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DEVICE COMPRISING AN ELECTRIC DISCHARGE TUBE HAVING A CONCENTRATED ELECTRON BEAM

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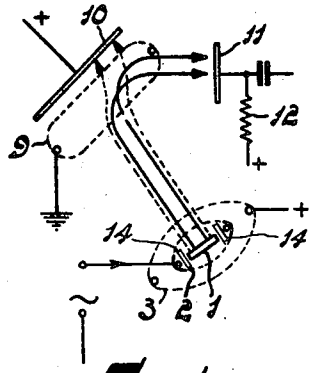

Fig. 1

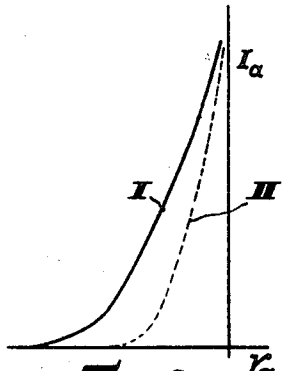

Fig. 2

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DEVICE COMPRISING AN ELECTRIC DISCHARGE TUBE HAVING A CONCENTRATED ELECTRON BEAM

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1 Claim. (Cl. 250—27)

This invention relates to a device comprising an electron discharge tube having a concentrated electron beam through the use of which a very high mutual conductance can be developed in a simple manner.

It has previously been suggested to increase the sensitivity of deflection control of a tube by means of a space charge developed between the beam and the deflection electrode, the deflection due to the deflection electrode being assisted by the space charge. Such an increase was attained by making improvements in the deflection control itself in a tube having a double control. In addition, it has been found possible to utilize the influence of space charge to ensure a very high mutual conductance even in the case of intensity control, if the electron beam is directed upon any of the collecting electrodes only as a result of space charges formed by the beam current itself in accordance with the intensity of the beam. The deflection of the electron beam due to these space charges, which was formerly found to be generally undesirable, is now used to direct a portion of the beam away from given collecting electrodes and onto a further collecting electrode. The last-mentioned collecting electrode forms, in general, the anode. The intensity of the beam is controlled by the control electrode so that increasing the beam intensity increases the intensity of that portion of the electron beam directed upon the collecting anode referred to. In addition, simultaneously with this increase in beam intensity a large portion of the beam is directed upon this electrode. The beam thus can be fully deflected in accordance with the controlled intensity of the beam without a separate deflection control.

The principle described can be realized with advantage with the use of a device comprising an electric discharge tube having a concentrated electron beam and an electrode system comprising at least a cathode, a control grid and two collecting electrodes, in which the beam can be directed upon any one of the collecting electrodes only by the space charges which are formed by the beam itself in accordance with the intensity of the beam. In accordance with the invention, the beam is passed into a cage maintained at a fixed low or zero potential so that at a low beam intensity the electrons strike a collecting electrode arranged at the back of the cage, whereas with increasing beam intensity the beam is reflected to a further collecting electrode because of the space charge produced in the cage.

Thus, with low beam intensity, the beam passes through the cage to a collecting electrode arranged at the back of the cage, whereas in the case of a high current strength the space charge set up in the cage is such that the beam is substantially reflected thereby to a further collecting electrode, arranged more or less laterally of the cage.

In order that the invention may be more clearly understood and readily carried into effect, it will now be described more fully with reference to the accompanying drawing, in which

Fig. 1 shows diagrammatically one embodiment of a tube suitable for use in a device according to the invention, and

Fig. 2 shows the Ia—Vg characteristic curve of such a tube.

Referring to Fig. 1, the cathode is designated 1, the intensity control electrode 2 and a screen 3. The control electrode 2 may comprise small screens so that the electron flow is concentrated to form a beam but, as an alternative, separate beam-forming electrodes 14 may be arranged. Referring to Fig. 1, use is made of a straight beam, which, in the case of a low current strength passes through a cage 9 and then reaches a collecting electrode 10. The cage 9 is at a fixed low voltage or at zero potential so that with increasing beam current a space charge is set up in the cage by which an increasing portion of the electron beam is reflected to an output anode 11 connected to an output circuit 12. In this case a high mutual conductance is obtained for the said anode.

Fig. 2 shows the Ia—Vg characteristic curve of a normal tube which has only intensity control without the use of space charge deflection (curve I). Curve II is the Ia—Vg characteristic curve of a similar tube in which space charge deflection is used. It clearly shows the intense increase in mutual conductance, the advantage being that the latter is obtainable without very accurate electrode machining or very small electrode spacings.

Obviously, still further embodiments are possible without departing from the scope of the invention.

What I claim is:

A circuit arrangement comprising an electric discharge tube having beam producing means including a cathode and control electrode and means for producing a concentrated electron beam in a given path of an intensity sufficient to establish a space charge in a field-free region, a first collecting electrode located in said given path, a second output collecting electrode disposed outside said given path to intercept a portion of said beam at higher intensities thereof, and a single cage-like electrode disposed in said given path entirely between the control electrode and the first collecting electrode and enclosing a field-free region; means to apply constant positive potentials relative to said cathode to the collecting electrodes, means to apply to said cage-like electrode a fixed potential between zero and a positive amount small relative to the potentials applied to the collecting electrodes to thereby establish a space charge within the region enclosed by the cage-like electrode, means to apply an input signal only to said control electrode to vary the intensity of said beam and thereby vary the magnitude of the space charge within the cage-like electrode and cause the beam to divide itself between the first and second collecting electrodes in accordance with the intensity of the input signal, and means coupled to said second collecting electrode for deriving an output signal therefrom corresponding to the input signal applied to the control electrode.

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