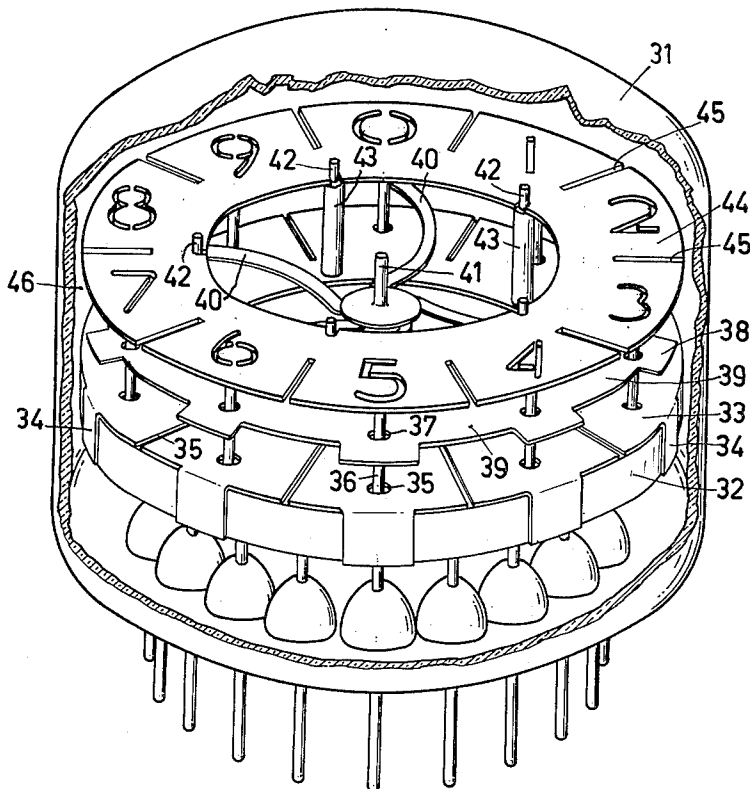


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GLOW-DISCHARGE INDICATOR TUBE

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GLOW-DISCHARGE INDICATOR TUBE

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This invention relates to glow-discharge indicator tubes in which the position of the glow light is determined by a voltage applied to an auxiliary electrode and which contain, in addition to a main anode and a main cathode, at least one auxiliary anode. The invention also relates to devices comprising such glow-discharge indicator tubes.

In a copending application Ser. No. 81,900, filed January 10, 1961, which is a continuation of application Ser. No. 852,121, filed November 10, 1959, now abandoned, there is disclosed a glow-discharge indicator tube in which a plurality of auxiliary anodes is arranged adjacent the main cathode so that, when the anode voltage and the auxiliary anode voltages are applied, the glow discharge is ignited and keeps burning in the vicinity of that auxiliary anode which has a low positive voltage with respect to the other auxiliary anodes. Since a plurality of auxiliary electrodes is provided, the glow discharge may occupy a different position on the cathode as a function of the auxiliary anode which exhibits a low potential difference. The anode is in the form of a wire parallel to the flat plate-shaped cathode, the auxiliary anodes being regularly distributed along the cathode and terminating adjacent the perpendiculars from the anode to the cathode.

According to the invention in a glow-discharge indicator tube the annular cathode is arranged between two annular anodes, one having apertures, if desired in the form of figures, adjacent the burning positions of the glow-discharge on the cathode, whereas rod-shaped auxiliary anodes extend through the other anode ring and through circular apertures in the cathode, which apertures have a diameter equal to the diameter of the auxiliary anodes, increased by twice the distance at which the minimum ignition voltage occurs in the relevant filling gas of the tube.

Due to the chosen arrangement of the auxiliary anodes with respect to the cathode, the ignition voltage between the auxiliary anodes and the cathode is hardly any more dependent on the positions of the rod-shaped auxiliary anodes in the apertures of the cathode since between the edge of each aperture and the associated auxiliary anode there can always be found a distance corresponding to the minimum ignition voltage, even when the rod lies eccentrically in the aperture. Due to the presence of two anodes one on each side of the cathode, it is insured that, if at least sufficient current is supplied in the circuit, the discharge also invariably occurs on the desired side of the cathode, independently of any small differences in the discharging conditions at the upper and lower surfaces of the cathode ring. According to the invention in order to prevent the glow-discharge from applying to an area other than the area to be indicated, the cathode ring is covered between the burning areas which surround the apertures through which the auxiliary anodes extend, with a thin layer of a metal having a high cathode fall in the

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glow-discharge such, for example, as nickel, or an insulator. According to the invention, the cathode ring is in addition, narrower between the burning areas in order to avoid dissipation of heat during the degassing of the burning areas.

Since for each auxiliary anode with respect to the aperture in the cathode there can always be found a distance at which the minimum ignition voltage occurs, use may be made of a filling gas the electrical properties of which are less subject to variation during the life of the tube than in the case of a less accurate arrangement of the auxiliary anodes with respect to the cathode.

In fact, since with the known arrangements in which the auxiliary anodes are slightly spaced from a cathode, the distances between the auxiliary anodes and the cathode cannot easily be made equal, it is necessary to use therein neon and 0.1% of argon as a filling gas, since this yields a very flat Paschen curve.

However, according to the invention since in the structure having auxiliary anodes extending through apertures in the cathode, the distance between the auxiliary anodes and the edges of the apertures in the cathode are equal to a large extent, use may be made of neon and 1% of argon as a filling gas, the composition of which varies due to burning away to a lesser extent than in the case of neon and 0.1% of argon. In addition, the distance between the anode and the cathode may then be smaller due to the steeper Paschen curve, resulting in a decrease of the parallax upon observing the glow-light through the anode ring. The tube is suitable for mass production.

In order that the invention may be readily carried into effect, it will now be described more fully, by way of example, with reference to the accompanying drawing, in which the sole FIGURE is a perspective view of a tube according to the invention.

In the drawing reference numeral 31 indicates the glass bulb of the tube which is partly cut open. Parallel to the base of the tube is a powdery glass disc 32 which carries a lower anode ring 33 having tongues 34 which embrace the side of the disc 32. The ring 33 is provided with ten apertures 35 each having a diameter of about 1.5 mm. Rods 36 of Fernico material each having a thickness of 0.6 mm. are located in the apertures 35 of the powdery glass disc 32. The rods 36 which constitute the auxiliary anodes of the tube, then extend into apertures 37 of a cathode ring 38, which apertures each have a diameter of 1.1 mm. The cathode ring 38 consists of molybdenum and a sectorwise nickel coating 39 which has been provided by spraying with nickel oxide and reducing the nickel oxide in hydrogen. The cathode ring 38 is supported by means of five bent spokes 40 which are supported by means of a central pin 41. The powdery glass disc 32 contains another five rods 42 which are electrically connected to the lower anode ring 33 and which also support an upper anode ring 44. Between the two anodes the rods 42 are surrounded by ceramic spacers 43. The upper anode ring 44 is provided with recesses in the form of figures opposite the portions of the cathode which are not covered with nickel. The upper and lower anode rings are provided with slots 45 to ensure proper distribution of the energy over the three rings upon high-frequency heating. The anode rings consist of stainless steel and the gas-filling of the tube consists of neon and 1% of argon at a pressure of 110 mms. of

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mercury. The thickness of the anode rings and the cathode rings is 0.07 and 0.15 mm., respectively, and the distance between them is 2.0 mms.

The wall is covered with an atomized cathode layer 46 obtained by atomizing the cathode at a high current intensity. Due to the high pressure of the gas in the tube, this cathode layer is present almost exclusively on the cylindrical side wall of the tube adjacent the electrodes so that the position of the glow-light upon viewing the tube in an axial direction may be observed unhindered through the figure-shaped apertures.

What is claimed is:

1. A glow-discharge indicator tube in which the position of the glow-light is determined by a voltage applied to an auxiliary electrode and which contains, in addition to a main anode and a main cathode, a plurality of auxiliary anodes arranged adjacent the main cathode so that, when the anode voltage and the auxiliary anode voltage are applied, the glow discharge is ignited and keeps burning in the vicinity of that auxiliary anode which has a low positive voltage with respect to the other auxiliary anodes characterized in that the annular cathode is arranged between two annular anodes, one having apertures, if desired in the form of figures, adjacent the burning positions of the glow-discharge, the rod-shaped auxiliary anodes extending through the other anode ring and through circular apertures in the cathode, which apertures have a diameter equal to the diameter of the auxiliary anodes, increased by twice the distance at which the minimum ignition voltage occurs in the relevant filling gas in the tube.

2. A glow-discharge indicator tube in which the position of the glow-light is determined by a voltage applied to an auxiliary electrode comprising an envelope containing an ionizable gaseous medium at a glow-discharge pressure, a pair of spaced annular main anodes, one of which is provided with circular apertures and the other of which is provided with character-shaped apertures, an annular cathode disposed between and spaced from either of said anodes, said cathode being provided with circular apertures in substantial alignment with the apertures in both of said anodes, auxiliary rod-like electrodes extending through the circular apertures of the anode and cathode and terminating adjacent the character-shaped apertures of the other anode, said circular apertures having a diameter equal to the diameter of the rod-like electrode plus twice the distance at which the minimum ignition voltage occurs in the gas whereby with positive voltages applied to the main anode and auxiliary electrodes, a glow discharge is initiated and maintained in the vicinity of an auxiliary anode having a small positive voltage relative to the other auxiliary electrodes.

3. A glow-discharge indicator tube in which the position of the glow light is determined by a voltage applied to an auxiliary electrode comprising an envelope containing an ionizable gaseous medium at a glow-discharge pressure, a pair of spaced annular main anodes, one of which is provided with circular apertures and the other of which is provided with character-shaped apertures, an annular cathode disposed between and spaced from either of said anodes, said cathode being provided with circular apertures in substantial alignment with the apertures in both of said anodes, a layer of material having a relatively high cathode fall covering surfaces of the cathode between the surface areas adjacent the apertures, auxiliary rod-like electrodes extending through the circular apertures of the anode and cathode and terminating adjacent the character-shaped apertures of the other anode, said circular apertures having a diameter equal to the diameter of the rod-like electrode plus twice the distance at which the minimum ignition voltage occurs in the gas whereby with positive voltages applied to the main anode and auxiliary electrodes, a glow discharge is initiated and maintained in the vicinity of an auxiliary anode hav-

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ing a small positive voltage relative to the other auxiliary electrodes.

4. A glow-discharge indicator tube in which the position of the glow light is determined by a voltage applied to an auxiliary electrode comprising an envelope containing an ionizable gaseous medium at a glow-discharge pressure, a pair of spaced annular main anodes, one of which is provided with circular apertures and the other of which is provided with character-shaped apertures, an annular cathode disposed between and spaced from either of said anodes, said cathode being provided with circular apertures in substantial alignment with the apertures in both of said anodes, a layer of nickel covering surfaces of the cathode between surface areas adjacent the apertures to increase the cathode fall at the so-covered cathode surfaces, auxiliary rod-like electrodes extending through the circular apertures of the anode and cathode and terminating adjacent the character-shaped apertures of the other anode, said circular apertures having a diameter equal to the diameter of the rod-like electrode plus twice the distance at which the minimum ignition voltage occurs in the gas whereby with voltages applied to the main anode and auxiliary electrodes, a glow discharge is initiated and maintained in the vicinity of an auxiliary anode having a small positive voltage relative to the other auxiliary electrode.

5. A glow-discharge indicator tube in which the position of the glow light is determined by a voltage applied to an auxiliary electrode comprising an envelope containing an ionizable gaseous medium at a glow-discharge pressure, a pair of spaced annular main anodes, one of which is provided with circular apertures and the other of which is provided with character-shaped apertures, an annular cathode disposed between and spaced from either of said anodes, said cathode being provided with circular apertures in substantial alignment with the apertures in both of said anodes, a layer of insulating material covering surfaces of the cathode between surface areas adjacent the apertures to increase the cathode fall at the so-covered cathode surfaces, auxiliary rod-like electrodes extending through the circular apertures of the anode and cathode and terminating adjacent the character-shaped apertures of the other anode, said circular apertures having a diameter equal to the diameter of the rod-like electrode plus twice the distance at which the minimum ignition voltage occurs in the gas whereby with voltages applied to the main anode and auxiliary electrodes, a glow discharge is initiated and maintained in the vicinity of an auxiliary anode having a small positive voltage relative to the other auxiliary electrodes.

6. A glow-discharge indicator tube in which the position of the glow light is determined by a voltage applied to an auxiliary electrode comprising an envelope containing an ionizable gaseous medium at a glow-discharge pressure, a pair of spaced annular main anodes, one of which is provided with circular apertures and the other of which is provided with character-shaped apertures, an annular cathode disposed between and spaced from either of said anodes, said cathode being provided with circular apertures in substantial alignment with the apertures in both of said anodes, said annular cathode being narrower between the apertures and having a layer covering the surfaces between the apertures consisting of a material which increases the cathode fall, auxiliary rod-like electrodes extending through the circular apertures of the anode and cathode and terminating adjacent the character-shaped apertures of the other anode, said circular apertures having a diameter equal to the diameter of the rod-like electrode plus twice the distance at which the minimum ignition voltage occurs in the gas whereby with voltages applied to the main anode and auxiliary electrodes, a glow discharge is initiated and maintained in the vicinity of an auxiliary anode having a small positive voltage relative to the other auxiliary electrodes.

7. A glow-discharge indicator tube in which the posi-

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tion of the glow-light is determined by a voltage applied to an auxiliary electrode comprising an envelope containing neon and 0.1% of argon at a glow-discharge pressure, a pair of spaced annular main anodes, one of which is provided with circular apertures and the other of which is provided with character shaped apertures, an annular cathode disposed between and spaced from either of said anodes, said cathode being provided with circular apertures in substantial alignment with the apertures in both of said anodes, auxiliary rod-like electrodes extending through the circular apertures of the anode and cathode

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and terminating adjacent the character-shaped apertures of the other anode, said circular apertures having a diameter equal to the diameter of the rod-like electrode plus twice the distance at which the minimum ignition voltage occurs in the gas whereby with voltages applied to the main anode and auxiliary electrodes, a glow discharge is initiated and maintained in the vicinity of an auxiliary anode having a small positive voltage relative to the other auxiliary electrodes.

No references cited.