May 6, 1952 W. M. GROSVENOR, JR., ET AL 2,595,673

AIR STERILIZING METHOD AND APPARATUS

Filed April 12, 1950

FIG. 1

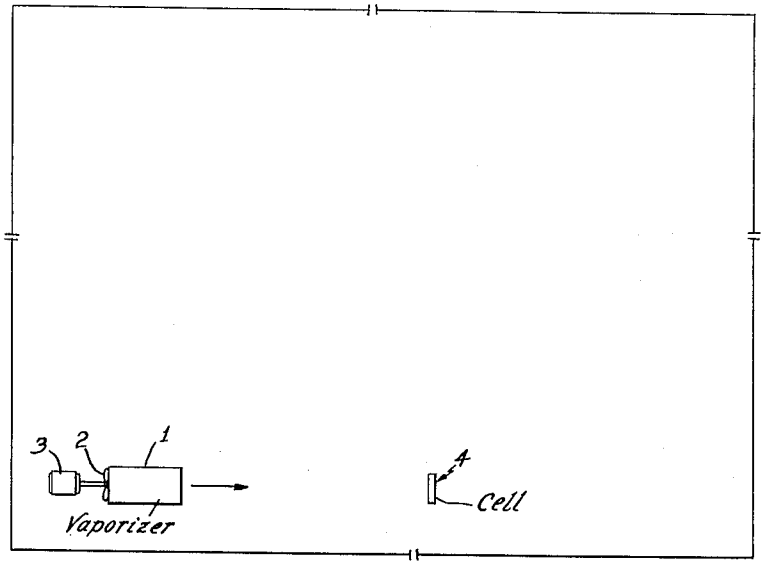


FIG. 2

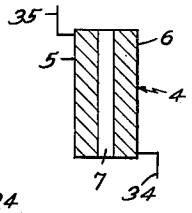


FIG. 3

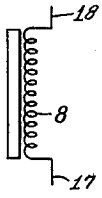
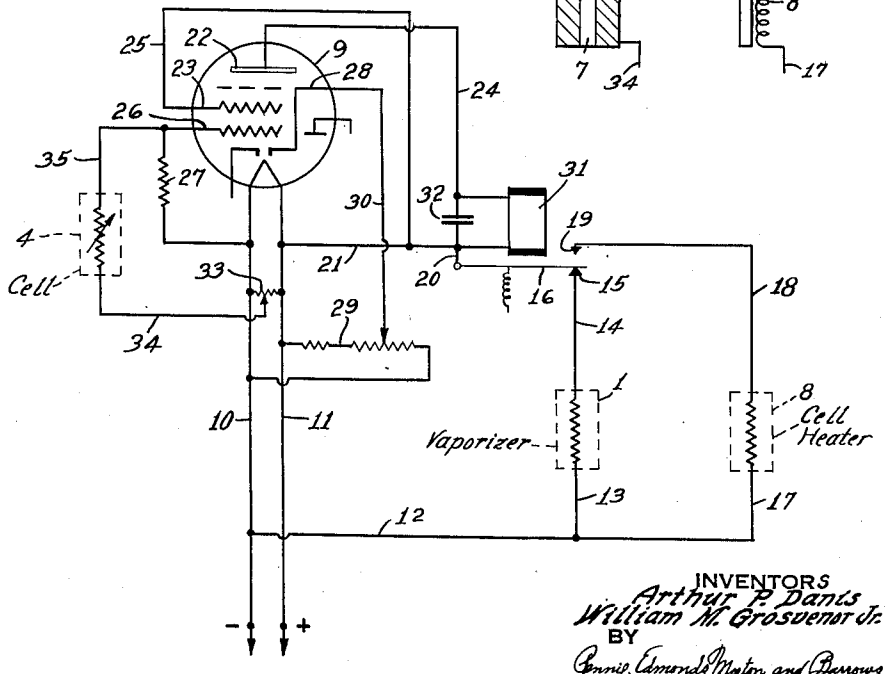


FIG. 4



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AIR STERILIZING METHOD AND APPARATUS

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2 Claims. (Cl. 21—74)

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This invention relates to an improved process and apparatus for supplying triethylene glycol vapor in effective amount for disinfecting the air of a closed space such as a room without supersaturating the air and without the accompanying objectionable fog, condensation on furniture, etc., which such supersaturation produces.

It is known that triethylene glycol vapors are effective for the disinfection of air and that a relatively narrow margin exists between the concentration of triethylene glycol vapor required for optimum bactericidal action and the saturation point of this vapor in air of various relative humidities and temperatures.

The present invention provides an improved process and vapor dispensing device whereby the air in a closed space such as a schoolroom can be continuously supplied with triethylene glycol vapor to maintain an effective concentration of such vapor in the closed space without danger of supersaturation of the air.

It will be appreciated that the relative humidity and temperature of the air in a room are subject to considerable variation and that the rate at which the room air is changed by natural or artificial ventilation will also vary.

Vapor dispensing devices have been proposed which are manually regulated and which can be adjusted to provide for larger or smaller amounts of vapors. But with manual regulation there may at times be insufficient vapor for the purpose intended and at other times an excess of vapor may be supplied with consequent condensation on and danger to the contents of the room.

The improved process and apparatus of the present invention do not require manual operation or regulation, but nevertheless enable effective amounts of triethylene glycol vapors to be supplied to the room without danger of supersaturation and condensation.

According to the present invention, the glycol vapors are supplied by an electrically heated vaporizer which vaporizes the glycol into a current of air passing therethrough and saturated or supersaturated glycol vapors are discharged from the vaporizer into the room. And such vaporizer is automatically controlled by a cell and electrical connections which turn off the vaporizer when the air in the room approaches saturation with glycol vapors and turns the vaporizer on again when the air falls below a predetermined degree of saturation.

From an apparatus standpoint, the invention includes an electrically heated glycol vaporizer

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and a resistance cell so located in the room that the air impinging on it has a higher glycol vapor content than the average vapor content in the room. This cell may thus be located in the path of the air discharged from the vaporizer into the room at a sufficient distance from the vaporizer so that the supersaturated air leaving the vaporizer is mixed with additional air and reduced to a glycol vapor content less than saturation but higher than that of the average air of the room before it reaches the resistance cell. The cell will have a conductive layer, formed by adsorption of glycol before the air in the room becomes saturated, and when the cell thus becomes conductive, the vaporizer will be turned off.

The cell used is typified by a sheet of glass having a conductive layer upon it and a narrow area between the conductive layer which is nonconductive such as is made by taking a sheet of mirror glass and scratching away the conductive layer to leave a narrow strip of glass uncovered by the conductive material and connecting the electrical contacts to the conductive material on each side of this insulating strip. The contacts of the cell are connected through relays with a switch which turns off or on the vaporizer depending on whether the cell acts as a conductor or an insulator.

This cell is placed in a position where the glycol-laden air from the vaporizer has a higher content of glycol vapor than the average content of the room. When the glycol vapor content impinging on the cell approaches saturation it condenses on the insulating surface of the cell and converts the insulating surface into a conducting surface. A salt soluble in the glycol, such as copper chloride, is deposited on this insulating area to aid in holding the glycol that impinges on it, and when the glycol is adsorbed to an extent sufficient to form a conducting layer, it closes the circuit and activates the relays which operate the switch and turns off the vaporizer.

The cell is also provided with a heater which is turned on when the vaporizer is turned off, and this heater is so arranged and is of such a nature that it slowly evaporates or tends to evaporate the adsorbed layer of glycol on the cell. So long as the glycol-laden air impinging on the cell is sufficiently high in glycol vapor the cell remains conductive and the vaporizer is shut off. When the glycol vapor in the air impinging on the cell falls below a certain degree of saturation, the heat vaporizes the glycol faster

than it is adsorbed until the cell becomes a non-conductor and this causes the relays to act to throw the switch in the opposite direction to turn on the vaporizer, and to turn off the heater for the cell.

The invention is applicable to existing installations having an electrically heated vaporizer. In such case there are added a resistance cell and electrical connections and relay and switch to control the electric heater of the vaporizer. In this case the cell will be located in the path of the air discharged from the vaporizer at a point where the glycol vapor content is below saturation but somewhat higher than the average vapor content of the room. The formation of a conductive layer on the cell by adsorption of glycol from the air will cause the main vaporizer to be turned off. The heater for the cell itself will be turned on at the same time and will gradually remove the conductive layer of glycol until the cell becomes a non-conductor, whereupon the relay will actuate the switch to turn on the vaporizer. The heater will be a very moderate heater which does not too rapidly drive off the adsorbed conductive layer.

The invention will be further described in connection with the accompanying drawings which illustrate in a somewhat conventional and diagrammatic manner an arrangement of apparatus embodying the invention and adapted for the practice of the process of the invention, but it will be understood that the invention is illustrated thereby but is not limited thereto.

In the accompanying drawings Fig. 1 shows in a conventional and diagrammatic manner a portion of a room with a vaporizer and cell located there, and with the electrical connections omitted;

Fig. 2 is a diagrammatic front view of the cell;

Fig. 3 is a side view of the cell showing the cell heater; and

Fig. 4 shows one form of wiring connections and arrangements and relay for operating the apparatus.

In Fig. 1 a portion of a room is shown conventionally with an electrically heated vaporizer 1 for vaporizing glycol into a current of air passing therethrough, the flow of air through the vaporizer being effected by the fan 2 and its operating motor 3. When the vaporizer is operating, the glycol is vaporized and the air passing through the vaporizer is somewhat heated and the resulting glycol vapor-laden air is forced from the vaporizer in the direction of the arrow toward the resistance cell 4 which is located at a considerable distance from the vaporizer. The location of this cell is at a sufficient distance so that the glycol vapor-laden air coming from the vaporizer is mixed with air in the room and diluted to a point where it carries a somewhat higher glycol vapor content than the average vapor content of the room. The air will be kept in circulation by the fan so that the air in the room will be kept in circulation.

One form of resistance cell is shown conventionally in Figs. 2 and 3. The front of the cell as shown in Fig. 2 has two side portions 5 and 6, such as the conductive metal layer on the back of a mirror, with a clear path 7 between them forming an insulating or non-conducting area until a film of glycol vapor is formed thereon. This area 7 is coated with a layer of a glycol soluble salt such as cupric chloride to aid in the forming of a conductive glycol layer when the glycol vapor content in the air approaches saturation. On the back of this cell is a heater 8 for heating the cell and aiding in the removal of the layer of glycol therefrom.

A conventional arrangement of relay and connections for operating the apparatus is shown in Fig. 4, this relay consisting of a one-stage amplifier using a tube 9 (117N7) and a single-pole, double-throw relay together with circuit components shown in the diagram. Current is supplied through the lines 10 and 11, one of which is connected through the line 12 and the branch line 13 to the vaporizer 1 and then through the line 14 to the terminal 15 which is normally connected as shown with the switch member 16, which in turn is connected through the lines 20 and 21 to the line 11. Another branch connection 17 leads from the line 12 to the cell heater 8 and then through the line 18 to the terminal 19 of the relay.

It will be seen that the plate 22 and screen 23 of the tube are connected through lines 24, 25 and 21 to the line 11; while control grid 26 is connected through the grid resistor 27 to the other side of the line 10. The cathode 28 is connected to a potentiometer set 29 through the line 30. The electromagnet 31 for operating the switch 16 is connected with the circuit of the plate 22, the 30 mfd. condenser 32 across the relay coil serving to convert the pulses of alternating current into a direct current preventing chattering of the relay.

Assuming at any instant the polarity of the A. C. supply is as indicated, it will be seen that plate 22 and screen 23 of the tube are connected to the positive side of the line, while control grid 26 is connected through grid resistor 27 to the negative side of the line. Cathode 28 is connected to the potentiometer set to make the cathode potential sufficiently positive (negative grid bias) with respect to the grid 26 so that the plate current flowing is insufficient to operate the relay.

The above conditions hold when the measuring cell has a very high resistance and so has a negligible effect upon the potential of grid 26. Thus, when the resistance of the cell is of the order of magnitude of the 3.9 megohm resistor 27, insufficient plate current flows to operate the relay.

When, however, a film of glycol is deposited on the cell, positive potential derived from the 0.1 meg. potentiometer 33, connected through the line 34 to the cell 4, which in turn is connected through the line 35 with the grid 26, causes a current flow through the cell and the 3.9 meg. grid resistor 27, reducing the negative bias of the grid 26 with respect to the cathode 28. The plate current consequently increases, operating the relay and causing the switch member 16 to contact with the terminal 19, which shuts off the current to the vaporizer 1 and turns on the cell heater 8 until in due time the original conditions are restored.

In the foregoing it has been assumed that one supply terminal was positive and the other negative. The fact that the supply is actually A. C. means that the plate current flows in pulses sixty times a second, while the condenser 32 across the relay coil 31 serves to convert these pulses into a direct current, preventing chattering of the relay. During periods of reverse polarity, no current flows in the plate 22 as the tube conducts in only one direction.

In the operation of the apparatus described the switch 16 will normally be in contact with

the terminal 15 and current will pass through the vaporizer 1 and the glycol will be vaporized therein and the resulting current of air highly laden with glycol vapors will be continuously discharged into the room until the glycol vapor content approaches saturation. The cell 4, located in the path of glycol vapor-laden air coming from the vaporizer, will remain non-conductive until the glycol vapor approaches saturation when it will be condensed or adsorbed on the surface 7 of the cell and will form a conductive layer thereon. Thereupon, the relay will be operated to disconnect the switch 16 from the contact 15, thus shutting off the current to the vaporizer, and connecting the switch with the contact 19, turning on the current to the cell heater.

The moderate application of heat to the cell will after a sufficient period of time vaporize the layer of glycol and render the cell again non-conductive through the insulating area 7. Thereupon the relay will be acted upon to disconnect the cell heater and to connect the vaporizer.

By locating the cell at a proper distance from the vaporizer and by regulating the cell heater, a conductive layer of glycol will be formed on the cell before the air in the room becomes saturated with glycol vapor and the vaporizer will be disconnected. The more nearly saturated the air in the room becomes, the more quickly the conductive layer will be formed and the longer the relative periods of time required for the gradual removal of the glycol vapor layer by the heater before the vaporizer is again started in operation.

With proper regulation the air in the room can be prevented from becoming saturated or supersaturated with glycol vapor while, nevertheless, maintained at a sufficiently high glycol vapor content to obtain the desired disinfection of the air.

We claim:

1. An apparatus for supplying triethylene glycol vapor in effective amount for disinfecting the air of a closed space without supersaturating the air therein including an electrically heated vaporizer for vaporizing the glycol vapors into a current of air, means for recirculating the air in the room through said vaporizer and for causing the glycol-laden air therefrom to enter the closed space with a directional flow and to mix with the air therein, a resistance cell having a normally non-conductive area which is adapted to become conductive by the adsorption of a layer of glycol thereon, said cell being located

in the path of said directional flow and at a distance from the vaporizer, a heater for heating said cell to effect gradual removal of glycol vapors therefrom when such a layer is formed, electrical connections for heating said vaporizer and for heating said cell, and a relay connected with said cell and operated thereby when a conductive layer of glycol is formed thereon to disconnect the heater of the vaporizer and to connect the heater of the cell, and to connect the heater of the vaporizer and disconnect the heater of the cell when the conductive layer of glycol is removed from the cell.

2. In a system for supplying triethylene glycol vapor to the air of a closed space by an electrically heated vaporizer through which the air of the closed space is recirculated and from which it is discharged with a directional flow, a resistance cell interposed in the path of said flow at a distance from the vaporizer, said cell having a normally non-conductive area which becomes conductive when a layer of glycol is deposited thereon, a heater for heating said cell to effect gradual removal of glycol vapors therefrom when such a layer is formed, electrical connections for heating the vaporizer and for heating the cell, and a relay connected with said cell and operated thereby when a conductive layer of glycol is formed thereon to disconnect the heater of the cell, and to connect the heater of the vaporizer and disconnect the heater of the cell when the conductive layer of glycol is removed from the cell.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,015,125	Polin	Sept. 24, 1935
2,064,651	Fiene	Dec. 15, 1936
2,148,143	Waitzman	Feb. 21, 1939
2,198,867	Fair	Apr. 30, 1940
2,234,853	Brown	Mar. 11, 1941
2,358,406	Lichtgarn	Sept. 19, 1944
2,369,900	Jennings	Feb. 20, 1945

OTHER REFERENCES

Weaver: "Measurement of Water in Gases by Electrical Conduction in a Film of Hygroscopic Material . . .," Journal of Research of National Bureau of Standards, R P 1865, volume 40, March 1948, pages 169–214.