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 APPARATUS FOR STERILIZING LIQUIDS BY MEANS OF ULTRA-VIOLET RAYS.
 APPLICATION FILED JUNE 7, 1910.

1,151,267.

Patented Aug. 24, 1915.

Fig. 1.

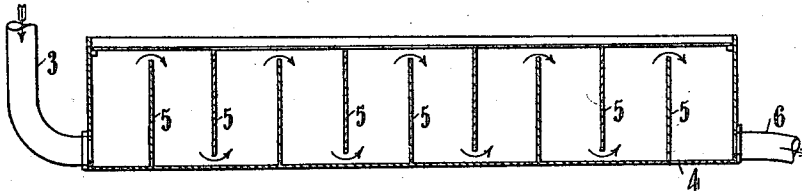


Fig. 2.

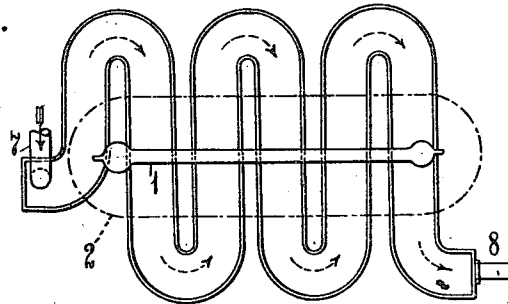


Fig. 3.

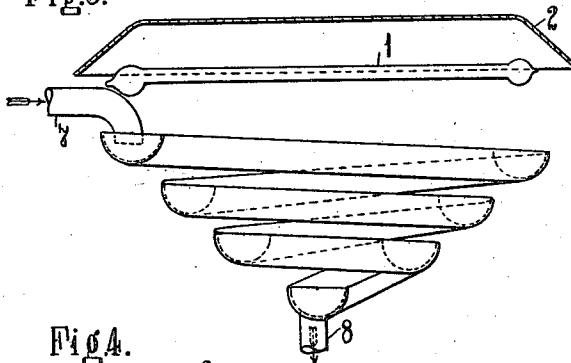


Fig. 4.

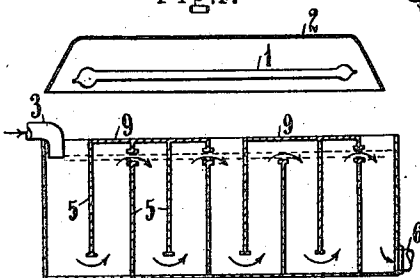
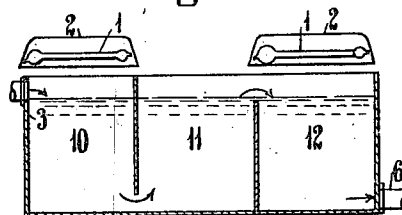


Fig. 5.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR STERILIZING LIQUIDS BY MEANS OF ULTRA VIOLET RAYS.

1,151,267.

Specification of Letters Patent.

Patented Aug. 24, 1915.

Application filed June 7, 1910. Serial No. 565,611.

To all whom it may concern:

Be it known that we, VICTOR HENRI and ANDRÉ HELBRONNER, citizens of the Republic of France, and MAX VON RECKLINGHAUSEN, a subject of the Emperor of Germany, residing at Paris, France, have invented the new and useful Improvement in Apparatus for Sterilizing Liquids by Means of Ultra-violet Rays of which the following is a specification.

This invention relates to the sterilization of liquids and more particularly to the sterilization of those liquids which are only slightly or not at all opaque to ultra-violet rays. Water for example is such a liquid.

It has already been proposed to sterilize water by inserting in conduits or channels through which the water flows mercury vapor lamps having containers of quartz or silica. These lamps emit ultra-violet rays and as quartz or silica is transparent to these rays they are able to pass freely into the surrounding water. This method, however does not utilize the rays to their fullest efficiency owing to the cooling of the lamp by the water which produces a harmful effect on the electrical characteristics of the lamp which will emit fewer rays when water cooled than when operating normally in the atmosphere and only cooled by the movement of the surrounding air.

According to our invention, instead of immersing the lamp or source of ultra-violet rays in the liquid, we place it outside and cause the liquid to flow past the lamp in a zigzag or undulating fashion, this being accomplished by causing the liquid to flow through a trough provided with baffle plates or otherwise so arranged as to cause the liquid to flow in the desired manner.

In order to utilize the rays emitted to their fullest possible extent, the lamp or other source is provided with a reflector and the sides of the troughs and baffles are made of a reflecting material, such as polished metal, so that the rays which pass through the liquid are caused to re-traverse the same and are therefore utilized to their fullest extent.

The liquid may be caused to pass and re-pass through the rays in several different ways. Assuming that the lamp is located over the liquid then the liquid may be caused to move up and down or toward and away

from the lamp in which case the direction of movement of the liquid will be substantially parallel with the direction of the rays, or the liquid may be caused to move in a zigzag path in a horizontal plane, in which case the direction of movement is substantially perpendicular to the direction of the rays.

In another method of carrying out the invention, the liquid is caused to traverse a spiral path, the spiral being formed on the surface of a cone and the lamp located within the entrance of the cone. With this arrangement the rays are utilized very efficiently and with a small apparatus.

In a further modified form of apparatus, troughs or conduits are so arranged that the liquid is exposed in its passage for a short time to the effect of the rays, and then during the next portion of its path is removed from the influence and again exposed to the influence of the rays and removed. This result can be obtained by arranging shutters over portions of the trough so as to leave what may be called "dark" spaces. We find that the sterilization is quickened in this manner and proceeds with greater efficiency.

Another way of obtaining the desired result would be to pass the liquid through a series of troughs some of which are exposed to the ultra-violet rays and others of which have no lamp or source of rays near to them.

In the accompanying drawings we have shown in a diagrammatic form various methods by which our invention may be carried out in practice.

Figure 1 is an elevation, partly sectional, of one form of apparatus, Fig. 2 is a plan of another form of apparatus and Figs. 3, 4 and 5 are elevations, partly sectional, illustrating other modified forms of apparatus.

Referring to Fig. 1, the source of ultra-violet rays is indicated as being a mercury vapor lamp 1 having a quartz container and provided with a reflector 2, the liquid to be sterilized is admitted through a pipe 3 to a trough 4 provided with a series of baffle plates 5 arranged with spaces at the top and bottom alternately so that the liquid is caused to pass through the trough in the direction of the arrows to the outlet 6; in order to utilize the effect of the rays to the fullest extent, the sides of the trough and the baffle plates are made of reflecting material.

In Fig. 2 the trough takes the form of a zigzag tube arranged in a horizontal plane provided with an inlet 7 at one end and an outlet 8 at the other end, the flow of liquid taking place in the direction of the arrows.

In Fig. 3 the trough is of a spiral form and is arranged so that the liquid in its passage along the same is exposed at all parts to the influence of the ultra-violet rays.

Figs. 4 and 5 show arrangements in which the liquid is withdrawn from the influence of the rays at certain parts of its passage. In the arrangement shown in Fig. 4, which is substantially similar to that of Fig. 1, certain of the baffles are united at the top by plates 9 which are impervious to the ultra-violet rays, so that when the liquid is traversing a space below said plates it will be removed from the influence of the rays. In Fig. 5 the same effect is obtained by using more than one source of the rays; the trough or receptacle is here divided into three compartments indicated at 10, 11 and 12. Compartments 10 and 12, are therefore arranged so that the liquid in its passage through the compartments is brought under the influence of the rays. In the middle compartment 11, however, the liquid is not subjected to the rays and this compartment therefore corresponds to what may be termed a "dark" space. We find that the best results are obtained by making the time of exposure of the liquid to the rays less than the time during which it is removed from their influence. This is indicated in Fig. 4 by making the covered parts of the trough larger than the uncovered parts, so that the liquid is only exposed to the rays for about $\frac{1}{4}$ of the whole time that it is passing through the apparatus. We do not, however, restrict our invention in this respect nor to these precise proportions.

In all the arrangements the interior surfaces of the conduits and baffle plates should be made of reflecting material so that the effect of the ultra-violet rays may be fully utilized by causing them to traverse back and forth through the liquid.

It will be observed that since the liquid is only slightly opaque, even if it is not absolutely transparent to the ultra-violet rays,

we are able to use conduits or troughs of considerable depth as the effect of the rays upon the inner layers of the liquid is little diminished by the effect of their passage through the outer layers.

It is desirable to arrange the baffle plates and troughs or conduits in such a manner that the liquid will flow at the same rate through all parts of the apparatus by which means every particle of the liquid is subjected to the influence of the rays for the same period of time, whereby the whole of the liquid is equally sterilized.

We claim as our invention.

1. The method of sterilizing liquids, which consists in passing the same through the region in the vicinity of a source of ultra-violet rays and subjecting all the liquid directly to the action of such rays and continually agitating the liquid while in the field of such rays and under the sterilizing influence of the same.

2. The method of sterilizing liquids, which consists in causing the same body of liquid to pass and repass through the region in the vicinity of a source of ultra-violet rays, subjecting all the liquid while in such region directly to the action of such rays, and continually agitating the liquid while in the field of such rays and under the sterilizing influence of the same.

3. The method of sterilizing liquids, which consists in passing the same through parts of an apparatus illuminated by the direct action of the ultra-violet rays from a suitable source, and agitating the liquid in its passage through the apparatus so that all particles thereof will at some time be exposed directly to the sterilizing influence of the rays.

In testimony whereof we have hereunto subscribed our names this 25th day of May, 1910.

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