

[54] **PORTABLE AIR PURIFIER**

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[22] Filed: **Dec. 30, 1971**

[21] Appl. No.: **213,957**

[52] U.S. Cl. **55/279**, 21/74 R, 21/102 R, 21/DIG. 2, 55/316, 55/470, 55/472, 250/48

[51] Int. Cl. **B01d 25/02**

[58] Field of Search..... 55/316, 279, 467, 55/470-473; 21/74 R, 54 R, 74 A, DIG. 2, 102 R; 62/264; 250/48

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[57] **ABSTRACT**

A unit, either stationary or portable, that recycles the air within a room or other interior area to concurrently

subject the air to filtering treatment to remove entrained solid particles, gases, oxidants associated with smog and other vapors, as well as to the action of germicidal ultra violet light in order to destroy contagious and infectious, airborne micro-organisms such as bacteria, staphylococcus, hepatitis, virus and other harmful, viable organisms that may be present in the air.

Solid particulate matter that is removed from the air by the unit includes dust, pollens, fungi, molds, lint and the like. Reactive gases and vapors that are removed from the air as it flows through the unit include the oxidants associated with smog, unburned hydrocarbons, ozone, tobacco odors, smoke and other materials in vapor form that are harmful to human health, including traces of mercury in vapor form existing in the air.

The unit is particularly adapted for use in any interior area wherein contaminated air effects health, whether human or animal, such as in doctors' and dentists' offices, examining and waiting rooms, hospital areas, including operating rooms, contagious wards, patient burn rooms, nurseries, food preparation quarters, morgues, or any other of the many areas in which disease may be spread by airborne means. The same holds true as to animal hospitals, veterinarians' waiting rooms, operating rooms and the like.

9 Claims, 6 Drawing Figures

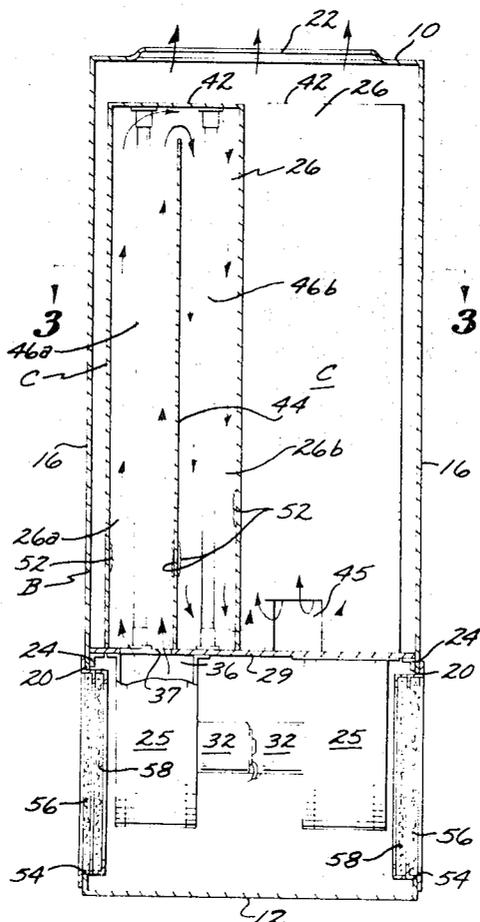


FIG. 1

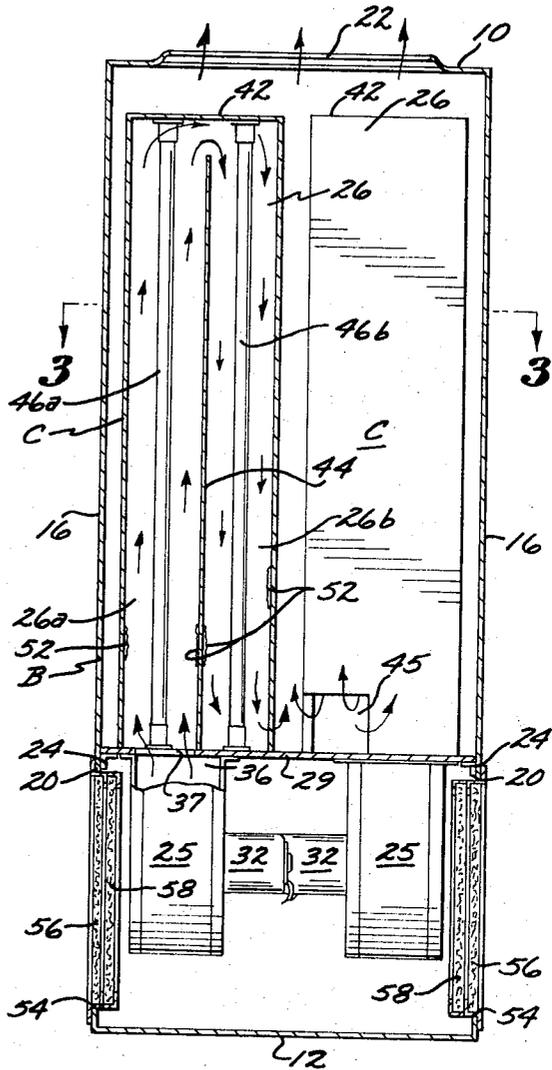
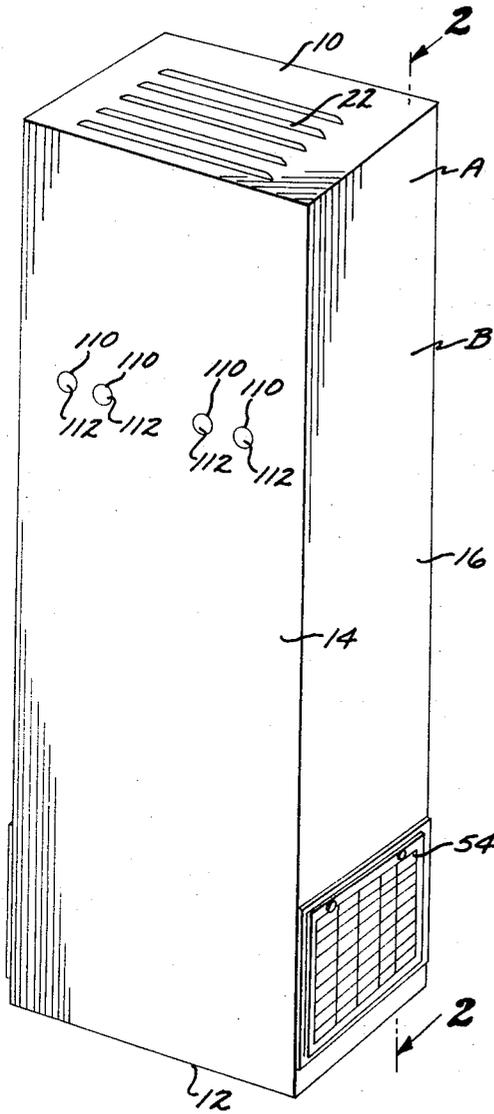


FIG. 2

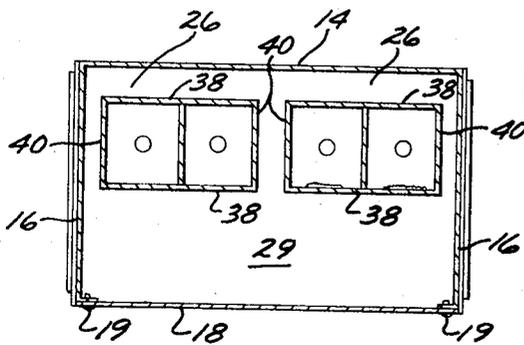


FIG. 3

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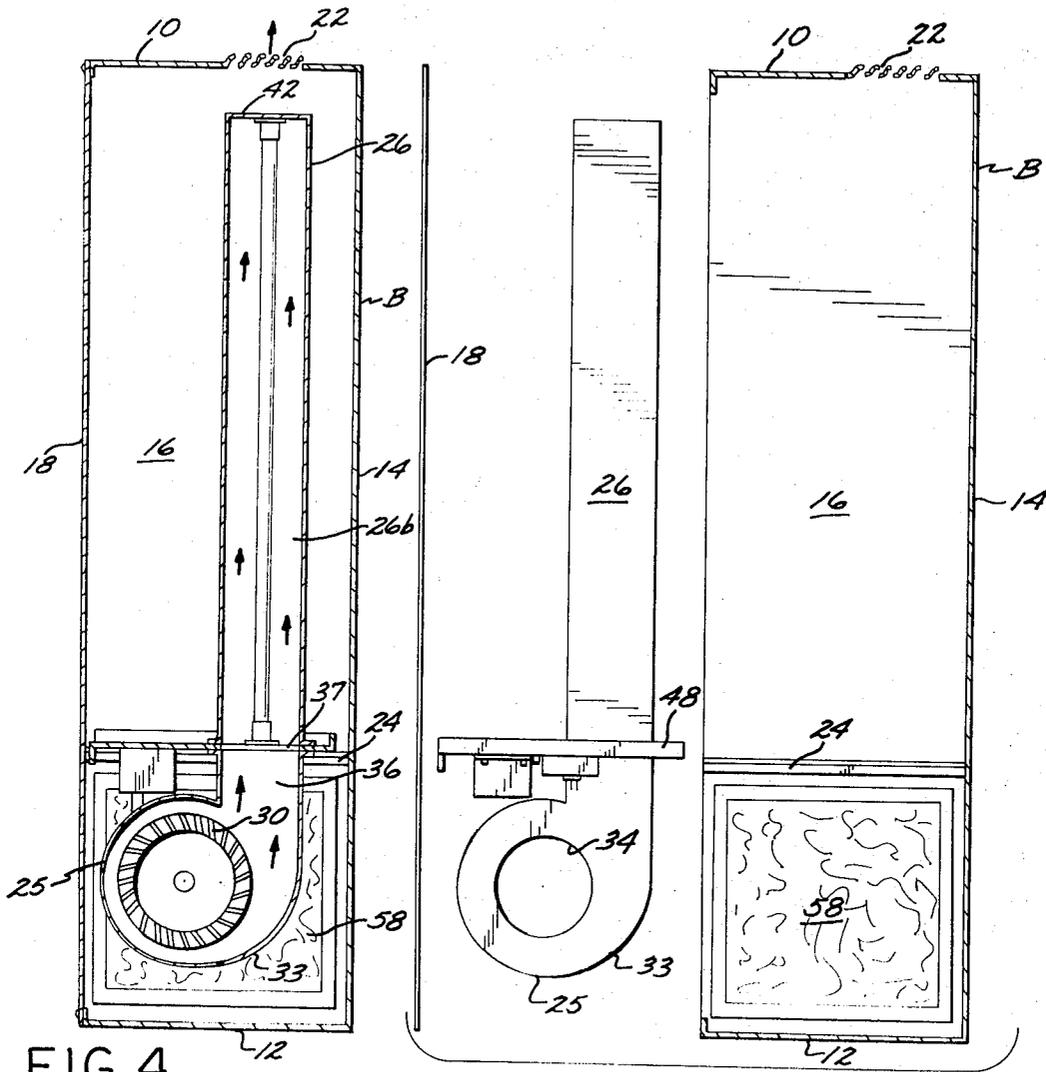


FIG. 4

FIG. 5

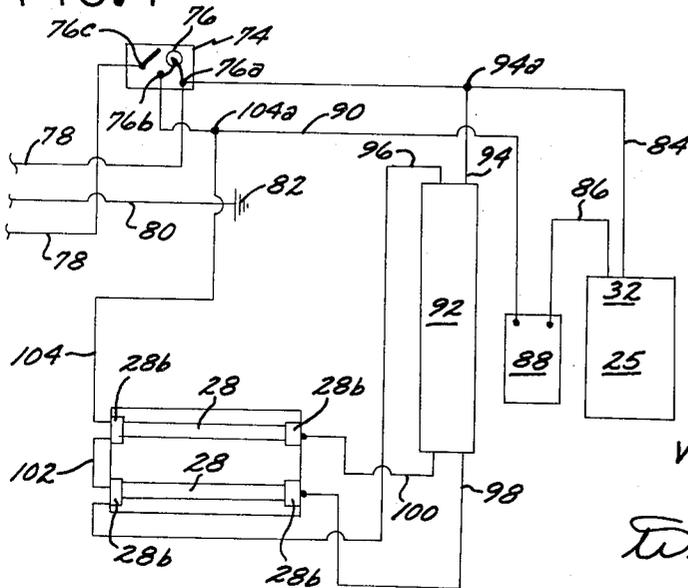


FIG. 6

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PORTABLE AIR PURIFIER

BACKGROUND OF THE INVENTION

1. Field of the Invention:

Air sterilizing and purifying unit.

2. Description of the Prior Art:

In the past, numerous devices have been developed and used that are known as air purifiers which embody a combination of blowers in conjunction with filters serving to remove particles that range in size from 1000 to 99.97 microns. The 99.97 micron size is that removed by the Hepa filter which, on its surface, removes bacteria but relatively few virus. The Hepa filters generally are not practical when used as a sterilizer, as the filter only gathers the bacteria and in no way kills or destroys the latter. Further, when the filter is changed or the airflow is shut off, the collected bacteria are redistributed to the air environment. Also, the Hepa, or "absolute filter" (97% efficient), is extremely expensive, requires excessive electrical horsepower to propel the blowers sufficiently to force the air through the filters. Excessive noise is a characteristic of the operation of such filters, and in most instances engineering personnel are required for the successful installation of the Hepa filter. The Hepa filter is in no instance an air sterilizer, but is only a means to entrap bacteria and other solids down to a micron size of 0.3, with the Hepa filter having absolutely no ability to remove odors, gases, vapors and the like from the air flowing there-through.

In the past, and in recent years, it has become increasingly apparent that many contagious and infectious diseases are transmitted from one person to another and from one animal to another in offices and rooms that appear to be meticulously clean and sterile. This anomaly arises from the fact that the air in the room supports minute and microscopic particles of dust, pollen, lint and other particulate matter that are wafted from place to place by the slightest air disturbance caused by breeze or air movement, and these particles serve as carriers for highly infectious microorganisms that may exist within the interior atmosphere, including virus, staphylococcus, streptococcus, T.B. bacillus and the like. Each and every contagious and infectious microorganism becomes a plague to a healthy and uninfected human or animal.

Thus, it will be apparent that an uninfected person entering an area where infectious air prevails, whether the reception room of a doctor or dentist as well as patients' rooms or operating rooms of a hospital, is stepping into an environment in which the air therein may be heavily contaminated with harmful microorganisms, although the walls and floor and physical objects in the room have been thoroughly cleansed with powerful germicides.

The primary purpose in devising the present invention is to supply a portable or stationary unit that may be positioned in a desired closed environment such as a room to recycle the air therein to remove contaminants and solids such as dust, pollen and lint by a filtering operation, but the filter being of such porosity that microorganisms such as bacteria and virus may pass therethrough to subsequently be destroyed by exposure to ultra violet light radiation.

Another object of the present invention is to provide a device in which at least a part of the filtering medium is of a character that adsorbs malodors, tobacco odors,

vapors, moisture, unburned and partially burned hydrocarbons and oxidants associated with smog.

Yet another object of the invention is to provide a device that is particularly useful in dentists' offices and reception rooms inasmuch as at least a part of the filtering medium is highly selective as to mercury in both vapor and finely particled form, in which forms it is highly toxic.

A still further object of the invention is to furnish a unit that preferably operates continuously to recycle air in a room to remove contaminants therefrom, with the air being drawn into the device adjacent or near the floor where contaminants tend to move due to gravity, and sterilized air being discharged at a substantial height above the floor.

A further object of the invention is to furnish a device in which the air containing micro-organisms is drawn through an elongate confined space in which they are exposed to direct radiation from germicidal ultra violet light lamps as well as ultra violet light that is reflected back and forth across the confined space in a random pattern.

SUMMARY OF THE INVENTION

25 An air sterilizer and purifier of attractive appearance that may be positioned at a desired location in a confined space such as a room to recycle the air therein, with the recycled air being free of small particulate material and substantially free of live micro-organisms and virus.

The device includes an elongate, vertically extending cabinet containing at least one air intake in the lower portion thereof that is in communication with at least first and second filters. The first of the filters is preferably white for ease of visual inspection and is capable of entrapping the larger particles in the air such as those of above 10 microns in size. The major function of the prefilter is to entrap the larger particles, but allow free-floating particles to pass therethrough. The term "free-floating particles" is defined to include droplet nuclei, viruses and micro-organisms. The second filter is preferably of the charcoal type, and removes undesirable odors, gases, vapors and the like that are either toxic or harmful to a human being or animal.

At least one power driven blower is situated in the lower interior portion of the cabinet, and with the suction thereof in communication with the second filter. The negative pressure created by the blower on the first and second filters causes a stream of air from the lower portion of the room in which the device is situated to flow inwardly through the filters to have foreign materials removed therefrom.

Filtered air from the discharge of the blower is directed upwardly within the cabinet to enter vertically extending first and second passageway defining means in which the air travels in opposite directions.

First and second elongate, electrically operated ultra violet lamps are centrally disposed within the first and second passageways. The surfaces defining the first and second passageways are covered with a light reflecting material of such character that ultra violet light from the lamps is reflected back and forth in the passageways in a criss-cross pattern, and micro-organisms and viruses entrained with the air flowing through the first and second passageways is accordingly subjected to maximum contact with the ultra violet light, and to the extent that substantially all such micro-organisms and

viruses are killed or deactivated prior to the air containing the same discharging from the second passageway into the interior of the cabinet where it again returns to the air of the room in which the device is situated through an air outlet in the upper portion of the cabinet.

The blower, electric motor for driving the blower, the first and second passageway defining means and the sets of ultraviolet light lamps are preferably assembled as an integral unit that may be removably mounted as such within the cabinet. Likewise, the first and second filters are removably mounted in the cabinet for they must be replaced periodically after they have become contaminated with particled foreign substances entrained with the air that flows therethrough.

From experience, it has been found that certain dimensions and characteristics of the air sterilizer and purifier are critical, such as that the first and second passageways must be at least 3 feet in length, and with the air containing the micro-organisms and virus that are to be killed being discharged through the air at a velocity of between 700 and 1100 feet per minute, and the cross sections of the first and second passageways being between 9 square inches and 16 square inches in size. The air sterilizer and purifier above described serves three functions, namely: (1) to filter the air and free the same of particled material above 10 microns in size; (2) deodorize the air and free the same of harmful or undesirable vapors and gases; and (3) to virtually sterilize the air of viable and infectious micro-organisms as the air traverses the first and second passageways and is exposed to radiation from the ultra violet lamps longitudinally disposed in said passageways.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the air sterilizer and purifier;

FIG. 2 is a vertical cross-sectional view of the air sterilizer and purifier taken on the line 2—2 of FIG. 1, with one of the first and second passageway defining means being shown in section and the other of the first and second passageway defining means being illustrated in elevation;

FIG. 3 is a transverse, cross-sectional view of the air sterilizer and purifier taken on the line 3—3 of FIG. 2;

FIG. 4 is a longitudinal cross-sectional view of the air sterilizer and purifier;

FIG. 5 is an exploded view of the cabinet, blower and passageway defining means, and the back that is removably mountable on the rearward portion of the cabinet; and

FIG. 6 is a schematic electrical wiring diagram used in connecting certain components in the air sterilizer and purifier.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The air sterilizer and purifier A, as may best be seen in FIGS. 1 to 3, preferably includes an elongate, vertically extending cabinet B that has a top and bottom 10 and 12, a front piece 14, and a pair of sidewalls 16. A back 18 is removably secured to the rearward open end of the cabinet by conventional locking means 19, shown in FIG. 5. First and second air intakes 20 are formed in the lower portions of the sidewalls 16, as illustrated in FIG. 2.

The top 10 has a louvered air outlet 22 formed therein. Two horizontally aligned supports 24 are mounted on the interior surfaces of sidewalls 16, as may be seen best in FIG. 2. Supports 24 are positioned above air intakes 20.

An integral unit C that includes at least one blower 25, first and second passageway defining assembly 26, and a pair of elongate ultra violet light lamps or tubes 46 that are removably supported above a horizontal plate 29. The plate 29 rests on supports 24 inside cabinet B. Blower 25 includes a rotor 30 that is driven by an electric motor 32, shown in FIG. 6. The blower 25 includes a housing 33 having an air intake 34 in one side thereof, with the discharge 36 of the blower being in communication with an opening 37 in plate 29 that leads into the first and second passageway-defining assembly 26, as shown in FIGS. 2, 4 and 5.

The first and second passageway defining assembly 26 includes two vertically extending side walls 38 and end walls 40. The upper ends of side walls 38 and end walls 40 have a horizontal cover 42 secured thereto. The interior of assembly 26 is divided by an upwardly extending partition 44 to define first and second passageways 26a and 26b which, on their upper ends, are in communication another. one anothr. First passageway 26a on its lower end is in communication with opening 37. The lower end of second passageway 26b is in communication with an opening 45 in the lower portion of one of the side walls 38.

First and second passageways 26a and 26b have first and second elongate ultra violet light lamps 46a and 46b disposed therein, with the lamps extending the longitudinal lengths of the passageways. The lamps 46a and 46b have the end terminals 48 thereof removably supported in conventional lamp engaging members 50 secured to cover 42 and plate 29, as shown in FIG. 2. The interior surfaces of the side walls 38 and end walls 40, cover 42 and partition 44 that define the first and second passageways 26a and 26b are covered with a crinkled, light-reflecting sheet material 52 that reflects ultra violet light from the lamps 46a and 46b in a random criss-cross pattern in the passageways. Due to this criss-cross reflection of ultra violet light in the first and second passageways 26a and 26b, micro-organisms entrained with the air flowing therethrough are exposed to the ultra violet light from all angles, and maximum destruction of the micro-organisms is achieved as a result thereof.

First and second air intakes 20, as may best be seen in FIG. 2, have louvered members 54 mounted therein by fastening means (not shown), or hingedly supported by means (not shown) from the side walls 38. Each of intake members 54 removably supports a first filter 56 and second filter 58 within cabinet B, as shown in FIG. 2. First filter 56 is directly behind the louvered intake member 54 and serves to remove particles from the air that are greater than 10 microns in size. The first filter 56 is preferably white for ease in inspecting the same to determine whether it should be replaced. The second filter 58 receives prefiltered air from the first filter 56. Second filter 58 preferably includes a material such as activated carbon, aluminum silicate, or the like, that is sufficiently porous to permit microorganisms in the air and particles in the air of less than 10 microns in size to pass therethrough. The activated carbon adsorbs malodors, tobacco odors, moisture, both burned and unburned hydrocarbons, oxidants associated with

smog, and most important mercury, whether in the form of vapor or in an atomized state. Mercury, when present in even minute quantities in the air, is highly toxic over a prolonged period of time.

Air that has been filtered but still contains microorganisms flows from the second filter 58 through the blower 25 to be discharged into the first passageway 26a where it flows upwardly and is then directed downwardly through the second passageway 26b to discharge through the opening 45 into the confined space within the cabinet B and the purified and sterilized air then flowing back into the room in which the unit A is situated. The air, in flowing through the first and second passageways 26a and 26b is subjected to ultra violet light radiation from the lamps 46a and 46b, as are micro-organisms and viruses entrained with the air.

The rate at which filtered air is discharged from blower 25 to first and second passageways 26a and 26b is critical, for the air flowing through the passageways must be at a sufficiently low velocity that substantially all micro-organisms therein are destroyed. Also, the rate of flow of air from the blower 25 must be such that the air in the room in which the air sterilizer and purifier is situated is recycled a number of times per hour.

From experience, it has been found that if the air flows through the first and second passageways 26a and 26b at a velocity of between 700 and 1100 feet per second, and the passageways are at least 3 feet in length, as well as the passageways having a transverse cross section of between 9 and 16 inches, the ultra violet light from the lamps 46a and 46b is sufficient to kill or deactivate micro-organisms present in the air when the air is recycled a number of times per hour.

The electrical wiring used in supplying power to the air sterilizer and purifier A is shown diagrammatically in FIG. 6. A manually operated switch 74 is provided that is mounted on a convenient location on the cabinet B. Switch 74 may include a pilot light 76 if desired to indicate that the device is operating, although other means to be described later may be used for this purpose. Electric power is supplied from a domestic electric outlet to the switch 74 and pilot light 76 by two insulated electric conductors 78, and a third conductor 80 that is connected to a ground 82.

Terminal 76a is connected by a conductor 84 to one terminal of motor 32, with the other terminal of the motor being connected by a conductor 86 to one terminal of a resistor 88. The other terminal of resistor 88 is connected by a conductor 90 to terminal 76b.

A ballast 92 is provided for the first and second ultra violet lamps 46a and 46b. Ballast 92 has conductors 94, 96, and 98, 100 connected to opposite ends thereof. The conductor 94 is connected to a junction point 94a in conductor 84. Conductors 98 and 100 extend to lamp-engaging members 50. The lamp-engaging members 50 on second ends of lamps 46a and 46b are cross-connected by a conductor 102, and are also connected to conductor 96 as well as to a conductor 104 that extends to a junction point 104a in conductor 90.

When switch 74 is closed, the electrically operated components shown in FIG. 6 are energized from power that flows through the conductors 78.

The front piece 14, if desired, may have horizontally spaced openings 110 formed therein that are vertically aligned with ultra violet lamps 46a and 46b. The openings 110 have transparent filters 112 formed therein that permit a user to visually determine whether the

lamps 46a and 46b are operating. The filters 112 serve to prevent the passage of light therethrough in a frequency range that would be harmful to the human eye.

It will be particularly noted that due to the porosity of the first and second filters 56 and 58 a large volume of air may be recycled through the air sterilizer and purifier A, as the filters remove only relatively large foreign particles and noxious gases and vapors from the air.

In the prior description, but one of the units C was described, but in FIG. 2 it will be seen that two of the units C are actually positioned in cabinet B and disposed side by side. When only one unit C is used in the cabinet B, the second air intake 20 is simply blocked off by conventional means (not shown).

The use and operation of the invention has been previously described in detail and need not be repeated. The cabinet B, if desired, may be mounted on casters (not shown) for ease in moving the air sterilizer and purifier A from room to room.

I claim:

1. An air purifying and sterilizing device for use in recycling the air in a room or other confined space to sequentially remove entrained solid particles of greater than 10 microns therefrom, together with vapors and gases that are harmful to the human system, and to destroy micro-organisms in said air that are less than 10 microns in size, said device including:
 - a. a cabinet having an air outlet and at least one air intake therein;
 - b. first and second filters, said first filter capable of removing solid particles of greater than 10 microns in size as air containing said particles passes therethrough, and said second filter capable of removing reactive gases and vapors including those that may be toxic from air flowing therethrough, with both said first and second filters sufficiently porous as to permit micro-organisms of less than 10 microns in size that are entrained with air to pass therethrough;
 - c. at least one electric motor-driven blower in said cabinet, said blower having an air discharge and an air inlet;
 - d. first means for supporting said first and second filters inside said cabinet in coaxially aligned sealing engagement with one another, with one of said filters disposed to receive air from said air intake and the other of said filters disposed to deliver air passing therethrough to said air inlet;
 - e. at least one first and second passageway-defining assembly in said cabinet in communication with said air discharge through which air after passing through said first and second filter flows at a velocity of between 700 to 1100 feet per second in opposite directions, with each of said first and second passageways being at least 3 feet in length, and each of said passageways having a transverse cross section of between 9 and 16 square inches, with air after traversing said first and second passageways discharging into the interior of said cabinet to subsequently be returned to said room by discharging through said air outlet;
 - f. a first set of first and second electrically operated ultra violet light generating tubes substantially centrally disposed in said first and second passageways and extending the longitudinal length thereof;

g. light-reflecting means covering the interior surfaces of said first and second passageways for reflecting light from said tubes at random patterns to obtain maximum exposure of said micro-organisms to said ultra violet light as air containing said micro-organisms flows through said first and second passageways; and

h. electric circuit means for concurrently operating said motor driven blower and said first set of first and second tubes to draw a stream of air through said first and second filters and discharge the same through said first and second passageway-defining assembly to purify and sterilize said air prior to said air being returned to said room through said air outlet.

2. An air sterilizing and purifying device as defined in claim 1 that includes two motor driven blowers and two first and second passageway defining assemblies in said cabinet, and said electric circuit means supplying power to both of said blowers and to said ultraviolet light lamps in both of said assemblies.

3. An air purifying and sterilizing device as defined in claim 1 in which said cabinet is elongate in shape in a vertical direction with said air outlet in the upper portion thereof, and said air intakes in the lower part thereof.

4. An air purifier and sterilizing device as defined in claim 1 in which openings are formed in said cabinet in vertical alignment with said lamps, and said device in addition including:

i. transparent filters in said openings that remove light of harmful frequency from light radiated by said ultra violet lamps, and visually permit a determination to be made as to whether said lamps are

operating.

5. An air sterilizing and purifying device as defined in claim 1 in which said first filter is formed from a light colored porous material for ease in visually inspecting the same to determine whether said filter should be replaced.

6. An air sterilizing and purifying device as defined in claim 1 in which said second filter contains a material that has a high affinity to adsorb metals present in the air in either a highly divided state or in the form of vapor.

7. An air purifying and sterilizing device as defined in claim 1 in which said first and second passageway defining means includes a dimensionally stable structure defined by a pair of vertically extending side walls and end walls that on their top are closed by a cover and on the bottom are secured to a horizontal plate having an opening therein, a partition that divides the interior of said structure into first and second elongate passageways that are in communication with one another at the top thereof, said first passageway in communication with said opening in said plate to receive a stream of air from said blower, and said air stream after traversing said first and second passageways discharging into said cabinet as purified and sterilized air through an opening in the lower portion of one of said side walls.

8. An air purifying and sterilizing device as defined in claim 7 in which said blower is secured to said plate.

9. An air sterilizing and purifying device as defined in claim 7 in which said first means are a pair of horizontal supports secured to said end pieces on which said plate rests.

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