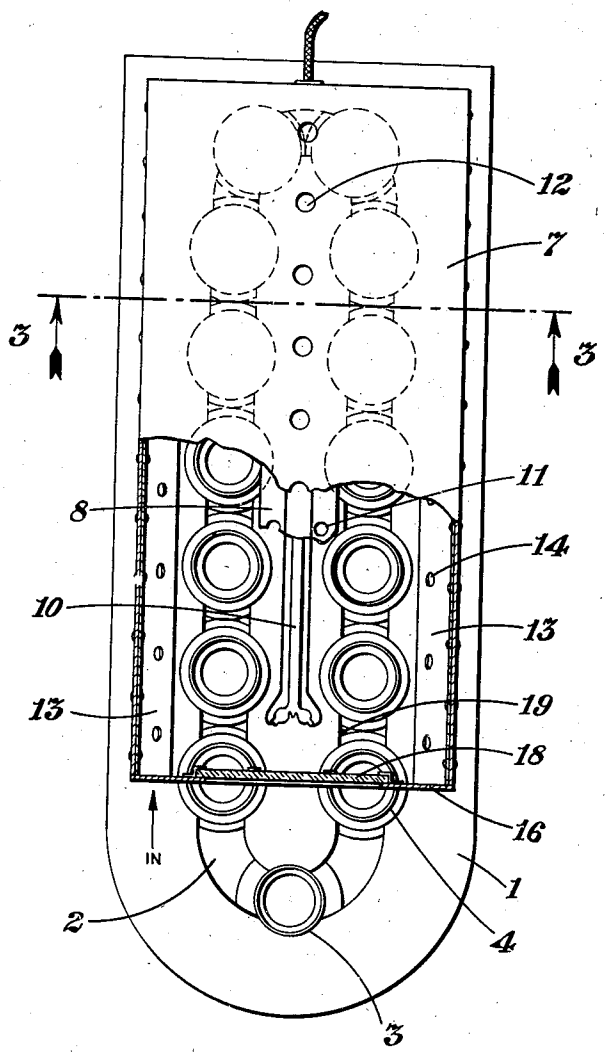
July 20, 1937. L. J. BUTTOLPH 2,087,751

METHOD AND APPARATUS FOR IRRADIATING MATERIALS

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Fig. 1



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Fig. 2

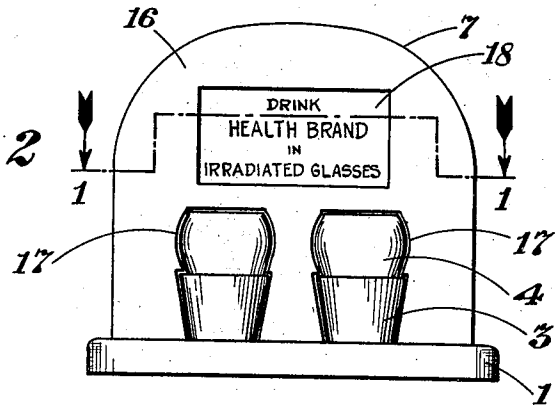


Fig. 3

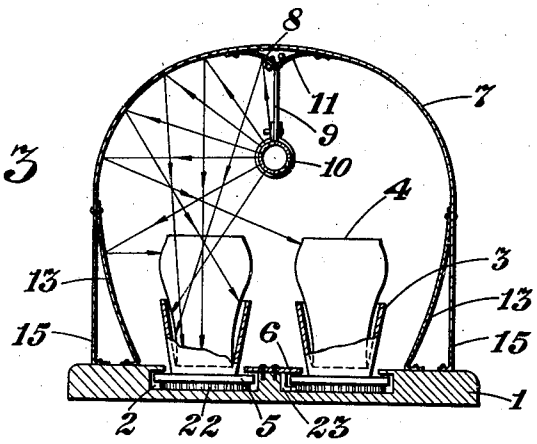


Fig. 4

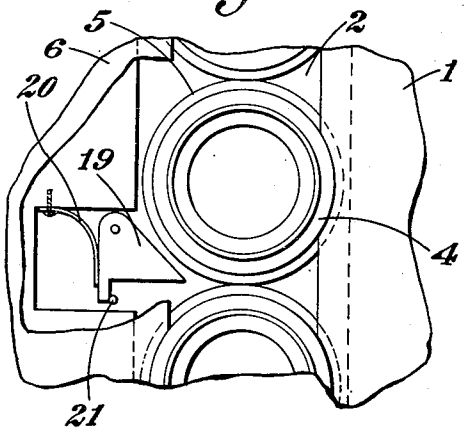
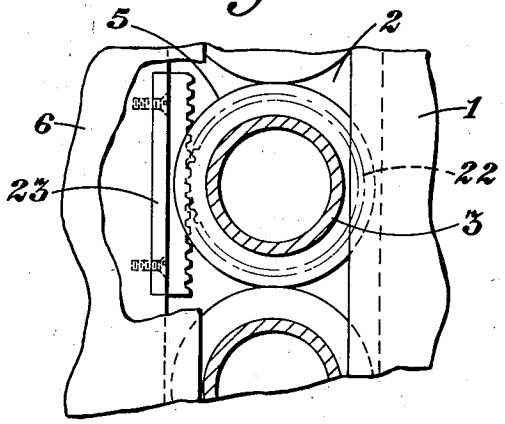


Fig. 5



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METHOD AND APPARATUS FOR IRRADIATING MATERIALS

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Application May 27, 1932, Serial No. 614,018

9 Claims. (Cl. 21—54)

The present invention relates to the art of sterilization by ultraviolet irradiation, and in particular to the irradiation of containers to render them sterile.

The invention consists in the new and novel apparatus, and in the novel method, as hereinafter set forth and claimed.

A particular object of my invention is to provide a novel method of irradiating containers. A further object of my invention is to provide apparatus whereby my novel method may be carried out with a minimum of manual effort. Still another object of my invention is to provide apparatus wherein the irradiated containers are necessarily taken from the apparatus in the same sequence in which they were placed therein. Still another object of my invention is to provide apparatus which will attract favorable attention thereto. Still other objects and advantages of my invention will appear from the following detailed specification, or from an inspection of the accompanying drawings.

While it has long been known that ultraviolet irradiation could be used to kill bacteria, this method of sterilization has not heretofore been practical for containers, such as drinking glasses or other relatively deep vessels, where both the entire inside and a portion of the outside are necessarily irradiated, due to the manipulation required to produce the desired result from a single artificial source of ultraviolet rays. I have now discovered that by combining an ultraviolet generator with a reflector of novel shape the desired sterilization, both inside and outside the containers, may be easily accomplished, provided the containers are maintained in a controlled relation to said generator and reflector for a reasonable period of time. During this irradiation the containers are preferably empty, although in some cases it is desirable to fill them with a liquid which is either permeable to the ultraviolet radiations or which is rendered bactericidal by the irradiation, so that in any case the entire interior of the container is rendered sterile. I have furthermore found that by means of a novel apparatus of my invention the desired result may be easily accomplished for a succession of containers, fed to said apparatus as occasion may demand, the irradiated containers being taken therefrom in the same sequence in which they were introduced. My novel apparatus furthermore has considerable advertising value, inasmuch as that some of the rays from the ultraviolet generator are visible through the containers being sterilized, said containers then serving as filters to protect the eyes of observers from the injurious far ultraviolet rays.

For the purpose of illustration I have shown several views of an apparatus embodying my invention in the accompanying drawings, in which

Fig. 1 is a plan view of a sterilizer for drinking glasses, with a portion thereof cut away to the line 1—1 of Fig. 2,

Fig. 2 is an elevational view of the same apparatus,

Fig. 3 is a sectional view of the same apparatus, taken on the line 3—3 of Fig. 1,

Fig. 4 is a plan view of a portion of the base showing in detail the means to prevent reverse movement of the empty containers, and

Fig. 5 is a plan view of another portion of the base showing an optional arrangement for producing positive rotation of the empty containers.

As shown in these drawings my novel sterilizer has a base plate 1 of cast aluminum, or any other suitable material, in the upper surface of which there is an endless channel 2. The major portion of said channel consists of two parallel legs, symmetrically located with respect to the center line of said base, these legs being connected by circular sections at each end. The outer wall of said channel is undercut throughout its length. In this channel there are a number of holders 3 of bakelite, aluminum or other suitable material, for the empty containers, such as the drinking glasses 4, which are to be sterilized. These holders may, of course, be minimized in size and/or made of fused silica or an ultraviolet transmitting glass when larger portions of the exterior of the glasses 4 are to be sterilized. Said holders each have a circular flange 5 on the bottom thereof which fits into the undercut portion of said channel. A metal plate 6 of suitable shape is affixed to the top of the base plate 1 with its edges overlapping the inner wall of said channel 2, whereby said holders 3 are locked into said channel, but are free to slide or rotate therein.

A trough-like reflecting hood 7 is mounted on the base plate 1, said hood being symmetrically disposed with respect to the two parallel legs of the channel 2, and having its axis parallel thereto. The top of this hood is relatively flat, with a sharply increasing curvature toward the sides thereof, terminating in vertical side walls. An auxiliary reflector 8, in the form of a broad V with slightly concave legs is attached to the under side of the hood 7 along the top thereof. Said reflector carries brackets 9 in which a substantially horizontal quartz mercury vapor arc lamp of the Cooper Hewitt type is supported,

said lamp being so positioned with respect to the reflecting hood 7 and the reflector 8 that virtually all the light intercepted by said reflecting surfaces is redirected upon the glasses 4 in the holders 3. Said reflector 8 has a series of ventilating openings 11 along each side thereof, which are staggered with respect to another series of ventilating openings 12 in the top of the hood 7, so that hot air can escape from the top of said hood, while the ultraviolet radiations will be trapped. The leads to said lamp 10 are conveniently brought in through the space between said reflector 8 and the hood 7. These leads are connected to a suitable source of energy through suitable auxiliary apparatus of conventional type. This auxiliary apparatus may be placed in a container below the base 1 or in any other desirable place. Neither the auxiliary apparatus nor the location thereof forms any part of my invention, however, and hence they will not be further described herein. Another auxiliary reflector 13 is affixed to the base 1 along either side thereof near the base of the hood 7, each of these reflectors being slightly concave and extending upwardly to the point where the curvature of said hood 7 begins. Each of said reflectors 13 thus serves as a continuation of the reflecting surface of said hood. A series of ventilating openings 14 near the bottom of said reflectors 13 are staggered with respect to another series of openings 15 in the side walls of said hood, thus admitting air without permitting the escape of ultraviolet radiations.

The back end of the hood 7 is closed off in any suitable manner, as by a vertical wall a short distance behind the circular portion of the channel 2, although an end wall having a surface of such shape as to reflect more light on the glasses 4 may be used if desired. The front end of said hood 7 terminates at the end of the straight legs of the channel 2, and is closed by a plate 16 having openings 17 therein which are but slightly larger than required for the passage therethrough of the holders 3 and glasses 4. As shown this plate is of metal, and carries a glass insert 18 near the top thereof, this insert carrying any desired legend; but if desired the entire plate may be made of glass, thereby attracting a greater degree of attention as a result of the radiations emitted therethrough. In either case the glass is opaque to the ultraviolet radiations, and hence there is no danger to attendants or observers from escaping radiations. The channel 2 within the hood 7 is made of such length that it is an even multiple of the diameter of the flanges 5, and enough of the holders 3 are placed in said channel to occupy the entire channel within said hood, with one more of said holders outside of said hood. Thus whenever a holder 3 containing a glass 4 is pushed into an opening 17 until said holder and glass substantially fill the opening another holder 3 and glass 4 will substantially fill the other opening 17, preventing any appreciable escape of ultraviolet radiations through said openings.

In order to prevent the operator from reversing the direction of feed I preferably provide a dog 19 in a recess in the base plate 1 which is in communication with the channel 2. This dog normally extends into said channel as a result of the pressure exerted thereon by the light spring 20, but is easily pushed back into its recess by the flange 5 of a holder 3 whenever said holder is moved in the desired direction. When any attempt is made to move said holders in the reverse direction, however, said dog is moved against a stop 21, preventing further movement of said dog or said holders, thus preventing a reversal in the direction of movement of the glasses 4 in the sterilizer, with its attendant use of only partly sterilized glasses.

In the use and operation of this sterilizing apparatus, assuming it to be empty, a holder 3 is filled with a glass 4 and then pushed into the left hand opening 17 in the front plate 16. This causes another holder 3 to be ejected from the opposite opening 17. A glass is likewise placed in this holder, and the holder and glass then pushed into the left hand opening, causing still another holder 3 to be ejected, these operations being repeated until the first holder which was loaded appears in the right hand opening 17. Both of said openings are then substantially closed by the respective glasses 4 and holders 3 positioned therein, with the result that no appreciable amount of ultraviolet can escape therethrough. The mercury vapor lamp 10 is then started into operation, as for example by the well-known inductive surge method, and allowed to warm up for a period of the order of ten minutes in order to allow the vapor pressure therein to increase to a point where the radiations therefrom will be rich in ultraviolet. A glass 4 is then placed in the empty holder 4 which is outside the hood 7, and said holder is then pushed into the left hand opening 17, thus ejecting the glass and holder which have been only partially within the hood 7 during this lamp warming period. This glass 4 is not used, but is pushed back into the left hand opening 17 as soon as a sterilized glass is desired for dispensing purposes, causing a perfectly sterilized glass to be ejected from the right hand opening. Thereafter a fresh glass is placed in the empty holder which is waiting whenever a sterile glass is desired, the insertion of the fresh glass into the opening 17 causing a sterile glass to be ejected as heretofore described. When the lamp is again started after any appreciable shutdown it is only necessary to await the warming of the lamp, after which the operator proceeds as before, resterilizing the first glass, and then using all thereafter for dispensing purposes.

As the holders 3 are moved along the channel 2 the glasses 4 contained therein receive a great deal of direct irradiation from the lamp 10. Due to the shape of the reflecting hood 7, and of the reflectors 8 and 13 these glasses moreover receive reflected radiations which reinforce the direct radiations and reach portions of each glass which are inaccessible to direct radiations. Thus the entire inside of each glass 4 and the outside thereof down to the holder 3 is continuously exposed to ultraviolet irradiation so long as the glass is within the hood 7. Twenty seconds of this irradiation has been found sufficient to completely sterilize a glass, hence an ample safety factor is provided, regardless of how dexterous the attendant may be, for obviously the number of glasses which may be used in twenty seconds is much less than the number contained within the hood 7. As the holders 3 move along the channel 2 there is a tendency, moreover, for them to turn, particularly as they traverse the circular portion of said channel, with the result that different portions of the glasses 4 are subjected to the somewhat more intense direct radiations from the lamp 10. This further increases the factor of safety, since it increases the uniformity of irradiation and decreases the time

necessary to sterilize the entire glass. Any rinse water remaining on or in the glasses **4** will not prevent the satisfactory sterilization of said glasses, since the water will be sterilized as a result of the irradiation thereof, and water so sterilized is known to have bactericidal properties which will sterilize the glass beneath. Moreover, a certain amount of the radiations will pass through this water, sterilizing the glass beneath by direct action thereon. In some cases the glasses may contain a liquid, such as water, or one having either its transparency to the ultraviolet radiations or the property of becoming bactericidal after irradiation, in which case the inside of the container will likewise be rendered sterile in the same manner as when some of the rinse water remains thereon. Any reverse movement of the holders **3**, due to a lapse on the part of the operator, is of course prevented by the dog **19**, so that all possibility of receiving an unsterilized glass is eliminated.

In some cases positive rotation of the holders **3** is ensured by molding teeth **22** into the lower edge of the flanges **5**. As shown these teeth have a slightly smaller radius than that of said flange in order to prevent frictional engagement between said teeth and the walls of the channel **2**, or the teeth on another holder **3**. At a desired point in said channel, such as just after the holders have entered the returning straight leg, as shown in Fig. 3, a rack **23** is inserted in the wall of said channel. Said rack engages said teeth and causes a limited rotation, of the order of 180°, of each holder **3** and the glass **4** contained thereby as it passes said rack. While a single short rack has been shown it is obvious that others may be added, or that a continuous rack may be added throughout the length of the channel **2** if a greater amount of turning is desired.

During operation of the sterilizer some of the visible radiations from the mercury arc lamp **10** pass out through the glasses **4** which are positioned in the openings **17**, furnishing a spectacular appearance which immediately directs attention thereto. Thus the advertising value of the device is greatly enhanced by these illuminated glasses, while at the same time these glasses serve the utilitarian purpose of preventing the escape of ultraviolet rays through the necessary entrance and exit openings. The panel **18** with its illuminated legend also adds greatly to the advertising value of the device without adding to the necessary expenditure of energy.

While I have described my novel method of sterilizing glasses by reference to a preferred structure it is to be understood that my invention is not limited thereto, but that various omissions, substitutions and changes, within the scope of the appended claims, may be made either in the steps of the process or in the structural details without departing from the spirit thereof.

I claim as my invention:

1. In apparatus for simultaneously irradiating both the interior and the exterior of containers, in combination, a source of ultraviolet light, means to support a container adjacent thereto, and means to reflect radiations from said source to the interior of said container and to portions of the exterior thereof which are not subjected to direct radiations from said source, said last mentioned means comprising a reflector having converging sides which extend along each side of a container on said supporting means.

2. In apparatus for irradiating containers, in combination, a tubular source of ultraviolet light, means to slidably support two rows of containers on a plane substantially parallel to said light source with the open mouths of said containers facing in the general direction of said light source, means to reflect radiations from said source to portions of said containers not subjected to direct radiations therefrom, means to move said containers, and means to rotate said containers with respect to said source as they are moved.

3. In apparatus for irradiating containers, in combination, a substantially horizontal tubular source of ultraviolet light, a base below said light source, a plurality of container holders mounted on said base for movement in a fixed endless path, the major portion of said path being constituted by two straight legs parallel to said source, and a housing for said lamp supported by said base, the interior of said housing being adapted to reflect radiations from said source on portions of containers held by said holders which are not subjected to direct radiations from said source.

4. In apparatus for irradiating containers, in combination, a substantially horizontal tubular source of ultraviolet light, a base below said light source, a plurality of container holders mounted on said base for movement in a fixed endless path, the major portion of said path being constituted by two straight legs parallel to said source, a housing for said lamp supported by said base, the interior of said housing being adapted to reflect radiations from said source on portions of containers held by said holders which are not subjected to direct radiations from said source, one end of said housing having openings therein of substantially the same shape as said containers to permit ingress and egress of said holders and the containers held thereby as they move along the fixed path, the length of said path within said housing being an even multiple of the greatest diameter of said holders, whereby a container positioned in one of said openings causes another container to be automatically positioned in the other of said openings, said containers forming an ultraviolet filter for said openings.

5. In apparatus for irradiating containers, in combination, a substantially horizontal tubular source of ultraviolet light, a base below said light source, a plurality of container holders mounted on said base for movement in a fixed endless path, the major portion of said path being constituted by two straight legs parallel to said source, a housing for said lamp supported by said base, the interior of said housing being adapted to reflect radiations from said source on portions of containers held by said holders which are not subjected to direct radiations from said source, and means to limit movement of said containers to one direction along said path.

6. In apparatus for irradiating containers, in combination, a substantially horizontal tubular source of ultraviolet light, a base below said light source, a plurality of container holders mounted on said base for movement in a fixed endless path, the major portion of said path being constituted by two straight legs parallel to said source, a housing for said lamp supported by said base, the interior of said housing being adapted to reflect radiations from said source on portions of containers held by said holders which are not subjected to direct radiations from said source, means to move said holders along said path, and means to rotate said holders as they are moved.

7. The method of irradiating a container from

a source of ultraviolet light which comprises subjecting portions of said container to direct radiations from said source, simultaneously reflecting radiations from said source to the interior of said container and to portions of the exterior thereof which are not subjected to direct radiations, and rotating said container with respect to said source to bring the indirectly irradiated portions of said container into the field of direct radiations from said source.

8. In apparatus for irradiating containers, in combination, a source of ultraviolet light, means to slidably support a plurality of containers along a line parallel to said light source with the open mouths of said containers facing in the general direction of said source, and means to reflect radiations from said source to portions of said containers which are not subjected to direct radiations therefrom.

9. The method of sterilizing dishes and the like which comprises moving the dishes through the effective range of a sterilizing radiation, and concomitantly rolling or turning the dishes to give an effective exposure to the radiation.

LEROY J. BUTTOLPH.