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COLD CATHODE DISCHARGE TUBE

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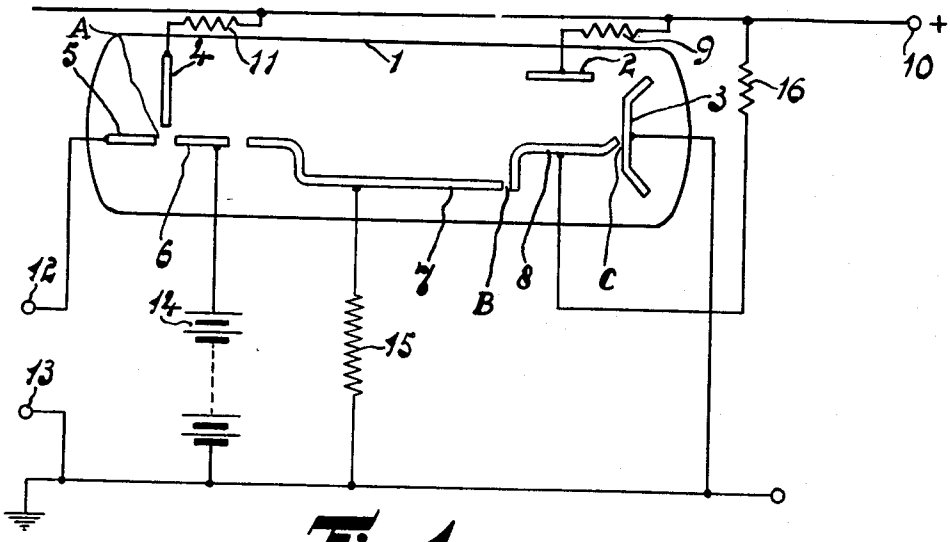


Fig. 1

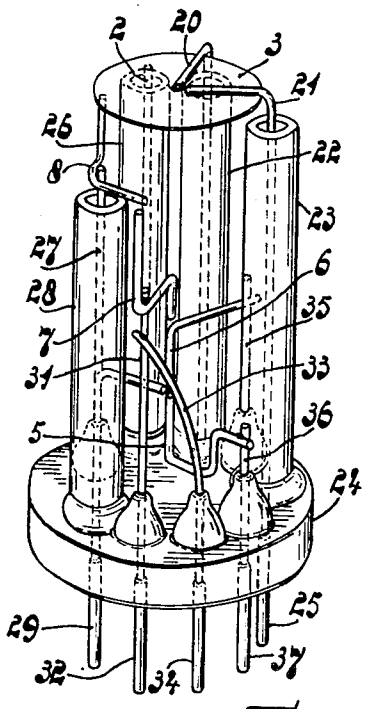


Fig. 2

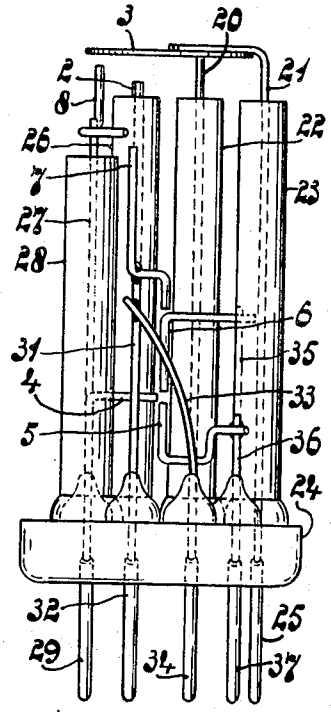


Fig. 3

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COLD CATHODE DISCHARGE TUBE

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Improvements in or relating to devices comprising a gaseous discharge tube of the type having a main discharge path and an auxiliary discharge path and gaseous discharge tubes intended for such devices.

This invention relates to a device comprising a gaseous discharge tube of the tube having a main anode and a main cathode and an auxiliary anode and an auxiliary cathode, in which the main discharge path is ignited by causing the auxiliary discharge to pass to a further auxiliary electrode, thus initiating the main discharge directly or indirectly, and in which the currents and voltages in connection with the structure of the tube are so chosen that the auxiliary discharge alone cannot initiate the main discharge. Furthermore, the invention relates to a gaseous discharge tube for use in such a device.

It has previously been suggested that the main and auxiliary discharge paths should be separated by a screen, in the case under consideration the cathode in which the auxiliary discharge takes place and whence the auxiliary discharge is brought into the main discharge path through an electrode extending through the screen. However, the presence of the screen does not make the manufacture of the tube a simple job.

The object of the invention is to provide a gaseous discharge tube for a device of the above-mentioned kind, in which a screen between the auxiliary and main discharge paths is not provided.

According to the invention, in a device comprising a gaseous discharge tube having a main anode and a main cathode, an auxiliary anode and an auxiliary cathode, in which the main discharge path is ignited by causing the auxiliary discharge to pass to a further auxiliary electrode which initiates the main discharge directly or indirectly and in which the currents and voltages in connection with the structure of the tube are so chosen that the auxiliary discharge alone cannot initiate the main discharge, the gaseous discharge tube contains between the auxiliary discharge path and the main discharge path in succession a transfer cathode, a coupling cathode and an ignition anode, the auxiliary cathode being connected by way of a control-voltage source to the main cathode, the transfer cathode having a positive voltage of some tens of volts with respect to the cathode, the coupling cathode being connected by way of a high resistance to the main cathode, the auxiliary anode being connected by way of a high resistance to a positive voltage source, the main anode being connected by way of a current-limiting resistor to a positive voltage source and the ignition anode being coupled by way of a very high resistance to a positive voltage source, so that the small current flowing between the coupling cathode and the ignition anode when the auxiliary discharge is not ignited causes a decrease in the voltage of the ignition anode such that it cannot ignite the main discharge path, whereas at a control voltage on the auxiliary cathode a little higher than the positive bias on the transfer cathode, the discharge passes to the latter and thence to the coupling cathode, the voltage of the coupling cathode as a result

of the high series-resistance increasing to such extent that the small current between the coupling cathode and the ignition anode is extinguished so that the voltage of the ignition anode increases to such extent that the main discharge path is ignited.

Consequently, in the device according to the invention, the main discharge path is ignited indirectly as a result of the passage from the auxiliary cathode via the transfer cathode to the coupling cathode.

In order that the invention may be readily carried into effect, it will now be described with reference to the accompanying drawing, given by way of example, in which

Fig. 1 shows a circuit diagram for a device according to the invention and, diagrammatically therein, a gaseous discharge tube, and

Figs. 2 and 3 are a perspective view and an elevation view, respectively, of the electrode system of a tube according to the invention.

In Fig. 1, the gaseous discharge tube is indicated by **1** and the main anode and main cathode by **2** and **3**, respectively. An auxiliary anode **4** and an auxiliary cathode **5** are provided between **2** and **3** at a distance from the main discharge path. The distance between the auxiliary discharge path and the main discharge path is sufficient to prevent the main discharge path from being ignited by the small auxiliary discharge current. A transfer cathode **6** is provided in the vicinity of the auxiliary discharge path and at that end thereof which is remote from the auxiliary discharge path there is provided a coupling cathode **7** and between this and the main cathode **3** an ignition anode **8** which extends into the main discharge path. The main cathode **3** is connected to earth, the main anode **2** being connected by way of a resistor of 33,000 ohms to the positive terminal **10** of a voltage source of 250 volts with respect to earth. The auxiliary anode **4** is also connected by way of a resistor **11** of 1 megohm to the positive terminal **10**. The auxiliary cathode **5** is earthed by way of a control-voltage source, which is not shown, but which is connected between terminals **12** and **13**. The transfer cathode **6** is connected to the positive terminal of a voltage source **14** having a value of 40 volts with respect to earth. A coupling cathode **7** is connected to earth by way of a resistor **15** of 680,000 ohms, the ignition anode **8** being connected to the terminal **10** by way of a resistor **16** of 20 megohms. Since the terminal **12** is connected by way of the inner resistance of the control-voltage source to the terminal **13**, a discharge occurs at point A between the auxiliary anode **4** and the auxiliary cathode **5**. This discharge cannot ignite the main discharge path. A further discharge current of very small value occurs between point B of the coupling cathode **7** and the ignition anode **8**. Said discharge current is about one tenth of the discharge current between the auxiliary anode and the auxiliary cathode, as a result of which the voltage of the coupling cathode exceeds earth potential by approximately 4 volts.

If with the aid of the control-voltage source the voltage of the auxiliary cathode **5** is chosen a little higher than 40 volts positive with respect to earth, the discharge of the auxiliary cathode **5** passes to the transfer cathode **6**. Owing to the transfer cathode **6** having a positive potential higher than that of the coupling cathode **7**, the auxiliary discharge passes between the auxiliary anode **4** and the coupling cathode **7**, the series-connected resistor **15** causing an increase in the potential of coupling cathode **7**, viz. up to about 40 volts positive with respect to earth, so that the small discharge between coupling cathode **7** and ignition anode **8** extinguishes, as a result of which the potential of the ignition anode **8** increases and the main discharge path is ignited at C.

In Figs. 2 and 3, the disc-shaped cathode 3 is at right angles to the axis of the tube and is supported by supporting wires 20 and 21, which extend through small glass tubes 22 and 23 to merge through a pressed glass bottom 24 into contact pins, of which the one which is shown is indicated by 25. The anode 2 is constituted by a rod which extends through a small glass tube 26 to the bottom 24 to merge also into a contact pin (not shown). The spacing between the ignition anode 8 and the cathode is smaller than the spacing between the main anode 2 and the cathode. The ignition anode 8 is supported by a wire 27 surrounded by a small glass tube 28 and merges into a contact pin 29. The ignition anode 8 comprises, in addition to the vertical part directed towards the cathode, a horizontal part which terminates in the vicinity of one end of the coupling cathode 7. The coupling cathode 7 is supported by a supporting wire 31, which merges into a contact pin 32, further support being provided by a wire 33 merging into a contact pin 34. The coupling cathode 7 has the shape of a stylated S, its lower end terminating in the vicinity of the transfer cathode 6, which consists of a bent wire and which is supported by a supporting wire 35. The active part of transfer cathode 6 is parallel to the axis of the tube. The auxiliary cathode also has a vertically active part 5 and is supported by a supporting wire 36 merging into a contact pin 37. The auxiliary anode 4 is at right angles to the axis of the tube, its supporting wire merging into the contact pin 29. The gas filling is composed of 50% of neon and 50% of argon at a pressure of 50 mms. of mercury column.

What is claimed is:

1. An arrangement comprising a cold cathode gaseous discharge tube; said tube comprising a main anode and a main cathode defining a main discharge path therebetween, an auxiliary anode and auxiliary cathode defining an auxiliary discharge path therebetween, said auxiliary discharge between said auxiliary anode and cathode being incapable of alone igniting said main discharge, a transfer cathode, coupling cathode and ignition anode being disposed in that order between said auxiliary and main discharge paths, said auxiliary anode being coupled to said transfer cathode and coupling cathode, said ignition anode being coupled to said coupling cathode and main cathode; means for maintaining the cathode electrodes at relatively low potentials and the anode electrodes at relatively high potentials and at which an auxiliary discharge is established between the auxiliary cathode and anode together with a small discharge between said ignition anode and coupling cathode; and means for introducing a control voltage in the vicinity of said auxiliary discharge path whereby the discharge is transferred to said coupling cathode by way of said transfer cathode thereby extinguishing the discharge between the coupling cathode and ignition anode and igniting the main discharge.

2. An arrangement comprising a cold cathode gaseous discharge tube; said tube comprising a main anode and a main cathode defining a main discharge path therebetween, an auxiliary anode and auxiliary cathode defining an auxiliary discharge path therebetween, said auxiliary discharge between said auxiliary anode and cathode being incapable of alone igniting said main discharge, a transfer cathode, coupling cathode and ignition anode being disposed in that order between said auxiliary and main discharge paths, said auxiliary anode being coupled to said transfer cathode and coupling cathode, said ignition anode being coupled to said coupling cathode and main cathode; means for maintaining the main cathode at a relatively low potential and the transfer cathode at a potential of some tens of volts positive relative to the main cathode, a first high resistance coupling the coupling cathode to the main cathode, a source of high positive voltage, a second high resistance coupling the auxiliary anode to said source, a third current-limiting resistance coupling said main anode to said source, a fourth very high resistance coupling the ignition anode to said source, and a control voltage source coupled between said auxiliary and main cathodes, said control source producing signal voltages slightly higher than the potential of said transfer cathode, whereby introduction of a control voltage causes the auxiliary discharge to be transferred to said coupling cathode by way of said transfer cathode thereby extinguishing a discharge between the coupling cathode and ignition anode thereby raising the potential of the ignition anode and igniting the main discharge.

3. An arrangement as claimed in claim 2 wherein the electrodes are adjusted at which the current between the coupling cathode and ignition anode is about one-tenth of the current between the auxiliary anode and cathode.

4. An arrangement as claimed in claim 2 wherein the main cathode is plate-shaped, and all the other electrodes are rod-shaped.

5. A cold cathode gaseous discharge tube comprising a main anode and a main cathode defining a main discharge path therebetween, an auxiliary anode and auxiliary cathode defining an auxiliary discharge path therebetween, said auxiliary discharge path being spaced from said main discharge path, a transfer cathode, coupling cathode and ignition anode being disposed in that order between said auxiliary and main discharge paths, said auxiliary anode being coupled discharge-wise to said transfer cathode and coupling cathode, said ignition anode being coupled discharge-wise to said coupling cathode and main cathode, said main cathode being plate-shaped and all of the other electrodes being rod-shaped, said electrodes being insulated apart within said tube.

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