

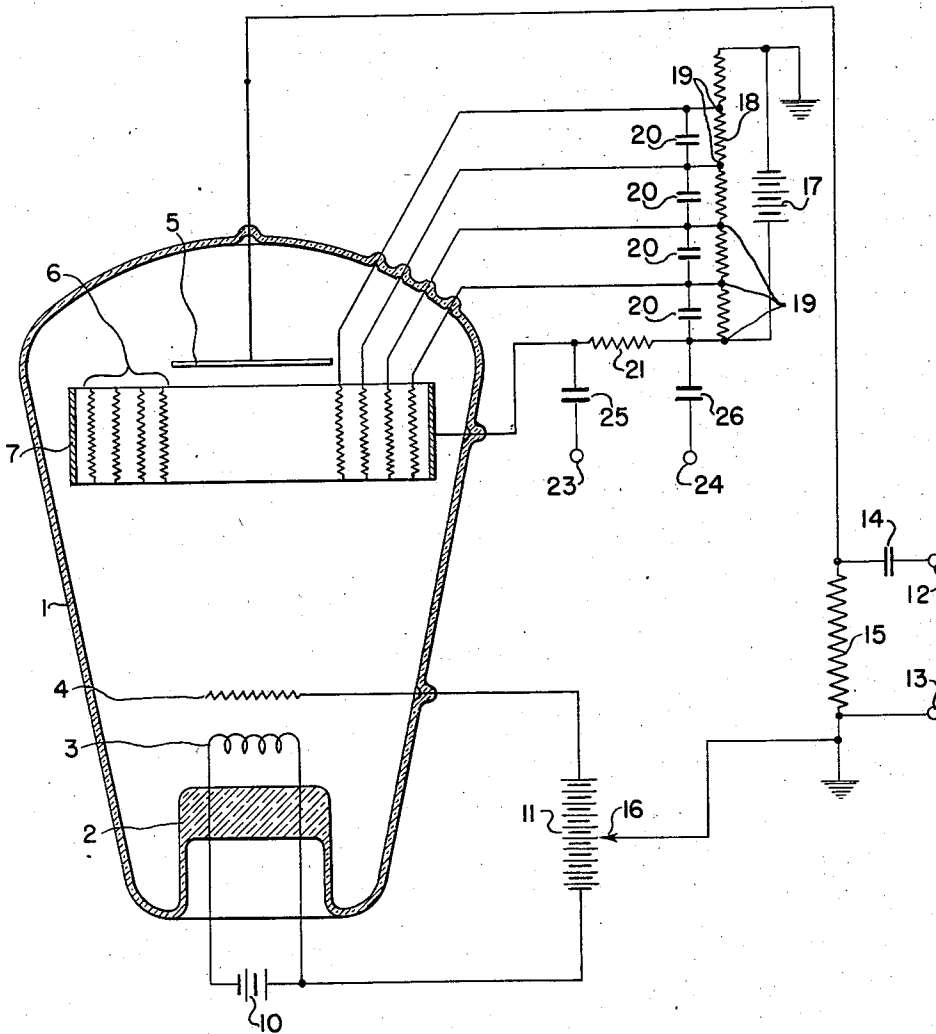
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ELECTRON CONTROL DEVICE

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ELECTRON CONTROL DEVICE

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2 Claims. (Cl. 179-171)

This invention relates to an electron-control device and particularly to devices employing electron multiplication by secondary emission, and this application is a continuation-in-part of my application Serial No. 230,552, filed September 19, 1938.

Conventional devices of this type comprise a source of electrons, a control electrode for controlling the electron flow in accordance with a signal, a plurality of secondary-electron-emitting electrodes held at successively increasing positive potentials for intensifying the controlled electron flow by electron multiplication, and an anode for collecting the multiplied electron flow.

The controlled flow of primary electrons comprises a signal component and a direct-current component which are both multiplied by electron impact with the secondary-electron-emitting electrodes, so that the current flow at the last secondary-electron-emitting electrode is limited to a predetermined value by the maximum permissible current density for reasons of space charge and by the permissible safe operating temperature of this electrode. The ratio between the mutual conductance of the electron-control device and the direct-current component, therefore, determines the maximum signal output safely obtainable from such a tube without overloading the same. In conventional structures, however, this ratio is very low so that a substantial portion of the output current comprises the undesired direct-current component and is not utilized for the desired signal component.

The object of the present invention, therefore, is to provide a new and improved electron-control device employing electron multiplication by secondary-electron emission having greater efficiency of signal amplification.

In accordance with the present invention there is provided an electron-control device comprising means for developing a flow of electrons, and a secondary - electron - emitting electrode upon which the electron flow is directed with sufficient velocity to release secondary electrons therefrom. Means are provided for varying the potential between the secondary-electron-emitting electrode and the first-named means in accordance with an input signal to vary the multiplication of electrons by secondary emission at this electrode, and means for collecting the secondary electrons and developing an amplified output signal.

For a better understanding of the invention, together with other and further objects thereof, 55

reference is had to the following description, taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the accompanying drawing, the single figure schematically shows an electron-control device embodying the present invention connected in circuit as a signal amplifier.

Referring now more particularly to the single figure of the drawing, there is shown an electron-control device comprising an evacuated envelope 1 having a re-entrant stem 2, and including a thermionic cathode 3, an accelerating grid 4 and a solid secondary-electron-emitting electrode 5 positioned in registry with each other. The envelope 1 also includes a plurality of cylindrical concentric grid-like secondary-electron-emitting electrodes 6 and a concentric electron collecting anode 7, surrounding the electrodes 6. The concentric structure of electrodes 6 and anode 7 is positioned adjacent the electrode 5 in such a manner that its axis intersects the center of electrode 5.

For the purpose of developing a flow of electrons, there is provided a battery 10 or any other suitable source of current for heating the cathode 3 to the point of electron emission. A battery 11 is connected between the cathode 3 and the accelerating grid 4 to provide an accelerating field for the emitted electrons. For the purpose of applying a control signal between the cathode 3 and the secondary-electron-emitting electrode 5, there is provided a pair of input terminals 12, 13 connected across an input resistor 15 by way of a condenser 14. Terminal 13 is also connected to a grounded tap 16 of the battery 11, in order to maintain the electrode 5 at ground potential, but positive with respect to the cathode 3 and negative with respect to the accelerating electrode 4.

Operating potentials are supplied to the secondary-electron-emitting grids 6 and the anode 7 by a battery 17 or other suitable voltage source, having its negative terminal grounded, and being connected across a voltage divider 18 provided with a plurality of taps 19, to which the secondary-electron-emitting grids 6 are directly connected in the manner shown, and to the most positive of which the anode 7 is connected by way of an output resistor 21. The taps 19 are interconnected by means of condensers 20 to bypass signal currents. The output signal developed across the output resistor 21 can be derived from a pair of output terminals 23, 24 connected

across the output resistor by way of condensers 25 and 26.

Referring now to the operation of the device, a flow of primary electrons is emitted by the cathode 3 when raised to the proper temperature. These electrons are accelerated by the operating potential applied to the accelerating grid 4 and are directed upon the solid secondary-electron-emitting electrode 5. An input signal applied to the terminals 12 and 13 causes a signal current to flow through the condenser 14 and the input resistor 15, thereby developing a voltage drop across the latter. Since the unidirectional operating voltage supplied by the battery 11 between cathode 3 and electrode 5 is in the order of approximately 10 volts, the ratio of primary electrons impacting the electrode 5 to secondary electrons released therefrom is rendered smaller than unity. In this order of voltage between cathode 3 and electrode 5, the secondary emission ratio is approximately a linear function of the voltage applied therebetween, and a large change in secondary emission ratio is obtained for a comparatively small change in voltage. The voltage between cathode 3 and electrode 5 is varied by the voltage drop developed across the input resistor 15 in accordance with an input signal applied to the terminals 12, 13. Thus, if the voltage between the cathode 3 and the electrode 5 is so adjusted that it is in the order of the input signal voltage amplitude, the minimum amount of direct-current component flows in the tube. Such operation yields an extremely favorable ratio of mutual conductance to direct-current component.

The low-velocity secondary electrons released from the electrode 5 by impact of the primary electrons thereon are readily accelerated to the closest of the secondary-electron-emitting grids 6, due to the positive potential applied thereto by way of the least positive of the taps 19 on voltage divider 18. The electrons released from the electrode 5 then successively impact successive ones of the grids 6, being multiplied by secondary emission upon each impact, and are finally collected by the anode 7. The multiplied electrons flow through the output resistor 21 across which they develop an amplified output signal which can be derived from the terminals 23 and 24, connected to opposite ends of the output resistor by way of condensers 25 and 26, respectively.

In the above there has been described an elec-

tron-control device, a particular feature of which is the control of the electron flow in the device by controlling the ratio of secondary electrons released from an electrode to the number of primary electrons impacting the same in accordance with an input signal, thus developing a high ratio of mutual conductance to direct-current flow in the device.

While there has been described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. An electron-control device comprising an evacuated envelope including a cathode, an accelerating electrode and a solid secondary-electron-emitting electrode positioned in registry with each other; a plurality of concentric secondary-electron-emitting grids adjacent said electrode; an anode disposed in concentric relation with said grids; means for applying operating potentials to said cathode, said accelerating electrode, said solid electrode, said grids and said anode; means for controlling the potential applied to said solid electrode in accordance with an input signal to control the secondary emission therefrom; and means connected to said anode for utilizing the electrons collected thereby to develop an output signal.

2. An electron control device comprising means for developing a flow of electrons, a secondary-electron-emitting electrode, means for directing the said electron flow upon said electrode to release secondary electrons therefrom, means for applying an operating potential between said first-named means and said electrode of such value that the secondary emission ratio is smaller than unity, means for varying said operating potential in accordance with an input signal to vary, to a high degree for comparatively small changes of said potential, the multiplication of electrons by secondary emission from said electrode, means for collecting the secondary electrons, and means for utilizing the collected electrons to develop an output signal.

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