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GASEOUS ELECTRIC DISCHARGE DEVICE

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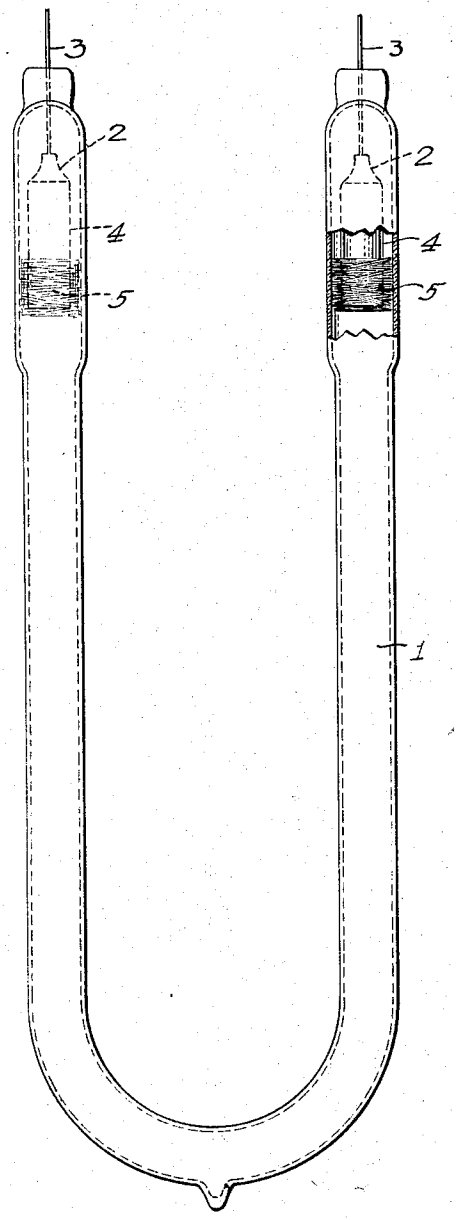


Fig. 1.

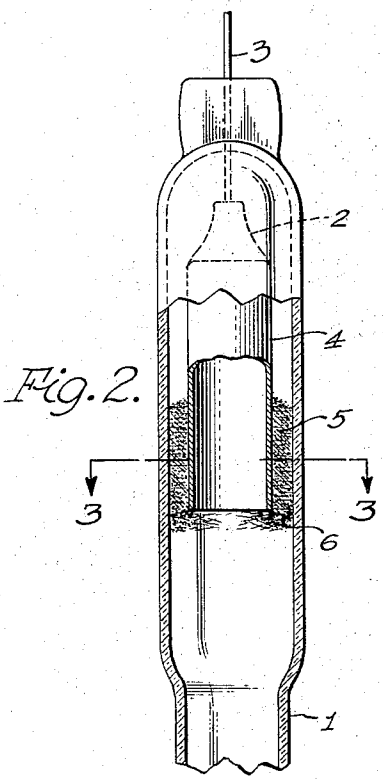


Fig. 2.

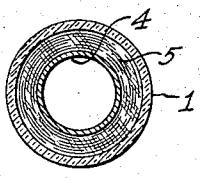


Fig. 3.

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GASEOUS ELECTRIC DISCHARGE DEVICE

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20 Claims. (Cl. 176—122)

This invention relates to improvements in gaseous electric discharge devices and more particularly to a means for protecting and preserving the cathodes thereof.

In the process of making gaseous discharge lamps it is important to expel all gases normally occluded in the metallic electrodes and likewise to expel all gases which cling to the tube itself. This is done by heating the electrodes to a cherry red under an electron bombarding process while repeatedly subjecting the tube to the suction of a vacuum pump. The temperatures to which the cathodes are thus subjected are greater than those employed during normal operation in order that undue further expulsion of gases by the electrodes will not later occur. Due to the abnormal heating and also due to the fact that the tubes are always subjected to this process while lying on a work-bench or table, it is necessary to support the electrodes in spaced relation from the tube as otherwise the electrode may contact the glass, causing partial fusion and later breakage. It is therefore an object of this invention to provide an improved support for the electrode which will effectively support and heat insulate the electrode from the glass tube.

It is well understood that it is impossible to completely expel all gases from a metallic electrode even by bombardment under abnormal temperatures. Also, while the rare gases may be obtained in highly purified condition, they contact glass surfaces and lubricated stop cocks during introduction and thereby become more or less contaminated. The presence of such foreign gases alters the desired color, requires greater current and may become sufficient in quantity to preclude operation. It is therefore another object of this invention to provide means in the tube which, as here illustrated, is inherent in the type of electrode support aforementioned, to clean up or scavenge all residual foreign gases in the electrode and tube.

During the operation of a gaseous discharge tube the cathode is given a sufficient potential to discharge electrons which break down or ionize molecules of the gases by collision. The electrons thus freed travel with the original or primary electrons toward the anode while a greater quantum of the positive ions seek the cathode to liberate additional electrons. The positive ions can, under certain conditions, combine with electrons at the surface of the cathode and thus form a layer of gas thereon extending to the exterior surface of the cathode. This is due very largely to the release of gases normally occluded by the metallic electrodes and to the fact that the positive ions are not positively prohibited from finding the exterior surface of the cathode. Further, if the voltage between the cathode and anode becomes abnormally high, the bombardment of the cathode by the positive ions causes abnormal heating of the cathode, which, in turn increases the saturation current. The undue heating from these or any other causes wears away the cathode and has a very deleterious effect on the life of the tube. It is, therefore, another object of the invention to provide a means for residence immediately adjacent the cathode for absorbing the gases expelled by the cathode during normal operation to prevent undue heating and sputtering with the resultant disintegration of the electrode and which will thus force the positive ions to find the interior of the cathode for electron liberation. This support thus acts as a mechanical shield against the positive ions to the extent that it largely removes the cause of external cathode bombardment, permitting the positive ions to find the interior thereof and it also acts as a chemical scavenger for extraneous gases.

Disintegration of the cathode as indicated above becomes noticeable to an observer because of the metallic deposit on the interior of the glass tube. This deposit of pure metal has the capacity to absorb or occlude the rare gas and has been known to absorb such sizable amounts of the gas as to prevent further operation of the tube. It is therefore a further object to provide a cathode support having the inherent properties of "cleaning up" foreign gases as described above and to extend this support forwardly of the cathode by an appreciable amount to preclude a deposition of the metal on the interior of the tube for a long period of time.

In such devices where mercury vapor is employed with a rare gas to produce a blue light it is sometimes difficult to obtain prompt vaporization of the mercury. It is therefore another object of this invention to provide a cathode support as described above, containing a material, such as sodium or potassium, which will combine with the mercury to form an amalgam thereby retaining a supply of mercury adjacent the hottest region in the tube for prompt vaporization upon re-activation.

In carrying our invention into effect we employ a silicate compound of the alkali or alkaline earth groups, preferably in a finely divided

condition, as for instance, glass wool, as a support for the electrode, the wool being adapted to fuse by an amount sufficient to render a quantity of free alkali, as sodium or potassium or barium or strontium, available for use as a scavenger or "getter" of foreign gases and as a means for forming an amalgam where mercury is used.

Other objects and advantages either directly described or implied will become hereinafter more fully apparent as reference is had to the accompanying drawing, wherein our invention is illustrated by way of example and in which—

Figure 1 is an elevation of a U-shaped gaseous electric discharge tube, partially broken away to clearly illustrate our invention;

Fig. 2 is an enlarged vertical sectional view of one end of the tube illustrated in Figure 1 with an electrode and our improved support therein, and

Fig. 3 is a transverse section taken along the line 3—3 of Figure 2.

More particularly, 1 indicates a hollow glass tube having an electrode 2 sealed in each end thereof. The tube is adapted to be filled with a rare gas, such as neon, argon and the like either with or without an amount of mercury. Each electrode is composed of an energizing lead wire 3 and a tubular bell-shaped electrode proper 4, usually made of copper. Each electrode is surrounded or wrapped with a finely divided silicate compound 5, preferably glass wool. The wool covers a substantial area of the outer surface of the electrode 4 and extends slightly outwardly thereof as indicated at 6.

Upon heating the electrode by current from the lead wire 3 there is a slight fusion of the glass wool with the electrode, releasing an appreciable amount of alkali or alkaline earth metal so that a quantity of free sodium, potassium, barium or strontium, etc., is available at the electrode for absorption of any occluded gas released by the electrode and also for scavenging any foreign gas within the tube. The wool, by encircling the open end of the electrode also acts as a mechanical screen for forcing the positive ions to the interior of the cathode for further electron liberation.

The slight fusion of the wool does not interfere with the electrode supporting function of the wool. In fact, from this standpoint, there is only a sufficient amount of fusion to assure that the wool will not lose its proper position.

The wool is so fragile that flakes from it become scattered throughout the tube. Upon attaining sufficient heat to decompose, the alkali or alkaline earth metals in these flakes properly serve as a scavenging or "getter" for foreign gases all along the length of the tube. In any case, the presence of the flakes is not detrimental in any way. It will thus be seen that the provision of this wool serves several distinct functions: it forms an electrode support, a cathode screen, a foreign gas scavenger, an amalgamator and an effective mitigator of sputtering.

Our invention may be modified without departing from our invention, and we therefore desire to be extended protection as defined by the scope of the appended claims.

What we claim is:—

1. In a gaseous electric discharge device, a sealed tube having electrodes therein, and a supporting means of glass wool for maintaining each of said electrodes in spaced relation with said tube, said supporting means completely encircling the electrode and covering in contacting relation a substantial portion of the length of the active end thereof.

2. In a gaseous electric discharge device, a sealed tube having electrodes therein, and glass wool for maintaining each of said electrodes in spaced relation with said tube, the glass wool completely encircling each electrode and covering a substantial portion of the length thereof and extending an appreciable distance beyond the active end of the electrode.

3. In a gaseous electric discharge device, a sealed tube having electrodes therein, and a fibrous silicate compound of alkali or alkaline earth metals disposed between said electrodes and between each of said electrodes and said tube.

4. In a gaseous electric discharge device, a sealed tube having electrodes therein, and a fibrous silicate compound of alkali or alkaline earth metals between said electrodes.

5. In a gaseous electric discharge device, a sealed tube having electrodes therein, and a fibrous silicate compound of alkali or alkaline earth metals supporting and in contact with the active end of each of said electrodes in said tube.

6. In a gaseous electric discharge device, a sealed tube having electrodes therein, and a vitreous fiber adjacent and in contact with the active end of each of said electrodes as a supporting means therefor.

7. In a gaseous electric discharge device, a sealed tube having electrodes therein, a supporting means comprising a material in a finely divided condition between the active end of each of said electrodes and said tube, said supporting means being adapted to fuse with the electrode by a slight amount thereby creating a bond between said means and said electrode.

8. In a gaseous electric discharge device, a sealed tube having electrodes therein, and a fibrous gas scavenging material immediately adjacent the active end of each of said electrodes adapted to absorb the released gases normally occluded in said electrodes.

9. In a gaseous electric discharge device, a sealed tube having electrodes therein, and a fibrous gas scavenging material completely encircling and in contact with the active end portion of each of said electrodes adapted to scavenge the released gases normally occluded in said electrodes.

10. In a gaseous electric discharge device, a sealed tube having electrodes therein, and a finely divided fusible material in said tube adjacent and in contact with the active end of each of said electrodes for slight fusion by the heat therefrom, said material upon slight fusion being adapted to release a gas scavenging element adapted to entrap and retain foreign gases present in said tube.

11. In a gaseous electric discharge device, a sealed tube having electrodes therein, and a finely divided slightly fusible material encircling and contacting the active end of each of said electrodes, said material upon fusing by a limited amount under heating and by its electrodes being adapted to release a gas absorbing element adapted to entrap and retain gases normally occluded by said electrode.

12. In a gaseous electric discharge device, a sealed tube having electrodes therein, and a fibrous compound of silicate and alkali or alkaline earth metals in said tube adjacent and in contact with the active end of each of said electrodes, said compound being adapted to par-

tially fuse under the heat from said electrode, said compound upon fusion being adapted to release said alkali or alkaline earth metals, said alkali or alkaline earth metals being adapted to act as a scavenger for foreign gases after such release.

13. In a gaseous electric discharge device containing an amount of mercury, a sealed tube having electrodes therein, and glass wool means adjacent and in contact with the active end of one of said electrodes for entrapping a quantity of the mercury during inoperation of said tube whereby vaporization thereof occurs immediately upon reheating of said electrodes.

14. In a gaseous electric discharge device containing an amount of mercury, a sealed tube having electrodes therein, and a material containing an alkali or alkaline earth metal immediately adjacent and in contact with the active ends of said electrodes for partial fusion, and release of said alkali or alkaline earth metal by the heat thereof, said alkali or alkaline earth metal upon release being adapted to form an amalgam with a portion of said mercury during inoperation of said tube whereby an amount of said mercury will promptly evaporate upon subsequent re-heating of said electrodes.

15. In a gaseous electric discharge device, a sealed tube having electrodes therein, and a support for each of said electrodes comprising a fibrous slightly fusible material containing an alkali or alkaline earth metal, said support encircling each of said electrodes and covering in contacting relation a substantial portion of the outer surface of the active end thereof, said support upon slight fusion being adapted to release a quantity of said alkali or alkaline earth metal, said alkali or alkaline earth metal upon release being adapted to serve as a getter for foreign gases in said tube.

16. In a gaseous discharge device including an electron discharge cathode positioned to be bombarded by positive ions travelling thereto for further electron liberation, a screen of glass wool for said cathode encircling the emission end thereof, said screen extending along a portion of the length of said cathode and comprising a means for forcing the said positive ions to enter the interior of said cathode for neutralization.

17. In a gaseous electric discharge device including an electron discharge cathode positioned to be bombarded by positive ions travelling thereto for further electron liberation, a screen of glass wool for said cathode encircling the emission end thereof and to extend forwardly thereof by an appreciable amount, said screen extending along a portion of the length of said cathode and comprising a means for forcing said positive ions toward the center of said cathode for neutralization.

18. In a gaseous discharge device, a sealed tube, an electron discharge cathode positioned in said tube to be bombarded by positive ions travelling thereto for neutralization, means for supporting said cathode in spaced relation with said tube, said means being composed of a silicate compound wool-like structure containing an alkali or alkaline earth metal encircling said cathode at the open end thereof, said wool comprising a screen for forcing said positive ions toward the center of said cathode for neutralization, said wool being adapted to partially fuse under the heat from said cathode and upon such fusion to release an amount of said alkali or alkaline earth metal, said alkali or alkaline earth metal being adapted to act as a scavenger of any foreign gases in said tube.

19. The combination as set forth in claim 18 wherein said means extends forwardly of the open end of said cathode by an appreciable amount.

20. In a gaseous discharge tube having an envelope enclosing a gas filling, an electrode disposed within said envelope and having a cylindrical outer surface concentrically spaced from said envelope, and a wrapping of glass wool covering the exterior surface of the active end portion of said electrode and substantially filling the space between the electrode and envelope, said wrapping of glass wool extending inwardly of the envelope beyond the active end of the electrode.

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