Sept. 8, 1936. E. F. WHITE 2,053,647

APPARATUS FOR CONDITIONING AIR

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Fig. 1.

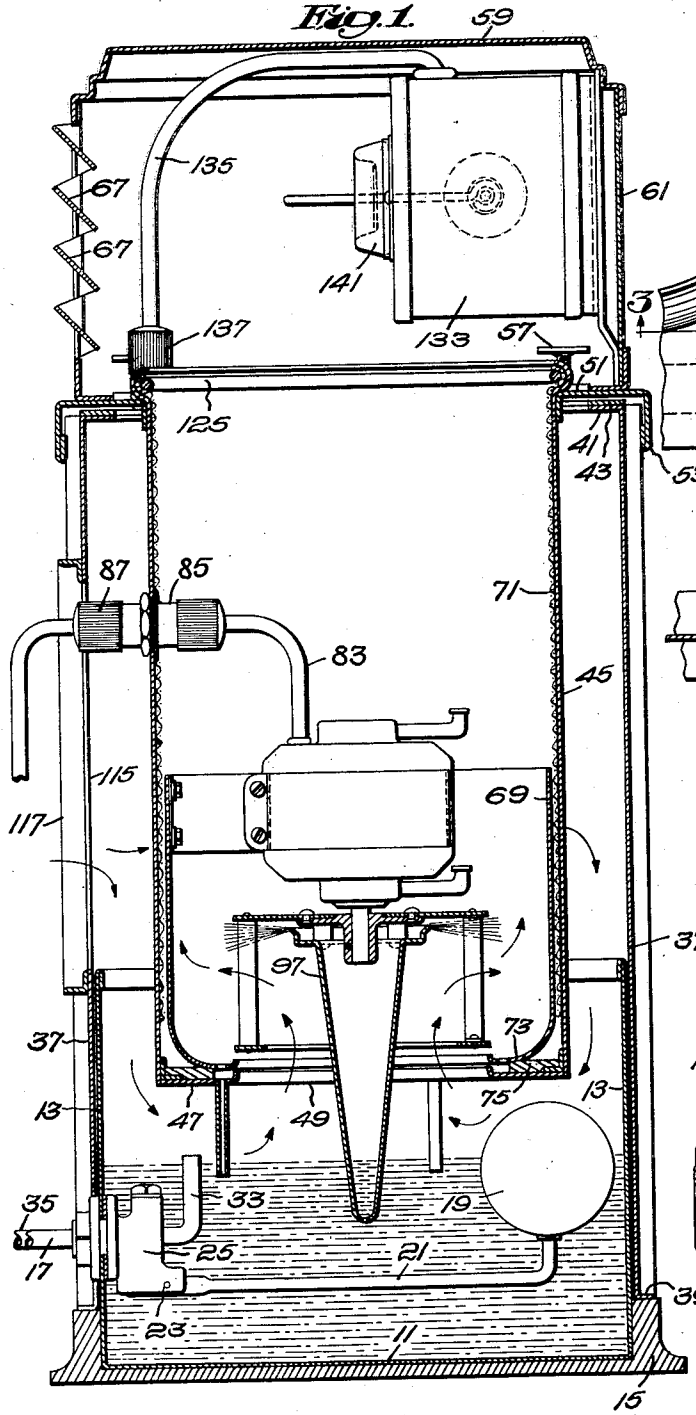


Fig. 2.

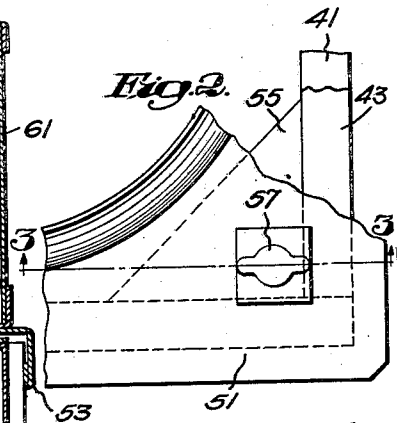


Fig. 3.

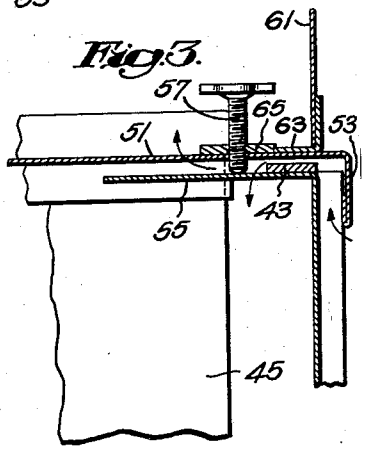
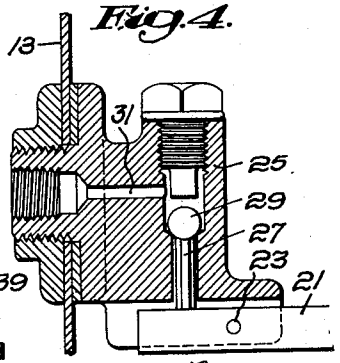


Fig. 4.



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Fig. 5.

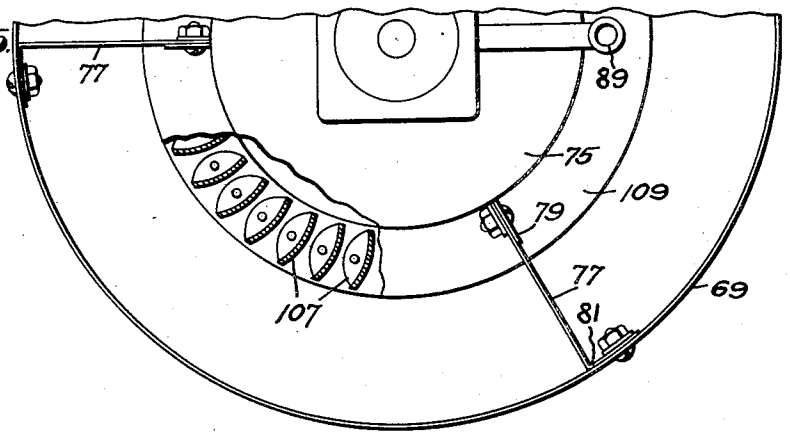
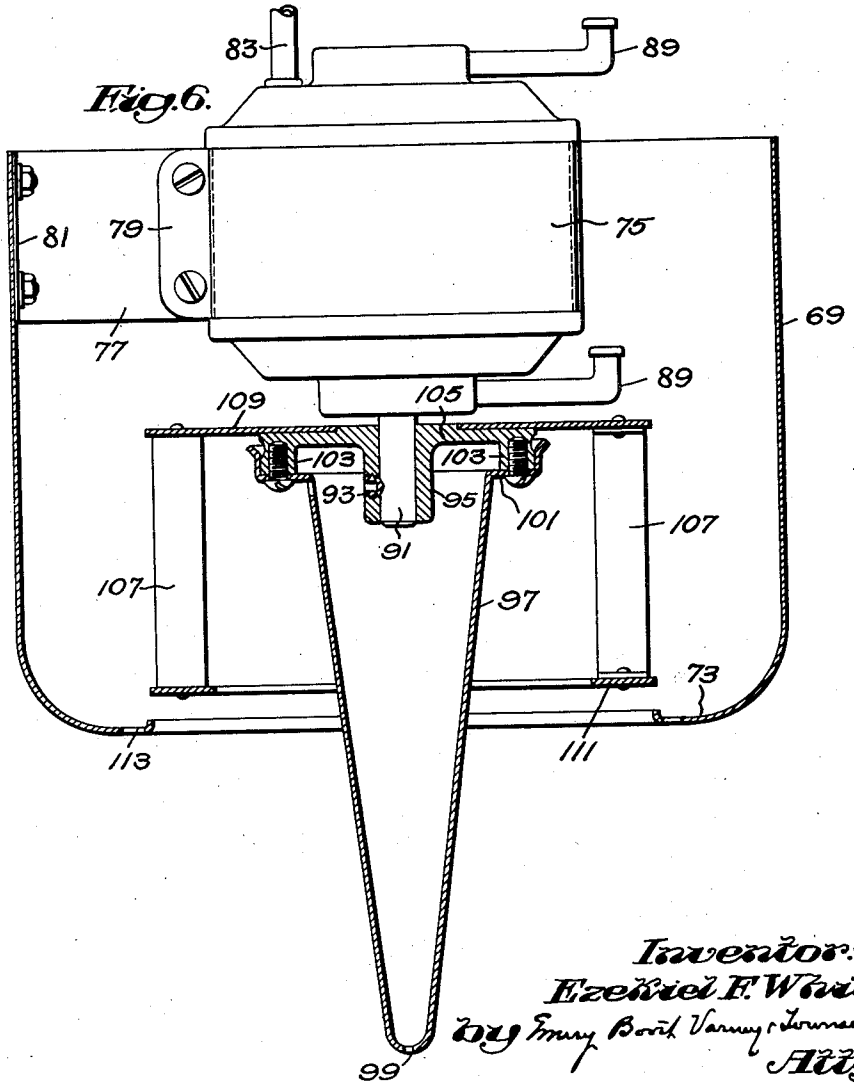


Fig. 6.



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Fig. 7.

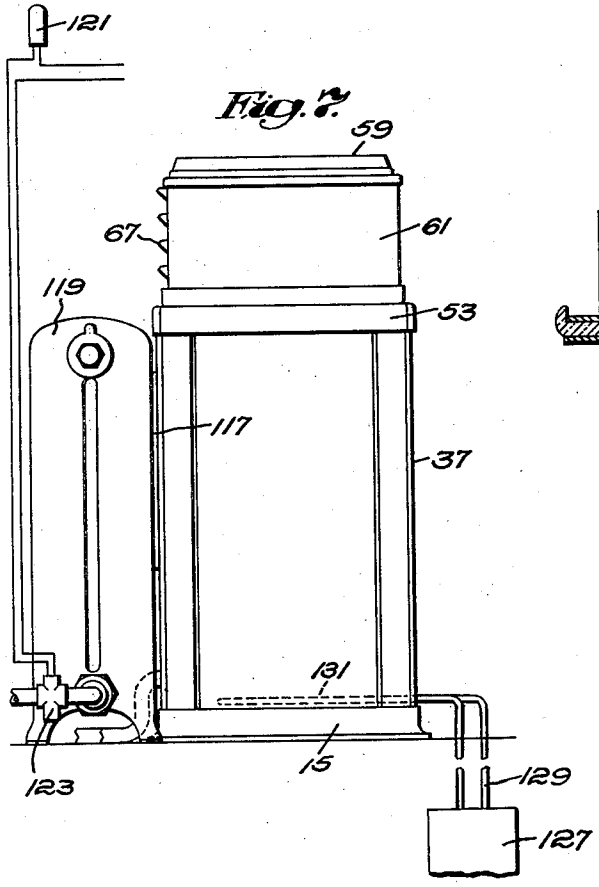


Fig. 8.

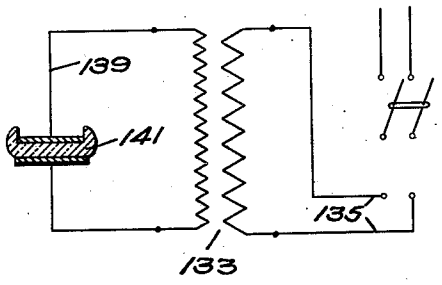
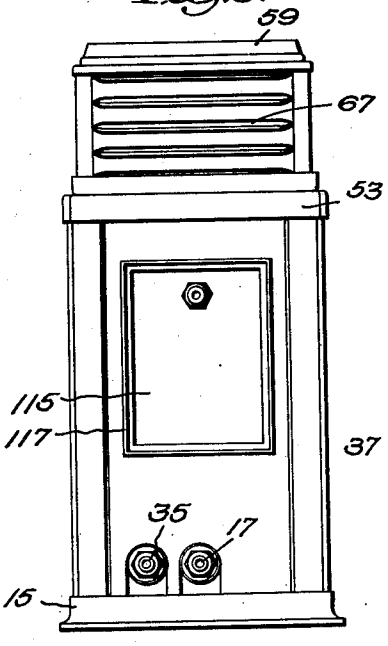


Fig. 9.



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UNITED STATES PATENT OFFICE

2,053,647

APPARATUS FOR CONDITIONING AIR

Ezekiel F. White, West Hartford, Conn.

Application March 6, 1933, Serial No. 659,751

3 Claims. (Cl. 261—91)

This invention relates to methods of and apparatus for conditioning air, and more particularly in respect to the temperature, humidity, cleanliness and revitalization, and has for its object the production of a small, compact and relatively inexpensive but complete and effective, air conditioning apparatus which effectively controls the conditioning of the air in the home, office or other places of like nature, without the necessity for the large or elaborate installations now commonly required.

Certain conditions should be met in such a system. The dry bulb temperature of the air in the room or compartment in question should be automatically maintained within a few degrees of some desired, predetermined point; the air in the room should be kept under constant circulation, should be thoroughly washed to eliminate dust and other foreign and injurious impurities, and should have imparted to it at all times the proper degree of humidity by the introduction into it of an amount of aqueous vapor dependent on and regulated by the conditions of the outside air.

These and other desirable conditions, as well as the revitalization of the air by the addition of ozone to the purified and humidified air of the room, are provided for in the hereinafter described embodiment of the invention, the latter permitting the installation of a small, simple and relatively inexpensive apparatus directly in the living room of the house, or in the office or other room being dealt with, without the necessity of more or less elabrate air ducts and remote conditioning apparatus and merely, if desired, through its association with the radiator or other heating unit in the room in combination with suitable means for controlling the radiator temperature.

The invention will be best understood by reference to the following description when taken in connection with the accompanying illustration of one specific embodiment thereof, while its scope will be more particularly pointed out in the appended claims.

In the drawings:—

Fig. 1 is a central, sectional elevation showing an apparatus embodying one form of the invention;

Fig. 2 is a plan view of a portion of one corner of the top plate for the cylindrical humidifying and purifying chamber, showing the adjustable support therefor on the casing;

Fig. 3 is a section on the line 3—3 in Fig. 2, showing also a wall of the cabinet, the top of which is removed in Fig. 2;

Fig. 4 is a central, sectional elevation on an enlarged scale of the water supply valve;

Fig. 5 is a plan view, in partial section, of the removable humidifying unit comprising motor, fan and pump;

Fig. 6 is a central, sectional elevation of the humidifying unit shown in Fig. 5;

Fig. 7 shows the relationship of a humidifying and purifying device, such as shown in Fig. 1, to a room radiator;

Fig. 8 is a diagrammatic representation of the electrical connections to the ozone generator, and

Fig. 9 is a side elevation of the mouth or receiving side of the humidifying, purifying apparatus shown in Fig. 1.

Referring to the drawings and to the embodiment of the invention there shown for illustrative purposes, the humidifying and purifying apparatus (Fig. 1) comprises a liquid receptacle or container in the form of a preferably metallic chamber of rectangular cross section having a bottom wall 11 and side walls 13, the bottom fitting into a recessed body 15 of rubber or other resilient material which constitutes a sound deadening support for the entire apparatus.

Means are provided for maintaining in the liquid chamber a body of liquid, such as water, the same comprising a pipe connection 17 leading to a main source of water supply under pressure, such as an ordinary water main, admission to the water receptacle being regulated to provide an adequate supply of water, preferably at an approximately constant level such as is indicated in Fig. 1, by means of a valve controlled by the float 19. The float is connected to the float arm 21 pivoted at 23 to the valve casing 25 which is secured to a wall 13 of the water container and carries near its end a vertical pin 27 (Fig. 4) adapted to engage the end of the free ball valve and lift it from its seat to admit water from the port 31 and pipe connection 17 to the container and restore its normal level when the liquid level drops.

The described construction of valve results in a complete closing of the valve when the desired level is reached and a reasonably wide open position when the liquid level drops, avoiding the dribbling or sizzling noise of the water which accompanies the use of float control valves as ordinarily constructed.

Preferably there is also provided a safety overflow pipe 33 having an open mouth just above the

normal liquid level and having a drain pipe connection 35 to provide for the escape of surplus water in the event that the float valve fails to function.

Telescopically fitting over the side walls 13 of the water container is an outer casing 37, also of rectangular cross section, the bottom of the casing being outwardly flanged at 39 to rest on the walls of the rubber support 15 and having its walls extending well above the water container so as to form an outer enclosing cabinet for the structure. The open rectangular top mouth of the casing has an inturned flange 41 on which there is secured a strip of rubber 43 or other resilient packing material. The casing may, if desired, be lifted and withdrawn from the water container to permit the ready inspection and cleaning thereof.

Contained within the cabinet casing 37 there is provided a humidifying and purifying chamber comprising the cylindrical body portion 45, preferably of sheet metal, the bottom wall 47 of which has a central opening 49 and is spaced a short distance above the normal water level in the container. The cylinder is of such reduced diameter relatively to the cross-sectional dimensions of the casing 37 as to provide an air circulating space about the outer wall thereof. The top of the cylindrical chamber 45, which is also spaced slightly from the inner edge of the flange 41 of the casing or cabinet, has an open mouth, its side walls terminating in an outwardly rolled edge to form an internal groove, such side walls being permanently connected just beneath the rolled edge, as by welding or soldering, to the downwardly flanged inner edge of the top plate 51, which latter rests on the top edge of the cabinet and terminates in an internal down-turned edge 53 overlying and laterally spaced from the upper outside walls of the cabinet. The top plate 51 may rest directly on the rubber strip 43, closing the top of the air circulating space outside of the cylindrical humidifying and purifying chamber, or it may be spaced slightly above the same by an adjustable amount, for a purpose hereinafter described.

To this end, there is provided at each corner of the inturned flange 41 at the open top of the cabinet or casing 37 a small triangular plate 55 (Figs. 2 and 3) against the top of which there may bear a vertical adjusting screw 57 carried by the top plate 51 of the cylinder chamber 45 so that, by turning in one direction or the other the four adjusting screws provided at the top plate, the cylinder chamber with its top plate may be lowered to cause the bottom of the top plate 51 to seat against the rubber strip 43 and seal off the air circulating space against entrance of air at that point, or may be raised to provide an air admission opening thereto, as indicated in Figs. 1 and 3.

The apparatus is surmounted by a top comprising a box-like casing having the closed top wall 59 and the sides 61, the latter having secured thereto the inturned flange 63 which rests on the top plate 51, being aligned thereon by four small rectangular blocks 65 each of which forms also a threaded reinforcement for the adjusting screws 57. The top forms an air receiving chamber open at the bottom to communicate with the open mouth of the cylinder to receive the air delivered therefrom. One side wall of the top has an air delivery opening which is provided with the air deflecting vanes 67.

Referring now to the humidifying and purifying mechanism, this (as shown in Figs. 5 and 6 on an enlarged scale) comprises a bowl-shaped cylindrical member 69 containing and supporting the motor, fan and water sprayer. This member has an open mouth at the top and a central opening in its bottom registering with the central opening 49 in the cylinder 45. When installed (Fig. 1) it is positioned concentrically within the cylinder 45 but preferably has an outside diameter somewhat less than that of the inside diameter to permit the insertion and retention of a scrubbing wall 71 lining the walls of the cylinder above the upper edge of the bowl. The bowl with its motor, fan and water sprayer may be inserted in and removed from the cylinder as a unit, resting therein through its inturned bottom flange 73 on the ring 75 of resilient material, such as rubber, carried by the bottom wall 47 of the cylinder, this effecting a further deadening of any noise arising in the operation of the parts.

Secured within the upper part of the bowl 69 is a small motor 75 which is secured to the bowl to rotate about a vertical axis by means of a flexible but self-centering connection, the latter constituting the sole support for the motor and its driven parts and being such that all vibratory motor noise is substantially suppressed. This connection comprises thin but wide radial sheet metal strips 77, herein three in number, lying in planes parallel to the axis of the motor, the inner ends of which strips are secured by screws to radial wing pieces 79 fixedly fastened to the motor casing and the outer ends of which are bent to form flanges 81 which are screwed or bolted to the inner walls of the bowl. In starting or stopping, or under any variations in load or power supplied, the acceleration or deceleration of the motor is cushioned by the yielding action of the strip supports which are capable of bending, thereby preventing transmission to the other parts of the apparatus of shocks or vibration, thereby suppressing resultant noise.

The motor is provided with lead wire connections contained in the cable 83 adapted to be removably inserted in the socket 85 (Fig. 1) which are fixed in the walls of the cylinder 45 at a point above the top of the bowl, power being supplied through a socket and cable connection 87 connected to any suitable source of electrical energy, such as a wall socket in a room. Accessible oil connections for the motor bearings, such as the pipes 89, may be employed.

The motor shaft 91 projects downwardly from the lower end of the motor casing and has secured in depending relation thereto, as by the set screw 93, the hub 95 through which there is supported and driven an impeller comprising a centrifugal fan, and similarly a concentrically related device for raising and spraying laterally upon the blades of the fan the water from the water compartment.

Such spraying device comprises an upwardly flared, hollow, cone-shaped body 97, the lower, smaller end of which is submerged beneath the level of the water in the water compartment and is provided with an opening 99 in its bottom through which water enters from the tank up to the level maintained in the tank. The upper end of the cone has an outwardly turned flange 101 by which it is fastened through two or more depending lugs 103 to the bottom of a plate or disk 105 secured to the hub 95. The outer walls of the flange are outwardly and upwardly flared to form a distributing cup, the lip of which is spaced from the plate 105. When the cone is rotated by the

motor a film of water is drawn up in the side walls of the cone by centrifugal force, and entering the cup is discharged over the lip thereof in the form of an annular spray sheet.

The rotary water distributing cup is arranged concentrically within the centrifugal fan, the blades 107 of which (Figs. 5 and 6) are peripherally arranged and extend vertically across and a substantial distance below the path of the spray sheet. The blades 107 are secured at their upper ends to a plate 109 fixedly secured to the hub disk 105 to be driven therethrough from the motor. At the lower ends the blades are secured to an annular plate 111, the latter being spaced from the inturned flange 73 of the bowl but having its outer periphery slightly overlapping the upturned edge of the flange. The central opening in the plate 111 registers with the central openings in the bowl bottom and the cylinder, providing an air induction opening through which air is drawn centrally into the air induction opening formed interiorly of the fan and by the rotation of the blades is expelled radially outward therefrom.

To suppress the noise arising from the water discharged from the distributing cup and dripping back into the tank, such water, which is thrown by the action of the cup and the fan blades against the inner walls of the bowl, is drained into a groove formed by the upturned edge of the flange 73, and thence through a series of orifices 113 therein into a similar groove in the underlying bottom wall 47 (Fig. 1), and thence through a series of small pipes opening into said last named groove and extending downwardly beneath the level of the underlying body of water.

One side of the cabinet or casing 37 is provided with an air admission opening 115, herein rectangular in shape, through which there is admitted all air supplied to the air circulating space, except such, if any, as may be provided for by the adjustable air admission opening at the top of such space. The opening 115 is surrounded by a lip or flange so that the apparatus may be positioned with the air admission opening 115 in close confronting relation to the upright radiating units of a room radiator 119 (Fig. 7). The heating medium in the latter is automatically controlled with relation to the temperature of the room in which it is located by means of a room thermostat 121. The latter may act (as in Fig. 7) to control the radiator by direct control of the radiator valve 123 so as to render the apparatus effective in the case of an individual room constituting one of many, the radiators of which are supplied from a common heater, or it may act by the distant control of the heater itself from which such heating medium is supplied, so long as the dry bulb temperature of the air in the room may be automatically maintained in close approximation to or within a few degrees of some fixed, selected point.

In the operation of the apparatus, with the motor connected to the power circuit, the fan serves to draw in air through the admission opening 115. The air enters directly from between the radiator units so that its temperature varies with the temperature of the radiator, which in turn is raised or lowered under the control of the thermostat, and, generally speaking, inversely with changes in the out-of-doors temperature. The air entering the annular air circulating space is directed downward, striking the surface of the water, after which it is deflected upward and drawn centrally into the fan about the cone 97. Relatively heavy particles of dirt, dust and the like become separated from the air due to their greater inertia and are deposited in the water, thus in part cleansing the air. The air then passes radially outward between the fan blades, being discharged tangentially therefrom under a relatively high velocity. It is then directed upward and in a spiral path about the interior walls of the bowl and the cylindrical casing.

The water raised by the cone 97 and discharged by the cup is projected tangentially from over the lip thereof in the form of a fine spray impinging on the blades of the fan which rotate in an orbit, passing through the path of the spray. The water is thrown violently outward by the fan blades through and across the current of air, providing an effective cleansing action for the air as to impurities which have escaped the previous separation, to which cleansing is also added the effect of the beating of the air by the wet blades. The larger particles of water collect on the inner surface of the bowl, whence they are drained down into the water compartment below. The more minute free particles of water may be carried somewhat farther along by the air and are finally deposited on the inner walls of the cylinder, keeping the latter wet, and being further exposed to the vaporizing action of the air forced over and in contact with such walls.

The spiral path established for the air in its upward passage through the cylindrical chamber provides in a very compact space an elongated surface of contact for the deposition and elimination of surplus water entrained in the air before the air is discharged from the mouth of the chamber. It also provides an elongated scrubbing surface contacting with the air for removing the last minute traces of impurities. The forcing of the air tangentially and spirally around the inner walls of the bowl and cylinder also throws all water away from the motor so that the latter may be operated free from any accumulation of water.

To increase the effectiveness of such final cleansing action, as well as a tendency to the deposition of entrained liquid, and the maintenance of a moistened humidifying surface, there may be provided a lining for the inner walls of the cylinder presenting a surface better capable of retaining moisture than the metallic walls of the cylinder, and also preferably capable of absorbing the last traces of any impurities in the air. Such lining herein comprises a fabric lining, as of coarse, rough toweling, presenting the scrubbing wall 71 already referred to. As illustrated in the drawings, this comprises a tubular piece of fabric fitting and lining the inside of the cylinder 65, extending down outside the bowl 69, and held in place at its top by the expansion ring 125 holding the upper edge of the tubular fabric in the internal groove at the mouth of the cylinder.

If the air passing through the humidifying compartment of the apparatus is relatively warm and dry, the particles of water deposited on the scrubbing surface are in large part eventually vaporized, furnishing the required humidity for the air, but if the air is relatively cool and moist part only of the water is vaporized, the balance finding its way back into the water compartment below.

The operation of the system in respect to the control of the relative humidity of the air in the room is as follows: When the air outside the

house is relatively warm the air in the room is relatively humid from natural external sources of moisture supply and little or no moisture is necessary to be added to the air in the room, which air adjusts itself to the external conditions of humidity as well as to conditions of temperature, except as the latter are counterbalanced by the effect of the radiator. Such adjustments as to humidity take place more or less rapidly, dependent on the infiltration of air from the outside to the inside of the building through cracks, doors and other openings, which infiltration in any case is substantial. But neither is it necessary under these conditions of relative warmth in the outside air to add any substantial heat to the radiator. Accordingly, the air drawn into the conditioning apparatus from the radiator is relatively cool and in its relative cool condition takes up a relatively small amount of moisture.

On the other hand, when the outside air is cold its moisture content is materially reduced and its capacity to carry moisture at this lower temperature is materially diminished. This cool and relatively dry air entering the building and the room in question by infiltration lowers the room temperature. The thermostat thereupon functions to supply heat to the radiator. The lower the out-of-doors temperature the higher becomes the average temperature maintained in the radiator. The cooler air in the room is drawn to the radiator, passes up through the same, is warmed and, at the same time, has its relative humidity substantially lowered. From this heated air current ascending from the floor upward through the radiator, the air is drawn into the mouth 115 of the conditioning apparatus. The heating effect of the radiator is to render the air materially more susceptible to the absorption of moisture, the degree of susceptibility varying with the temperature of the radiator. Passing through the apparatus, the air emerges properly warmed, washed and humidified.

It will be seen that by the combination of the air conditioning apparatus receiving its air directly from the radiator or other heating medium together with the thermostat controlling the latter with relation to the varying outside temperature, the air is cleansed and the required humidity is imparted to it all within the room itself.

When the outside air is cool and needs to be heated it also requires the additional moisture to secure the required relative humidity in the air of the room. But the thermostat then acts to raise the temperature of the radiator and the required moisture is taken up from the humidifier. When the air out of doors is relatively warm less moisture needs to be added to the air in the room, and the automatically lowered temperature of the radiator provides for an air supply at a temperature which meets these conditions.

It will be observed that the cleansing action of the air conditioning apparatus is also rendered particularly effective by its close association with the radiator. The latter provides a current of heated air rising upwardly from the floor through the radiator and tending to carry with it settled accumulations of dust, dirt and other impurities, as well as those which are circulating through the room and which soon reach and enter the rising current. These are delivered directly into the air conditioning device and immediately and effectively eliminated by the cleansing operation.

For the same out-of-doors temperature, the temperature of the radiator, and the point therefore to which the temperature of the air entering the humidifier is raised, will vary with the different radiator installations both in respect to the heating medium employed, as, for example, steam or hot water, and in respect to the size of the radiator employed for heating a given room. It is therefore desirable to provide some means for adjusting the temperature of the air before humidification is effected and adapting that temperature to the conditions fixed by the particular radiator installation. No change, however, would ordinarily be required in such adjustments when once satisfactorily established.

This adjustment is herein provided by raising more or less the top plate 51 through the adjusting screws to provide the air admission opening, hereinbefore referred to, and supplying therethrough to the annular circulating space a certain portion of air which does not pass through the radiator. This lowers more or less (dependent on the adjustment of the opening) the temperature of the air actually passing through the humidifier.

As an example, submitted merely for illustration, in a hot water heating system where the temperature of the water in the radiator may never exceed 125° F. and the warmest air delivered by the radiator may not exceed 100°, it may be necessary to take substantially all the air through the radiator directly into the mouth 115 of the apparatus, sealing off the adjustable air admission opening. On the other hand, in the same room, but in the case of a steam heating system using a temperature of 215° and heating the air to 180° F. or thereabouts, if air is taken exclusively through the radiator, then, to lower the temperature of the humidified air and avoid absorbing too much moisture, a substantial amount of air may be entered through the air admission opening at the top of the cylinder and independently of the radiator.

While the humidity imparted to the air is also dependent on the temperature of the water employed, in the foregoing it has been assumed that the water temperature remains substantially uniform, which would be true for all practical purposes in a case where the water compartment is replenished from time to time from the water main and tempered more or less by the temperature of the room.

Variations in the temperature of the water, however, may be employed to vary the humidity of the air and, if desired, may be utilized to dehumidify the air circulating through the apparatus by maintaining the water at a relatively low temperature, as by artificially chilling it, so that in warm weather the air delivered to the room may be both cooled and de-humidified.

There is diagrammatically illustrated such an arrangement, this contemplating the employment of a refrigerating unit 127 of any usual and suitable construction, which may be located at any convenient place, as in the basement of a dwelling, and is adapted to circulate a refrigerating medium through pipes 129 to refrigerating coils 131 submerged in the water compartment and acting controllably to lower the temperature of such water.

A similar result may be had by placing ice in the water compartment, or, to a substantial degree, even by maintaining a continual circulation of water from the water main, the temperature of which water in warm weather is ordinarily at a substantially lower point than that of the air in the room, it being only neces-

sary, in order to dehumidify and cool the air, that the temperature of the water should be below the dew point of the air.

As previously stated, the cleansed and humidified air is delivered from the humidifying cylinder into the compartment of the top casing and is thence redelivered into the room. In order to revitalize the air, provision is made for adding to the air before redelivery into the room a certain amount of ozone which is thereby diffused into the current of cleansed and humidified air and redelivered to and circulated throughout the room. Ozone being heavier than air tends to settle and localize where generated, but by this means it is distributed and circulated throughout the entire room space.

For this purpose there is mounted at the back of the casing top an ozone generator, diagrammatically represented in Fig. 8 and shown in outline elevation in Fig. 1. This comprises a transformer 133, the primary of which is connected by the cable connection 135 to a source of alternating current through a socket connection 137, the high potential secondary of which is connected in a circuit 139 separated by the glass insulator 141. This produces an ionic discharge through the glass, ionizing the air surrounding the glass and converting a part of it into ozone which commingles with and is diffused into the air delivered from the apparatus. The ozone thus diffused is effective in destroying unpleasant odors, sterilizing the air and imparting to it a revitalizing quality.

While I have herein shown and described for the purpose of illustration one specific embodiment of the apparatus herein claimed and one method of carrying the herein described conditioning of air into effect, it is to be understood that wide variations in and departure therefrom may be made, all without departing from the spirit of the invention.

I claim:

1. In an air conditioning apparatus for conditioning the air of a room and adapted to be installed therein, the combination with a casing having a water compartment, of an upright cylindrical chamber having a lower air induction opening above said water compartment and an upper air delivery opening and presenting through its inner walls an extended surface between said lower and upper openings for the deposition of air-entrained water, means for directing the air through the induction opening and delivering it through an upward spiral path forcibly in contact with the inner walls of said chamber, the same comprising a centrifugal fan within said chamber above the induction opening thereof, said fan being rotatable about a vertical axis and having fan blades peripherally arranged about an air induction passage communicating with said induction opening and adapted to forcibly expel the air tangentially outward against the walls of said chamber, means for raising water from said compartment and delivering it in the form of a spray against the upper surfaces of the fan blades, the same comprising a centrifugal water elevating and spraying device positioned in said induction passage, and a motor supported within said chamber and rotatable about an upright axis, said motor supporting and driving said fan and water elevating and spraying device.

2. In an air conditioning apparatus for conditioning the air of a room and adapted to be installed therein, the combination with a casing having a water compartment,. an upright cylindrical chamber within said casing having a lower air induction opening above said water compartment, an upper air delivery opening presenting through its inner walls an extended surface between said lower and upper openings for the deposition of air entrained water, means for directing air from the casing through the induction opening and delivering it through an upward spiral path forcibly in contact with the inner walls of said chamber, the same comprising a centrifugal fan within said chamber above the induction opening thereof, said fan being rotatable about a vertical axis and having fan blades peripherally arranged about an air induction passage communicating with said induction opening and adapted to forcibly expel the air tangentially outward against the walls of said chamber, means for raising the water from said compartment and delivering it radially outward in the form of a spray against the surfaces of the fan blades, a motor supported within said chamber and rotatable about an upright axis, said motor supporting and driving said fan and water elevating and spraying device, and a moisture retaining, absorbent lining for the inner surface of said chamber above said fan.

3. A temperature and humidity controlling device for a room adapted to be installed therein in close hot-air-receiving relation to a room radiator, said device having an upright air receiving casing with an air receiving opening in one side to receive heated air from said radiator, a lower water compartment below said air receiving opening, an inner casing spaced from said outer casing to provide a passage for heated air downwardly from said air receiving opening and having an air induction opening above said water compartment and an upper delivery opening, a bladed impeller in said inner casing rotatable about a vertical axis above said air induction opening, means for raising water from said water compartment and spraying it radially outward on the blades of said impeller, and a motor within said inner casing for driving said impeller and water raising means.

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