Jan. 12, 1960 H. GAWEHN 2,921,236

ELECTRICAL DISCHARGE DEVICE

Filed Nov. 16, 1955

Fig.1

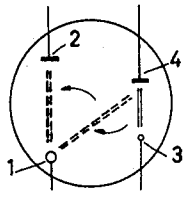
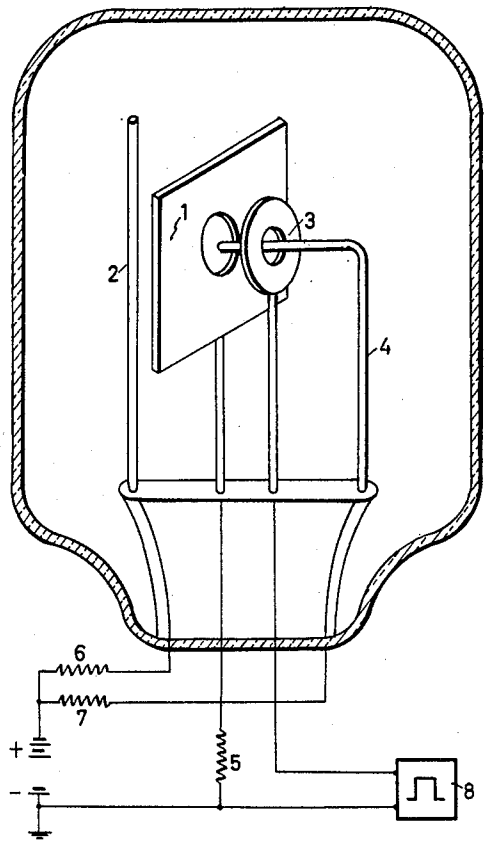


Fig.2



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United States Patent Office 2,921,236
Patented Jan. 12, 1960

2,921,236

ELECTRICAL DISCHARGE DEVICE

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Application November 16, 1955, Serial No. 547,251

Claims priority, application Germany December 23, 1954

7 Claims. (Cl. 315—168)

This invention is concerned with a gas- or vapor-filled electrical discharge device adapted for operation as a switching tube, comprising electrodes forming a main discharge path and one or more auxiliary discharge paths.

One of the essential features of the invention has to do with forming and arranging the discharge paths so as to provide for the starter electrode, particularly the starter anode, if desired by cooperation with exteriorly disposed switching means, an automatically operating bias which is effected by the firing voltage of an auxiliary discharge path.

It is already known in connection with such cold cathode switching tubes to bias a starter anode so that a relatively slight potential increase effects a starter discharge which ignites secondarily a main discharge. The sensitivity of such arrangement, that is, the magnitude of the potential increase required for the ignition is among others determined by the constancy of the bias voltage. Exacting requirements accordingly call for particular expenditures regarding electrical switching means for stabilizing the bias voltage.

The present invention accomplishes this object with simpler means, namely, by particular formation and arrangement of the electrodes within a corresponding tube. The required bias voltage is supplied by the potential of an auxiliary anode, by an auxiliary discharge which is among others also required for pre-ionization to prevent delay of firing, the firing of the main discharge path being effected by increase of the potential of the auxiliary anode.

In accordance with further objects and features of the invention, the firing voltage of the auxiliary discharge and therewith the potential at the auxiliary anode may be stabilized by conducting the current for the auxiliary anode over a resistor having a resistance which is so high that the auxiliary discharge operates with a normal cathode drop. The arrangement results in automatic stabilization of the bias voltage for the secondary discharge from the auxiliary anode to the main cathode which is required for the ignition or firing of the main discharge. Since the firing voltage is in such a discharge practically constant, it is not necessary to effect the potential increase of the auxiliary anode, required for the ignition, directly at such anode; the same result may be accomplished by increasing the potential of the auxiliary cathode.

The above-indicated operations may be effected in different ways. For example, it is possible to control in known manner a starter anode for the main discharge path as an independent electrode by the potential of an auxiliary anode, for example, by galvanically connecting these two electrodes within or outside of the corresponding tube. It is also in particularly simple manner possible to use the auxiliary anode by particular spatial disposition as a starter anode for the main discharge path.

The invention will now be explained with reference to the accompanying diagrammatic drawing, in which—

Fig. 1 shows in purely schematic manner elements of a glow discharge tube, all exterior switching means being for simplicity omitted; and

Fig. 2 shows in schematic manner an arrangement in which the auxiliary anode is by particular spatial disposition used to operate as a starter anode for the main discharge.

The thoughts underlying the invention will be first explained with reference to Fig. 1.

A cathode 1 and cooperating anode 2 define a space across which the main discharge is to be effected, and an auxiliary cathode 3 and cooperating auxiliary anode 4 define a space across which the auxiliary discharge is to be effected. The space between the cathode 1 and anode 2 exceeds the space provided between the auxiliary cathode 3 and auxiliary anode 4, the latter electrodes being closer together, so that the corresponding ignition voltage can be held at a minimum. Now, assuming an active auxiliary discharge between 3 and 4, and further assuming that the potential at the auxiliary anode 4 is in some way increased, there will occur a secondary discharge from the auxiliary anode 4 to the main cathode 1. The main discharge between the main anode 2 and the cathode 1 is triggered by the pre-ionization resulting from the secondary discharge between the auxiliary anode and the main cathode as in part indicated by the dash lines and the corresponding arrows.

Fig. 2 shows, as has been indicated before, an arrangement in which the auxiliary anode 4 is spatially arranged so as to act also as the starter anode for the main discharge path. Only the essential parts of the arrangement are shown in simplified schematic representation. The various parts corresponding to those shown in Fig. 1 are indicated in Fig. 2 by identical reference numerals.

The main cathode 1 and the auxiliary cathode 3 of the corresponding switching tube are respectively connected by way of a resistor 5 and an impulse transmitter 8 to the negative preferably grounded terminal of a suitable current source whose positive terminal is connected over resistors 6 and 7 with the two anodes, namely, the main anode 2 and the auxiliary anode 4, respectively. The voltage of the current source is such that only the auxiliary discharge path between the electrodes 3 and 4 is active, and the magnitude of the resistor 7 is such that the auxiliary discharge operates with little current, but with a fully developed normal cathode drop, for example with 100 μA.

Now, if a positive voltage pulse from the impulse transmitter 8 is conducted to the auxiliary cathode 3, the potential of the auxiliary anode 4 is likewise increased due to the constancy of the operating voltage of the auxiliary discharge, causing a reduction in current of the stabilized discharge, a voltage drop at the resistor 7, and an increase in the voltage of the auxiliary anode 4 with respect to the main cathode 1, whereupon the secondary discharge between the auxiliary anode 4 and the main cathode 1 is ignited.

The spatial disposition of the two anodes, namely, at different sides of the main cathode is in the arrangement advantageous because the main cathode separates the main discharge space from the auxiliary discharge space. Both discharge spaces are however electrically coupled together by a hole in the main cathode so that the ignition of the main discharge can take place.

The sensitivity of the described arrangement increases as the auxiliary discharge is brought more proximate to the main cathode, rendering it possible to make the firing or ignition voltage of the secondary discharge only a few volts higher than the operating voltage of the auxiliary discharge path.

In order to avoid in such arrangement formation of the auxiliary discharge between the auxiliary anode 4 and the main cathode 1 immediately upon connection of the op-

erating voltage, or persistence thereof at the main cathode upon extinguishing of the main discharge, it is in accordance with the invention advisable to make the smallest spacing between the auxiliary anode 4 and the main cathode 1 greater than the spacing between the auxiliary anode 4 and the auxiliary cathode 3. Substantially the same effect may however be obtained by corresponding dimensioning of the resistor 5 disposed in the cathode circuit or by providing for a higher potential of the main cathode as compared with that of the auxiliary cathode.

The above discussed embodiments have to do exclusively with arrangements comprising two distinct cathodes. It is however also possible to use a common particularly shaped cathode and to provide thereon separate operating points for the individual discharge paths. It is possible by a particular configuration of the corresponding electrodes to obtain with favorable electrical coupling of the individual discharge paths and sufficient spatial separation a satisfactory control sensitivity without danger of producing an undesired ignition of the main discharge path.

Changes may be made within the scope and spirit of the appended claims.

I claim:

1. A gaseous discharge tube circuit comprising a main cathode and a main anode cooperating therewith to define a space across which a main discharge is to be effected, an auxiliary cathode and an auxiliary anode cooperating therewith to define a space across which a continuously active auxiliary discharge is effected, first circuit means for placing said anodes on a predetermined potential, second circuit means for placing said main cathode on a predetermined different potential, third circuit means for placing said auxiliary cathode on the same different potential as said main cathode, and means for increasing the potential on said auxiliary cathode to effect a discharge between the main cathode and auxiliary anode to ignite the main discharge between said main cathode and said main anode.

2. A gaseous discharge tube comprising an apertured main cathode and an apertured auxiliary cathode disposed spaced therefrom on one side thereof, a main anode disposed spaced from said main cathode on the other side thereof, an auxiliary anode extending through the aperture in said auxiliary cathode and terminating in the vicinity of the aperture formed in said main cathode, first switching means for causing an auxiliary discharge between said auxiliary cathode and cooperating auxiliary anode, and second switching means for raising the potential of said auxiliary discharge to initiate a main discharge between said main cathode and cooperating main anode, said auxiliary anode functioning as a starter electrode for said main discharge.

3. A gaseous discharge tube circuit comprising a tube having a main anode, an unheated main cathode spaced from said main anode and defining therewith a gap across which a main discharge is to be effected; an auxiliary cathode and an auxiliary anode spaced therefrom and defining a gap across which a continuously active glow discharge is to be effected; said auxiliary anode defining a gap with said main cathode across which a secondary discharge is to be effected; a voltage source connected to said auxiliary anode and cathode effecting said glow discharge; means controlling bias on said auxiliary anode at a value automatically determined and stabilized by the voltage producing said glow discharge; and circuit means maintaining substantially equal potential values on said cathodes prior to initiation of said main discharge.

4. A gaseous discharge tube circuit according to claim 3 comprising means for increasing the potential on said auxiliary anode to trigger the ignition of said main discharge.

5. A gaseous discharge tube circuit according to claim 4 comprising circuit means including a resistor for conducting current to said auxiliary anode, said resistor having a value effecting auxiliary glow discharge with substantially normal cathode drop.

6. A gaseous discharge tube circuit according to claim 3 comprising means for interconnecting said cathodes.

7. A gaseous discharge tube circuit according to claim 3 wherein said main cathode contains an opening exposing said main discharge gap to said glow discharge.

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