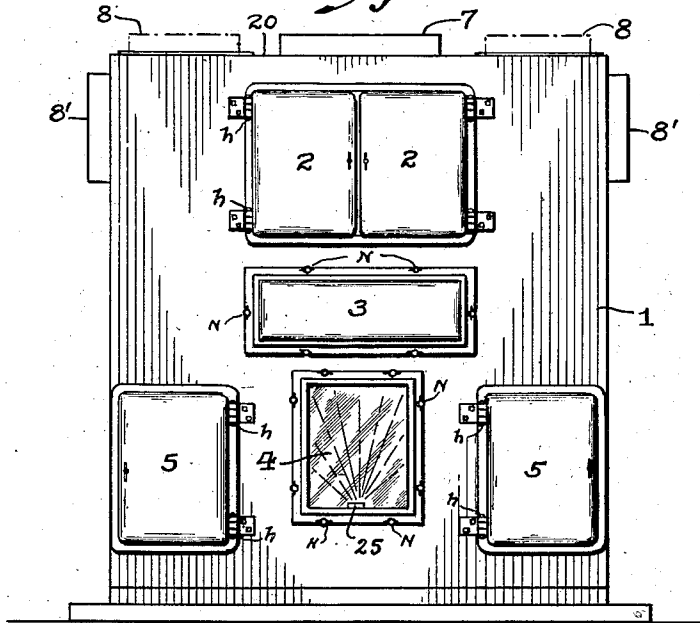


Fig. 2.

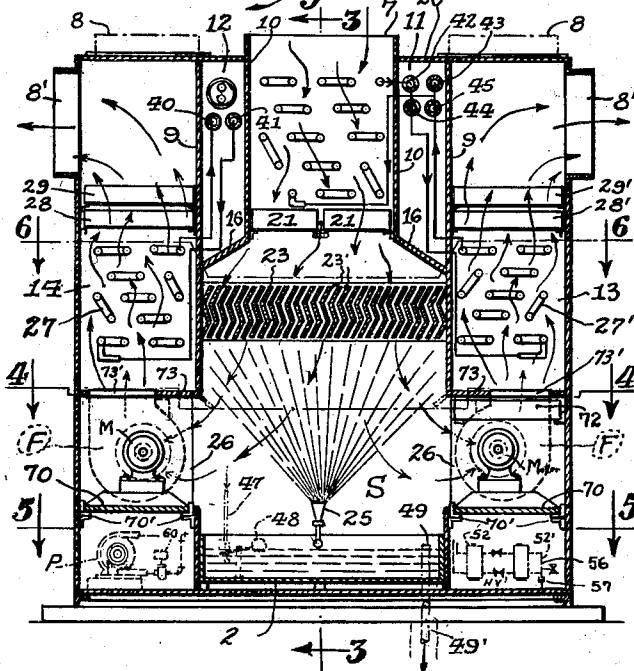
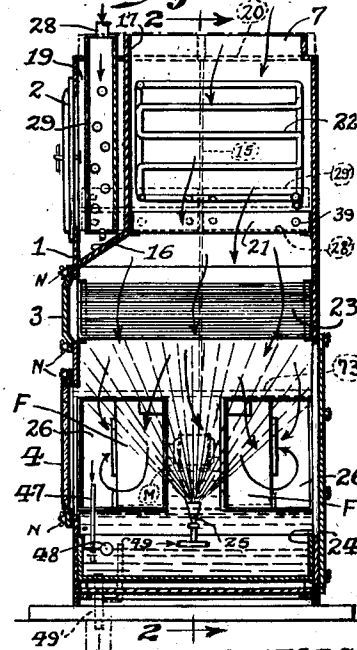


Fig. 3.



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5 Sheets-Sheet 2

Fig. 4.

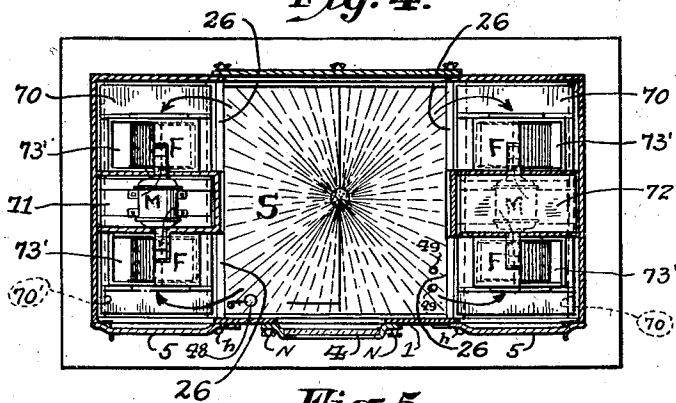


Fig. 5.

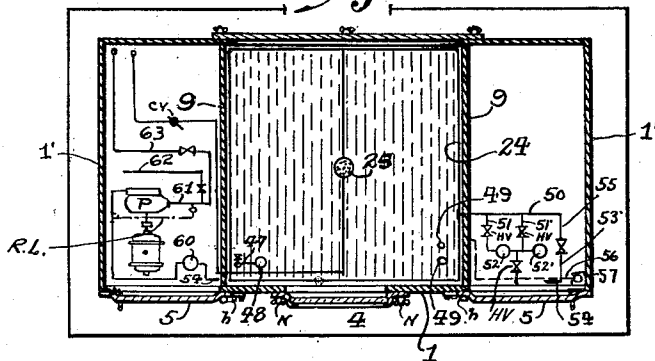
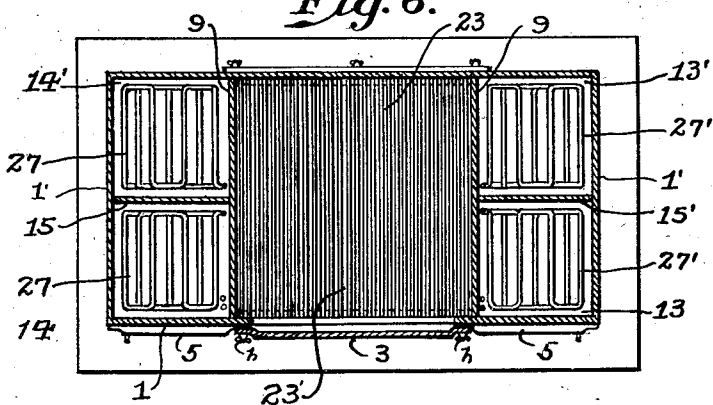


Fig. 6.



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5 Sheets-Sheet 3

Fig. 7.

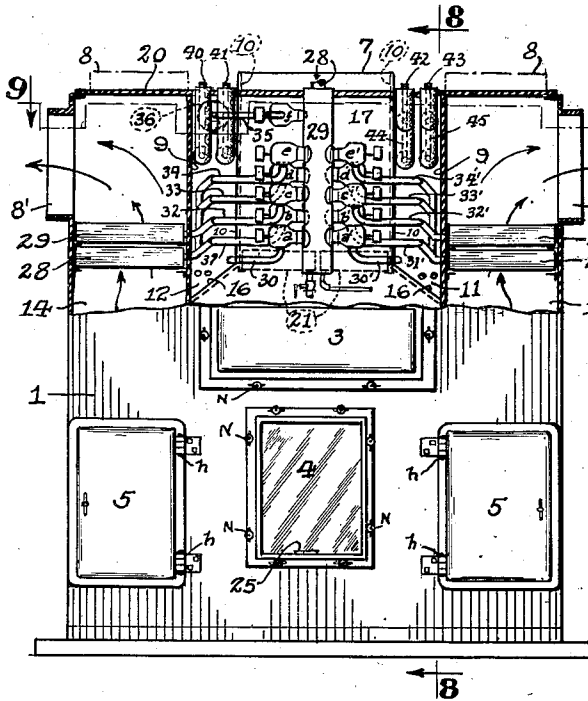


Fig. 8.

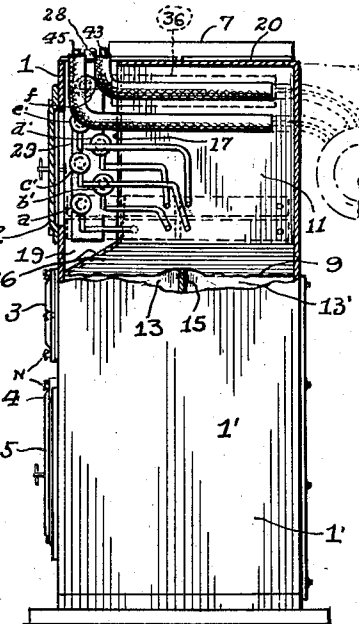


Fig. 9.

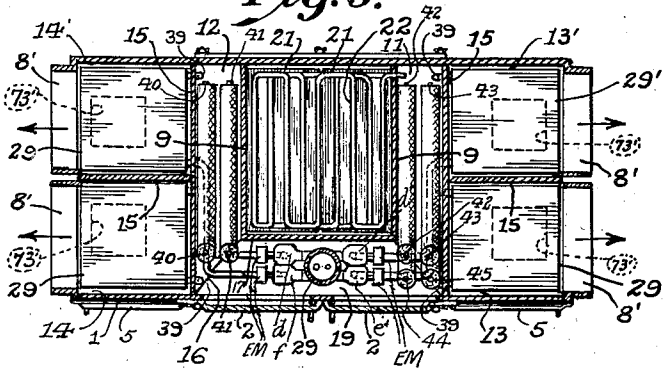
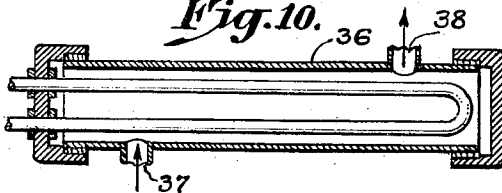


Fig. 10.



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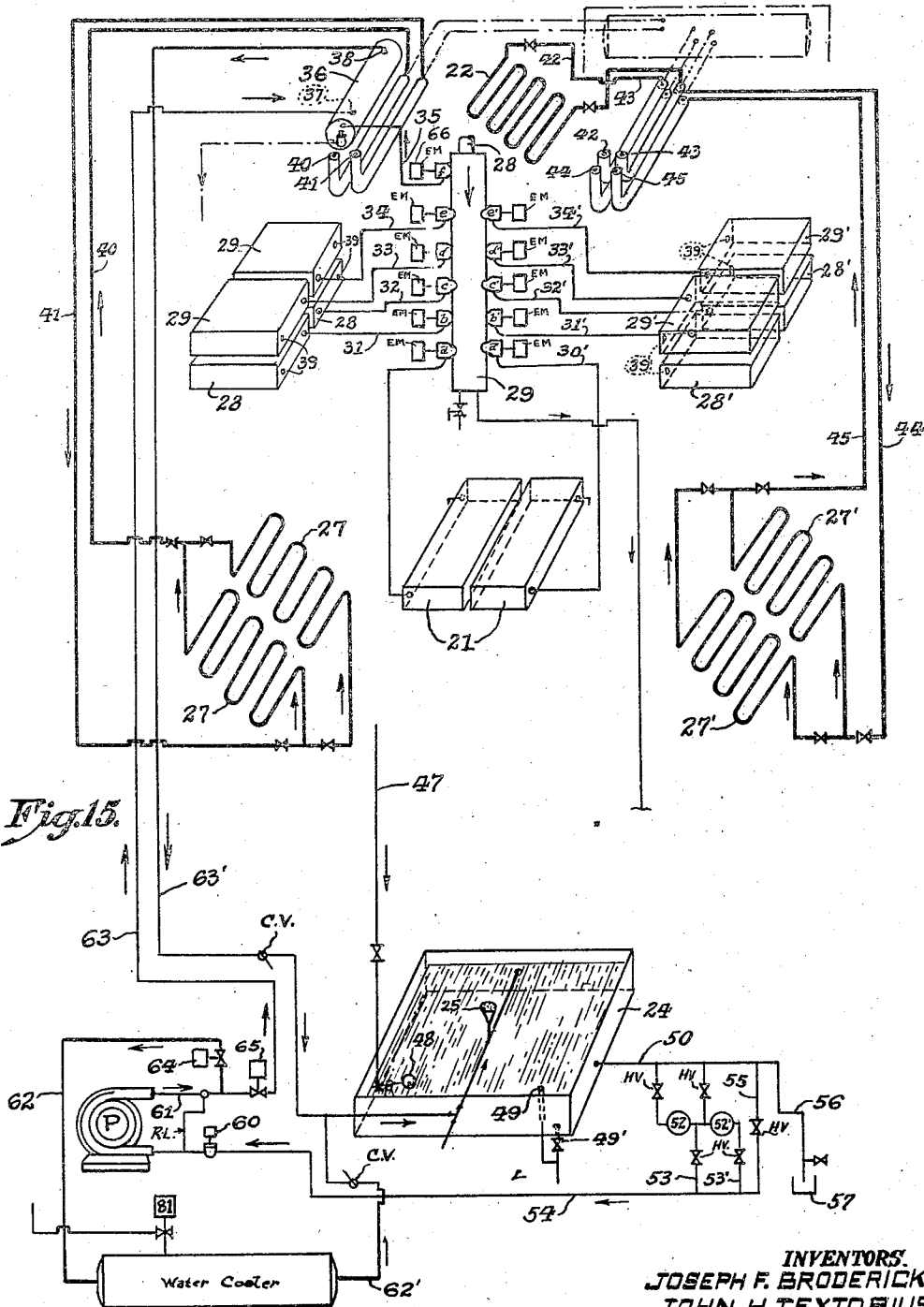
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AIR CONDITIONING APPARATUS

Filed April 18, 1933

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,023,622

AIR CONDITIONING APPARATUS

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Application April 18, 1933, Serial No. 666,718

7 Claims. (Cl. 257—3)

Our invention relates to air conditioning apparatus especially designed and constructed to accomplish the treatment of air or gas to remove therefrom dust, bacteria, foreign matter, etc.; and to establish the air or gas at desired predetermined humidity and temperature. The invention provides an apparatus capable of use in industrial, residential, public or private institutions or buildings regardless of size.

One of the principal general objects of the invention is to provide apparatus for the above purposes in the nature of a compact unitary machine which can be installed complete in the basement or other part of a building remote from the area or rooms to which the air is to be delivered, thus facilitating economy of construction and operation as well as conserving valuable space in many instances.

Another object of the invention is to provide apparatus or a machine of the above type, especially but not exclusively designed for low pressure (frictional) operation, and capable of treating a large volume of air in a relatively small space. One of the important features accomplishing this object being the downward substantially vertical flow of air through a spray chamber against an upward and angularly disposed spray of water, the spray being so directed and the spray chamber so formed that the impingement of the spray and resultant back-lash increases the turbulence and atomization of the spray in the spray chamber.

Another object of the invention is to provide for spraying either hot or chilled water or water of selected intermediate temperatures within the chamber, and means for automatically controlling the temperature of the spray responsive to the temperature and humidity of the conditioned air.

Other objects and advantages of the invention include the provision of a machine or apparatus of the character mentioned capable of either humidifying or dehumidifying the air; means for automatically maintaining the condition of the treated air at predetermined humidification and temperatures; and to provide such apparatus in the form of unitary device capable of being grouped to take care of the needs of buildings of various sizes.

While we have thus far mentioned use of the invention chiefly in connection with the treatment of air, we wish it to be understood that the same is capable of use industrially for the treatment of various gases for the purpose of maintaining them at predetermined relative humidity

and temperature either by humidifying them, dehumidifying, heating or cooling them. Furthermore, apparatus embodying our invention may be used as a heating plant.

All of the objects and advantages of the invention will become apparent and will be pointed out during the course of the following detailed description of the accompanying drawings, in which

Fig. 1 is a front elevation of the exterior of a machine embodying our invention;

Fig. 2 is a view on the line 2—2 of Fig. 3;

Fig. 3 is a view taken on the line 3—3 of Fig. 2;

Fig. 4 is a view taken on the line 4—4 of Fig. 2;

Fig. 5 is a view taken on the line 5—5 of Fig. 2;

Fig. 6 is a view taken on the line 6—6 of Fig. 2;

Fig. 7 is a view similar to Fig. 1 with a portion of the front of the housing broken away;

Fig. 8 is a view taken on the line 8—8 of Fig. 7;

Fig. 9 is a view taken on the line 9—9 of Fig. 7;

Fig. 10 is a detailed sectional view of a heater or cooler for the spray water;

Fig. 11 is a front perspective view of a machine which may be used as a heating plant and showing the arrangement of parts on the interior of the machine diagrammatically;

Figs. 11a and 11b are perspective views of the fan assemblies removed from the machine;

Fig. 12 is a diagrammatic view of the automatic control means for the heating and cooling elements of the machine showing the electric circuits;

Fig. 13 is a small top plan view showing how the units may be grouped;

Fig. 14 is a side view of a machine with a separate refrigerating unit coupled thereto or positioned in proximity thereto; and

Fig. 15 is a complete diagrammatic view of the heating, cooling, and spraying means.

Referring to the drawings, and particularly at present to Fig. 1, the numeral 1 designates the front panel of the housing for the apparatus, said panel being provided with a plurality of openings closed respectively by doors 2, 3, 4, 5 and 6. The front panel 1 is preferably of metal as also are the sides, back, and top of the apparatus, and the exterior of the housing may be finished in the style of the usual refrigerator finish or may be covered by baked enamel or a plastic heat insulating material. The walls of the housing are also preferably lined with a heat insulating material such as generally used in casings of refrigerators or refrigerating apparatus, such lining not being shown in the drawings. The doors 2, 3 and 6 may be hinged con-

connected to the housing as indicated by the letter *h*, while the doors 3 and 4 are preferably gasketed and are tightly held in their openings to compress the gaskets, not shown, by jam nuts or wing nuts *N* fitting on cooperating bolts, to provide a water tight seal between the doors 3 and 4 and the panel 1.

Projecting outwardly from the top of the housing is the end of a stack 7 adapted to be connected to a conduit for delivering air to the machine for conditioning. Also, on the top of the machine at opposite sides thereof there may be collars 8, two at each side of the machine, and similar collars 8' on each side panel of the machine for delivering the conditioned air to conduits for conveying it to the proper rooms or parts of the building.

Referring to Figs. 2-6, it will be noted that plates 9 are mounted between the front and back of the machine and which, in connection with the sides 10 of the stack, divide the top part of the machine into spaces or compartments 11 and 12, at opposite sides of the stack. At each side of the housing are flues 13, 13' and 14, 14', (Fig. 6) formed by partitions 15 between the walls 9 and the sides 1' of the housing. Each flue communicates with openings surrounded by collars 8 and 8'. At this point, we would mention that such of the collars 8, 8', as are not connected to conduits leading to rooms to receive the treated air may be closed by suitable caps or plates not shown. There are preferably eight collars, four on top and four collars on the sides, and it would be preferable to use either the four top collars and close the side ones or use the side collars and close the top ones. This assumes that the capacity of the machine is sufficient to deliver a required amount of air to four rooms, but it will be understood that this is purely illustrative and that the capacity of the machine may be such as to care for more or less rooms. However, we consider it highly desirable to provide the machines of a unitary character capable of supplying air say to four rooms, and rather than build a larger machine to take care of more rooms, to simply arrange the units side by side so that two units would furnish air to eight rooms, three units to twelve rooms, etc. This illustration of course assumes rooms of usual standard size such, for instance, as school rooms, and large residences, and, of course, a machine capable of supplying conditioned air to such rooms in requisite number of cubic feet per minute could supply six, eight or more rooms of smaller capacity.

The lower ends of the plates 10 forming the sides of the stack 7 (Figs. 2 and 3) are flanged diagonally outward as at 16, and have their lower ends rigidly connected to the plates 9 by any suitable means. It is possible, of course, instead of flanging or bending the plates 10 to provide flanges 16, to connect separate plates between the ends of the plates 10 and 9, to form bottoms of the compartments 11 and 12, which as hereinafter described, may be utilized for the housing of cooling, heating or other elements.

The front of the stack 7 is formed by plate 17 mounted parallel to the front 1' of the casing and connected between the plates 10. The lower end of the plate 17 is flanged similarly to the plates 10 and connected to the front of the housing. Thus, a space 18 is provided between the front of the stack 7 and front 1' of the housing, said space communicating with the chambers 11 and 12 and also being adapted to receive part

of the heating or cooling means. It will be noted that the stack consists of an inverted substantially funnel-shaped member secured between the plates 9 and 10 and front wall 1, and having its top end projecting through and above the top plate 20 of the casing.

Within the stack 7 and adjacent its lower ends are heater tubes or coils 21 (primary heaters) which may be connected, as hereinafter explained, to a suitable source of steam supply. Also, within the stack and above the heaters 21 are the coils 22, which are hereinafter referred to as the primary cooler, and which are connected to a suitable source of chilled water, brine at low temperature, or which may be used as direct expansion refrigerator coils using any suitable commercial refrigerant.

Below the flanges 16, 18, of the stack, that is, below the flaring end of the stack and across the chamber S, which is defined by the front and back of the housing and the lower ends of the plates 9, there is mounted a baffle 23 having irregular passages 23' through which the air passes upon entering the chamber S from the stack. The purpose of such baffle is to assist in freeing the air from dust and foreign matter as much as possible. Referring again to Fig. 1, the door 3 is mounted across the casing 1 in front of the baffle 23, so that upon opening or removing the door 3, one may have access to the baffle 23 for cleaning the passages whenever necessary.

In the bottom of the chamber S is a trough 24 and above the trough is a spray nozzle 25 connected to pipes hereinafter described for conducting water of predetermined temperature to the nozzle, so that the water will issue from the nozzle in the form of a spray directed upwardly and outwardly towards the top of the chamber S, as shown in Figs. 2 and 3. The position of the nozzle is preferably centrally of the chamber S, so that the spray will contact the upper portion of the walls of the chamber, and the lower surface of the baffle 23 creating a back-lash and resulting in further breaking up of the spray into a mist at the top of the chamber immediately beneath the baffle 23. The impingement of the spray against the walls and baffle and further breaking up of the spray creates an additional turbulence in the spray chamber immediately at the point where the air enters through the baffle. One of the advantages of the construction and arrangement of the parts defining the spray chamber and the manner of projecting the spray affords a relatively short length of travel of the air through the spray chamber, whereby a relatively great volume of air can be treated in a relatively small and compact spray chamber.

Through each of the walls 9 adjacent the bottom of the spray chamber, are openings 26 leading to compartments containing fans *F* which draw the air down through the stack 7, baffle 23, and spray chamber and project it upwardly through flues 13, 13' 14 and 14' and across the secondary cooling coils 27 and 27', and secondary heaters 28, 28' and 29', for delivery to the rooms or desired parts of a building through conduits connected to collars 8 or 8'. There is preferably a fan to supply each flue.

We have previously explained that the door 3 may be opened to give access to the baffle 23 for cleaning the passages therein. The fans *F* and operating mechanism therefor and mechanism for circulating the water are mounted behind the doors 5 and 6, and by opening the doors access may be had for such parts for the purposes of

repair at any time. Also, the door 4 may be removed to give access to the spray chamber S and the parts therein, and the doors 2 may be opened for access to the parts housed in the compartment 19.

Referring particularly to Figs. 2, 3, 7-10, it will be noted that within the space 19 between the stack and the front of the housing is a pipe 28, leading from any suitable source of steam supply, and to which is connected a header 29 having branches *a, a', b, b', c, c', d, d', e, e', and f*. The branches *a* and *a'* are connected by pipes 30, 30' respectively to the primary heaters 21. The branches *b, b'*, (see Figs. 7 and 15) are connected by pipes 31, 31' respectively to the front secondary heaters 28, 28'; the branches *c, c'*, are connected by pipes 32, 32' to the back secondary heaters 28, 28'; the branches *d, d'*, are connected by pipes 33, 33' to the front upper secondary heaters 29, 29'; and the branches *e, e'*, are connected by pipes 34, 34' to the rear upper secondary heaters 29, 29'. Each of the heaters is provided with an opening 39 to receive a return pipe. The branch *f* is connected to a pipe 35 leading through the water heater 36 shown in detail in Fig. 10, as comprising a jacket having a coupling 37 to receive the spray water inlet pipe and the coupling or nipple 38 receive an outlet pipe. The water passing to the spray nozzle may be diverted through the heater when required in accordance with conditions and automatic means hereinafter described, Fig. 10 showing the steam pipe within the heater and around which the water circulates. We wish it to be understood that we may employ electric water heaters of known and available types or any other heating medium for the water instead of the steam coil shown and described.

There is provided in connection with each of the extensions *a, a', b, b', c, c', d, d', e, e',* a valve, each operated by an electro-magnet EM so that all of the primary and secondary heaters may be collectively and individually placed in communication with or closed from communication with the source of steam supply through the pipe 28. Each of the electro-magnets EM is connected in circuit with and operated by thermostats. The operation of the valves to control the flow of steam to the primary and secondary heaters and location of the thermostats will be explained in detail in connection with the explanation of the operation of the apparatus.

Within the space or chamber 11 are pipes 40 and 41, the former leading to the secondary cooling coils 27 in the flues on the left side of the machine and the latter leading from said coils. These pipes may conduct the chilled water, brine, or other refrigerant from any suitable type of refrigerating apparatus. Pipes 42 and 43 are located in the space or chamber 11 and are connected preferably to the same apparatus as the pipes 40 and 41 to conduct the refrigerant to and from the primary coils 22 in the stack 7. Pipes 44 and 45 also lead to and from the refrigerating apparatus to conduct the refrigerant to and from the secondary cooling coils 27' in the flues at the right side of the machine. The respective groups of pipes 40, 41, 42, 43, 44, 45, may be provided with automatically operated valves similar to the steam valves, or expansion valves actuated in response to thermostatic elements located in the air terminal spaces, so that the refrigerant may be conducted simultaneously through all of the coils both primary and secondary or through

the primary alone or through the secondary coils alone.

From the description thus far given, it will be seen that the air entering through the stack 7 may be either heated by the primary heaters 21 or chilled by the primary coil 22 and then drawn by the fans through the baffle and spray and openings 26 and sent on to the conduits leading to the air terminal spaces, and the air leaving the fans may further be chilled by the secondary coils 27, or heated by either or both of the secondary heaters in the respective flues according to the conditions existing in the air terminal spaces or rooms directly affecting the thermostatic controls. It will be apparent that the temperature of the air or gas treated with our apparatus may be controlled over a very wide range.

As has been pointed out, it is an important object of the invention to regulate or control the relative humidity of the air or gas. This is accomplished largely by controlling the temperature of the spray. To this end, the trough 24 is supplied with water through a pipe 47 mounted adjacent the front wall of the housing and extending up into the space 19 for connection with a pipe leading from a source of supply. The flow of water through the pipe 47 to the trough is preferably controlled by a float valve 48, and an overflow pipe 49 leads through the trough and housing to a drain, to which is also connected a drain outlet 49'.

A pipe 50 leads from the trough 24 and is connected to branch pipes 51, 51', in which are mounted strainers 52. Branch pipes 53, 53' connect pipes 51 and 51' to pump suction pipe 54 extending across the bottom of the casing. Pipe 50 is also connected by a pipe 55 around strainers 52 to pipe 56. Valves HV are mounted in pipes 51, 51', 53, 53' and 55, so that the water may be diverted through either one strainer or the other, through pipes 51, 53 or 51', 53', or through pipe 55, according to which of the valves HV are open. Pipe 56 is also connected to a drain branch 56 leading to a sediment pocket 57. A thermostatic element 60 is installed in the pipe line and may be installed in the pipe 50 leading to the pump P. A pump discharge pipe 61 is connected with branches 62, 63, the former leading to water cooling means which may be the refrigerating apparatus previously referred to, and the latter leading to the water heater 36 in the chamber 12 and shown in detail in Fig. 10.

An electro-magnetic valve 64 is mounted in the branch 62 of the pump discharge line, and a similar valve 65 is mounted in the branch 63 of the pump discharge line to the water heater. The operation of these valves and the means actuating them will be hereinafter explained in detail, and for the present we would state generally that the electro-magnetic valves 64, 65, are alternately operated in response to humidistats in the air terminal spaces or elsewhere, or by other elements as presently explained, so that water will be drawn from the tank 24 through the strainers by the pump and discharged either to the water cooler and thence to the spray nozzle 25, or to the water heater and thence to the spray nozzle. The result is that the water sprayed from the nozzle 25 is of predetermined temperature according to the requirements for the humidity of the air which is determined by the setting of humidistat or other control elements as hereinafter pointed out.

The thermostatic element 60 in the pump suction line operates the magnetic valve 66 to open

and close communication between the extension *f* on the header 29, and the hot water heater 36. The same element 60 also operates a valve 81 in the water cooler. The function of controlling the said valves in the water heater and water cooler is to further assure maintenance of proper predetermined humidification of the treated air as will become more apparent hereinafter.

A relief line RL is connected between pipes 54 and 61. Check valves CV are mounted in the pipes 63' and 62', leading from the water heater and cooler to the spray nozzle.

Referring to Figs. 2-4, it will be noted that behind the doors 5 and 6 between the sides of the housing and the walls 9 there are plates 70 supporting the fans F, there being one fan in alignment with each of the openings 26 in the walls 9, as shown in Fig. 4, and below each delivery flue. The fans may be rotated by electric motors M arranged in housings 71 between the fans and having a shaft projecting from each end and connected to the fans. Also, within the fan chamber is the transformer 72. Above the fans are plates 73 closing the top of the fan chamber and provided with openings 73' through which the partly treated air is discharged by the fans. We wish it to be understood that the arrangement of fans, motor, and transformer is purely illustrative and that other means for rotating the fans may be employed and that such means may be located either within the housing or on the exterior. The arrangement of the electric motors, transformer, and fans within the chamber just described, affords very compact arrangement, and by slidably mounting the plates 70 on angle irons 70', the entire assembly of fans and motors may be removed.

Bearing in mind our previous explanation, that the apparatus shown in this application is purely illustrative, and that for the purpose of convenience and understanding of the invention, we have mentioned that there may be four outlets connected to conduits leading to different rooms, and now referring to Fig. 12, the numeral C1 designates a thermostat located in one of the rooms, and C2, C3 and C4 designate thermostats located respectively in the other rooms, and each of the thermostats C1, C2, C3 and C4, being automatically operable in response to temperature changes to establish or close an electric circuit to operate valves in two of the secondary heaters. Referring again to the thermostat C1, it will be noted that electric wires 75, are also connected to one of the electro-magnets EM, and wires 76 are also connected to another of the electro-magnets EM. The valves in the header 29 operated by the said electro-magnets may be the ones in Fig. 7 mounted in the extensions *b* and *d*. Assuming that thermostat C1 is set to control or maintain the temperature of the air in rooms or terminal spaces served at 68°, and if the air in the said room should drop to a temperature below 68°, then the thermostat C1 will close circuits through the wires 75 and 76 to the electro-magnets to open valves in the extensions *b* and *d* and admit steam to the upper and lower secondary heaters with which the extensions *b* and *d* are connected. Thus, the temperature of the air passing these secondary heaters through the flue communicating with the particular room will be increased, and as the temperature in the room reaches 68°, one of the secondary heaters will be cut out, that is, either the circuits 75 and 76 will be opened, and when the temperature goes above 68° then both of the circuits will be open and

the valves in the extensions *b* and *d* will be closed. Any subsequent drop in temperature will cause one of the circuits to be closed to operate one of the valves 35 in either of the extensions *b* and *d*. Thus, all of the valves in the respective extensions on the header 29 connected to the secondary heaters will be controlled automatically by the thermostats in the respective rooms.

As previously mentioned, the invention also provides for maintaining the conditioned air at a predetermined amount of humidity, which is obtained by controlling the temperature of the spray water and which we may accomplish in several ways. First, a dew-point control element 77 located either in the air terminal spaces or the discharge duct of the machine for contact by the air which has passed the primary heaters and coolers through the spray chamber and secondary heaters and coolers, as shown in Fig. 12, is connected by wires 78 to the circuit 79 for effecting simultaneous operation of the valves 64 and 65 in the pump discharge. The dew-point control element is also connected by wires 80 to the circuit 80 for effecting simultaneous operation of the valve 66 controlling the heating medium of the water heater, and the valve 81 controlling the supply of the refrigerant or cooling medium to the water cooler. Assuming that the air contacting the dew-point control element 77 is of greater humidity than desired, the valve 64 will be opened and the valve 65 closed, so that the water will be pumped through the cooler to the spray nozzle. At the same time that the valves 64, 65, are respectively opened and closed, the valve 66 is also closed and the valve 81 opened, thus supplying refrigerant to the water cooler. If the condition of the air is such as to call for an increase in humidity, the valves 64, 65, will be operated reversely to the above, that is, the valve 64 will be closed and the valve 65 opened. When the valve 64 is closed and the valve 65 opened, the valve 66 is also opened and the valve 81 closed, so that the heating medium is supplied to the water heater through which the water is pumped to increase its temperature and the humidity content of the air. We would mention at this time that the valves 64, 65 in the pump discharge line are preferably by-passed.

Still referring to Fig. 12, it will be noted that a humidistat 82 may be provided in any of the rooms or air terminal spaces. This element may be set by the owner of the premises or person in charge to control at will the humidity content of the air. This element 82 is shown connected by wires 83 to circuits 79 for control of the valves 64, 65, and by wires 84 in the circuit 80 for control of the valves 66 and 81. The operation of the valves in response to the element 82 would be exactly the same as described in connection with the dew-point control 77. Preferably either the dew-point control element is provided or the humidistat elements 82 are provided, it not being necessary, nor, we believe, entirely desirable, to provide both.

The element 60 in the pump suction line affords another means of controlling the relative humidity of the air. This element can be set to control the temperature of the spray water at a predetermined degree, such degree determining the relative humidity of the air. Assuming that the water flowing through the pump suction line is at a temperature below that at which the element 60 is set, the element will contract and energize the circuit 79 through wires 85, closing the

valve 64 and opening the valve 65, and at the same time through the wires 86, closing the circuit 80, opening valve 66, and closing valve 81. If the temperature of the water running through the suction line rises above that at which the element 60 is set, then the valves 64, 65, and 66 and 81 are operated reversely, so that the water will be conducted through the cooler and hence to the spray nozzle.

Still referring to Fig. 12, it will be noted that the electro-magnets which operate the valves in the extensions *a*, *a'*, on the header 29 to control the admission of the heating medium to the primary heaters 21, are connected by wires 87 to cool air thermostat 88 which is preferably located in the air inlet conduit for direct contact with the entering air. This thermostat may be set at any point to operate the electro-magnets and valves 35 controlling the flow of heating medium to the primary heaters in response to the temperature of the entering air. It will thus be seen that the entering air may affect the element 88 to cause opening of the valves 35 controlling the flow of heating medium to the primary heaters, or the temperature of the air may be such that the valves will not be opened. In either event, the air is sucked down across the primary heaters and coolers through the baffles 23 and through the turbulent spray or mist at the top of the spray chamber, the temperature of which is maintained and controlled by any of the means hereinbefore described to humidify or dehumidify the air or gas. The air then passes on through the openings 26 in the walls 9, through the fans and past the secondary heaters and coolers in the several flues to the terminal space or rooms. If the dew-point control 77 is within the discharge ducts it will function as previously described. The air entering the terminal space or rooms, will, of course, contact the thermostatic elements C1, C2, C3 and C4, which may open and close the valves V controlling the respective secondary heaters.

It is obvious that a machine or apparatus may be furnished complete in the forms shown in Figs. 1, 2 and 11 with all of the parts assembled in compact form, it only being necessary when the device is installed to admit water to the trough 24 which is done by coupling the pipe 47 to a source of water supply. The thermostatic and/or humidistatic elements are installed in the rooms or area to be served with the air, and electric wiring is completed between the installed electro-magnetic valves and the humidistatic and/or thermostatic devices.

We wish it to be understood that the exact form shown in the drawings is purely illustrative of one preferred embodiment of the invention and that numerous alterations and modifications may be made at will. For instance, the primary and secondary heaters may be in the nature of coils such as shown and described, or heavy straight pipe provided with surface extension fins and connected to suitable headers, the dimensions being such as to fit within the flues. We also wish it to be understood that a machine constructed in accordance with our invention and embodying the features above described may be made in various sizes or shapes to supply requisite amount of conditioned air to any number of rooms or to large auditoriums, factories and the like. We believe that for all commercial purposes it may be best to build the machines of a standard size and capacity to supply a predetermined amount of conditioned air to areas of predetermined size, and if

the area to be supplied is greater than the capacity of the machine, to simply accumulate two or more machines which may be arranged side by side as shown in Fig. 13. A single source of supply of heating medium for the primary heaters, secondary heaters, and spray water, will serve any number of machines, and the same is true of the refrigerant and water and electric supply.

In the description of the operation of the machine in connection with Fig. 12, we do not deem it necessary to describe the primary and secondary coolers, as these can be operated and controlled in the same manner as the primary and secondary heaters. If the apparatus is to serve as a heating plant the cooling coils in the flues 15 and stacks may be omitted, and only the heaters installed, such arrangement being shown in Fig. 11.

The motors for rotating the fans and the pump would preferably be provided with variable speed controls. Furthermore, we deem it advisable to provide both manual and automatic means for starting and stopping the motors. Such automatic means might be a temperature responsive element located for contact by the air, and which, should the air reach an undesired temperature will, through proper electric circuit in which the element and motors are connected, stop operation of the motors.

The flow of the air in a direction opposite to the flow of the spray is especially important in connection with the construction and arrangement of the spray chamber and the projection of the spray accomplishing atomization or impact expansion of the spray by its impingement against the top of the chamber, whereby the spray is broken into a finer mist than otherwise possible and through which the entering air must pass to effect uniform and thorough coadmixture, or absorption by the air. Since the invention is well adapted to the production of a low pressure apparatus, it is preferable to provide for the downward flow of air directly against the upward flow of spray water and through the mist created by the impingement or impact of the water against the parts at the top of the chamber, and this arrangement as previously explained, provides for handling a great volume of air in a relatively small space, and operating at low pressure.

We claim:

1. Air conditioning apparatus comprising a unitary housing having an air inlet, a heater in said housing disposed in the path of the entering air, a spray chamber in the bottom of said casing, means to project a spray of water in said chamber in a direction opposite to the direction in which the air enters said chamber and with great turbulence at the portion of said chamber which the air first enters, delivery flues communicating with said spray chamber, means to draw air through said inlet and spray chamber and to deliver it through said flues, heaters in said flues, means to regulate the temperature of the spray water in response to the humidity of the delivered air, means to automatically regulate the temperature of the heaters in said flues in response to the temperature of the delivered air, and means to regulate the temperature of the heater in the housing in response to the temperature of the entering air.

2. Air conditioning apparatus comprising a housing, a spray chamber within said housing, an air inlet leading into said spray chamber, means to create a turbulent spray of water in

said chamber with greatest turbulence at the portion of the chamber which the air first enters, a water heater, a water cooler, means automatically operable in response to the humidity of the air which has passed through said spray chamber to cause the water to be sprayed to flow either through said heater or through said cooler, means to cool the air in advance of entry into the spray chamber, and means responsive to the temperature of the entering air to control said air cooling means.

3. Air conditioning apparatus comprising a housing, a spray chamber within said housing, an air inlet leading into said spray chamber, means to create a turbulent spray of water in said chamber with greatest turbulence at the portion of the chamber which the air first enters, a water heater, a water cooler, means automatically operable in response to the humidity of the air which has passed through said spray chamber to cause the water to be sprayed to flow either through said heater or through said cooler, means to heat the air in advance of entry into the spray chamber, and means responsive to the temperature of the entering air to control said air heating means.

4. Air conditioning apparatus comprising a unitary housing having an air inlet and a plurality of air outlets for connection respectively with a conduit to conduct air into the housing and conduits to conduct the air away from said housing, a spray chamber within the housing communicating with said air inlet, flues communicating with each of said outlets and with said spray chamber, means to cause the air to flow through said inlet, spray chamber and flues, means to heat the entering air, means to cool the entering air, an air heater in each of said flues, an air cooler in each of the flues, and means responsive to the temperature of the areas to which the air is delivered from said outlets and flues to control the air heaters and coolers in the respective flues.

5. Air conditioning apparatus comprising a housing having an air inlet and a plurality of air outlets for connection respectively with a conduit to conduct the air into the housing and conduits to conduct the air away from the housing to spaces to be served, a spray chamber within the housing communicating with said air inlet, means to project the spray of water toward the air inlet in a direction opposite to the direction in which the air travels when entering the spray chamber, means to accomplish atomization of the spray in the region of the chamber which the air

first enters, flues communicating with each of said outlets and with the spray chamber, means to cause the air to flow through said inlet, spray chamber and flues, an air heater in each of said flues, means responsive to the temperature of the spaces to which the air is delivered to control the air heaters in the respective flues, an air heater disposed in the path of the entering air in advance of the spray chamber, means to control the temperature of said heater, and means responsive to the humidity of the air passing from said outlets to control the temperature of the spray.

6. Air conditioning apparatus comprising a housing having an air inlet and a plurality of air outlets for connection respectively with a conduit to conduct the air into the housing and conduits to conduct the air away from the housing to spaces to be served, a spray chamber within the housing communicating with said air inlet, means to project the spray of water toward the air inlet in a direction opposite to the direction in which the air travels when entering the spray chamber, means to accomplish atomization of the spray in the region of the chamber which the air first enters, flues communicating with each of said outlets and with the spray chamber, means to cause the air to flow through said inlet, spray chamber, and flues, an air heater disposed in the path of the entering air in advance of the spray chamber, and means to control the temperature of said last heater.

7. Air conditioning apparatus comprising a housing having an air inlet and a plurality of air outlets for connection respectively with a conduit to conduct the air into the housing and conduits to conduct the air away from the housing to spaces to be served, a spray chamber within the housing communicating with said air inlet, means to project the spray of water toward the air inlet in a direction opposite to the direction in which the air travels when entering the spray chamber, means to accomplish atomization of the spray in the region of the chamber which the air first enters, flues communicating with each of said outlets and with the spray chamber, means to cause the air to flow through said inlet, spray chamber, and flues, an air heater disposed in the path of the entering air in advance of the spray chamber, means responsive to the temperature of the entering air to automatically control the temperature of said last heater.

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