Dec. 20, 1955 J. A. VICTOREEN 2,728,005

GASEOUS DISCHARGE TUBE

Filed March 9, 1949

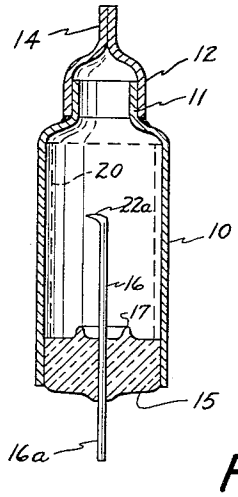


FIG. 1

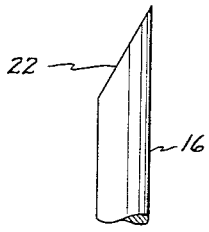


FIG. 2

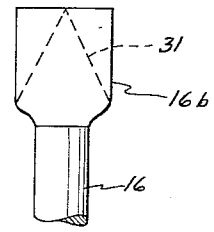


FIG. 4

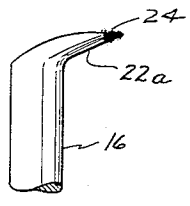


FIG. 3

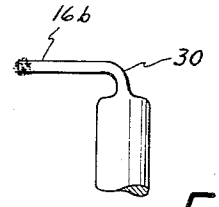


FIG. 5

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GASEOUS DISCHARGE TUBE

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Application March 9, 1949, Serial No. 80,523

2 Claims. (Cl. 313—54)

This invention relates to improvements in discharge devices of the gaseous conduction type and to an improved method of making the same. This application is an improvement over that of the copending application for Glow Tube, Ser. No. 60,254, filed November 16, 1948, of myself and James H. Eddleston.

As pointed out in the previously filed application, tubes of the so-called voltage regulator type were common knowledge prior to this invention. It was also a fact that the starting voltages of the prior art varied, depending on various conditions, and that, therefore, although the prior tubes were satisfactory for voltage regulators, there were other places where such a tube would have been useful but where they could not be used because of the irregularities in the starting or striking voltages. Prior to my invention, the variations in striking voltages were such that no tube available on the market was capable of being started at the same voltage consecutively throughout long periods of time, even when conditions were maintained substantially the same.

Another disadvantage of the prior tubes resided in the fact that they were, in the main, extremely fragile, and even the most rugged of the prior tubes could not withstand the shocks to which they are put in the field. For instance, these tubes are very useful in places where they must be able to withstand very large changes in gravitational forces, and the large centrifugal forces which may be acquired due to high speed rotation as well as vibration. These requirements were such that, prior to my invention, no tube was available that could fulfill these requirements.

By my present invention, I am able to make tubes which will fulfill all the requirements for rugged use and still meet the electrical requirements. By my present invention, tubes may be constructed wherein the striking voltage may be determined within very close limits.

Broadly, the invention contemplates the use of a radio-active material within the tube. This material is preferably disposed in such a place that it ionizes the gas to provide sufficient free ions at the place of discharge that the instability of starting is removed and the tube always starts at the same voltage.

I believe that this is largely due to the fact that the ionizing events which cause the starting are made certain rather than left to chance as in the prior tubes. This being based on the well known fact that a discharge in the prior tubes could only be brought about by some ionizing event which was usually due to the passage of a cosmic ray through the tube.

The prior tubes, therefore, could not start until certain conditions existed to favor such starting. These were usually the combination of a high voltage, the value of which was determined by the parameters of the tube, plus the varying condition of cosmic ray presence which could not be determined or forecast. The result was that sometimes a tube designed to start at 150 volts started at 140 volts, then again at 160 volts and never at exactly the same time after voltage was applied, for after

voltage was applied, the tube had to wait for the ionizing event which might be immediately or several seconds, or in some cases, several minutes. This phenomena was also evidenced by the exhibition of large and variable dark currents which occurred in the region prior to and as the potential approached the breakdown or starting voltage point. It is believed that this was one of the main reasons for the instability of the prior devices. By utilizing my present invention, this region of instability is removed and there is practically no variation in the dark currents prior to the breakdown point.

As pointed out in the aforesaid application, the results of the invention are effected by the discovery that placing a source of ionization near the place of discharge caused sufficient ionization of the gas that recourse to a cosmic ray for the ionizing event necessary to the starting was eliminated, and striking was effected within extremely close limits of the starting voltage for which the tube was designed. As shown in the said application, the ionizing medium was provided by providing a flag or a holder of a piece of material such as gold in which the radio-active material was incorporated. Although this was highly satisfactory, it had certain disadvantages which the present invention eliminates. For instance, I have discovered that it is desirable to concentrate the ionizable medium at the point of discharge. This causes a conservation of the medium.

Furthermore, when such tubes are constructed, it requires the handling of the radio-active material which is dangerous to personnel. This is further enhanced because the flags were very small and had to be secured as by welding into position. The welding also had some undesirable effects upon the flag. After the tube was constructed, there was also the possibility that the weld, not being as good as it should be, might break, allowing the flag to fall from its desired position and either make the tube inoperative or result in short circuits which, under some conditions, may be highly dangerous.

The present invention contemplates the manufacture of a tube which will withstand even greater shocks than the previous tube, and wherein the hazards of manufacture are substantially eliminated and the manufacturing operation is greatly simplified. The ionizable material may be highly concentrated in a small area and thus placed at the best place to effect the desired operation of the tube.

Briefly, the invention comprises forming the anode to the desired configuration and electro-depositing the ionizer on the cathode.

In the drawings, I have illustrated a tube wherein the invention may be carried out. It will be appreciated that the drawings are merely by way of an example, however, and not intended to be a restriction on the use of the invention which is defined in the appended claims. Furthermore, I have explained the invention in connection with the best known theory of its operation at the present time, and should it later be discovered that the operation is because of some other theory which is not now understood, I do not desire to be limited thereby.

In the drawings:

Fig. 1 is a vertical medial section of a device constructed according to my invention with certain alternate construction shown by dotted lines;

Fig. 2 is a fragmentary elevational view of an anode in a first state of its production;

Fig. 3 is a similar view in a subsequent stage of its production; and

Figs. 4 and 5 are similar views respectively of a modified form of anode.

Throughout the drawings like parts are designated by like reference characters.

Referring now to Fig. 1, I show a metal cylindrical en-

velope 10 having the upper end necked over at 11 to receive the end of a tube 12. The envelope 10 may be made of any suitable metal such as nickel or "Kovar" which is a nickel-cobalt-iron alloy. The tube 12 may be copper or lead or other easily deformable material soldered into the neck 11 and adapted to be pinched off and soldered at 14 to provide for the sealing of the tube.

The base of the tube has welded thereto a glass bead 15 through which an anode 16 extends, the end 16*a* extending below the base for connection into an exterior circuit not shown.

The inner surface of the bead 15 may be provided with a ring 17 for increasing the surface resistance within the tube. The exterior of the tube base is preferably coated with a silicone preparation which is polymerized to form a high resistance surface having the well known water repellant characteristics.

The envelope 10, which is cylindrical, may comprise the cathode. It is provided with a coating of material on its inner surface to form the cathode surface and having the desired work function. If desired, the coating may be replaced by a sleeve 20 of metal having the desired work function.

The anode may be formed of a cylindrical rod, Fig. 2, which is formed first by cutting the rod on an angle at 22. The thin end may then be bent as indicated at 22*a*, Fig. 3, so that it points toward the cathode. Preferably, this is effected after the rod is secured in the bead.

After the end of the rod is bent to provide the point, as shown in Fig. 3, the extreme end of the points has deposited thereon, by electro-plating, a quantity of radio active cobalt 24. I also contemplate grinding the point to needle like sharpness, to thus provide a subsequent greater concentration of the radio active cobalt on the point.

Although radio active cobalt is indicative because it has a desired half life (approximately 5.3 years) it will be apparent that other radio active isotopes of metal may be used with equal facility, and that radio active cobalt is merely cited as an example of a desirable material. The degree of concentration may be varied by the amount of electro plating.

Although electroplating is indicated as being the most economical, any manner whereby the material may be deposited is useful such as vaporization in a vacuum, commonly known as sputtering, or the same may be applied by dipping in lacquer containing the radio active material. Electroplating enables the operation to be effected cheaply and easily and enables the desired concentration at the point to be effected.

Another manner in which the anode may be formed is illustrated in Figs. 4 and 5. In this embodiment, the metal on the end of the anode is upset to form a spade shaped end 16*b* which is then bent at an angle, as shown at 30 in Fig. 5, to provide a thin section extending toward the cathode. It is also desirable that the spade shaped end simultaneously with the upsetting be sheared as shown by the dotted lines 31 to provide a pointed end which is then bent as shown in Fig. 5.

In either of the cases, the bent anode then has its end placed in the electroplating bath to the desired depth, which enables the same to be plated over the desired area with the proper amount of material.

It is preferable that the plating be effected after all of the other operations on the anode are performed. Then, there only remains to insert the same into the envelope, exhaust the air and replenish the same with the desired gas or mixture thereof at the desired pressure.

I have found that 2% argon and 98% helium provides a very desirable mixture for such a tube which may be at a pressure varying between 10 and 100 mm. of mercury, although for some applications, pressures beyond these limits are useful.

It will be seen that because of the concentricity of the elements that the evacuation of the tube may be effected quickly and easily. This structure is also such that high centrifugal forces may be applied without destroying the tube and without changing the position of the elements in the tube. The structure also lends itself to making the tube in various sizes, and especially to making of tubes that are very small; for instance, tubes smaller than ⅛ inch in diameter and less than one inch long may be made relatively rapidly and inexpensively because of the improved structure. Because the radio active material is deposited on the anode, which, compared with the point of the prior disclosure, is easier to handle and less expensive. Furthermore, time consuming operations of welding a flag to the anode are eliminated. The anode is thus easier to handle without danger of contamination to the anode or the hazards of the emanations to the personnel.

A tube constructed according to my invention may be made to strike at a voltage within a fraction of a volt of the desired voltage with extremely large variations in ambient temperature.

The method of binding the radioactive material to the support eliminates any possibility of the material being dislodged during operation with subsequent destruction of the tube.

Having thus described my invention, I am aware that numerous and extensive departures may be made therefrom without departing from the spirit or scope of the invention.

I claim:

1. A gaseous conduction tube including a cylindrical cathode, an anode disposed coaxially of the cathode and a radio active material electro-deposited on the anode, said anode being provided with an integral point extending toward the cathode and said radio active material being deposited on said point.

2. A gaseous conduction tube including a cylindrical cathode, an anode disposed coaxially of the cathode and a radio active cobalt electro-deposited on the anode, said anode being provided with an integral point extending toward the cathode and said deposit of radio active cobalt being on the point.

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