April 22, 1947. J. R. DESCH ET AL 2,419,485

ELECTRONIC DEVICE

Filed June 3, 1943

FIG. 1

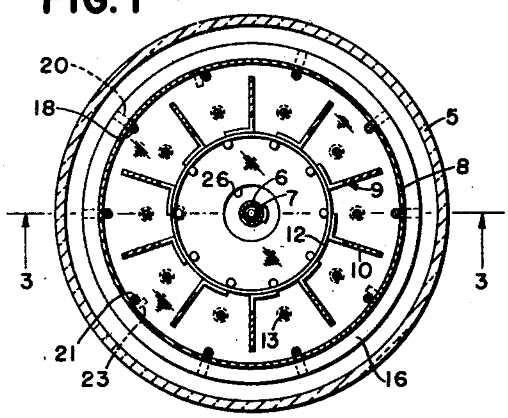


FIG. 2

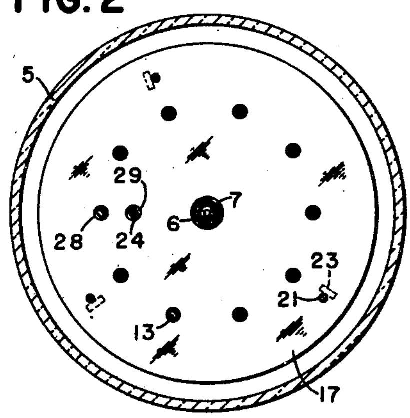


FIG. 3

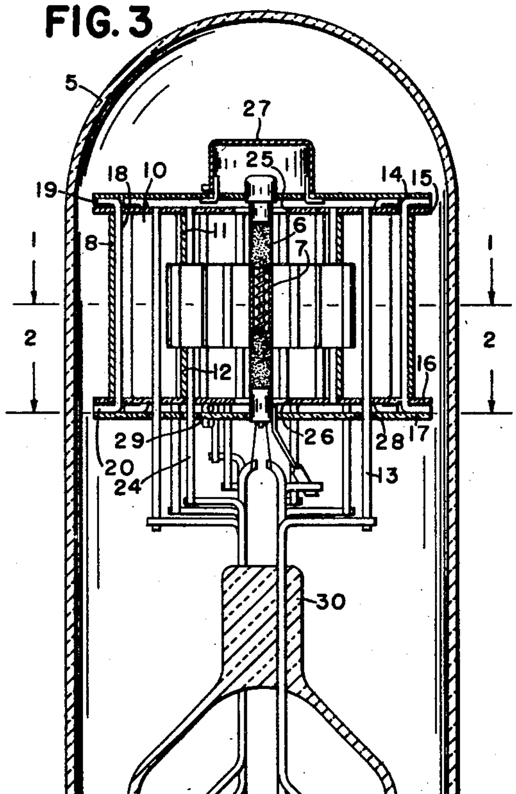
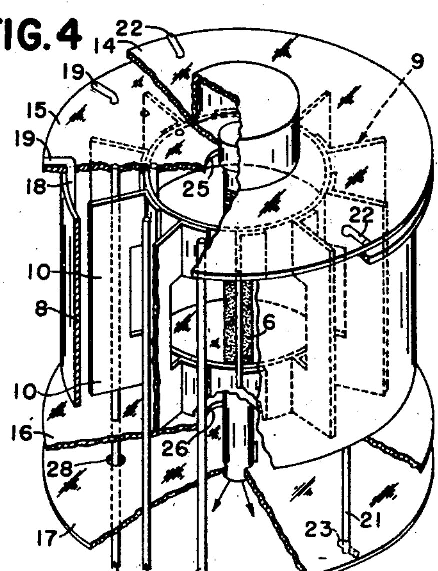


FIG. 4



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ELECTRONIC DEVICE

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4 Claims. (Cl. 250—27.5)

1

This invention relates to gaseous electron discharge devices and in particular to a novel gaseous electron device which is the equivalent of a plurality of individual tubes which might be rendered conducting separately or in combination.

The novel discharge device has an electrode arrangement which enables a plurality of separate discharge paths to be obtained in an ionizable medium in a single envelope, any of which discharge paths may be rendered conducting when proper potentials are applied to the electrodes associated with these paths. The electron discharge device consists of a central heated cathode, a cylindrical anode surrounding the cathode, a shielding element or electrode located between the cathode and the anode and dividing the gaseous medium between the cathode and the anode into a plurality of sections or cathode-anode discharge paths, and a separate control electrode in each discharge path which can control whether or not conduction will take place in that path. The shielding element may also serve as a common control electrode which may be used with the other control electrodes to control conduction in the various discharge paths. Upper and lower disks or shields of electrically-non-conducting material, such as mica, are provided to assist the shielding element to define the various discharge paths.

The electrodes are connected to the upper and lower shields to form a unit which is supported in the gaseous medium within the envelope by means of conductors which extend from the electrodes through the press of the stem of the envelope and enable the electrodes to be connected in external circuits for control thereby. In the novel construction, a pair of spaced upper shields and a pair of spaced lower shields are provided to enable the cathode to be isolated from the other electrodes to prevent any leakage from occurring between the cathode and the other electrodes along the upper and lower shields.

In one mode of operation of the device, an operating potential is placed across the anode and the cathode, and the shielding element or common control electrode and the separate control electrodes in each of the discharge paths are given potentials which are sufficiently negative with respect to the cathode that they will prevent conduction from occurring in the various discharge paths. In order to cause conduction in any of the paths, the potential on the separate control electrode in that path is changed from a negative potential to a positive potential to prime that path for conduction, but, while the change in potential will prime the path for conduction, conduction will not occur at this time, due to the negative potential on the shielding element or common control electrode. After the selected discharge paths have been primed, the negative potential on the shielding element or common control electrode is reduced to a value which will be effective to cause a discharge to occur in any path which has been primed or has its separate control electrode at a positive potential, but will be ineffective to cause conduction to occur in any discharge path in which the separate control electrode has a negative potential.

2

Since the shielding element or common control electrode and the separate control electrodes cooperate to cause the conduction to occur in any desired path, the tube may be operated by raising the potential of the shielding element or common control electrode from its normal blocking potential to substantially that of the cathode to thereby prime all the sections or discharge paths and then raising the potential of the separate control electrode of any desired path or paths to cause conduction to begin therein.

As explained above, one anode and one cathode serve for the various discharge paths in the single envelope, so that, when any discharge path becomes conducting, it will be effective, if any resistance is in the anode-cathode potential supply circuit, to cause the potential between the anode and the cathode to drop to such a value that any other discharge path will be prevented from becoming conducting even though the separate control electrodes or the shielding element or common control electrode might have the negative blocking potential removed therefrom.

The electron discharge device is capable of replacing a plurality of separate electron discharge devices or tubes. One of the uses of the novel device is to represent and store data by selectively rendering the discharge paths conducting; for instance, each discharge path in the device may be assigned to represent a digit or other symbol and be effective, when conducting, to provide a continuous representation of that digit or symbol as long as conduction continues in that path. The novel device may also be used as a selective switching device or to provide selective controls for other devices.

It is an object, therefore, to provide a novel gaseous electron discharge device having a plurality of separately operable discharge paths therein.

Another object of the invention is to provide a novel gaseous electron discharge device having a plurality of separate and distinct electron discharge paths between a single anode and a single cathode in a single gaseous medium.

Another object of the invention is to provide a novel gaseous electron discharge device having a plurality of separate and distinct electron discharge paths between a single anode and a single cathode and having a separate control electrode associated with each discharge path for selecting its associated discharge path for conduction therein and a common control electrode associated with all the paths, the separate and common control electrodes being effective to prime and to initiate conduction in any selected discharge path.

Another object of the invention is to provide a novel arrangement of electrodes in an electron discharge device to obtain a plurality of separate discharge paths in a common gaseous medium included in a single envelope and to provide a novel method of mounting the electrodes whereby undesirable leakage between electrodes is eliminated.

With these and incidental objects in view, the invention includes certain novel features of construction and combinations of parts, the essential elements of which are set forth in appended claims and a preferred form or embodiment of which is hereinafter described with reference to the drawing which accompanies and forms a part of this specification.

In the drawing:

Fig. 1 is a section through the electron discharge device, taken along the line 1—1 in Fig. 3.

Fig. 2 is a section through the electron discharge device, taken along the line 2—2 in Fig. 3.

Fig. 3 is a section through the electron discharge device, taken along the line 3—3 in Fig. 1.

Fig. 4 is a perspective view of the electrode assembly and shields, with certain parts broken away to show other parts more clearly.

Description

The electron discharge device described herein to illustrate the invention is arranged to have ten separate discharge paths therein, but it is obvious that this number of discharge paths may be increased or decreased, if desired, without departing from the invention.

The novel electron discharge device herein disclosed is included within a glass envelope 5 (Figs. 1, 2, and 3), which is filled with one of the ionizable inert gases to cause a typical gas discharge between a cathode and an anode when proper operating potentials are applied thereto and when proper controls are exerted on the device.

The cathode 6 is formed as a hollow cylinder and is heated by a filament 7, which occupies a position within the cathode. Surrounding the cathode 6 and spaced equidistantly therefrom at all points is a cylindrical anode 8. The space between the cathode 6 and the anode 8 is divided into ten sections or discharge paths by a shielding element, shown generally at 9, which is formed by connecting ten radial separators or fins 10 equidistantly about upper and lower annular members 11 and 12. Each of the sections or discharge paths within the envelope 5 has a rod-like control electrode 13 located therein, which control electrode is effective to control the discharge in the particular discharge path in which it is located.

The various electrodes are held in proper spaced relation to one another by a pair of upper shields 14 and 15 and a pair of lower shields 16 and 17, which are made of electrically-non-conducting material, such as mica, and which, in addition to holding the electrodes in proper spaced relation, also assist the shielding element 9 to define the various sections or discharge paths.

The anode 8 is held in position by a plurality of rods, certain of which, as shown at 18, extend through the inner upper and lower shields 15 and 16 and are bent over as at 19 and 20 to connect these shields and the anode 8 into a unit, and others of which, as 21, extend through both upper and both lower shields and are bent over as at 22 and secured as at 23 to provide for the fastening of the outer upper and lower shields 14 and 17 to the unit formed by the anode and the inner upper and lower shields. The bent-over portions 19 and 20 of the rods 18 are effective to space the upper two shields and the lower two shields.

The shielding element 9 is fastened to the inner pair of shields 15 and 16 by a plurality of rods 24, which extend into these shields. The control electrodes 13 are also secured in the inner upper and lower shields.

Thus it is seen that the anode 8, the shielding element 9, and the control electrodes 13 are secured to the inner shields 15 and 16 to form a unit to which the outer shields 14 and 17 are fastened by certain of the rods, as 21, which hold the anode in place.

The cathode 6 extends through openings 25 and 26, respectively, in the shields 15 and 16 and is secured to the outer upper and lower shields 14 and 17. A cup-shaped member 27 is carried by the upper shield 14 and extends over the cathode 6 to assist in confining the ionization to the space between the cathode 6, the anode 8, and the upper and lower shields 15 and 16.

The lower outer shield 17 has openings, as 28, through which the control electrodes 13 may extend without touching the lower outer shield, and an opening 29, through which one of the rods 24, which fasten the shielding element 9 in place, may extend.

Accordingly, it is seen that the cathode 6 is supported by the outer upper and lower shields 14 and 17, while the anode 8, the shielding element 9, and the control electrodes 13 are supported by the inner shields 15 and 16. This construction isolates the cathode from the anode, the shielding element, and the control electrodes and eliminates leakage between the cathode and these parts which might occur along the upper and lower shields.

The control electrodes 13, the rod 24 which extends through the lower shield from the shielding element 9, one of the rods 21 which extends through the lower shield from the anode 8, the cathode 6, and the filament 7 are connected to conductors which are sealed in the press 30 of the stem of the envelope 5. The conductors support the electrode and the shield unit within the envelope and provide connections whereby the electron discharge device may be connected in a circuit for operation.

To illustrate some of the ways in which the novel electron discharge device may operate, its use to represent and store data will be considered. A digit value is assigned to each of the separate discharge paths, and the operating condition of the discharge device will represent any digit when the discharge path corresponding to that digit is conducting. Conductivity in any discharge path may be controlled by the control electrodes 13 alone or in combination with the shielding element 9.

In the operation of the novel device, the cathode may be connected to ground over a resistor, and a positive potential, sufficient to cause ionization in any of the paths, may be applied to the electrode. A sufficient negative bias is applied to the control electrodes 13 in the various discharge paths to prevent the ionization of the gas in these discharge paths, and a negative potential sufficient to prevent conduction may be applied to the shielding element 9, or the shielding element 9 may be at cathode potential, depending upon the particular controls desired and the environment in which the tube is used.

When a negative blocking potential is given to the shielding element 9, conduction in any discharge path will be prevented until this negative potential is reduced, even though the negative potential of any of the control electrodes 13 has been reduced below the critical firing point. Under these conditions, the potential of control electrode 13 in the path corresponding to the digit to be stored is changed from a negative potential to a positive potential, and, when the negative blocking potential of the shielding element 9 is reduced, the path which has been primed by having its control electrode at positive potential will fire and become conducting, but all other discharge paths will be prevented from firing by the negative potential on the control electrodes in these paths.

The above controls may be reversed by raising the potential of the shielding element 9 to prime the discharge paths and thereafter raising the potential of a selected control electrode 13 to cause that particular path to become conducting.

When the electron discharge device is used with the shielding element 9 at cathode potential, the selective firing of any discharge path may be effected by raising the potential of the control electrode 13 of the selected path above the critical or firing potential.

After any discharge path has been rendered conducting, it will continue to conduct and represent the particular digit value until the discharge in the path is extinguished by any of the well-known methods used to extinguish conduction in gaseous electron discharge devices.

While the form of the invention herein shown and described is admirably adapted to fulfill the objects primarily stated, it is to be understood that it is not intended to confine the invention to the one form or embodiment herein disclosed, for it is susceptible of embodiment in various forms all coming within the scope of the claims which follow.

What is claimed is:

1. An electron discharge device capable of selective discharge in any of a plurality of discrete discharge paths, said discharge device consisting of a single envelope filled with an ionizable medium and containing a cathode; a cylindrical anode surrounding the cathode and equidistant therefrom at all points; a shielding element surrounding the cathode and having a plurality of radial fins to divide the ionizable medium between the anode and the cathode into a plurality of discrete cathode-anode discharge paths, said shielding element being a conductor of electricity and being capable of use as an electrode; a plurality of rod-like control electrodes, one control electrode being associated with each discharge path to control conduction therein; means to support the cathode within the envelope and upper and lower shielding means of electrically-non-conducting material for supporting the anode, the shielding element, and the control electrodes and cooperating with the shielding element to further define the discharge paths.

2. An electron discharge device consisting of an envelope having therein an ionizable medium; a cathode; a cylindrical anode surrounding the cathode and equidistant therefrom at all points; a shielding member surrounding the cathode and dividing the ionizable medium between the anode and the cathode into a plurality of discrete discharge paths; a control electrode located in each discharge path; a first pair of electrically-non-conducting disks, one of which is secured to the upper end and the other of which is secured to the lower end of the anode and to which the shielding element and the control electrodes are secured; and a second pair of electrically-non-ducting disks fastened to the first pair of disks, one above and one below and in spaced relation thereto, said cathode being fastened to the second pair of disks and extending through apertures in the first pair of disks, the mounting of the cathode in the pair of disks separate from the disks supporting the other electrodes being effective to prevent leakage from occurring between the cathode and the other electrodes along the disks.

3. An electron discharge device consisting of an envelope having therein an ionizable medium; a cathode; a cylindrical anode surrounding the cathode and equidistant therefrom at all points; a shielding element surrounding the cathode and dividing the ionizable medium between the anode and the cathode into a plurality of discrete discharge paths; a control electrode located in each discharge path; a first pair of mica disks, one of which is secured to the upper end and the other of which is secured to the lower end of the anode and to which the shielding element and the control electrodes are secured; and a second pair of mica disks fastened at points adjacent the circumference thereof to the first pair of disks, one above and one below and in spaced relation thereto, said cathode being fastened to the second pair of disks and extending through apertures in the first pair of disks, the mounting of the cathode in the pair of disks separate from the disks supporting the other electrodes being effective to prevent leakage from occurring between the cathode and the other electrodes along the disks.

4. A gas-filled electron discharge device having a cathode; an anode spaced therefrom; a shielding element located between the cathode and the anode and dividing the space between the cathode and the anode into a plurality of separate cathode-anode discharge paths so that conduction in any path will be confined to that path; a control electrode located in each discharge path to control conduction in its particular path; means for supporting the cathode in proper position in the device; and an additional means for supporting the anode, the shielding element, and the plurality of control electrodes in proper spaced relation to each other and to the cath-

ode; the supporting of the cathode separately from the other electrodes being effective to prevent leakage between the cathode and the other electrodes from occurring along the supporting means.

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