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GLOW-DISCHARGE INDICATOR TUBE

Original Filed Nov. 10, 1959

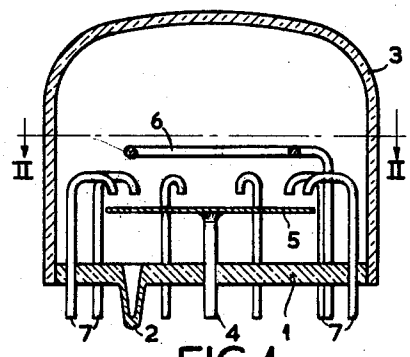


FIG. 1

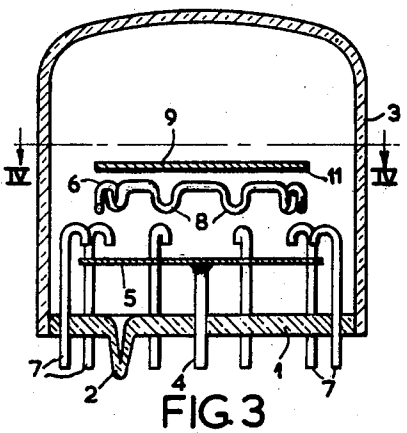


FIG. 3

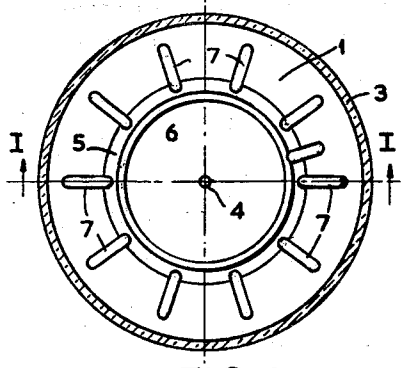


FIG. 2

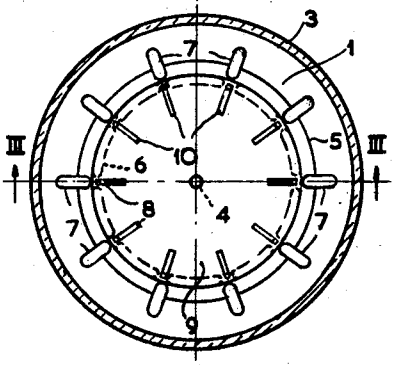


FIG. 4

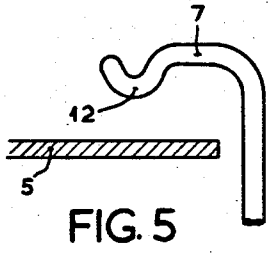


FIG. 5

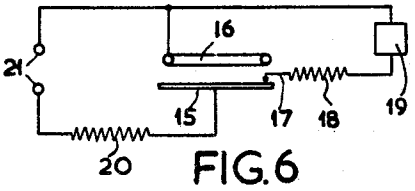


FIG. 6

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GLOW-DISCHARGE INDICATOR TUBE

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Claims priority, application Netherlands Jan. 6, 1959
9 Claims. (Cl. 313—196)

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 circuits including such glow-discharge indicator tubes. This application is a continuation of application Serial Number 852,121 filed November 10, 1959.

In U.S. Patent No. 2,940,012 a glow-discharge tube has been suggested in which between the anode and the cathode two discharge paths with different igniting voltages are possible. Adjacent the discharge path of higher ignition voltage there is arranged an auxiliary anode so that the discharge in the path of higher ignition voltage is ignited when a low voltage difference in the positive sense is applied between the auxiliary anode and the main anode. In the associated circuit, the elements are chosen so that the discharge is intermittent with a comparatively long RC-time.

An object of the invention is to provide a glow-discharge indicator tube which permits more than two positions of the glow light to be obtained.

According to the invention, a glow-discharge indicator tube is provided in which the position of the glow light is determined by a voltage applied to an auxiliary electrode. This tube contains, in addition to a main anode and a main cathode, at least one auxiliary anode. 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 simplest form for the arrangement of the electrodes is that in which the anode is a wire parallel to a flat plate-shaped cathode, the auxiliary anodes being regularly distributed along the cathode and terminating adjacent the perpendiculars from the anode to the cathode.

In order to assist the glow discharge in keeping burning at the area of ignition, either the anode may be provided with projections adjacent the auxiliary anodes, or the cathode may locally exhibit more favorable conditions of burning.

Furthermore, a screen having apertures through which the positions of the discharge are visible may be arranged on that side of the anode which is remote from the cathode. This screen may be, for example, of mica which is coated with an opaque conductive layer due to the atomisation of the cathode in preparing the tube.

According to the invention and in order to ensure that the discharge keeps burning at a chosen area of ignition and, also that the discharge follows positional changes in response to changes in potentials of the auxiliary anodes, it is necessary to apply a cyclically varying anode voltage with respect to the cathode. It is possible, for example, to use the positive half of a sinusoidal alternating voltage or even a full-wave rectified alternating voltage. If desired, it is even possible to apply an alternating voltage

of not too high frequency if the tube has sufficient rectifying action. As a further alternative, the circuit may be powered from a direct-current source in which case the circuit is designed so that the discharge is intermittent.

The invention will now be described with reference to the accompanying drawing, in which:

FIGS. 1 and 2 are cross-sectional views of a glow-discharge indicator tube according to the invention;

FIGS. 3 and 4 are cross-sectional views illustrating a modification;

FIG. 5 illustrates a favorable form of the auxiliary anode; and

FIG. 6 is a circuit diagram employing the tube according to the invention.

In FIGS. 1 and 2, the tube comprises a glass base **1** together with an exhaust tube **2** and an envelope **3**. A flat molybdenum cathode **5** is secured, for example, by soldering to a central lead-in pin **4**. The anode comprises a wire-shaped ring **6**. The cathode plate **5** is surrounded by ten wire-shaped auxiliary anodes **7**, the ends of which terminate at a short distance from the cathode. The anode-cathode distance is about 4 mms. The gas filling consists of 20 cms. of neon and several tenths per cent of argon. The gas pressure has been chosen so high that the working point is far to the right of the Paschen minimum so that the influence of the cathode upon the ignition voltage is less than in the case of a much lower pressure.

Referring to FIGS. 3 and 4, the anode ring **6**, in the vicinity of the auxiliary anodes, exhibits small depressions **8** which approach the cathode more closely than does the remaining part of the ring. The positioning of the discharge adjacent the area of ignition is thus enhanced. A mica screen **9** having slot-shaped apertures **10** is arranged over the anode. In FIG. 4, the depressions **8** of the anode are just visible in the slot-shaped apertures **10** which may have the shape of figures.

FIG. 5 shows how the portion **12** of auxiliary anode **7** which is adjacent the cathode **5** has the form of a curved wire. This provides more reproducible conditions of ignition than a punctiform end of a wire.

FIG. 6 shows a circuit including a tube according to the invention in which the cathode and the anode ring are indicated by **15** and **16**, respectively. One of the auxiliary anodes is indicated by **17**.

The auxiliary anode **17** is connected via a resistor **18** to an element **19** which is also connected to anode **16**. The element **19** may be, for example, a unit of one of the decades of a transistor counting circuit from which a voltage of several volts, for example 2 to 8 volts, may be derived when this unit is operative. The circuit is such that, in the operating condition, the auxiliary anode **17** becomes positive with respect to the anode **16**.

The cathode **15** is connected via a resistor **20** to one of the terminals **21**, to which the anode is also connected.

If each of the units of a decade is thus connected to an auxiliary anode and if a suitably chosen cyclically varying voltage is applied between the terminals **21**, the discharge upon increasing anode voltage will be ignited adjacent that auxiliary anode which has a low positive voltage, e.g. several volts, with respect to the main anode, that is to say adjacent the auxiliary anode associated with the unit **19** which is operative. An indication of the condition of the circuit is thus obtained in a simple manner.

In general it is desirable for the voltage peaks on the anode (and the auxiliary anodes) to be chosen not unduly high, since otherwise due to differences between the discharge paths, it is possible upon rapidly increasing voltage that a wrong auxiliary anode may be ignited.

The foregoing embodiments are intended to be illustrative only, the invention being defined in the appended claims.

What we claim is:

1. An indicating system including a glow-discharge indicator tube comprising an envelope and within said envelope an ionizable gas at a glow-discharge pressure, main anode and main cathode electrodes defining a discharge path therebetween, a plurality of auxiliary anodes positioned in said discharge path adjacent the main cathode, means to apply a cyclically varying positive potential to said main anode relative to said cathode, and means to apply a positive potential to one of said auxiliary anodes relative to the other auxiliary anodes whereby the glow-discharge occurs solely between the main anode and cathode electrodes and said latter auxiliary anode.

2. An indicating system including a glow-discharge indicator tube comprising an envelope and within said envelope an ionizable gas at a glow-discharge pressure, main anode and main cathode electrodes defining a discharge path therebetween, a plurality of auxiliary anodes positioned in said discharge path adjacent the main cathode, means to apply a cyclically varying positive potential to said main anode relative to said cathode, and means to apply a positive potential to one of said auxiliary anodes relative to the other auxiliary anodes and the main anode whereby the glow-discharge occurs solely between the main anode and cathode electrodes and said latter auxiliary anode.

3. An indicating system including a glow-discharge indicator tube comprising an envelope and within said envelope an ionizable gas at a glow-discharge pressure, main anode and main cathode electrodes defining a discharge path therebetween, a plurality of auxiliary anodes positioned in said discharge path adjacent the main cathode, means to apply a cyclically varying positive potential to said main anode and said auxiliary electrodes relative to said cathode, and means to apply a positive potential to one of said auxiliary anodes relative to the other auxiliary anodes whereby the glow-discharge occurs solely between the main anode and cathode electrodes and said latter auxiliary anode.

4. An indicating system including a glow-discharge indicator tube comprising an envelope and within said envelope an ionizable gas at a glow discharge pressure, main anode and main cathode electrodes defining a discharge path therebetween, a plurality of auxiliary anodes positioned in said discharge path adjacent the main cathode, means to apply a cyclically varying positive potential to said main anode relative to said cathode, and means to apply a positive potential to one of said auxiliary anodes relative to the other auxiliary anodes and several volts different relative to the main anode potential whereby the glow-discharge occurs solely between the main anode and cathode electrodes and said latter auxiliary anode.

5. A glow-discharge indicator tube in which the position of the glow light is determined by a voltage applied to an auxiliary electrode; said tube comprising a planar cathode, an annular anode in a plane parallel to and spaced from said cathode, and a plurality of auxiliary anodes regularly distributed in the vicinity of said cathode and having ends terminating adjacent perpendiculars from said annular anode to said cathode.

6. The tube of claim 5, in which said annular anode comprises a depression toward said cathode in the vicinity of each of said auxiliary anodes, said depressions being closer to said cathode than the remaining portions of said annular anode.

7. The tube of claim 5, in which said auxiliary anodes are wires and said ends are curved.

8. An indicating system comprising a glow-discharge indicator tube having a planar cathode, an annular anode in a plane parallel to and spaced from said cathode, and a plurality of auxiliary anodes regularly distributed about the periphery of and in the vicinity of said cathode and having ends terminating adjacent the perpendiculars from said annular anode to said cathode, means applying an intermittent voltage between said cathode and annular anode, and means selectively applying a low positive voltage to said auxiliary anodes with respect to said annular anode.

9. A glow-discharge indicator tube in which the position of the glow light is determined by a voltage applied to an auxiliary electrode; said tube comprising a planar cathode, an anode in a plane substantially parallel to and spaced from said cathode, and a plurality of auxiliary anodes supported with their ends regularly distributed about an annular locus in the space between said anode and cathode and terminating adjacent perpendiculars from said anode to said cathode.

References Cited in the file of this patent

UNITED STATES PATENTS

2,937,318	Chao	May 17, 1960
2,946,921	Von Gugelberg	July 26, 1960