Nov. 20, 1951 M. A. TOWNSEND 2,575,372

COLD CATHODE GASEOUS DISCHARGE DEVICE

Filed Aug. 9, 1949

FIG. 1

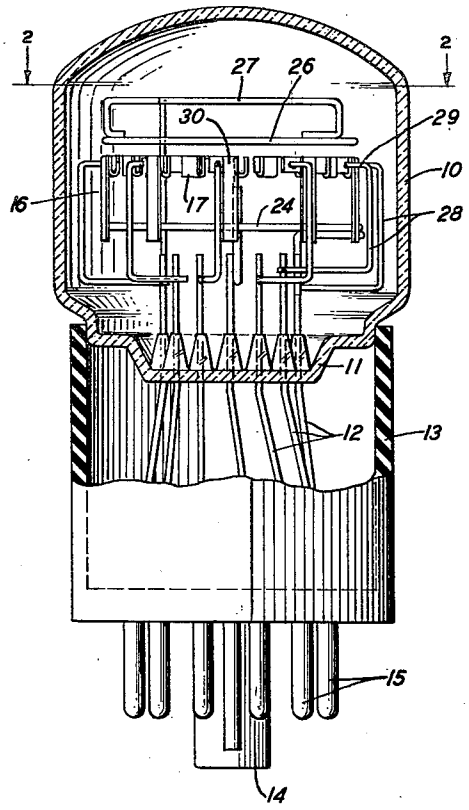


FIG. 2

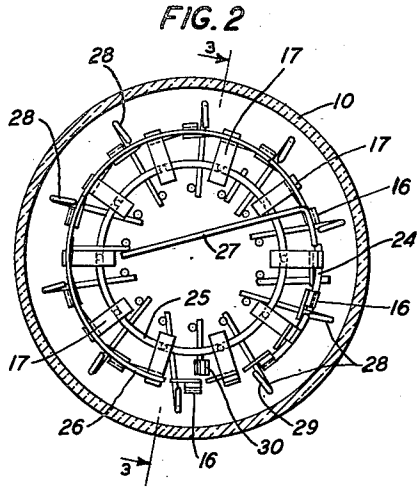


FIG. 4

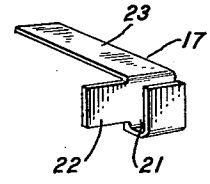


FIG. 5

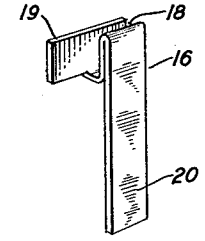


FIG. 3

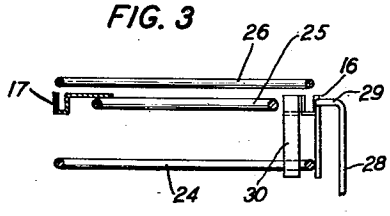
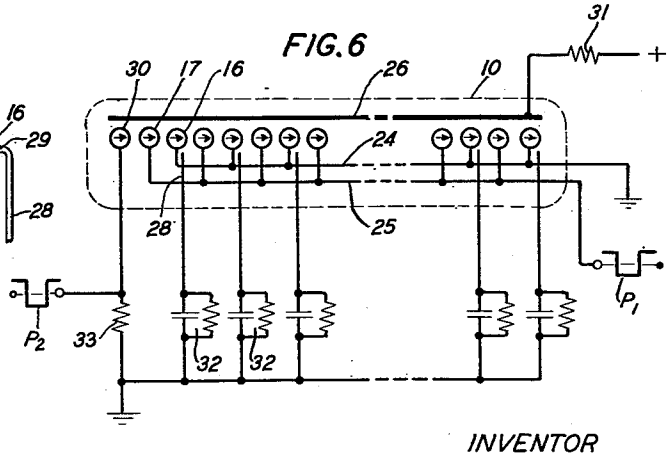


FIG. 6



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COLD CATHODE GASEOUS DISCHARGE DEVICE

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Application August 9, 1949, Serial No. 109,338

6 Claims. (Cl. 313—182)

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This invention relates to gaseous discharge devices and more particularly to multicathode glow discharge devices of the general type disclosed in the application, Serial No. 101,322 filed June 25, 1949, of M. A. Townsend.

Devices of the general type disclosed in the application above-identified comprise, in one form, a plurality of cathodes mounted in a row, for example, circular, linear or of other geometrical form, and an anode in cooperative relation with the cathodes, the latter being constructed and arranged so that in response to signal pulses applied to certain of the cathodes the anode-to-cathode discharge is stepped along the row of cathodes, advancing one position for each applied pulse. Individual load circuits may be connected directly to certain of the cathodes.

One general object of this invention is to facilitate the association of a multiplicity of load circuits with a device of this general type. More specifically, one object of this invention is to enable the attainment of a plurality of high voltage low current output signals for such device suitable for controlling a multiplicity of individual load circuits.

In accordance with one feature of this invention, in a multicathode device of the type hereinabove described, a plurality of auxiliary or probe electrodes are provided, each being positioned adjacent a respective one of the cathodes so that when the discharge occurs at one of these cathodes the potential of the auxiliary or probe electrode thereadjacent assumes a value substantially equal to that of the anode and a corresponding pulse or signal is produced in the output or load circuit coupled to that auxiliary or probe electrode.

The invention and the above-noted and other features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing, in which:

Fig. 1 is an elevational view of a multicathode glow discharge device illustrative of one embodiment of this invention, a portion of the enclosing vessel and of the base being broken away to show the internal structure more clearly;

Fig. 2 is a view in section taken along plane 2—2 of Fig. 1;

Fig. 3 is a fragmentary detail view in section taken along line 3—3 of Fig. 2;

Figs. 4 and 5 are detail perspective views showing the construction of certain of the cathodes in the device illustrated in Fig. 1; and

Fig. 6 is a circuit schematic illustrating one manner in which the device of Fig. 1 may be utilized.

Referring now to the drawing, the device illustrated in Fig. 1 comprises a vitreous enclosing vessel or envelope 10 having therein an ionizable atmosphere, for example neon or hydrogen, and

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having a dished stem 11 in which a plurality of leading-in conductors 12 are sealed. The vessel 10 is affixed to an insulating base 13, which may be of conventional construction and mounts a positioning stud 14 and a plurality of terminal prongs 15 to each of which a respective one of the leading-in conductors 12 is connected.

Mounted within the vessel are a plurality of cathodes 16, hereinafter referred to as A cathodes, and a second plurality of cathodes 17, hereinafter referred to as B cathodes, which are positioned in circular array with each A cathode interposed between two B cathodes. Each of the A cathodes, as illustrated in Fig. 5, comprises a channel-shaped portion 18, a plane tail portion 19 extending from the channel portion 18 and a mounting portion 20. Similarly, as illustrated in Fig. 4, each of the B cathodes 17 comprises a channel portion 21, a plane tail portion 22 and a mounting portion 23. The cathodes may be formed of sheet refractory metal, such, for example, as molybdenum or columbium.

As illustrated most clearly in Fig. 2, the A and B cathodes are mounted with the tail portion 19 or 22 of each in juxtaposition to the channel portion 18 or 21 of the next preceding cathode viewed clockwise. The mounting portions 20 of the A cathodes are affixed, as by welding, to a metallic support ring 24 which is mounted by one of the leading-in conductors 12. The mounting portions 23 of the B cathodes 17 are affixed, as by welding, to a second mounting ring 25 which also is supported by one of the leading-in conductors 12. Overlying all of the A and B cathodes and coaxial therewith is an annular anode 26 which is supported from one of the leading-in conductors 12 by a metallic bridge piece 27.

Adjacent one of the B cathodes, as illustrated most clearly in Figs. 2 and 3, is a normal or reset cathode 30 which has a channel-shaped portion in proximity to the tail portion 22 of the B cathode nearest thereto.

The device comprises also a plurality of auxiliary or probe electrodes 28, for example constructed of wire, each having a bent end portion 29 extending into juxtaposition to one end of the channel portion 18 of a respective A cathode. Each of the auxiliary or probe electrodes 28 is connected to a respective one of the leading-in conductors 12 whereby it may be associated with an individual output or load circuit.

The general manner of operation of the device is illustrated in Fig. 6. The A cathodes 16 are connected together electrically by the ring 24 and grounded, as shown. The B cathodes 17 are similarly connected together electrically by the ring member 25 and are connected to an input circuit for applying pulses of the general form indicated at P_1 to these cathodes. The anode 26 is maintained positive with respect to the A and B cathodes by a suitable source to which it is

connected through a resistor 31. Individual load or output circuits 32, indicated as resistance-condenser combinations in Fig. 6, are coupled to the auxiliary or probe electrodes 28. The reset or normal cathode 30 is connected to ground over a resistor 33 and to a suitable source for applying a negative pulse of the general form illustrated at P_2 thereto.

In the operation of the device, in response to the application of a pulse P_2, a discharge is initiated between the normal or reset cathode 30 and the anode, and input pulses P_1 are applied to the B cathodes 17. As described in detail in the application heretofore identified, because of the construction of the A and B cathodes, specifically, inasmuch as the channel portions are more efficient as glow emission elements than the tail portions, the discharge between any one of them and the anode is localized or concentrated at the channel portion 18 or 21 and, therefore, the tail portion 19 or 22 of the next succeeding cathode, viewed counter-clockwise, is adjacent a region of high ionization density at the next preceding cathode. Thus, in response to input pulses P_1, the discharge is stepped from one cathode to the next, specifically from each cathode to the next succeeding cathode. The direction of the stepping of the discharge is indicated by the arrows in Fig. 6. Specifically, in response to the first pulse P_1, assuming that the discharge is at the normal or reset cathode 30, the discharge first transfers to the B cathode 17 nearest the cathode 30 and upon cessation of the pulse transfers to the next succeeding A cathode. In response to the next succeeding pulse, the discharge transfers first to the next succeeding B cathode and then upon cessation of the pulse to the next succeeding A cathode. In other words, in response to a series of pulses P_1, the discharge is stepped from the normal cathode 30 to the A cathode following it and thence to successive A cathodes advancing from each A cathode to the next succeeding one for each pulse. In the interval between pulses, the discharge remains at the cathode 16 to which it is stepped. Thus, a discharge may be established between any of the A cathodes 16 and the anode by applying an appropriate number of pulses P_1 to the B cathodes.

When a discharge obtains between any A cathode and the anode 26, the auxiliary or probe electrode 28 adjacent this cathode assumes a potential somewhat below that of the anode 26 whereby a low current, high voltage signal is produced across the load circuit 32 connected to that auxiliary or probe electrode. The potential of the auxiliary or probe electrodes remote from the cathode at which the discharge obtains is so small as to be negligible.

Advantageously, the resistors 32 are very large in comparison to the resistor 31. In a particular and illustrative case, the resistor 31 may be of the order of 20,000 ohms and the resistors in the load circuits 32 may be of the order of one megohm.

When a discharge is at any of the A cathodes it may be returned to the normal or reset cathode 30 by application of a strong negative pulse P_2 across the reset resistor 33.

Although specific embodiments of this invention have been shown and described, it will be understood that they are but illustrative and that various modifications may be made therein without departing from the scope and spirit of this invention.

What is claimed is:

1. A gaseous discharge device comprising a row of cathodes, an anode opposite said cathodes, means for initiating a discharge between one of said cathodes and said anode, means for stepping the discharge from cathode to cathode along the row of cathodes, and a plurality of output electrodes each adjacent a respective one of said cathodes.

2. A gaseous discharge device comprising a plurality of cathodes, an anode opposite said cathodes, each of said cathodes having two portions of different efficiency as glow discharge elements and said cathodes being mounted in a row with the more efficient portion of each opposite the less efficient portion of the next succeeding cathode, and a plurality of output electrodes each laterally adjacent a respective one of said cathodes.

3. A gaseous discharge device comprising a plurality of cathodes, an anode opposite said cathodes, each of said cathodes having two portions of different efficiency as glow discharge elements and said cathodes being mounted in a row with the more efficient portion of each opposite the less efficient portion of the next succeeding cathode, and a plurality of output electrodes each having a rod-like portion adjacent and extending toward a respective one of said cathodes.

4. A gaseous discharge device comprising a plurality of cathodes, an anode opposite said cathodes, each of said cathodes having a channel portion and a tail portion and said cathodes being mounted in a row with the channel portion of each opposite the tail portion of the next succeeding cathode, and a plurality of output electrodes each having a rod-like portion in proximity to a respective one of said cathodes.

5. A gaseous discharge device comprising a plurality of cathodes, each of said cathodes having two portions of different efficiency as glow discharge elements and said cathodes being mounted in a row with the portion of higher efficiency of each in juxtaposition to the portion of lower efficiency of the next succeeding cathode, means electrically connecting one group of alternate cathodes together, means electrically connecting the other alternate cathodes together, an anode opposite said cathodes, and a plurality of output electrodes each adjacent a respective one of said other alternate cathodes.

6. A gaseous discharge device comprising a plurality of cathodes each having a channel portion and a tail portion, said cathodes being mounted in a row with the channel portion of each in juxtaposition to the tail portion of the next succeeding cathode, an anode opposite said cathodes, means electrically connecting alternate cathodes together in two groups, and a plurality of auxiliary electrodes each having a rod-like portion in proximity to a respective cathode of one of said groups.

MARK A. TOWNSEND.

REFERENCES CITED

The following references are of record in the file of this patent:

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