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E. T. CASELLINI ET AL
ELECTRICAL DISCHARGE TUBE

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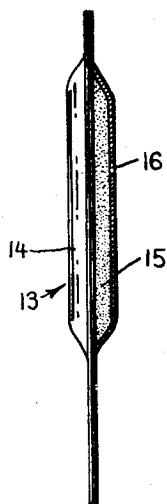


Fig. 4

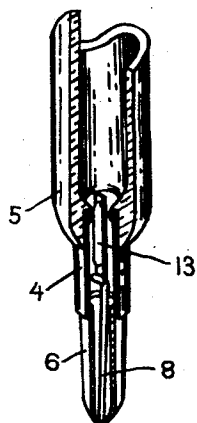


Fig. 2

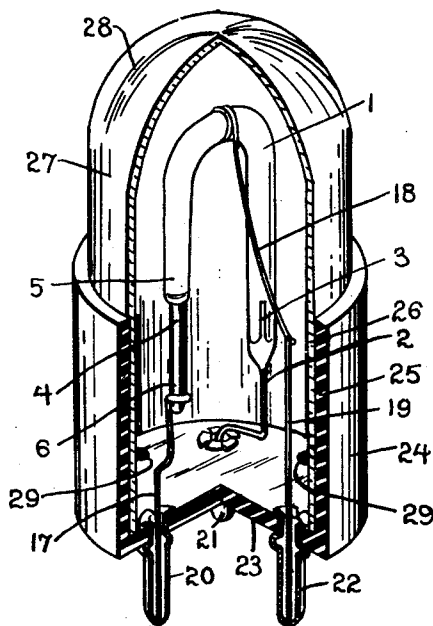


Fig. 1

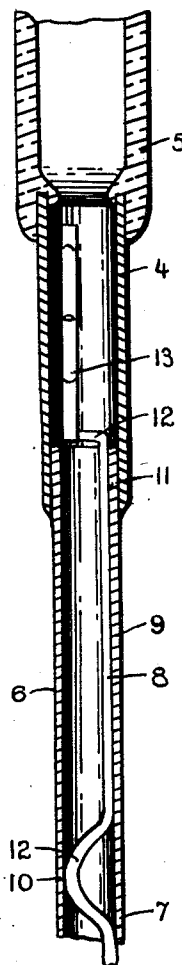


Fig. 3

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ELECTRICAL DISCHARGE TUBE

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5 Claims. (Cl. 176—122)

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This invention relates to electric gaseous discharge devices and particularly to those suitable for producing intense discharges of short durations.

Objects of the invention are to produce an inexpensive, compact, efficient discharge device of improved life in flashing service. Although the device is intended principally for producing intense light flashes or electrical pulses, advantage can be taken of the invention in other types of service.

A feature of the invention is a metallic chamber around the cathode and sealed to the glass envelope. Another feature is a cathode of barium in a metallic sleeve, and still another is a cathode conductor and support wire sealed into an end of said metallic chamber. A further feature is a control or starting electrode wrapped around the outside of the discharge envelope. Other features are a glass outer envelope, a base fitting over one end thereof, and ventilating holes in said base. All these features are not essential to every embodiment of the invention.

Other objects, advantages and features of the invention will be apparent from the accompanying specification, in which:

Figure 1 is a cut-away perspective view of a device according to the invention;

Figure 2 is a similar view of the electrode at one end of the lamp tube of the device;

Figure 3 is a sectional view of the same electrode before the cathode is treated and the tube sealed; and

Figure 4 is a sectional view of the cathode.

In Figure 1, a U-shaped piece of glass tubing 1 has the lead-in wire 2 sealed therethrough at one end to terminate in the anode 3. A metal tube 4 is sealed to the other end 5 of the glass tubing 1, this tube 4 being of a metal capable of being sealed to the type of glass used.

The end of tube 4 not sealed to the glass is preferably welded to form an hermetic seal with a piece 6 of tubing, preferably copper or the like, of good electrical and heat conductivity. Before exhausting the tube 1 of gases, the copper tube 6 is open at its bottom end 7, which may be placed in communication with an exhaust system.

A length of copper wire 8 extends into tube 6 along one wall and is bent or crimped over to the opposite part of the tube wall 10 at a point removed from the welded portion 11, to form a mechanical or friction support for the wire 8 during the exhaust process. After the exhaust procedure is completed the tube 6 is pressed together at one point, preferably between the bend 12 and

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the wall 11, to form an hermetic seal in which the wire 8 is firmly held, and the tube 6 cut off transversely preferably near the middle of this crimped portion, after that portion is welded if desired. Solder may be applied to the finished joint.

The cathode 13 may comprise an iron tube 14 sealed at its ends and filled with barium metal 15. A small hole 16 in the side of the tube permits the barium to diffuse gradually to the outside of the cathode as needed. Some of it may deposit on the inside wall of tube 4 during operation.

The anode 3 may be merely a wire, for example an extension of lead-in wire 2, if desired. Its size, particularly its cross-sectional area transverse to the tube's longitudinal axis should be proper to give a low anode drop. The tube 1 may be filled with gas at a pressure sufficient to operate at the desired voltage. Xenon at 40 mm. of mercury pressure is very effective where an intense light of white color is desired. Other gases can be used, and may be more suitable where the tube is used for control purposes rather than for illumination. Mercury vapor may be used, with or without a rare gas, but care should be taken to prevent the vapor pressure becoming sufficient to explode the tube. If desired, the amount of mercury present in the tube may be kept below the quantity necessary to produce too high a pressure when completely evaporated. When mercury vapor is used, the flash may be made shorter than usual if the mercury vapor pressure rises quickly enough from heating by the discharge, to increase the voltage to a value higher than that available from the source to which the electrodes are connected.

The tube 1 may be supported by lead-in wires 17 and 2, attached to chamber 6 and electrode wire 3, respectively, and by the wire 18, wrapped around the outside of glass tube 1, to form a control electrode, and in turn connected to lead-in wire 19. Support and lead-in wires 17, 2, and 19 extend respectively, into contact pins 20, 21, 22, affixed firmly to the insulating bottom 23 of base 24, whose cylindrical side-wall 25 fits around the tubular portion 26 of glass envelope 27, which may have a rounded top 28. The base 24 and glass envelope 27 together form an enclosure for the tube 1 and its supports. Vent holes 29 are provided in the bottom portion 23 of bases 24, to allow circulation of air for cooling the tube 1 and its chamber 4, 6. The tube 1 may get hot enough, in operation, to char paper.

The metal chamber 4, 6 aids in cooling tube 1

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and the gas therein. In some cases, it may be desirable to put a water jacket around this electrode for further cooling.

The electrodes 3 and 13 may be connected to a source of voltage, for example through pins 20 and 21. This voltage is preferably somewhat below the voltage necessary of itself to produce a discharge between the electrodes 3 and 13, but sufficient to support a discharge once it is started by the application of control voltage to electrode 18. The application of a comparatively small energy or voltage to electrode 13 will thus serve to initiate the discharge. The control voltage will ordinarily be applied between cathode 13 and the electrode 18.

In one embodiment of our invention, we used a glass tube of .190 inch outside diameter and 0.11 inch inside diameter, bent into a U or J shape as in Figure 1, and having a length of about 1¾ inches along the curve. The tube 4 of metal sealable to glass was of 0.125 inch diameter and ½ inch long, while the copper tubing 8 was of 0.1 inch diameter and ¼ inch long in the finished tube. The anode 3 was 0.004 inch in diameter and extended about ¼ inch into the gas inside the tube. With a filling of 40 mm. of xenon this tube operated in a range of 300 to 700 volts across the electrodes 13 and 3, being triggered off by a voltage of about 2500 to the control electrode 18. The tube may be triggered off in a single flash, or in a succession of flashes, for example, at a repetitive rate of 500 per second. The peak currents in the tube may be extremely high, with the average power being only about 5 watts.

For the usual hard glass such as Corning 7052, a potassium barium borosilicate glass, with a coefficient of expansion of about 5×10^{-6} , the metal tube 4 sealed thereto may be of "Kovar," an alloy of 17% cobalt, 29% nickel, 0.3% manganese and the balance iron. A softer glass will not permit as great an instantaneous power, but if used would require an appropriate metal for sealing. The more transparent the glass is to the entire spectrum produced by the gas the cooler the glass will run.

If desired, the tube can of course be operated without using the control electrode 18, by using a high enough voltage across the other electrodes 3 and 13 and an appropriate ballast. For flashing operation the tube may be operated on the discharge of a condenser, as is customary with flash tubes.

The foregoing specific examples are merely by way of explanation and not of limitation. The word glass is used in a broad sense, to include all refractory light-transmitting materials; in the event the tube is used as a control tube, the material need not necessarily be light-transmitting.

The tube can be made without the cathode 13, and operated as a "cold cathode" tube, in which case the voltage required will be much higher and the tube less suitable for a condenser discharge. This drop may be somewhat reduced in

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this case by coating the interior of the hollow tube 4 with electronemissive material.

The tube 4 will act as cathode during operation and as exhaust tube during manufacture.

What we claim is:

1. An electric gaseous discharge lamp comprising a short bent glass tube, a gaseous filling therein, a metal wire anode sealed through and closing one end of said tube, a metal tube sealed at one of its ends to the other end of said glass tube, a second metal tube of better conductivity than the first hermetically attached at one end to the end of said first metal tube extending away from said glass tube, the other end of said second metal tube being sealed, a conducting wire extending from the sealed end of said second metal tube, a hollow metal tube attached to said conducting wire and having an opening in its side, and a filling of barium in said hollow metal tube.

2. The combination of claim 1, in which the hollow metal tube having an opening in its side is within the metal tube sealed to the glass tube.

3. The combination of claim 1, a wire control electrode wrapped around a portion of said glass tube, a hollow base, contact pins extending through said base, lead-in wires extending from said contact pins to the electrodes to support said tube, and a glass tube closed at one end and fitted into said base at the other end to enclose said tube and its associated supports, said base having holes in its end for ventilation.

4. An electric gaseous discharge lamp comprising a short glass tube, a gaseous filling therein, a metal anode sealed through and closing one end of said tube, a metal tube having one of its ends sealed to the other end of said glass tube, the other end of said metal tube being closed, a hollow metal tube disposed entirely in said first-mentioned metal tube and connected thereto, and having an opening in its side, and a filling of barium in said hollow tube.

5. The combination of claim 4, and a conductor wire connecting said hollow metal tube to said first mentioned tube and having a bend contacting opposite walls of said first-mentioned metal tube to hold said hollow metal tube in place.

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