

EFFICIENT & ECONOMICAL UVC SANITATION BOX

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Abstract

During a pandemic situation like covid-19 our main objective is to provide a system which can help doctors as well as staff members. This paper describes a prototype model of a box-type sterilizer using C-band UltraViolet Radiation. This sterilizer is based on a hollow rectangular box with a door on one end. Mounted closeness to the interior surfaces of the box are lamps that, when powered, produce UVC radiation. In the operation, an object to be sterilized is placed inside the box, the door is closed and then the ultra violet lamps are powered. Any Living organisms present on the object to be sterilized are killed by the UVC radiation. Tubes of quartz glass, which are transparent to UVC radiation are used to support the object to be sterilized and separate the object to be sterilized from the lamps on the bottom interior surface. Tubes are also used to separate the object to be sterilized from the lamps on the interior surfaces. Hence this model can help in future regarding the safety purpose in hospitals as well as in domestic use.

KEY WORDS: *UVC radiation, Ultra violet sterilizer, aluminum box, COVID-19, delay timer, ultra violet lamp, electric choke.*

I. INTRODUCTION

Coronavirus disease (COVID-19) is a deadly disease that originated from Wuhan, China. When infected by the COVID-19 virus people will feel mild to moderate respiratory illness and they will recover without such special treatment.[1] Older people are easy targets for the virus as they have low immunity. It's always better to take precaution and be well informed about the disease source and causes.[1] Keep yourself and others safe from the infection by washing your hands by washing your hands and other from infection by washing your hands and using alcohol-based rub frequently and not touching your face. Coughing and sneezing are the prime explanation for the spread of the COVID-19 virus through discharge from nose and droplets of saliva, so it's important that you simply also practice safe release of the droplets through coughing and sneezing (for example, cover your face using your elbow when coughing or sneezing). [1] As the search showed that Coronaviruses are a group of RNA viruses that cause diseases in mammals and birds. In humans and animals, they cause respiratory tract infections that can be mild to severe. Mild illness also can be caused by other factor, for instance cold (which is additionally caused by other viruses, predominantly rhinoviruses), while more lethal varieties can cause SARS, MERS, and COVID-19.[2] Coronaviruses are large, roughly spherical particles with unique surface projections. Their size is irregular and generally is an average diameter of 100-120 nm. [3] Extreme sizes are known from 40 to 190 nm in diameter. The total molecular weight is on average 40,000 kDa.[3] They are enclosed in an envelope embedded with a number of protein molecules. A study published in the New England Journal of Medicine stated plastic is the surface the virus remains viable on for the longest - up to 72 hours. On chrome steel the virus was detected up to 48 hours after

application. For cardboard it was 24 hours and for copper just four hours.[4] As our project is about an IOT based hospital security system, we have made an Ultraviolet Sanitization Box to ensure the safety of a person who is performing the activity. A box-type sterilizer using C-band Ultra-Violet (UVC) radiation is based on a hollow rectangular box with a door on one end.[5] Mounted nearness to the inside surfaces of the box produce UVC radiation once they are given enough power. In operation, an object to be sterilized is placed inside the box, the door is closed and then the ultra violet lamps are powered.[6] Any Living organisms present on the object to be sterilized are killed by the UVC radiation quartz, that are transparent to UVC radiation are want to support the thing to be sterilized and separate the thing to be sterilized from the lamps on the bottom interior surface.[6] The process of sterilization uses minimum 10minutes for sanitation of object surface. Any living organism, Page 1 bacteria, virus gets killed when place inside during the process. Ultra violet tube ranges from 250nm-280nm with minimum requirement of 16volts. An electrical choke is used in order to provide input volts for ultra violet tubes. Also, for the safety of lamps, an electrical timer is used in order to shut power after certain period of time (every 3 min).[6].

II. EASE OF USE

A. Time saving

Firstly, this project is based on time saving tactics as it takes only minimum of 10 minutes in order to sanitize and maximum of 12 minutes.[7][11]

B. Easily portable

Compact in size makes it more comfortable and easy to carry with minimum space required. Also it's rigid body makes it compete severe damages.

III. HARDWARE ARCHITECTURE

A. Ultra-violet lamp.

Ultra-violet(uv) [11] is a form of electromagnetic radiation which are shorter than visible light but longer than x-rays. Ultra-violet lamps used vary from 16volts to 18volts and vary in nanometers by 250nm-280nm and easily available in market. [8]



FIG.1 UV-C LAMP

B. Electric choke

A electric choke [12] is coil usually consist of coils of insulated wires often wound on a magnetic core. Electric choke is a inductor which is used to block higher-frequencies while passing direct current (DC) and lower-frequencies of alternating current(AC) in electrical circuit. A choke with 2mH winding and rated to handle 2 amperes. [9]



FIG.2 ELECTRIC CHOKE

C. Frame

Aluminum box [13] consists of a 5 faced rigid body of plastic or any other material box commonly covered with aluminum for the safety of handler from ultra violet rays from inside and outside. Also a metal shredded frame fix inside the box in order to place object in the center of box for sanitation.

Aluminum sheets eases the process by reflecting and covering the whole surface of body placed inside the box.



FIG.3 ALUMINUM BOX

D. Delay timer

Delay timers [14] are used to control the circuit for a certain amount of time. Using timers, we can delay the circuit operation. The 555 timer IC here is used as an integrated circuit (chip) used in the timer, in order to delay 1 min every after 3 minutes. Derivatives provide two or four timing circuits.[10]



FIG.4 DELAY TIMER

IV. BOX DESIGN

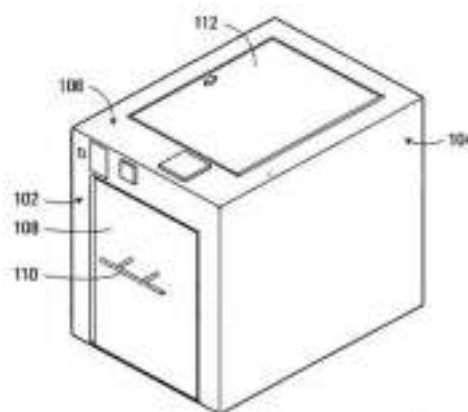


FIG.5 TOP VIEW OF ULTRA VOILET STERILIZATION BOX

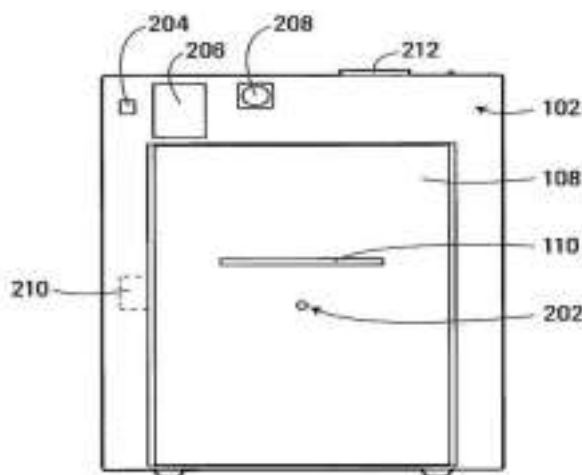


FIG.6 SIDE VIEW OF ULTRA VOILET STERILIZATION BOX

V. DETAILED DESCRIPTION

As illustrated in FIG. 5[15], a sterilizer is formed as a box, or housing, having left and right sides, front and back sides, and top and bottom sides, where all side are opaque to UVC radiation. In the front, right perspective view of,

the front side, right side 104 and top side are in view. The front side 2includes a front door with a door handle. [15] The top side includes a top access door. As illustrated in the elevation view of FIG. 6[15], the front door includes a door safety switch and a door lock. Additionally, in the portion of the front side that is above the front door various control elements are evident, including a master lamp power Switch a lamp monitor and a timer. A fan exit port is illustrated protruding slightly from the top side of the sterilizer. [15] UVC lamps, which are individually or collectively referred to, are illustrated including horizontally mounted "top" UVC lamps horizontally mounted "right" UVC lamps, horizontally mounted "left" UVC lamps, vertically mounted "back UVC lamps and also the horizontally mounted "bottom UVC lamps. The UVC lamps may, in particular, be cold cathode UVC germicidal lamps with optional ozone lamps (not shown) or any other suitable UVC lamps. Object is to be separated so as to be sterilized from the back UVC lamps, a set of "back" quartz cross tube (individually or collectively) are vertically mounted in the interior of the sterilizer. In one embodiment, the quartz cross tubes are manufactured of pure fused hard quartz glass (also known as hard glass pure fused quartz) as this material currently allows the highest UV transparency available. Above the interior of the sterilizer is an electronic compartment, access to which, for service of the electronic components located within the electronic compartment, is provided by the top access door.[15]

On a broader scale an object which is to be sterilized is placed in the interior of the Sterilizer. The front door is closed and the UVC lamps are switched on and the object to be sterilized is bathed in UVC radiation. Due to the placement of UVC lamps on many, if not all, of the interior sides of the sterilizer, few, if any, portions of the object to be sterilized are shadowed from the UVC radiation. Additionally, the object to be sterilized is supported upon the bottom quartz

cross tubes, which are transparent to UVC radiation, and, therefore, do not shadow the object to be sterilized from the UVC radiation. The object to be sterilized may be further protected from contact from the array of UVC lamps on each interior side of the sterilizer by corresponding arrays of quartz cross tubes mounted perpendicular to the UVC lamps.[17] In operation, a user of the sterilizer unlocks the door lock of the front door and opens the sterilizer to expose the interior thereof. The user may then place an object to be sterilized upon the bottom quartz cross tubes in the interior, close the front door 108 and lock the door lock. The user may then use the timer to select a desired duration of exposure and activate master lamp power switch to power the UVC lamps.[15] When the selected duration of exposure expires, the UVC lamps may be automatically powered off. The user may then unlock the door lock and open the front door to remove the object, which may now be considered to be sterilized. Sterilization may be considered the killing of all DNA-based organisms present on the object before the introduction of the object into the sterilizer, for example, those organisms that cause: Anthrax, Severe Acute Respiratory Syndrome, Avian Bird Flu and Creutzfeldt Jacob Disease. [16]

VI. SUMMARY

In this paper, we introduced a method for sterilizing objects in a box type sterilizer which uses C-band Ultra Violet Radiation. This sterilizer can kill any DNA-based organisms present on the object when the lamps producing UVC radiations are powered. The box is compact in size and requires minimum space. Earlier models which were introduced on UV sterilization were not that time efficient as this model is. We have done changes in wavelength of UV radiation used and also we have used aluminum sheets which cover the whole surface of the object kept inside

the box. Aluminum sheets is used to reflect the UV rays so that the rays neither escape the box nor they are absorbed by any other surface hence making the sterilization process quicker and more efficient. Also we have used an electrical timer for safety of lamps so that it shuts down the power after certain period of time, taking every 3 minutes in 10 minutes.

Also during exposure, the lamp monitor measures and provides an indication to the user of the power output of the UVC lamps. It is known that, over time, the power output of the UVC lamps diminishes. As the power output of the UVC lamps diminishes, it is necessary to increase the duration of exposure of an object to be sterilized to radiation from the UVC lamps to properly sterilize the object.[19] Consequently, according to the indication of power output provided by the lamp monitor, the user may set the timer appropriately for the next object to be sterilized. A person having skill in the art should be able to determine a necessary duration of radiation from the amount of radiation per unit time concluded from the lamp monitor and the expected amount of radiation to which is it is desired to expose the object to be sterilized. Additionally, the lamp monitor may be configured to indicate when the power output of the UVC lamps has diminished to a level below a predetermined threshold. Such an indication may be interpreted as a sign that the UVC lamps need to be changed. [19]

VII. CONCLUSION

During a pandemic situation like covid-19 where sanitization has become a necessity we wanted to provide an affordable system which can help doctors as well as staff members. In order to achieve this objective, we made a box

type sterilizer which used C-band Ultra Violet Radiation. This sterilizer could kill any DNA-based organisms present on the object within a reasonable amount of time when the lamps producing UVC radiations were powered. To make this sterilization process quicker we had done changes in wavelength of UV radiation used and also we had used aluminum sheets to cover the whole surface of the object kept inside the box. Aluminum sheets used expedited the process by reflecting the UV rays so that the rays neither escape the box nor they were absorbed by any other surface.

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