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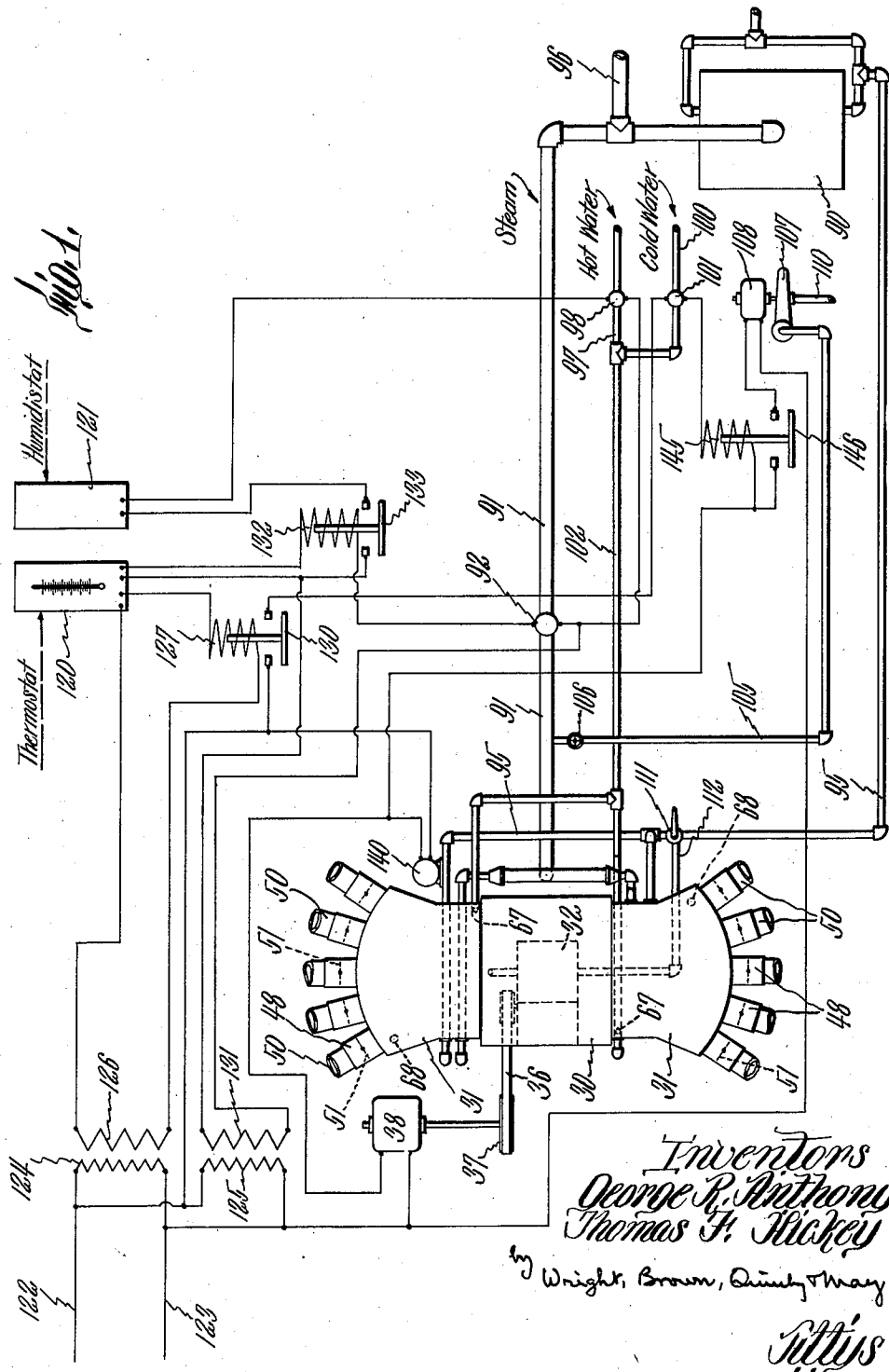
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1,993,539

APPARATUS FOR CONDITIONING AIR

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3 Sheets-Sheet 1



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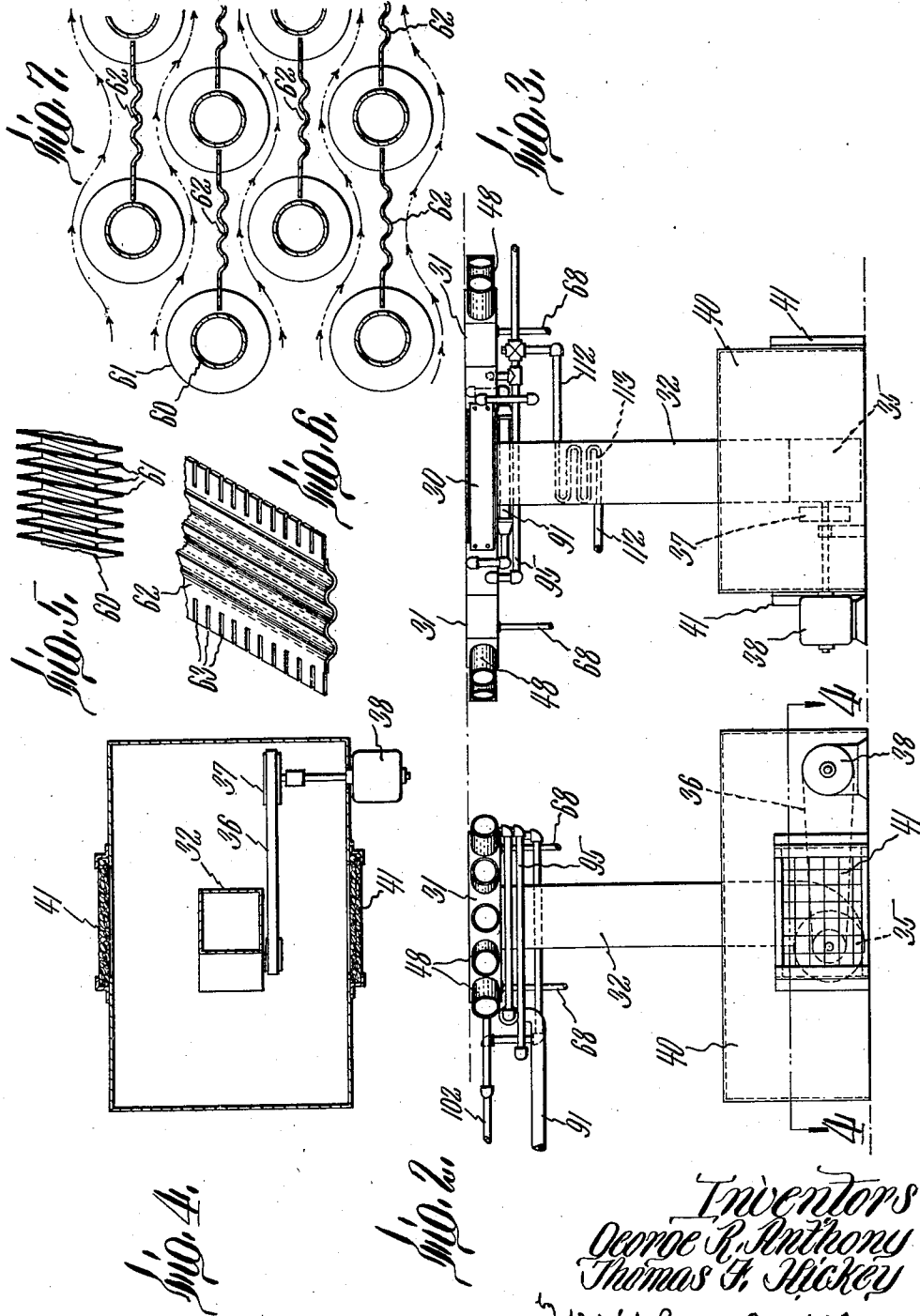
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3 Sheets-Sheet 2



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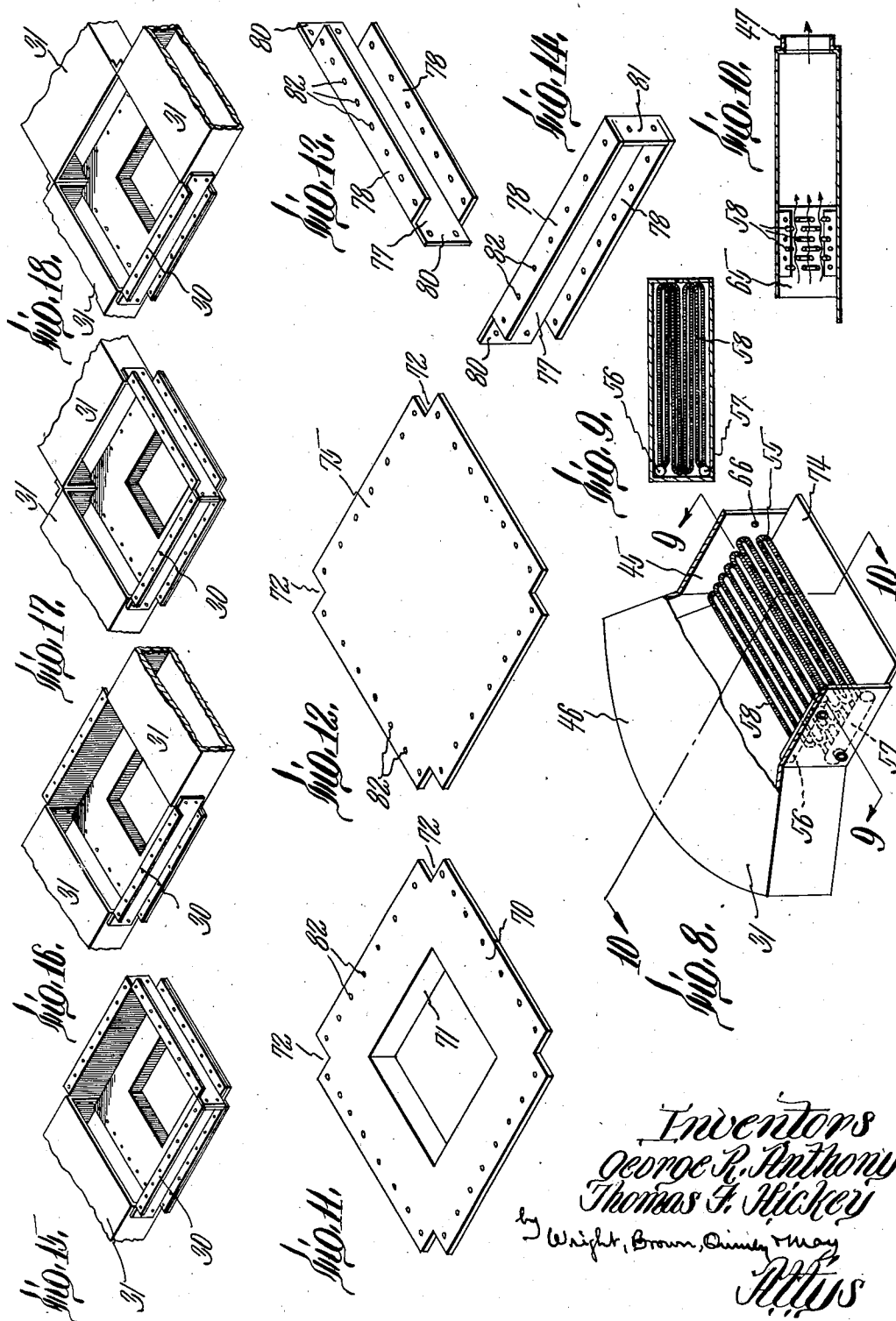
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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APPARATUS FOR CONDITIONING AIR

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4 Claims. (Cl. 257-9)

This invention relates to apparatus for conditioning air to be supplied to dwellings and the like. It is an object of the invention to provide apparatus which is within reach of the householder of ordinary means. To this end the apparatus is designed for the utmost simplicity consistent with efficient and satisfactory service so that installations can be made with standardized parts of minimum variety.

It is a further object of the invention to provide apparatus that shall be automatic in operation and so be effective in maintaining the atmosphere of a building such as a dwelling at any desired condition of temperature and relative humidity within its range of operation.

The embodiment of the invention described and illustrated comprises one or more distributor units which can be readily assembled in any desired number, according to the requirements of the particular installation with a suitable blower and with steam and water supply pipes, automatic controls being provided to regulate the operation of the several instrumentalities. Each distributor unit contains a heating or cooling and moistening unit.

For a more complete understanding of the invention, reference may be had to the description thereof which follows and to the illustration thereof on the drawings, of which

Figure 1 is a diagrammatic showing of a typical installation, including control instruments.

Figure 2 is an elevation of the air supply apparatus illustrated in Figure 1.

Figure 3 is an elevation of the same from a different angle.

Figure 4 is a section on the line 4-4 of Figure 2.

Figure 5 is a fragmentary elevation of radiator tubing used in each heating unit.

Figure 6 is a baffle member which may be employed in the heating unit.

Figure 7 is a fragmentary sectional view of a heater unit showing an arrangement of baffles with the radiator pipes.

Figure 8 is a perspective view of a distributor unit.

Figure 9 is a section on the line 9-9 of Figure 8.

Figure 10 is a section on the line 10-10 of Figure 8.

Figure 11 is a perspective view of a bottom plate for the central air chamber.

Figure 12 is a perspective view of a ceiling plate for the same.

Figures 13 and 14 are perspective views of blanking plates for sides of the central air chamber.

Figures 15 to 18 are perspective views of various assemblies of one or more distributor units with the bottom and side plates of the central air chamber.

Referring to Figures 1 to 4, a typical installation is herein illustrated with two distributor units. As shown, this installation comprises a central air chamber 30 which is adapted to be attached to the ceiling of a cellar or to any suitable overhead support. As illustrated, this central chamber is square, but it is to be understood that it may have a circular contour or be in the form of a polygon of any suitable number of sides. Leading from the central air chamber 30 are one or more distributor units 31, two such units being shown in Figure 1 by way of illustration. The number of distributor units which can be used with the square central chamber is from one to four. In any given installation, the number employed will be determined by the particular requirements in each case. Air is supplied to the air chamber 30 through an up-take 32 which leads from a suitable fan or blower 35 driven by any suitable means. As shown, the fan is connected by a belt 36 to a pulley 37 mounted on the shaft of an electric motor 38. As indicated in Figures 2 and 3, the fan and driving belt may be mounted within a casing 40, the motor shaft passing through the wall of the casing, so that the motor may be outside of the casing. One or more suitable air filters 41 are mounted in the wall of the casing 40 so as to purify the air entering the distributing system from the outside atmosphere or as re-circulated from the building. These filters may contain any suitable filter material, such as spun glass, which will catch and retain the dust carried by the atmosphere outside the casing. These filtering units are preferably adapted for easy replacement. The distributor units 31 are made in standard form so as to be interchangeable. By using one or more of these units, installations may be easily adapted for the requirements of dwellings or other buildings from a small sized house up to a house of the order of twenty rooms.

As shown in Figures 1 and 8, each unit 31 consists of a casing or housing enclosing a rectangular chamber 45 opening into a sector-shaped chamber 46. In the arcuate side of this sector-shaped chamber a series of openings are provided surrounded by collars 47 (Figure 10) each adapted to hold a connecting sleeve 48 from which an air pipe 50 leads to any desired portion of the house. Each connector sleeve 48 is provided with a butterfly damper 51 which is

adapted to be fixed in adjusted position when the apparatus is first installed so as to distribute the air currents properly to the various portions of the house. Ordinarily, these dampers need not thereafter be touched. The shape and arrangement of the distributor unit with the several air pipes attached thereto promote even and satisfactory distribution of the air which enters the unit.

In the rectangular chamber 45 of each distributor unit is mounted a heating or cooling unit 55. As shown the heating or cooling unit consists of a supply header or manifold 56 and a discharge or return header 57. Connecting these headers are a number of coils 58 of radiator piping, the pipe in each coil preferably having reverse bends to follow a path back and forth across the chamber 45. Six such coils 58 are illustrated in Figure 8, but it is obvious that a larger or smaller number may be employed if desired. As indicated in Figures 9 and 10, the pipes in alternate coils are staggered so that the transverse stretches of pipe in each coil are horizontally opposite the spaces between stretches of piping in the next adjacent coil. This causes the air passing through the heating or cooling unit to follow a tortuous or wavy path, as indicated in Figures 7 and 10, thus bringing substantially all of the air into close proximity to some portion of the heated or cooled surface of the unit. In order to provide efficient heating action in relatively small compass, it is preferred to employ tubing such as is illustrated in Figure 5, this tubing consisting of a tubular core 60 having thin fins 61 extending radially therefrom to afford a large heated surface for contact with air passing through the unit. For efficient operation, we preferably employ tubing of any suitable material such as copper or aluminum, this tubing having such fins formed integrally thereon. This results in conduction of heat from the core to the fins with maximum efficiency. In the form of tubing shown in Figure 5, the fins are in the form of helical turns which may be formed on the exterior of a tube by a spinning process. The air passing through the unit is exposed to heated surfaces of large aggregate area, these surfaces being so arranged that practically all of the air must pass in close proximity to some portion thereof, as is evident from Figure 7. By such means, a stream of air can be efficiently heated by a heating unit of relatively small and compact size. If desired, baffle plates 62 may be employed between successive stretches of piping in the same horizontal plane to guide the air passing through the unit and to contain water for humidification. These baffles may be corrugated, as illustrated in Figure 6, and notched along the edges as at 63 to receive the fins of the tubes between which the baffles extend.

Referring to Figures 8 and 10, the heating unit 55 is spaced from the air supply end of the distributor unit so that a space is left therein for use as a spray chamber 65. Through a side wall of the spray chamber a perforation 66 is provided for a spray nozzle 67 (Figure 1) which can be of any desired construction adapted to produce a spray of suitable fineness. The spray from the nozzle 67 is projected across the stream of air entering the distributor unit, and is thus carried immediately into contact with the heated surfaces of the heating unit 55. The fine droplets are thus converted into aqueous vapor by contact with the heated surfaces. If baffles 62 are employed in the unit, excess spray may be

caught thereon. As these baffles are heated by radiation from and by contact with the radiator tubes, the water which collects thereon will tend to evaporate so as to increase the humidification of the air passing through the unit. In case the water supplied through the spray is in excess of the evaporating capacity of the heating unit, the excess may be drained from the distributing unit as by a suitably trapped outlet pipe 68, the distributing units 31 being preferably mounted with a slight inclination so that free water therein will tend to flow toward the drain pipes 68. The drain pipes 68 are of sufficient capacity to lead off the entire volume of water entering through the spray, since when cold water is sprayed into the distributor unit, as in summer time, little if any of this water is evaporated. On the contrary, moisture entering with the air may be condensed by the spray so that the volume of water leaving the distributor unit through the pipe 68 would be greater than that entering the unit through the spray.

Sheet 3 of the drawings illustrates various arrangements which may be made with the standardized distributor units 31. One or more of these units are secured to the bottom and ceiling plates of the central air chamber 30, forming lateral ducts leading from the air chamber through the heating or cooling units. The remaining sides of the central chamber consist of suitable blanking elements such as are illustrated in Figures 13 and 14. The two shapes therein shown are sufficient to meet the requirements of any of the various arrangements illustrated in Figures 15 to 18. Hence complete equipment for any variety of installation employing from one to four distributor units can be carried in stock with a minimum number of items. In forming the central air chamber, a bottom plate 70 is employed, this preferably consisting of a flat plate centrally cut so as to provide portions to be bent down as at 71 to form a collar on which the end of the up-take 32 is fitted. The corners of the plate 70 may be notched as at 72 so that the marginal portions of the plate may project into the mouth of a distributor unit 31 so as to form a tight joint with the bottom member of the distributor unit. This bottom member may project beyond the side walls and top of the unit as at 74 in order to afford ample overlap for a tight joining of the abutting surfaces. A ceiling plate 75 is employed as the top of the central air chamber. This ceiling plate may be bolted or otherwise secured to the ceiling of a cellar, or other suitable support, so as to assist in carrying the weight of the assembled central air box and distributing units. For additional support, iron straps (not shown) may be passed under the units 31 and secured to the ceiling of the cellar or other overhead support. The plate 75 is preferably of the same external dimensions as the bottom plate 70 being similarly notched as at 72 to receive the side walls of one or more distributing units 31.

The blanking plates may be provided in two shapes as shown in Figures 13 and 14. Each of these plates consists of a flat portion 77 with bent up side flanges 78. The flat portion 77 projects beyond the flanges forming a pair of tongues 80 in the plate illustrated in Figure 13. One of these tongues 80 may be bent up to form an end flange 81 as shown in Figure 14. These plates are selectively used as required in assembling the different numbers of distributor units which may be required for different installations,

as illustrated in Figures 15 to 18. The various elements constituting the air delivery apparatus may be secured together by any suitable means such as bolts and nuts suitably spaced along the joints. The plates may be provided with suitable bolt holes 82 for such purpose, these holes being properly spaced by a suitable template or otherwise so as to register when the plates are assembled. Thus the air-distributing portion of the apparatus can readily be installed without the use of special tools, standardized parts being employed to fit together.

The apparatus thus far described is intended for assembly with apparatus for supplying heat, cold and moisture, as required for the proper conditioning of the air to be supplied to the building served by the apparatus. The heat may be conveniently supplied in the form of steam produced in a steam boiler 90 of suitable size and construction for the service required, this boiler being supplied with automatic fuel-regulating devices so as to maintain in the boiler a desired pressure, as for example two pounds or so. A steam pipe line 91 leads from the boiler to a control valve 92, and thence to the supply manifolds of the one or more heating units 55. A return line 95 is provided, this line bringing the condensate back to the boiler 90. In case it is desired to heat certain portions of the house or adjoining buildings by direct radiation, a branch pipe 96 may lead from the steam line to suitable radiators for heating in the usual manner. Hot water for the sprays may be supplied through a suitable pipe 97 controlled by a valve 98, cold water for the sprays being supplied through a pipe 100 controlled by a valve 101. These valves are preferably electrically operable. The pipes 97 and 100 lead through a joint supply pipe 102 to the one or more nozzles 67 employed in the distributor units. Thus by opening the valve 98 or the valve 101, either hot or cold water may be sprayed into the spray chambers.

If desired, chilled or refrigerated water may, in hot weather, be circulated through the heating units 55. To this end a supply pipe 105 for such chilled water may be connected to the steam pipe 91 between the valve 92 and the units 55, the pipe 105 having a valve 106 which is kept closed in winter time. The steam valve 92 will, of course, remain closed during hot weather. The pipe 105 leads from a suitable circulating pump 107 by a suitable motor 108, the pump being supplied from a suitable refrigerating unit (not shown) through a pipe 110. The steam return line 95 is provided with a two-way valve 111 by which the steam return may be closed and connection made at the same time to a cold water return 112 leading to the refrigerating unit. If desired, the return line 112 may be passed through a suitable radiator unit 113 (Figure 3) which may be mounted at any convenient point in the air stream, as for example, in the up-take 32, to provide additional cold surface for contact with the stream of air supplied by the blower 35. Such additional contact surface is often desirable owing to the smaller temperature difference between atmospheric air and chilled water, as compared with the temperature difference between atmospheric air and steam.

Control mechanism for this purpose may include a double thermostat 120, adapted to respond to excessive chill in winter time or excessive heat in summer time, and a humidostat 121 responsive to conditions of humidity in the vicinity of its location. These instruments, which are

well known in the art and need no detailed description, contain electric switches by which valves or other electrically operated apparatus may be controlled. Electrical energy for operating the control portions of the apparatus may be supplied from any suitable source such as the usual 110-volt alternating current commonly supplied for lighting purposes. By way of illustration, the installation illustrated diagrammatically in Figure 1 is adapted for use with such a supply as through line wires 122, 123. To these line wires are connected in parallel the primary coils 124 and 125 of a pair of step-down transformers, also power circuits to the motors 38 and 108. The secondary coil 126 of one of these transformers is adapted to deliver a current of suitable voltage such as 20 volts to a circuit in which are connected the cold side of the thermostat 120 and the solenoid 127 of a relay switch 130. The secondary coil 131 of the other transformer is adapted to deliver a suitable voltage to a circuit including the hot side of the thermostat 120, the solenoid 132 of a relay switch 133 and the solenoid which operates the steam valve 92. In parallel with the steam valve 92 a branch circuit extends through the hot water valve 98, the humidostat 121, and the terminals of the switch 133. When the thermostat 120 responds on its hot side to a deficient temperature in its location, the solenoid 132 is energized to close the switch 133 and the steam valve 92 is opened. The opening of the steam valve supplies steam at once to the heating units since steam is constantly maintained under suitable pressure in the boiler 90. At the same time, the closing of the switch 133 puts the humidostat 121 into an otherwise closed circuit so that the humidostat is thus rendered effective to cause the opening of the hot water valve 98 if the relative humidity of the atmosphere of its location is deficient. The motor 38 which drives the blower 35 may be connected across the 110-volt supply in series with a switch controlled by a thermostat 140, this thermostat being mounted on the return line 95 of one of the heat units so as to close its switch when the heating units have been heated by steam from the boiler. Thus, when the steam valve 92 is turned on, the units are customarily cold and the switch controlled by the thermostat 140 is opened so that the blower is not operating. As soon as the steam heats up the units 55 so that they are ready for a stream of air, the return pipe 95 is thus heated by returning steam so as to close the switch of the thermostat 140 and thus to start the operation of the blower. Thus in winter time the blower operates only when the heating units are properly heated, and forced drafts of cold air into the rooms of the house are avoided.

In warm weather the relay switch 130 closes a circuit passing through the cold water switch 101 and the motor 38, this circuit cutting around the thermostat 140 so as to be independent thereof. Thus when the cold side of the thermostat 120 responds to excessive temperature in its locality, it operates to close the switch 130 and thus to start the blower to send air into the rooms. At the same time the cold water valve 101 is opened to deliver a cool spray into the spray chambers. This washes and cools the air stream, and to some extent regulates the humidity thereof.

If a refrigerating unit for the supply of refrigerated water for circulation in the heating units 55 is included in the installation, the circuit controlled by the switch 130 also includes the sole-

noid 145 of a relay switch 146. This switch closes a circuit through the motor 108 so that when the switch 130 closes, the cold water spray is turned on, the blower is started, and the circulation pump 107 is started. This additionally cools the stream of air supplied by the blower, and also condenses out superfluous vapor which such air may contain when it passes the blower.

It is evident that any variations and modifications may be made in the particular embodiments of the invention herein shown and described without departing from the spirit or scope thereof as defined by the following claims.

We claim:

1. Air conditioning apparatus comprising a blower, an up-take extending upwardly therefrom, a junction housing at the upper end of said up-take, the housing comprising an apertured bottom piece secured to the upper end of the up-take, a top piece above the up-take, and a series of side pieces enclosing a chamber between said bottom and top pieces, said side pieces consisting of one or more distributing units and a sufficient number of blanking plates to complete the enclosure of said chamber, said units and plates being interchangeable with each other.

2. Air-conditioning apparatus comprising an apertured bottom plate, a ceiling plate spaced above said bottom plate, and a series of interchangeable units joined to said plates around

their peripheries to enclose with said plates an air chamber, said units including one or more distributors each having a heat-exchange member therein.

3. Air-conditioning apparatus comprising an apertured bottom plate, a ceiling plate spaced above said bottom plate, and a series of interchangeable units joined to said plates around their peripheries to enclose with said plates an air chamber, said units including one or more distributors each having a heat-exchange member therein spaced from the interior of said chamber, and a spray-nozzle adapted to project spraying to the space between the heat-exchange member and the interior of the chamber.

4. Air-conditioning apparatus comprising a cabinet having an inlet opening and an outlet opening, an air-filter in said inlet opening, an air-duct leading from said outlet opening, and distributing means communicating with said duct, said means including a bottom plate apertured to receive said duct, a ceiling plate spaced above said bottom plate, and a series of interchangeable units secured about the peripheries of said plates to enclose therewith an air-chamber, said units including one or more distributors opening into said chamber, each distributor having a heat-exchange member therein.

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