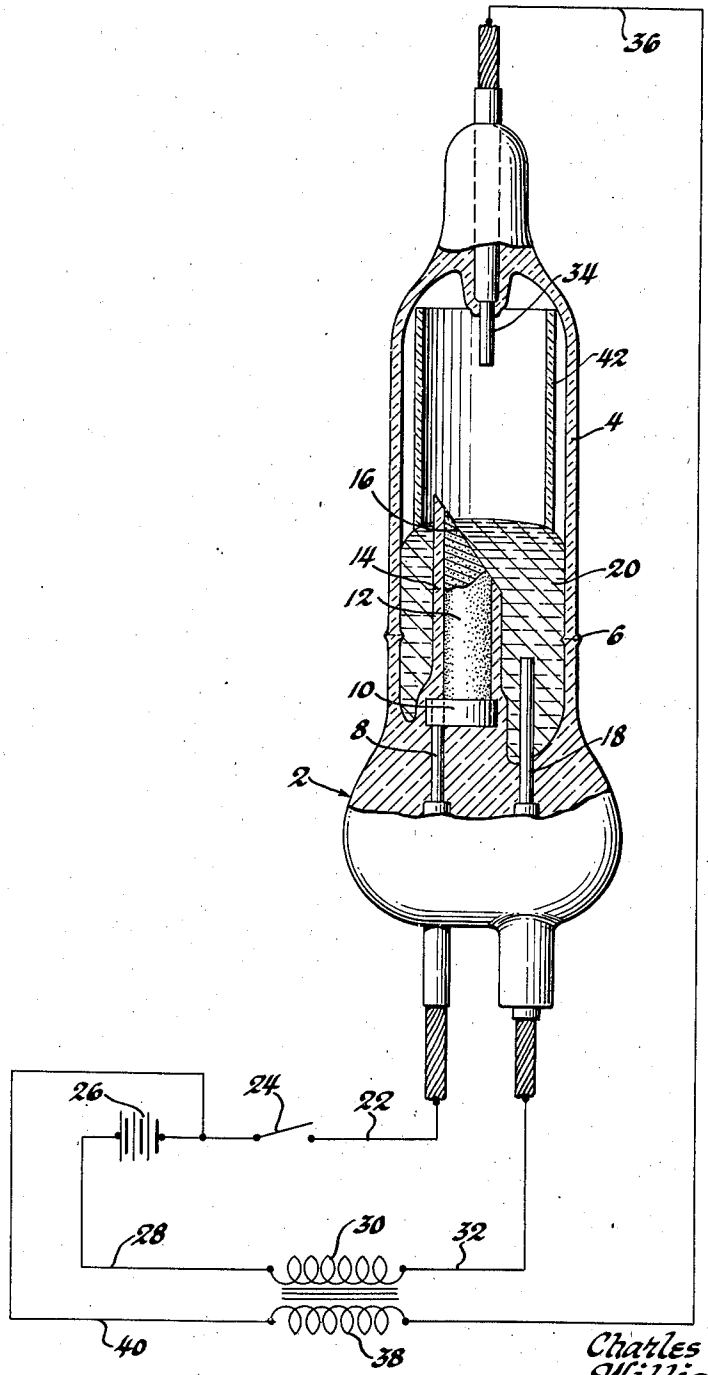
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ULTRAVIOLET TUBE

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ULTRAVIOLET TUBE

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This invention relates to means for producing ultraviolet rays and more specifically to ultraviolet apparatus which may be operated from a low voltage initial source.

Under certain circumstances it might be necessary to provide means for seeing certain objects or configurations at night which are not illuminated themselves and upon which no light waves of ordinary length are allowed to impinge. In other words, when it is necessary to resort to the so-called "blackout" methods as employed in England during raids, some means for identifying various objects or highways are necessary in order to allow movement of either civilians or troops.

It is therefore an object of our present invention to provide a means for identifying or locating certain objects along the sides of a highway so that traffic may flow without the danger of the identification of such marks from the air. The type of system broadly considered here is that of utilizing luminous paint to cover certain posts or other identifying marks at certain intervals along the side of highways which of course would be of sufficiently low intensity that they would not be visible to the eye unless some ultraviolet rays were allowed to impinge thereon and cause the radioactive material to glow with sufficient luminosity to be visible. These could be spaced at regular intervals along the sides of the highway and so painted and then vehicles which it was desired to drive thereon could have some ultraviolet light means projectible forward in the same manner as the ordinary headlight beam does at present. These ultraviolet beams would then cause these markers to glow sufficiently to be visible to the driver in a horizontal distance, but would not be visible at any vertical distance, and thus the vehicle could be operated along the outlined highway without detection from the air. It might also be necessary to carry identifying luminous plaques on the front and rear of vehicles so that they can be seen by other vehicles and collisions will be avoided. However, means for producing ultraviolet rays have been very bulky, heavy and expensive and have required a high voltage. It is therefore a further object of our invention to provide a source of ultraviolet ray which may be carried upon a mobile vehicle.

It is a still further object of our invention to provide an inexpensive, rugged source of ultraviolet ray for application to the vehicle headlight assembly which will operate on the normal storage battery voltage of the vehicle.

With these and other objects in view, the embodiments or our invention will be best understood by reference to the following specification and claims and the illustrations in the accompanying drawing, in which:

The single figure shows a tube source of ultraviolet ray and the attendant circuit therefor.

Referring now more specifically to the drawing, in the figure there is shown a hollow glass envelope indicated generally at 2, the lower part of said glass envelope being formed of glass capable of withstanding a reasonable amount of temperature variation and also one whose characteristics of expansion are similar to certain metals used for electrodes so that a positive seal may be acquired between the electrodes and the glass. We have found that a glass very satisfactory for this purpose is the "Nonex" glass manufactured by the Corning Glass Works. The upper half of the glass envelope however, and that portion indicated at 4, is formed of a glass whose characteristics permit a high percentage of the ultraviolet rays to pass with little difficulty so that this portion of the tube does not act to filter out the ultraviolet rays, but allows their easy passage. In this instance we have found that an ultraviolet transmitting "Corex" glass, also made by the Corning Glass Works, is satisfactory. These two portions are fused together at the line indicated at 6 to form a single unitary shell to house the electrodes. This is merely described as illustrating one form which our invention may take. Any envelope which can be made from material which will form a satisfactory seal with the electrodes and pass ultraviolet light would be satisfactory and our invention should not therefore be limited to the form shown.

Sealed into the lower portion of the envelope 2 is an electrode 8 staked into one side of a metal band 10, said metal band encircling and being definitely connected to the lower portion of a substantially circular carbon electrode 12. This assembly is entirely encased in a glass tube 14, which is a sub-assembly, prior to the insertion into the hollow glass envelope which may either be evacuated or filled partially with an inert gas. The upper end of the carbon electrode and the glass tube are ground off to form a tapered surface 16. Also sealed into the lower portion of the tube is a second ordinary metallic electrode 18 which projects up into the hollow portion of the tube. A pool of mercury 20 fills the tube up to the approximate center, as indicated,

thus forming a circuit between the two electrodes.

Connected to the electrode 8 externally is a line 22 which proceeds to a switch 24 connected to the positive side of the battery 26, the negative side of said battery being connected by line 28 to one side of a transformer primary 30, the opposite side of said transformer being connected by line 32 to the electrode 18. In the upper portion of the tube and extending directly down and substantially concentric to the assembly there is sealed a third electrode 34 which projects down a substantial distance into the interior of the tube, but is spaced from the upper surface of the mercury at all times. This electrode is connected through line 36 to one side of the secondary winding 38 of the transformer, the other side of said secondary being connected by line 40 to the positive side of the battery 26. The transformer formed of the primary 30 and the secondary 38 has a substantial step-up ratio, and, for example, we have found that a transformer of 23 turns and a secondary of 1500 turns operates satisfactorily, although the ratio is of course not at all critical.

When the switch 24 is closed a circuit is completed from the positive side of the battery through switch 24, line 22, electrode 8, carbon electrode 12, mercury pool 20, electrode 18, line 32, transformer primary 30 and line 28 back to the battery 26. This causes current to flow through the primary 30 and also said current flowing between the carbon electrode 12 and the mercury pool 20 causes a heating of the mercury in contact with the carbon surface and in the manner of mercury interrupters, particularly those of the type disclosed in Ruben Patent No. 2,107,742, will cause the mercury at such contact point to vaporize and thus break the circuit. However, it will immediately recondense and reform the circuit so that there is an automatic interrupted current set up. The electrode 12, as before mentioned, has a tapered surface such as shown in 16 and the purpose of this tapering is to provide a better displacement action between the mercury in contact with the carbon surface so that when the mercury is heated to vaporize it will be thrown somewhat to one side in the form of a wave and then flow back against the surface to provide both a better discharging action of the mercury from the surface and a more even flow back to the surface.

There will of course through this interrupting action at the surface of the mercury and carbon be some arcing and this arcing will be a source of ultraviolet rays and some will therefore be sent out from this point. The tapered surface, however, permits the arc at the carbon tip to be exposed above the mercury on only a slight movement of the mercury away from the surface. This enables operation at higher frequencies and tends to produce a much steadier light and reduce flicker. However, the amount of these rays is not large, though in some instances it may suffice. By applying the secondary voltage generated through the transformer secondary to the electrode 34, we have found that upon the vaporization of the mercury and the initiation of a small arc at the surface of the carbon the additional secondary voltage will cause a large arc to be set up between the electrode 34 and the surface of the mercury due to said induced secondary voltage, and this secondary current is substantially in phase with the primary current. The voltage induced in the secondary is not sufficient itself to cause an arc to strike between the mercury pool and the upper electrode alone, but with the smaller arc of the interrupter portion acting, will cause the larger arc to strike. This causes an abundant source for ultraviolet rays which may be sent out through the upper portion of the glass tube, which, as before mentioned, is formed of glass which allows the passage of ultraviolet rays. Therefore, as the two lower electrodes 12 and 18 provide the interrupter action for the construction, the third electrode and the attendant voltage induced in the transformer provides a high voltage flash-over to provide a sufficient source of ultraviolet ray.

We have found, however, that there is of course a considerable amount of heat generated during the production of such rays and to prevent the burning or pitting of the glass envelope we have inserted therein a small cylindrical member 42 formed of quartz which floats upon the top of the mercury pool 20 and protects the glass envelope portion 4 from the direct heat of the arc and therefore prevents the pitting and deterioration and smoking up of the same. If desired, the quartz cylinder may be anchored to the lead 18. We have also found that the introduction of a very small piece of magnesium foil into the mercury just prior to sealing off the tube assists substantially in maintaining the mercury in its desired condition and maintains the same very clean and unoxidized. The magnesium alloys very completely with the mercury and therefore vaporizes to a small degree when the mercury vaporizes. This magnesium vapor assists materially in the ultraviolet generation.

It will thus be evident that this device is simple in its operation and construction, entirely automatic, rugged, and will operate from a low voltage source.

We claim:

1. In a system, a supply of direct current, a transformer having primary and secondary windings connected to the source, interrupter means including an electrode connected in the primary circuit, supporting means for the interrupter means and an electrode connected to the secondary and mounted on the said supporting means in spaced relation to the interrupter electrode means but sufficiently close to draw an arc therefrom when the voltage is raised through the transformer action.

2. In a system, a supply of direct current, a transformer having primary and secondary windings connected to the supply, autonomic mercury interrupter means connected in the primary transformer circuit and an electrode mounted in juxtaposition to the mercury and connected to the transformer whereby voltage induced by the interruptions in the primary causes the secondary voltage applied to the electrode to be sufficient to draw an arc from the mercury.

3. In a system, a supply of direct current, transformer means for increasing voltage having primary and secondary circuits connected to the supply of current, autonomic mercury interrupter means connected in the primary circuit, an electrode connected in the secondary circuit, a common evacuated support for the interrupter means and the electrode, the latter being mounted in spaced relation to the mercury whereby the interrupter action causes some arcing and vaporization of the mercury to assist in arcing action between the electrode and the mercury.

4. In a device of the class described, an insulating envelope, a pair of electrodes sealed in said envelope in spaced relation, one of said electrodes being formed of carbon, a pool of mercury in the envelope extending between said electrodes, a third electrode spaced above the other two and above the mercury pool and adapted when voltage is applied thereto to cause an arc between the mercury surface and itself and shielding means floating on the surface of the mercury surrounding the arcing area to protect the inside of the envelope against the arc heat.

5. In a device of the class described, a hollow insulating envelope, a pair of spaced electrodes sealed in the envelope, one of said electrodes being formed of carbon and surrounded by insulating means with the exception of the upper extremity which is cut at an angle to the electrode and thus forms a tapered surface, a pool of mercury extending between the two electrodes but not extending entirely to the top of the carbon electrode, these two electrodes and the mercury forming a current interrupter when current is supplied, the tapered face of the carbon providing a cleaner break with the mercury.

6. In a device of the class described, a hollow insulating envelope, a pair of spaced electrodes sealed in the envelope, one of said electrodes being formed of carbon and surrounded by insulating means with the exception of the upper extremity which is cut at an angle to the electrode and thus forms a tapered surface, a pool of mercury extending between the two electrodes but not extending entirely to the top of the carbon electrode, these two electrodes and the mercury forming a current interrupter when current is supplied, the tapered face of the carbon providing a cleaner break with the mercury, means for supplying direct current to the electrodes, a third electrode carried by the envelope and spaced above the mercury pool and means for applying a voltage thereto to cause an arc between this electrode and the mercury pool.

7. In a system for generating ultraviolet rays, an insulating envelope, a plurality of electrodes sealed into said envelope in spaced relation, at least one of said electrodes being formed of carbon, a pool of mercury extending from the carbon electrode to one of the other electrodes, a transformer having a primary and secondary winding, a source of direct current, said source, transformer primary, and two electrodes being connected in series to provide an automatic interrupter to generate pulsating current and mercury vapor within the envelope, a third electrode being connected to the transformer secondary, said third electrode spaced above the mercury pool whereby the pulsating primary current will induce a high voltage in the secondary and the third electrode will arc to the mercury pool.

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