

June 25, 1940.

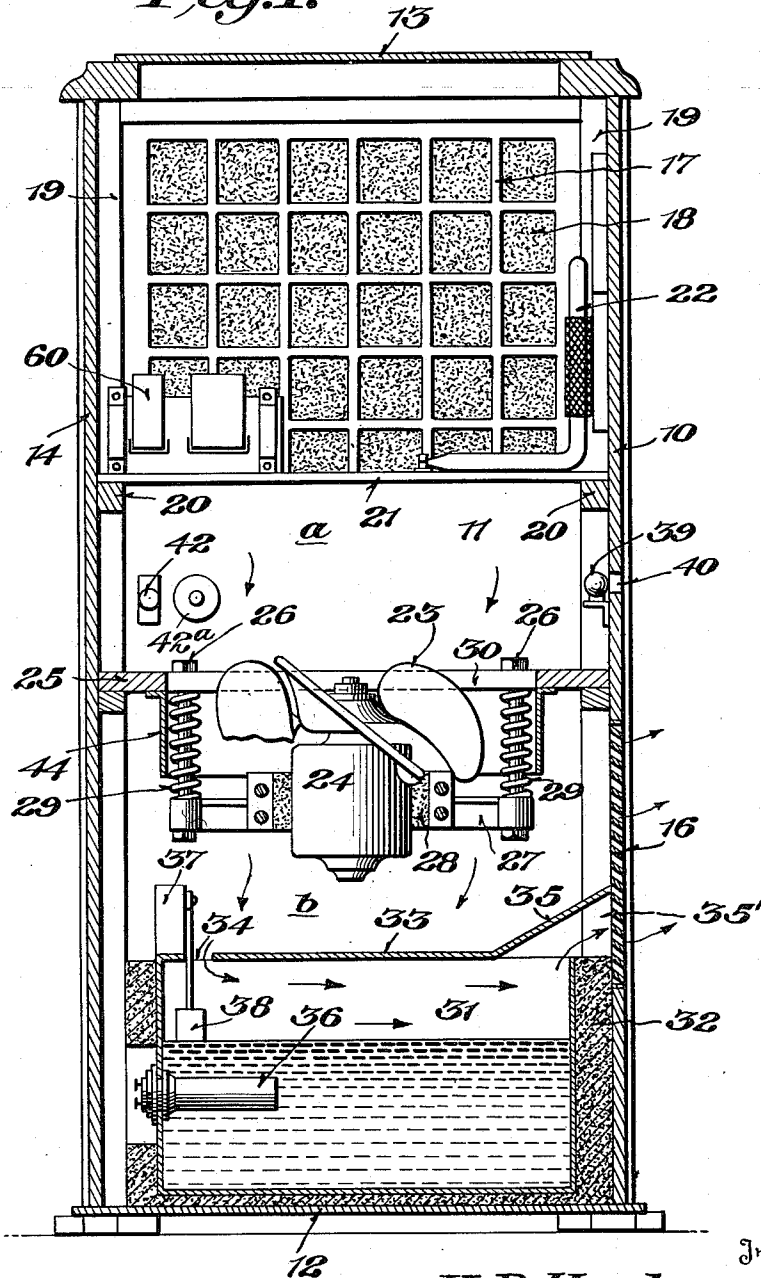
H. B. HARTMAN

2,205,831

AIR CONDITIONING APPARATUS

Original Filed April 17, 1936 5 Sheets-Sheet 1

Fig.1.



Inventor

H.B.Hartman,

By

R. P. Woelhaefer
Attorney

Attorney

June 25, 1940.

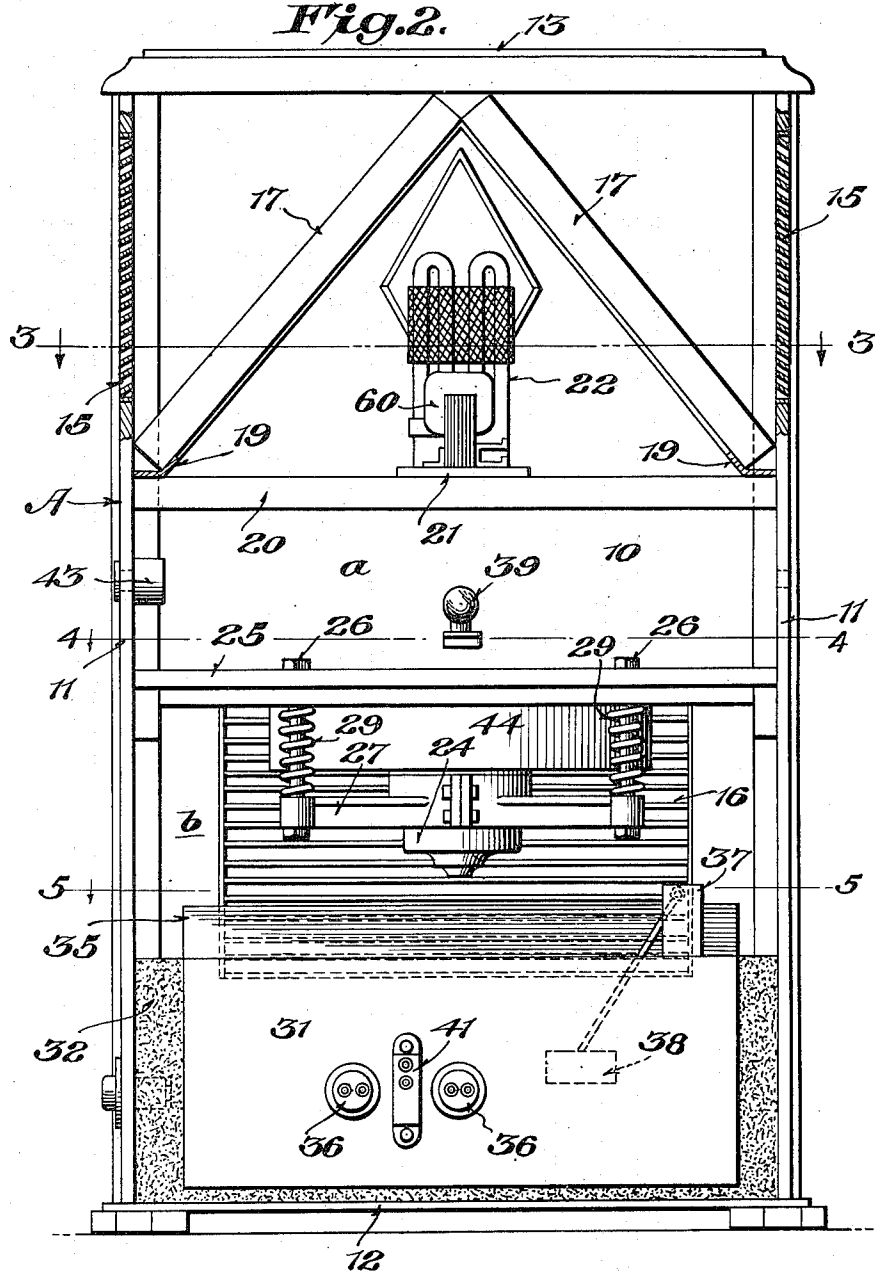
H. B. HARTMAN

2,205,831

AIR CONDITIONING APPARATUS

Original Filed April 17, 1936 5 Sheets-Sheet 2

Fig. 2.



Inventor
H. B. Hartman,

By **R. P. Wolhaupter**
Attorney

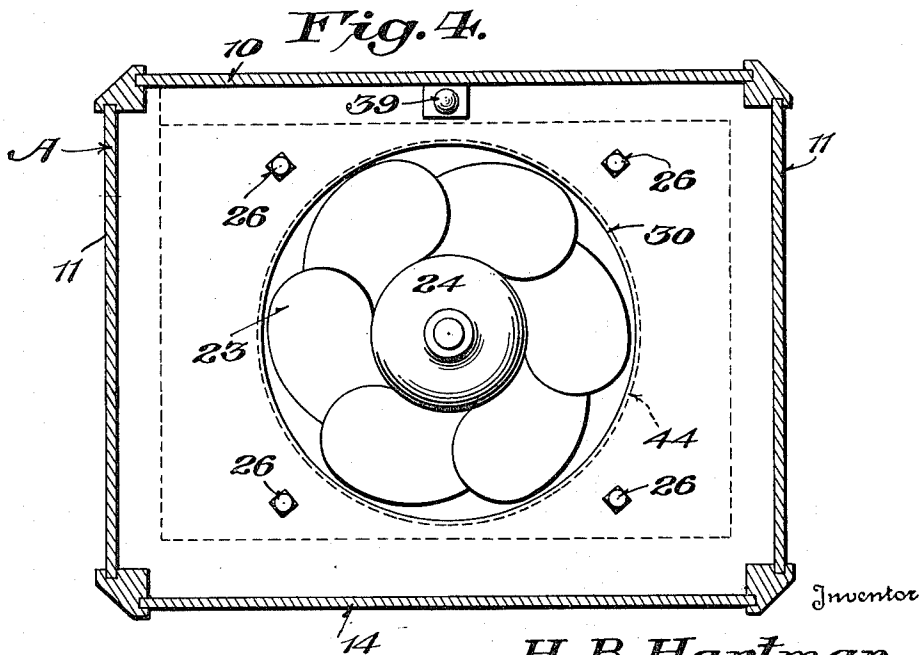
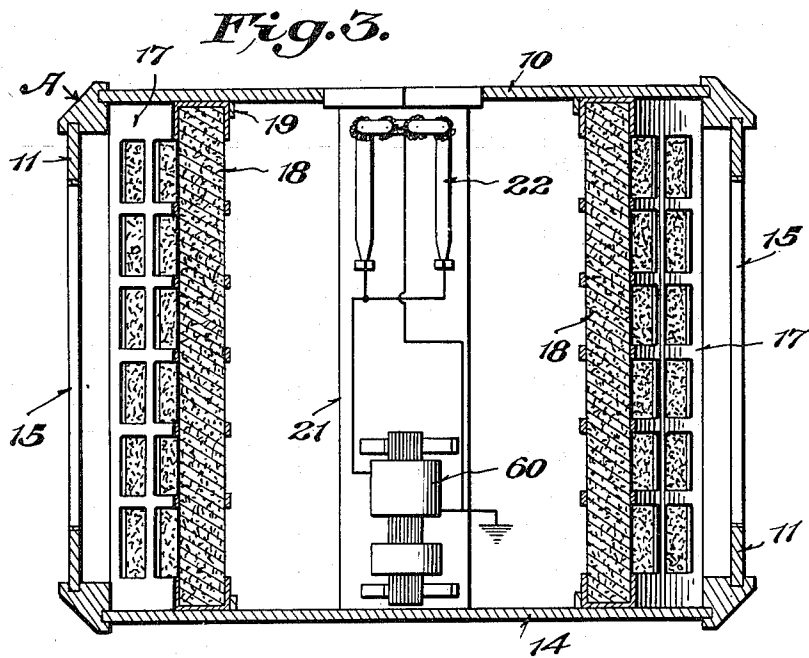
June 25, 1940.

H. B. HARTMAN

2,205,831

AIR CONDITIONING APPARATUS

Original Filed April 17, 1936 5 Sheets-Sheet 3



Inventor
H. B. Hartman,

By *W. P. Wolhaupter*
Attorney

June 25, 1940.

H. B. HARTMAN

2,205,831

AIR CONDITIONING APPARATUS

Original Filed April 17, 1936 5 Sheets-Sheet 4

Fig. 5.

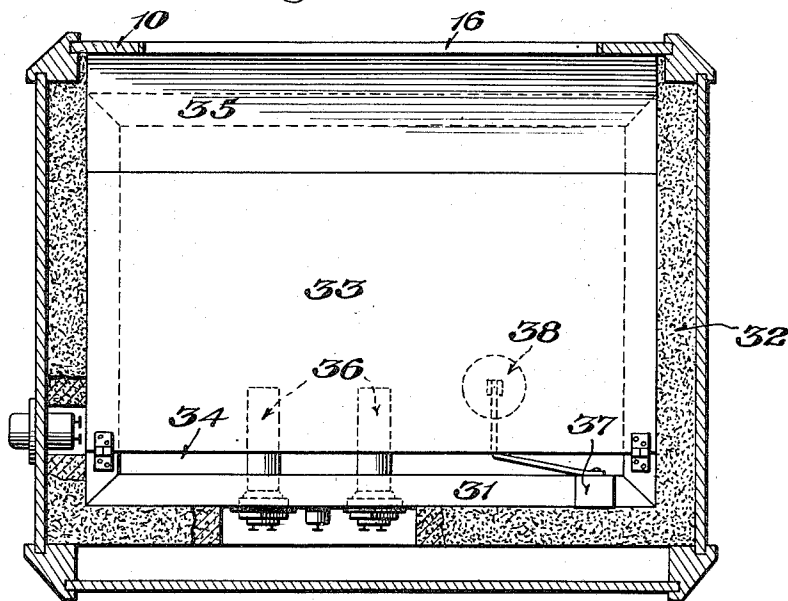
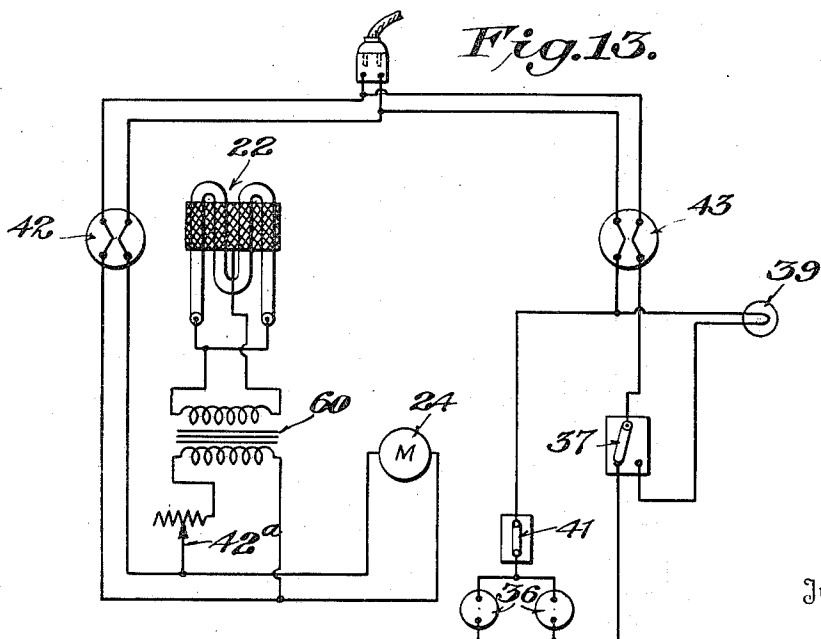


Fig. 13.



Inventor

H. B. Hartman,

By

N. P. Wechsauer

Attorney

UNITED STATES PATENT OFFICE

2,205,831

AIR CONDITIONING APPARATUS

Harry Buxton Hartman, Florence, Mass.

Application April 17, 1936, Serial No. 74,987
Renewed March 21, 1940

1 Claim. (Cl. 21-74)

This invention relates to the art of air conditioning, and has generally in view to provide an improved apparatus for cleaning, ozonizing and humidifying air.

One special object of the invention is to provide an apparatus for conditioning the air in a room or other enclosure which provides circulating the air downwardly from a point above the room floor, first through a cleaning or filtering means, then ozonizing the cleaned or filtered air and finally humidifying the cleaned and ozonized air and returning it to the room near the floor thereof, thereby to obtain high efficiency in conditioning the air and to maintain the room air at an even temperature.

Another special object of the invention is to provide a portable, inexpensive apparatus for carrying out the foregoing method, which apparatus is embodied in compact form within a cabinet forming an attractive article of furniture.

Another special object of the invention is to provide a novel, highly efficient ozonizing unit. That is to say, it is provided to provide a gas filled tube whose exterior surface is only partially covered with an external grid, thereby obtaining greater generating efficiency and longer life of the apparatus. It has been determined by experiment and practice that a perforated metal envelope or a gauze wire completely encircling a gas filled tube causes excessive heating of the tube with consequent rapid deterioration of both tube and gauze. However, this disadvantage is overcome by the present invention because practically no heat is developed due to the fact that one-half of the surface of the tube is not covered by the grid and therefore the entire tube remains relatively cool, and, moreover, the tube can be operated continuously with the grid extending the full length of the tube.

With the foregoing and other various objects in view, which will become more fully apparent as the nature of the invention is better understood, the same consists in the novel method and in the novel features of combination and arrangement in an apparatus for carrying out the method, as will be hereinafter more fully described, illustrated in the accompanying drawings and defined in the appended claim.

In the drawings, wherein like characters of reference denote corresponding parts in the different views:

Figure 1 is a central, vertical, transverse section through an apparatus embodying the structural features of the invention and by means of

which the method of the invention may be practiced.

Figure 2 is a rear view of the apparatus shown in Figure 1, the rear panel of the cabinet being removed to show the apparatus contained within the cabinet.

Figures 3, 4 and 5 are horizontal sections on the lines 3-3, 4-4 and 5-5, respectively, of Fig. 2.

Figure 6 is an enlarged rear elevation of the ozonizing unit shown in Figures 1 to 3.

Figure 7 is a side elevation of the ozonizing unit.

Figure 8 is a section on the line 8-8 of Figure 6.

Figure 9 is an enlarged cross-section of a portion of Figure 6.

Figure 10 is an enlarged fragmentary side view of a portion of Figure 6.

Figure 11 is a view similar to Figure 6 illustrating an ozonizing unit of slightly modified form.

Figure 12 is a section on the line 12-12 of Figure 11; and

Figure 13 is a diagram of the wiring of the apparatus.

Referring to the drawings in detail, A designates, generally, a cabinet which may be formed in any suitable manner from any suitable material, or materials, into any desired size and shape, depending upon the desired capacity of the apparatus therein contained, and which preferably embodies an exterior design and finish adapting the same to serve as an attractive article of furniture.

The cabinet A illustrated in the present instance is of suitable height and of rectangular shape in horizontal section, and comprises a front wall 10, side walls 11, 11, a bottom wall 12, a top wall 13 and a rear wall or panel 14 which preferably is either bodily removable or hinged for swinging movement to a position to afford access to the interior of the cabinet.

In upper portions of the side walls 11, 11 of the cabinet A are louvers 15 for the admission into the cabinet of the air to be conditioned, while in the front wall 10 of said cabinet, near the bottom thereof, are other louvers 16 through which the conditioned air is delivered from the cabinet.

Within the upper portion of the cabinet is arranged suitable means for cleaning or filtering all of the air entering said cabinet through the louvers 15. In the present instance this means comprises a pair of flat filtering elements 17, 17

extending substantially from front to back of the cabinet and disposed in downwardly diverging relationship with their upper edges meeting at the middle of the cabinet near the top wall 13 thereof and their lower edges engaging, or substantially engaging the side walls 11, 11, respectively, below the louvers 15. The said filtering elements are in the form of cellular frames having suitable air cleaning or filtering material 18 disposed in the cells thereof, and in order to assure that all air entering the cabinet through the louvers 15 passes through the material 18, suitable strips of metal 19 or any other suitable means are employed to seal any spaces between the edges of the filtering elements and the walls of the cabinet and also between the upper edges of the filtering elements.

Since the filtering elements 17, 17 may require periodic replacement, they preferably are slidably mounted on suitable supports 20 carried by the cabinet walls so that they may readily be inserted into and removed from the cabinet through the rear thereof.

A support 21 is suitably mounted within the cabinet inwardly of the filtering elements 17 and on this support is suitably mounted an ozonizing unit, designated generally as 22, which, in the broader aspects of the invention, may be of any suitable form. As shown, this ozonizing unit is disposed for operation to ozonize the air after the air has passed through the filtering elements 17, 17 which is an important feature of the invention because all of the ozone produced is effective for air conditioning purposes; whereas, if the air were filtered subsequently to ozonization much of the ozone would be consumed in ozonizing the filtering elements. For the sake of compactness of the apparatus, the ozonizing unit 22 preferably is disposed within the space between the filtering elements 17, 17. It may, however, be disposed below said space or at any location where it acts to ozonize the air after it has been cleaned or filtered and preferably prior to humidification thereof.

Suitably mounted within the cabinet to produce a circulation of air into the cabinet through the louvers 15 and from the cabinet through the louvers 16, is a fan 23 including an electric driving motor 24. To obtain quietness in operation, the fan blades are of a known shape for this purpose and the motor is mounted in a special manner as follows: Suitably mounted within the casing is a horizontal partition element 25 which divides the casing into upper and lower compartments a and b and has depending therefrom a plurality of studs or bolts 26 on which is mounted a two-part motor supporting frame 27, the two parts of which are clamped about the motor casing. Felt or other suitable sound deadening and vibration absorbing material 28 is interposed between the frame 27 and the motor casing and coil springs 29 are provided on the studs or bolts 26 between the partition element 25 and the motor frame. Other coil springs may be provided on the studs or bolts 26 between the headed lower ends thereof and the motor frame if desired. In any event, the motor is yieldably mounted relative to the cabinet, both by the springs 29 and the material 28 so that it operates practically without sound or vibration.

In the partition element 25 is a central, circular opening 30 for flow of air from the upper compartment a to the bottom compartment b, and the motor and fan are aligned with this opening.

In the bottom of the cabinet is mounted a water tank 31 which is well insulated at its bottom, sides and ends by suitable insulating material 32 and which is closed at its top by a cover 33 which itself is of insulating material or else preferably insulated in any suitable manner.

In the cover 33 near the rear of the cabinet A is formed a slot 34 of suitable length and width for admission of a minor part of the air circulated by the fan 23 into the water tank 31, while adjacent to the front of the cabinet, said cover 33 is extended at an upward inclination toward the lower of the louvers 16, as indicated at 35, to provide a passageway 35' for flow of air from the water tank through said louvers.

Within the water tank is one or more electric heating elements 36 of any suitable design for the purpose of heating water contained in said tank; while suitably mounted adjacent to said tank is an electric switch, designated as 37, which is controlled by a float 38 within said tank, said switch being included in circuit with said heating element, or elements, and also with an electric lamp or other suitable electrically operated signal device 39, preferably of the usual type, which may be mounted at any suitable location, within the cabinet for example behind a sight opening 40 in the front wall 10 thereof. When the tank 31 contains water at or above a predetermined level, the float 38 operates the switch 37 to maintain the heating element circuit closed and the signal element circuits open, and when the water falls below said predetermined level, said float operates said switch to open the heating element circuit and to close the signal element circuit, thereby to prevent waste of current and to indicate that water should be supplied to the tank 31.

At 41 is designated a thermostatic switch which is included in the circuit of the heating element or elements 36 and which is operable to open said circuit when the water in the tank 31 is heated to a predetermined degree, thereby to prevent overheating of the water and waste of current.

At 42 is designated a manually operable switch for controlling the supply of current to the ozonizing unit 22 and the fan motor 24, and at 42^a is designated a rheostat for regulating the amount of current supplied to the ozonizing unit, while at 43 is designated a manually operable switch of any suitable type for controlling the supply of current to the heating elements 36, the arrangement in this respect preferably being such that the heating element circuit may be closed and opened independently of the ozonizing unit and fan motor circuit whereby humidification may be effected as desired.

Assuming that the ozonizing unit, fan motor and heating element circuits are closed, the apparatus operates as follows: Air is drawn by the fan into the cabinet through the louvers 15 from a relatively warm strata of air above the floor of the room within which the apparatus is disposed and passes first through the filtering elements 17, 17 and thereby is cleaned. At least some of the air then passes over the ozonizing unit with the result that ozone is produced and is carried along with the air through the opening 30 in the partition element 25 into the compartment b, becoming thoroughly intermixed with the total volume of the air passing through said opening because the fan is disposed adjacent to said opening and is surrounded by a casing 44 depending from said partition element 25. After passing into the compartment b, the major volume of the air is delivered through the upper

of the louvers 16 into the room near the floor thereof. The remaining minor volume of the air enters the water tank 31 through the opening 34 in the cover thereof and passes through the upper portion of said tank above the level of the water therein, absorbing moisture in its passage, and flows from said tank through the passageway 35' and from the cabinet through the lower of the louvers 16, becoming mixed with the main volume of the air delivered from the cabinet outside of and adjacent to said cabinet.

Experiments have shown that ozonization is effected more effectively and efficiently and by the use of a lesser amount of current when the air is under a negative or suction pressure than when it is under positive pressure. In the present apparatus the air is under negative or suction pressure when it is subjected to the action of the ozonizing unit 22. Therefore, production of ozone in the present apparatus is highly efficient. Moreover, by heating the water in the tank 31, vapor is given off so that humidification of the air also is highly efficient. On the other hand, if the water in the tank is not heated, little or no humidification takes place despite the continual passage of part of the air through the water tank.

While any suitable ozonizing unit may be employed in the present apparatus, the unit used preferably is of an improved type as illustrated in the drawings. Referring particularly to the unit illustrated in detail in Figures 6 to 10, it will be observed that the same comprises a tube 45 of glass or other suitable dielectric material which is bent to provide a pair of inverted U-shaped loops, the adjacent or inner legs of which are connected together at their bottoms to provide an intermediate U-shaped loop. In other words, said tube is bent to provide four legs, designated as 46, 47, 48 and 49, respectively, which are disposed in parallel, spaced apart relationship in a common plane and of which the two intermediate legs 47 and 48 are connected together at their lower ends, and at their upper ends are connected with the two outer legs 46 and 49, respectively, whereby there is provided the looped formation mentioned. This tube is suitably closed at its ends and, after first having been evacuated of air, is filled with a rare gas or blend of gases having low electrical resistance. To adapt said tube to be mounted on a support, such as the support 21, the free or lower end portions of the two outermost legs 46 and 49 are bent to extend laterally from said legs, normal to the common plane thereof, as indicated at 46' and 49', respectively. On the support 21 is mounted a block 50 having a pair of recesses in which the leg portions 46', 49' adjacent to the legs 46, 49 are seated and held by a cooperating block 51 clamped against said block 50 by screws 52. Near their outer or free ends, the leg portions 46', 49' are engaged and held by spring clips 53, 53 mounted on the support 21 and having good electrical connections with said leg portions through metal bands 54 suitably fastened to the latter.

At one side of the legs 46, 47, 48 and 49 is disposed a sheet of flexible woven wire cloth 55 which is formed, preferably, from stainless steel and which may aptly be described as comprising a series of interlaced, vertically disposed coils similar to coil springs. At points spaced across this sheet extra coils 56 are interlaced with the coils of the sheet to provide what may be termed flaps, and in these coils or flaps, and also in the

two terminal or outermost coils of the sheet are inserted wires or rods 57 which, at their ends, are provided with eyes 58. There are eight of the rods 57 comprising four pairs related to the legs 46, 47, 48 and 49 of the tube 45, respectively, and the spacing of the flaps or coils 56 is such that between each pair of the rods 57 there is a section of the sheet 55 of a width to extend approximately one-half the way around the related leg of the tube 45. Small coil springs 59 connect the eyes 58 of the respective pairs of wires or rods 57 and extend across the sides of the tube legs opposite the sides thereof against which the sheet 55 is disposed, thereby functioning to draw the respective sections of said sheet into engagement with and approximately one-half the way around the related tube legs and to hold the sheet 55 thus operatively engaged with said tube legs, as best illustrated in Figure 8.

At 60 is designated a transformer which may be mounted on the support 21 or at any other suitable point and which may be of any suitable construction. One of the output terminals of this transformer is connected with the wire mesh sheet 55 at its lower edge approximately midway between its side edges, and the other of said output terminals is connected with both free or terminal end portions 46', 49' of the tube 45 through the clips 53.

When high voltage current is supplied through the transformer 60 to the tube 45 and the sheet 55, it is conducted throughout the length of said tube by the low resistance gas or gases contained therein and, by induction, passes from the tube through the latter to the sheets 55, creating an ozone generating corona discharge which is accelerated by what may be termed an electrical breeze which is produced by reason of the woven wire sheet being spaced substantially entirely outwardly from the tube legs. In other words, there is only point contact between each tube and each turn of each of the coil-spring-like elements comprising the sheet 55, all of the remaining portions of said sheet being spaced outwardly from the tubes. Therefore, there is an ozone generating corona discharge between each tube and the receding portions of each turn of each of the coil elements, and because of the electrical breeze between the tubes and the outer portions of the coil elements, not only is the generation of ozone accelerated, but the ozone produced is delivered outwardly into the air streams flowing around the unit 22. In this connection, experiments have shown that, as compared with tube legs encased by a woven metal fabric, the output of ozone, other factors being equal, by the present generator is considerably greater, due, no doubt, to the sheet 55 extending only partially around the tube legs, whereby both the tubes and said sheet remain cool, and to the points of contact between the coils of the sheet and the tubes and the spacing of the major portions of the coils from the tubes.

The unit illustrated in Figures 11 and 12 is, in all essentials, the same as the unit illustrated in Figures 6 to 10 except in respect to the manner of mounting the woven wire sheet 55^a against the legs of the tube 45^a. Figures 11 and 12 also illustrate that the flaps or extra coils 56 may be eliminated if desired. As illustrated in said figures, a wire or rod 57^a is inserted in each of the terminal coils of the sheet 55^a and also at

evenly spaced apart intervals in three of the intermediate coils of said sheet. At their upper and lower ends the said wires or rods 57^a are suitably engaged with pins 61 extending inwardly from upper and lower plates 62. Aligned with the plates 62 and disposed at the sides of the tube legs opposite the sheet 55^a are bars 63 which are recessed to accommodate the tube legs and which are connected with the plates 63 by bolts 64. By means of nuts on the bolts 64, the plates 62 are drawn inwardly toward the tube legs and thereby the sections of the woven wire sheet 55^a between the wires or rods 57^a are caused to embrace the adjacent sides of the tube legs.

Obviously, instead of the tube of the ozonizing unit having four legs, said tube may have more than four legs or only two legs or even a single leg and the width of the wire mesh sheet may be correspondingly varied. Obviously, too, instead of having the apparatus of the invention to discharge directly into a room, the apparatus may be placed at any desired location and a conduit or conduits may lead from the air outlet opening of the apparatus to any desired point or points.

Other modifications of the invention will readily suggest themselves to those familiar with this art and it will of course be understood that various changes in the form, proportion and minor details of construction may be resorted to,

without departing from the spirit of the invention and scope of the appended claim.

I claim:

Air conditioning apparatus comprising a casing having air inlet and air outlet means in upper and lower portions thereof, respectively, air filtering and air ozonizing means within the upper portion of the casing, a horizontal partition within the casing below said air filtering and air ozonizing means and above said air outlet means, said partition having a circular opening and a circular sheath depending therefrom in alignment with said opening, a fan suspended from said partition for circulating air through said casing, said fan having blades disposed within said sheath with their outermost edges disposed closely adjacent to said sheath whereby all air passing through the casing is thoroughly intermixed, a water container in the bottom portion of said casing below said sheath, and a cover for said container having an air inlet opening in air receiving relationship to air delivered through said sheath by said fan and also having an air outlet opening leading to a portion of said air outlet means, another portion of said air outlet means being disposed to permit egress of air from the casing without requiring that the air pass first through said water container.

HARRY BUXTON HARTMAN. 30