April 23, 1946. J. H. CONE ET AL 2,398,772

ELECTRON TUBE

Filed Oct. 10, 1940

FIG. 1

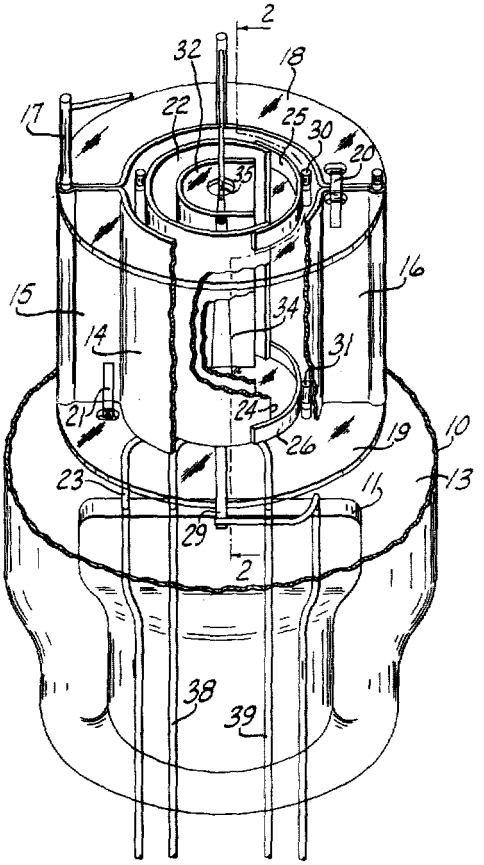


FIG. 2

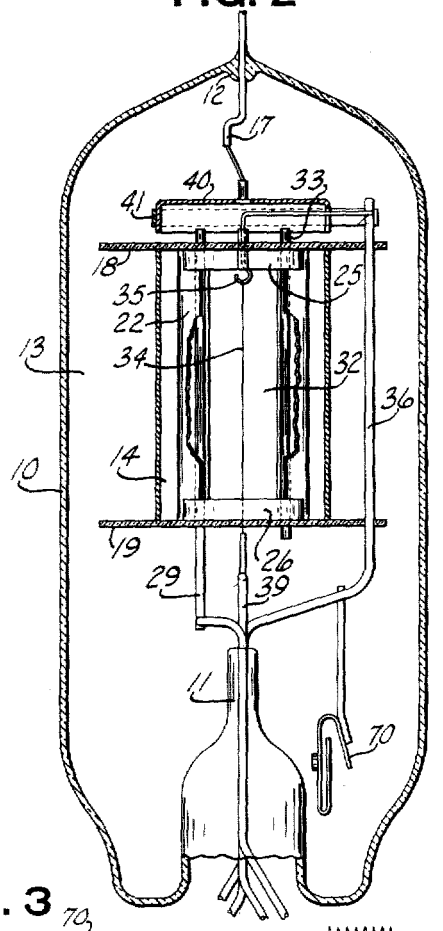
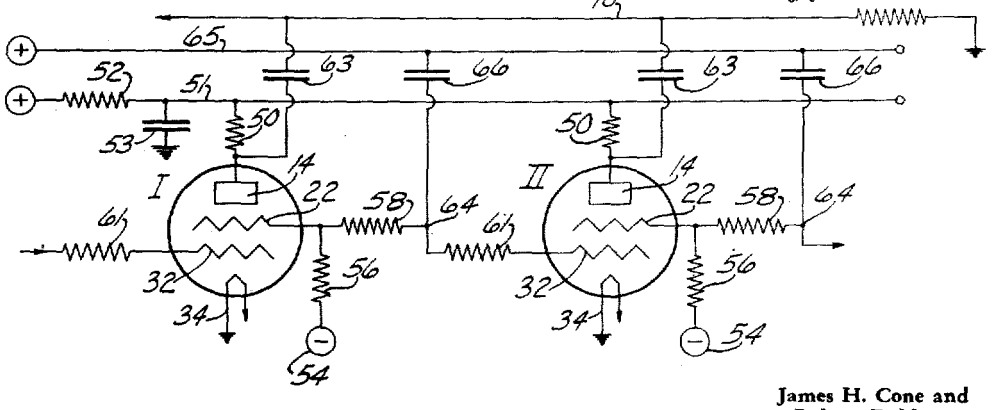


FIG. 3



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UNITED STATES PATENT OFFICE

2,398,772

ELECTRON TUBE

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Application October 10, 1940, Serial No. 360,584

2 Claims. (Cl. 250—27.5)

This invention relates to an electron gas discharge device and more specifically pertains to one in which a current tapping member is provided for collecting and utilizing the positive charges existing in the conducting gaseous medium.

In introducing a current tapping member into an electron gas discharge tube for the collection of positive charges, it is desirable to give it a negative potential, that it may attract a greater number of positive charges. It is also desirable to keep the negative charge on the current tapping member from preventing a discharge in the tube. When a negatively biased grid is used to control the discharge in such a tube, it is desirable that the critical potential of the control grid be in the negative region and yet that the negatively charged current tapping member be positioned in the region of greatest conductivity.

Therefore, it is the principal object of this invention to provide a grid-controlled gas discharge electron tube having a current tapping member for collecting positive charges from the conducting gas.

Another object of the invention is to provide such a tube wherein the current tapping member is given a normal negative potential which is to be reduced by the collection of positive charges when the tube is conducting.

Another object of the invention is to provide such an electron tube wherein a negatively biased control grid has a negative critical point.

Another object of the invention is to provide such an electron tube wherein the negatively charged current tapping member is in the region of greatest conductivity but does not assume complete control of the discharge.

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.

Of said drawing.

Fig. 1 is a perspective view of the tube with the envelope and other parts broken away.

Fig. 2 is a section through the tube on the line 2—2 of Fig. 1.

Fig. 3 is a circuit utilizing the novel tube.

The tube comprises a gas-tight envelope 10 (Figs. 1 and 2)—for instance, glass—containing a press 11, a seal 12, and a gaseous medium 13—for instance, one of the rare inert gases exemplified by neon and argon, or mercury vapor.

A cylindrical anode 14, having longitudinal fins 15 and 16, is supported in the envelope between two mica insulating discs 18 and 19, to which the anode is fastened by clips, the top disc 18 being clipped to fin 16 by clip 20 and the bottom disc 19 being clipped to fin 15 by clip 21. The mica discs themselves are supported and alined by the conductor wires 23 and 29 entering the tube through the press 11. A conductor wire 17 leads from the anode to the outside of the envelope through the seal 12.

A cylindrical screen 22 is arranged within and coaxial with the anode 14 close to the anode walls, being of equal length to the anode and supported by the conductor wire 23, before described, entering the envelope through the press 11 and piercing the mica discs 19 and 18. A longitudinal window 24 is cut in the current tapping screen member 22 for its full length, except for support bands 25 and 26, to which are attached pins 30 and 31, which pierce the mica discs 18 and 19, respectively, to support and aline the screen with relation to the anode 14.

A trough-shaped control grid 32 is disposed within the screen 22, its long axis parallel to and substantially coaxial with the axis of the anode and the screen, its ends being bounded by the mica discs 18 and 19. The long opening of the trough faces the window 24 of the screen 22, the edges of said opening being approximately positioned in the same radial lines from the coaxis as are the sides of window 24. The control grid is supported by the conductor wire 29, before mentioned, and by pin 33 secured thereto, the ends of which pierce the mica discs.

A filament cathode 34, supported by hook 35, which is in turn fastened to support 36 held in the press 11, is disposed along and close to the common axis of the electrodes. The ends of the filament are connected to heater current conductors 38 and 39 entering through press 11. A shield cap 40 is supported by a band 41 fastened to support 36. There is an electrical connection between the cap 40 and the cathode filament 34 through hook 35. A getter 70 is provided.

Electrons issuing from the filament cathode 34 through the trough opening of the grid 32 freely travel directly to the anode. However, the edges of the window 24 of the surrounding current tapping screen 22 are positioned within the boundaries of the densest region of the positive charges in the ionized gas. Thus, although the collector screen member 22 is negatively charged,

it has no absolute controlling influence on the trigger action of the tube, it being possible to cause the grid to lose control while it is still negatively charged.

While the particular structure of the tube, as shown in the drawing, is the most desirable embodiment of the invention, other arrangements of the elements relative to one another, as regards spacing and configuration, which perform the functions explained, are within the scope of the invention.

The utility of such a tube is shown in the circuit of Fig. 3, which represents a typical portion of a system of electron tubes arranged to be fired sequentially by positive electrical impulses impressed on all the tubes simultaneously by a common conductor 65.

The tubes in such a system are interconnected in series by the same type of circuits, and each tube is supplied with the same operating and control potentials. An explanation of the network and circuit connecting the two tubes shown will serve to disclose how any number of tubes may be interconnected either in a straight series or in a non-ending ring series.

The elements of the tubes in Fig. 3 bear the same reference numbers as those of Figs. 1 and 2. The anodes 14 are connected to a common conductor 51, each through a resistor of 5,000 ohms like resistors 50. Conductor 51 is given a positive potential of 70 volts with respect to ground and has in series with it and the source of potential a 100-ohm resistor 52. Conductor 51 is also grounded through a capacitor 53 of 1 microfarad. The cathodes 34 are grounded. The current tapping screen member 22 of one tube and the control grid 32 of the next tube in the series have a common source of negative potential of 75 volts like sources 54. Each current tapping screen member 22 has in series with it and its source of potential 54 a resistor, like resistors 56, of 500,000 ohms. The control grid of the following tube of the sequence has in series with it and its source of potential 54 the same resistor 56 of 500,000 ohms, as described, a resistor like resistors 58 of 100,000 ohms, and a resistor like resistors 61 of 50,000 ohms. Thus, each screen 22 is connected to the control grid of the following tube through resistors like resistors 58 and 61.

The characteristics of the gas discharge electron tube taken as an example, as determined by the selection and spacing of the elements in the tube, are such that with a positive anode potential of 70 volts and with the collecting screen at 75 volts negative, the critical potential of the control grid is 5 volts negative.

If tube I is "fired" and rendered conductive in any manner, as by rendering its control grid and current tapping screen member positive beyond the critical points, the anode 14 will immediately drop in potential to about 15 volts positive, due to resistors 50 and 52. Current tapping screen 22 is positioned by the disclosed method so as to collect enough positive charges to have its normal potential of 75 volts negative reduced to about 25 volts negative, which potential change is therefore impressed on control grid 32 of tube II. Now, if a positive 50-volt potential impulse is impressed on conductor 65, through each capacitor 66 and points 64, the control grid 32 of tube II will be given a positive pulse that takes it past the critical 5-volt negative point, and the tube II fires.

As tube II fires, its anode potential is reduced to approximately 15 volts positive, due to resistors 50 and 52 in the anode supply. This drop in potential causes a negative impulse of about 55 volts to be impressed on conductor 70 through capacitor 63, which pulse is in turn impressed on the anode of every other tube in the connected series through their respective capacitors 63. As tube I is discharging, its anode is at a potential of 15 volts positive, and the negative impulse of 55 volts will carry it more negative than the grounded cathode, extinguishing the discharge and allowing the control grid to resume control. Thus, as tube II is fired after tube I by a 50-volt positive potential impulse impressed on conductor 65, and tube I is extinguished by a 55-volt negative potential impulse impressed on conductor 70 by the firing of tube II, so may any number of tubes so interconnected be rendered conductive in sequence each by a single positive potential impulse.

This explanation is given to show how the negatively biased collector screen 22 is used to create a positive change in potential and how such a positive change in potential may be utilized.

While the device 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 tube, comprising a cathode; a control electrode surrounding the cathode except for an aperture, whereby a sufficient negative charge on the control electrode will prevent a discharge of electrons from the cathode and an insufficient negative charge thereon will allow electrons to be discharged through the aperture; a current tapping electrode surrounding the control electrode except for an aperture for allowing a discharge of the electrons through the aperture of the control electrode to be unhindered, said current tapping electrode being out of the zone of electron flow so as to have no total control over the discharge of electrons from the cathode; an anode surrounding the cathode, the control electrode, and the current tapping electrode; and an ionizable medium contained in an envelope surrounding the anode, the cathode, the control electrode, and the current tap_ ing electrode, whereby upon a discharge of electrons occurring from the cathode, the current tapping electrode will collect charges from the ionizable medium.

2. An electron discharge device comprising an enclosing gas-filled envelope containing a press; a cylindrical electron-receiving electrode having an electrical conductor connected thereto which pierces the envelope through a seal, and having an insulating disc fastened to each end; a cylindrical screen electrode disposed within the electron-receiving electrode between the insulating discs and having a common axis with the electron-receiving electrode, said screen electrode containing a longitudinal window; means securing the screen electrode to the insulating discs and the press for support of the electron-receiving electrode and the screen electrode, said securing means also issuing from the press as an electrical conductor to the screen; a trough-shaped control electrode located centrally within the screen electrode, its long axis being parallel with said common axis, and its longitudinal opening facing the window in the screen, the longitudinal edges of the window and the edges of the opening being substantially on the same radii from the common axis; means supporting the control elec-

trode, said means consisting of an electrical conductor secured to the electrode and leaving the envelope through the press; an electron-emitting electrode positioned substantially along the common axis and supported by a member held in the press; electric conductors joined to the ends of the emitting electrode and leaving the envelope through the press; and a shield cap positioned over one end of the electron-receiving electrode and electrically connected to the electron-emitting electrode.

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ROBERT E. MUMMA.

Certificate of Correction

Patent No. 2,398,772. April 23, 1946.

JAMES H. CONE ET AL.

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, lines 51 and 52, strike out the words "current tapping"; line 55, for "collector" read *current tapping*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2d day of July, A. D. 1946.

[SEAL]

LESLIE FRAZER,
First Assistant Commissioner of Patents.

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