

June 15, 1965

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3,189,405

DECONTAMINATING DEVICE AND FOG GENERATOR

Filed March 6, 1962

FIG. 1

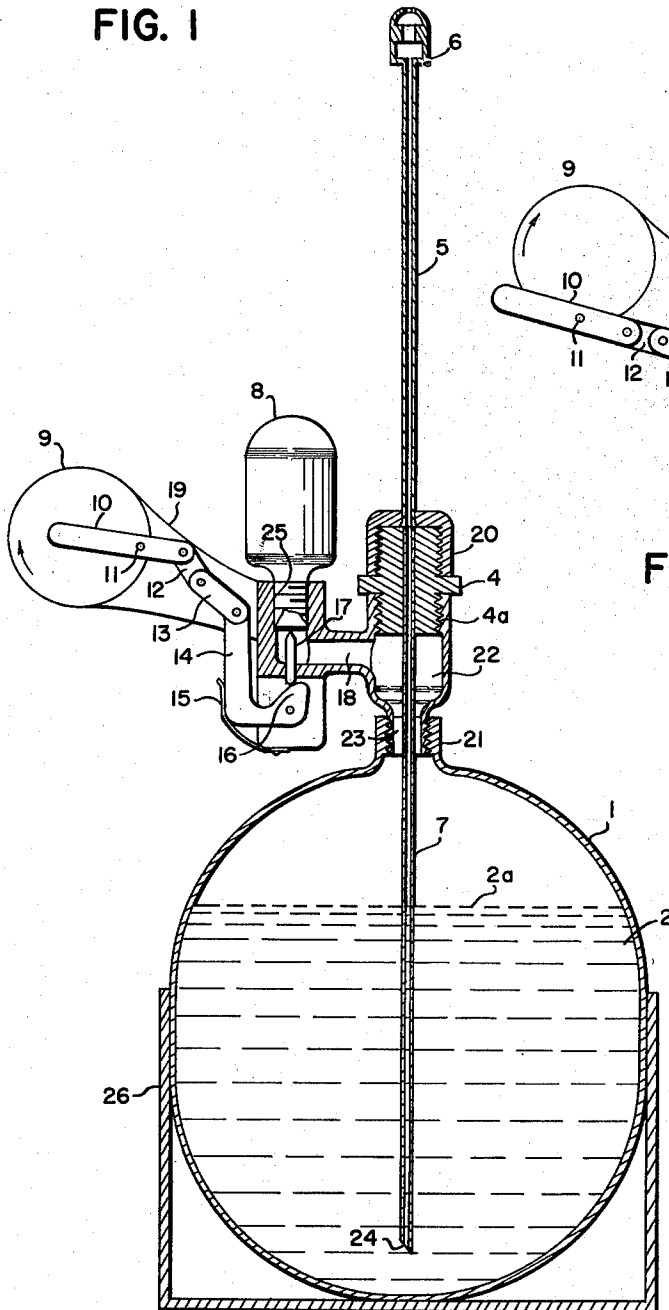
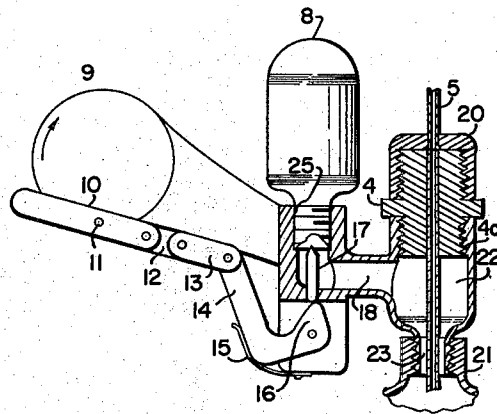


FIG. 2



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DECONTAMINATING DEVICE AND FOG GENERATOR

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Filed Mar. 6, 1962, Ser. No. 177,928

1 Claim. (Cl. 21—121)

(Granted under Title 35, U.S. Code (1952), sec. 266)

A non-exclusive, irrevocable, royalty-free license in the invention herein described throughout the world for all purposes of the United States Government, with the power to grant sublicenses for such purposes, is hereby granted to the Government of the United States of America.

This invention relates to a novel decontaminating device. More particularly it relates to a simple, inexpensive device for automatically generating a vapor or fog of water or a decontaminating solution within an enclosure.

Despite the usual aseptic conditions maintained in hospitals during surgery and in hospital housekeeping generally, an increasing occurrence of certain infections among patients and hospital personnel has been observed in recent years. These infections apparently are caused by the presence of the infecting organisms in the atmosphere and on the surfaces (e.g., walls, ceilings, and floors) of operating rooms and elsewhere in hospitals. Washing the surfaces with antiseptic and germicidal agents has not proved to be too efficient a method for decontaminating such rooms, perhaps for the reason that the organisms suspended in the atmosphere were not attacked.

It is known that various agents are capable of effecting rapid and complete sterilization when applied to a variety of articles such as clothing, surgical and other scientific instruments, and the like. For example, it is known that ethylene oxide, released in the form of a gas, is an excellent sterilant. However, not only is the material relatively expensive, but it is dangerous to handle because it is highly explosive both in the presence or absence of oxygen. Furthermore, it must be used in gas-tight enclosures to prevent escape of the sterilant during the period in which it must be in contact with the contaminated objects.

Formaldehyde, in industrially available concentrations, is also an excellent sterilant, especially where surface treatment only is required and where it is not necessary to take advantage of the penetrating powers of a gas. However, because formaldehyde is a powerful irritant when brought into contact with human or animal skin, or when inhaled, it is necessary to provide elaborate protection for the person using the material.

One object of this invention is to provide a device for dispensing a decontaminating agent, such as formaldehyde, within an enclosure whereby it is possible to treat the contained atmosphere as well as the surfaces such as the walls, ceiling, and floor.

Another object is to provide such a device whereby it is possible to release the decontaminant in an enclosure without the immediate presence of an operator, thereby insuring personal safety.

A further object is to provide such a device that is simple and economical to construct from readily available components.

These and other objects, which will be apparent to those skilled in the art, are achieved by means of the invention described in detail below and shown in the accompanying drawing which FIGURE 1 is a schematic representation in cross section of a preferred form of the completely assembled device, and FIGURE 2 shows the method by which the gas cartridge, described more fully below, is pierced.

In general, the device of this invention comprises a

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pressure tank or container equipped with an education or siphon tube having an atomizing nozzle at its external end, a cartridge containing carbon dioxide or other gas under pressure, a holder and a valve having a release mechanism, and a remote control or a delayed-time release mechanism for activating the valve to introduce the pressurized gas into the tank and atomize the formaldehyde or other disinfectant contained in the tank.

In detail, the device comprises a tank or container 1 for holding the liquid formulation 2. The container is provided with a threaded neck 21 into which is screwed a valve assembly indicated generally by 3. Such valve assemblies are commercially available devices and are used with cartridges of a gas, such as carbon dioxide, for inflating rubber life rafts. A filler plug 4 is screwed into the upper outlet end 4a of the valve assembly. Plug 4 is drilled to provide a through passageway and a dip tube 7 of polyethylene or other suitable material, inserted in this passageway, extends to substantially the bottom of the tank. End 24 of the dip tube is cut at an angle, such as 45°, to permit easy entrance of the liquid. The upper end of the filler plug is adapted to receive a conventional quick coupler into which one end of a rigid elongated tube 5 is secured. The other end of tube 5 is provided with an atomizing nozzle.

The valve assembly 3 is also provided with a threaded port 25 for receiving a sealed cartridge 8 containing carbon dioxide or other gas under pressure. A passageway 18 connects with passageway 22 that surrounds the upper portion of dip tube 7 and communicates with the interior of the tank. The valve assembly further is provided with the usual piercing pin 17 that rests on the cam surface 16 of pivoted lever 14. Any suitable resilient means may be used to prevent accidental piercing of the seal in the cartridge. Thus, as shown in the drawing, a curved leaf spring 15 is rigidly secured by one end to the exterior of the body of the valve while the other, free end bears against lever 14. To pierce the seal in the cartridge as shown, it would, therefore, be necessary to pull the lever in a counterclockwise direction against the opposing pressure of spring 15. Other valve designs are available in which, for example, a coiled compression spring (not shown) surrounds the piercing pin, normally forcing it away from the seal.

The free end of lever 14 is connected by means of links 12 and 13 to the striking arm 10 of a conventional timing mechanism assembly 9. Arm 10 is pivoted to the body of the timer 9 by means of pivot pin 11 and is also connected by means not shown to the internal mechanism of the timer. Such timer assemblies are readily available commercial items.

The entire device may be mounted in any suitable support means or box 26.

To use the device, the tank 1 is first filled through filler plug 4 with a predetermined amount of the desired liquid formulation and the tube 5 is then coupled to the plug. A sealed pressurized gas-containing cartridge 8 is then connected to the valve assembly, and the device is ready for operation.

The operator first places the device in the room to be treated and sets the timer to go off after any desired interval, generally long enough to permit him to perform any other necessary duties in the room or merely to permit him to leave and close the doors. At the end of the period for which the timer has been set, the timing mechanism causes lever to rotate, as for example, in the clockwise direction indicated by the arrow. This exerts a pulling force, through links 12 and 13, on lever 14 against the pressure of spring 15. Since the pivoted end of lever 14 is provided with a cam surface (which need simply be an eccentric), the latter forces piercing pin 17

through the seal in the gas cartridge and releases the gas into the interior of tank 1. Pressure of the gas on the surface 2a of the liquid formulation forces the latter up through dip tube 7 and tube 5 from which it is discharged into the atmosphere of the room as a fog or vapor by means of atomizing nozzle 6.

As will be readily apparent, the above described device is extremely simple and economical to construct.

However, modifications or elaborations may be made in the basic structure without departing from the spirit of the invention. Thus, instead of connecting the timer to lever 14 of the valve assembly through a series of linkages, the same results can be achieved by having the arm 10 strike a spring trap mechanism (not shown), similar to a rat trap, for example, in which the jaw of the trap is connected by means of a cable or chain to lever 14. Also, instead of providing a delayed time release mechanism as illustrated, the device may be operated by remote control through solenoid valve.

As already indicated, any suitable disinfectant formulation can be used in the described device. Two types of formaldehyde solutions have been found to be particularly effective. Both are commercially available. One formulation contains 37% formaldehyde, 48-51% water, and 12-15% methanol. Another, developed for the plastics industry contains 38% formaldehyde, 5% water, and 57% methanol. The first formula is preferred because it is more stable over the wide range of temperatures encountered in most storage conditions.

1300 ml. of either composition when vaporized will effectively treat a room of 2500 cubic feet overnight.

To dispense the above amount of formaldehyde solution, the tank 1 should have a capacity of about 104 cubic inches, and should be made of a material which is chemically inert to formaldehyde or to whatever decontaminant is being used. Stainless steel cylinders are satisfactory but expensive, and the tank can be made of cheaper materials, such as glass or plastics, inexpensive steel lined with a resistant lacquer, glass, resin-base enamels, polyethylene, polyfluorocarbons, and the like.

For most efficient operation, the pressure provided by the gas cartridge should be sufficient to discharge the entire contents from the tank immediately, i.e., about 500 p.s.i.g. for 1300 ml. of formaldehyde solution contained in a tank of 104 cubic inches capacity. This is necessary to avoid excessive loss of pressure due to solution of the gas in the liquid. For safety, the tank should be able to withstand a pressure of about 1700 p.s.i.g.

A Type A-1 cartridge described in Military Specification MIL-C-6561 A, containing 45 grams of carbon dioxide is suitable.

Instead of carbon dioxide, any other suitable liquefied gas can be used to provide the necessary pressure. Among these are chlorodifluoromethane, chlorotrifluoromethane, propylene, propane, and nitrous oxide. The choice of gas will be dictated by considerations of economy, availability, and the nature of the decontaminant.

As already indicated, any suitable valve assembly can be used. One such mechanism, for use with carbon dioxide cartridges is the Type A-130 described in Military Specification MIL-L-25370 USA.

When using formaldehyde solutions in the amounts

above indicated, a polyethylene dip tube of 0.25 inch O.D. having $\frac{1}{16}$ inch thick wall and an exterior tube of aluminum having similar dimensions have been found satisfactory. The oil burner nozzle should have a capacity of about from 0.6 to 1.0 gallon per hour and should preferably be made of stainless steel.

It will, of course, be obvious that the foregoing dimensions can be varied according to the volume of formaldehyde to be dispensed.

Since the action of the formaldehyde is most effective when the relative humidity within the enclosure to be treated is about 60%, it is desirable to adjust the humidity before the disinfectant is released. For this purpose, a duplicate dispenser, containing only water in an amount determined from the observed relative humidity in the room, can be placed in the room together with the formaldehyde dispenser and the timer set to release the water before the formaldehyde is released.

We claim:

A device for generating a fog or vapor comprising:

- (a) a container for holding a liquid to be vaporized and having an opening in the top thereof;
- (b) a valve connected to the container for admitting a gas under pressure to said container, said valve being provided with a plurality of ports, said valve communicating with the interior of the container through a first of said ports;
- (c) release means connected to the valve in operating relationship with means within said valve for initiating flow of gas into the valve through a third port thereof;
- (d) time-controlled means connected to the release means for actuating said release means at a predetermined time;
- (e) first liquid conducting means connected to the valve in a second port thereof and extending in the interior of said valve through the first port of substantially the bottom of the container;
- (f) exterior second liquid conducting means attached at one end thereof to the valve at said second port and communicating with said first liquid conducting means, said first and second conducting means being adapted to discharge the entire contents of the container when flow of gas is initiated; and
- (g) an atomizing nozzle connected to said second liquid conducting means at the other end thereof.

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