

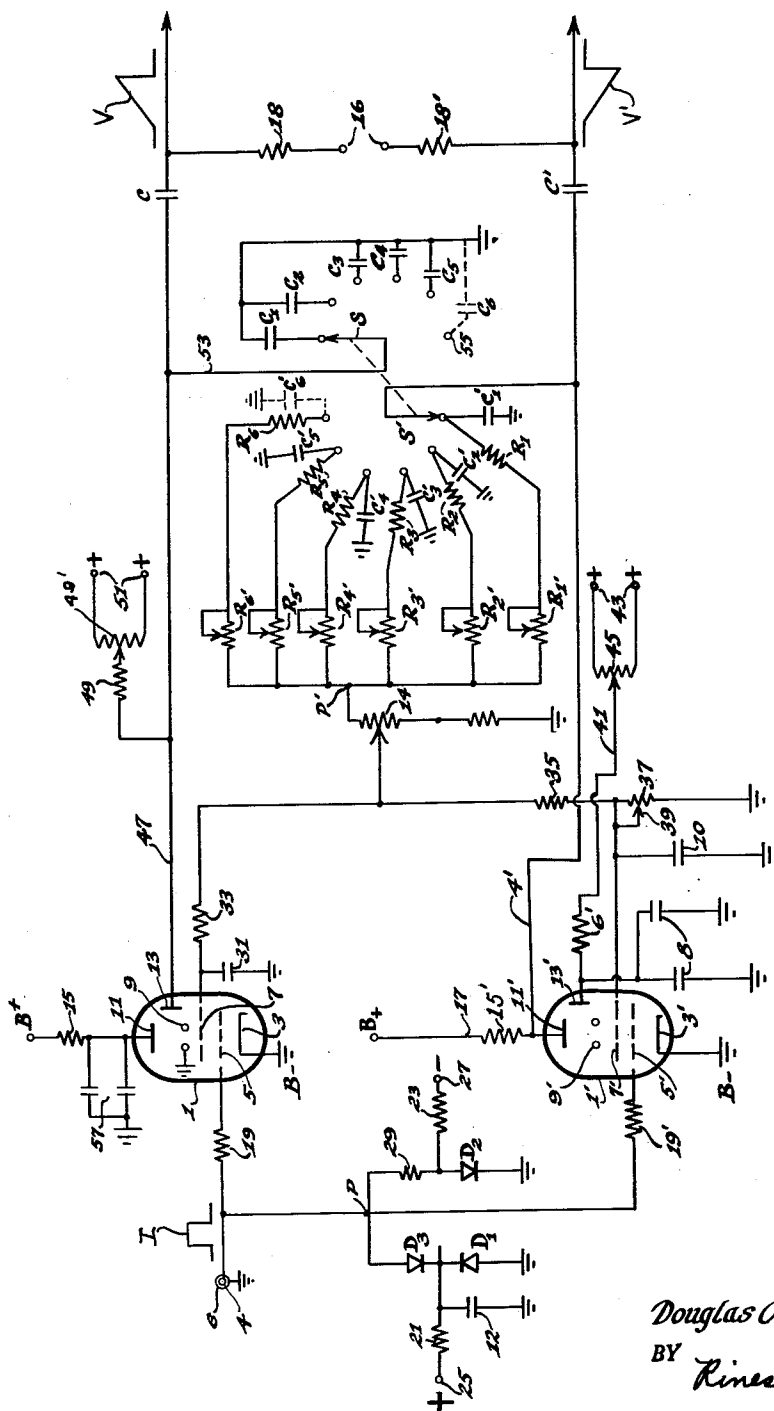
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D. O. COCHRANE

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SWEEP SIGNAL GENERATING SYSTEM

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INVENTOR.
Douglas Oliver Cochrane
 BY *Rines and Rines*
 ATTORNEYS

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SWEEP SIGNAL GENERATING SYSTEM

Douglas Oliver Cochrane, Dorchester, Mass., assignor to Edgerton, Germeshausen and Grier, Inc., Boston, Mass., a corporation of Massachusetts
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The present invention relates to sweep circuits and, more particularly, to electronic circuits adapted to generate sweep outputs suitable for deflecting cathode-ray and similar charged-particle beams.

The art is replete with sweep circuits of differing configuration employed for generating deflection voltages or currents for use in cathode-ray and similar apparatus to deflect the electron beam. Single-ended and push-pull circuits have been evolved employing different types of electron and gaseous-discharge tubes. It has been discovered, however, that improved operation, for the purposes later explained, may be obtained with the aid of novel sweep-circuit configurations embodying electron tubes of the type having a secondary electron-emissive electrode as one of the electrodes within the tube.

An object of the present invention, accordingly, is to provide a new and improved sweep circuit embodying tubes that employ an internal secondary electron-emissive electrode.

A further object is to provide a new and improved sweep circuit.

Other and further objects will be explained hereinafter and will be more particularly pointed out in connection with the appended claims. In summary, the invention relates to the employment of a multi-electrode electron tube having a pair of electrodes which serve as an anode and a secondary electron-emitting electrode. Sweep capacitor means is connected in a circuit to one of the said pair of electrodes and means is provided for holding the other electrode of the said pair at substantially constant potential during the passage of current through the tube and in the said circuit including the capacitor and the said one electrode of the pair. A preferred push-pull arrangement is hereinafter set forth, as are the desired circuit details.

The invention will now be described in connection with the accompanying drawing, the single FIGURE of which is a schematic circuit diagram of a preferred form of the invention.

Referring to the drawing, the tubes of a pair of electron tubes 1 and 1' embody respective primary-electron-emitting cathode electrodes 3 and 3', control-grid electrodes 5 and 5', screen-grid electrodes 7 and 7', beam-forming electrodes 9 and 9', anode electrodes 11 and 11', and secondary electron-emitting dynode electrodes 13 and 13' disposed adjacent to the respective anodes 11 and 11'. For reasons later explained, the electrical connections to the tubes 1 and 1', are not the same. Both of the cathodes 3 and 3' are shown connected to the B— or grounded terminals of the anode potential source B+, B—, the positive terminal B+ of which is connected through anode resistor 15 to the anode 11 of the tube 1, and through resistor 15' and connector 17 to the anode 11' of the tube 1'. The term "ground" as used herein, is intended to connote not only actual earthing, but also any other reference potential, such as chassis potential and the like.

The beam-forming electrode 9 of the tube 1 is shown grounded and the control-grid electrodes 5 and 5' are connected through respective resistors 19 and 19' to a common input terminal 4. A preferably grounded input terminal 6 may also be provided coaxially disposed with respect to the input terminal 4. The input terminals 4 and 6 may apply between the respective control grids 5

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and 5' and the corresponding cathodes 3 and 3' of the tubes 1 and 1', input pulses I from a source of triggering pulses that are to initiate the sweep voltages desired in accordance with the present invention. The tubes 1 and 1' may, for example, be of the EFP-60 type, and the voltage source B+, B— may be of the order of 500 volts.

In order to insure the proper polarity and range of amplitude of the input voltage applied to the control electrodes 5 and 5', Zener-type diodes D₁ and D₂ may be provided, respectively connected through resistors 21 and 23, to the opposite bias voltage sources indicated by the positive terminal 25 and the negative terminal 27. The diodes D₁ and D₂ may, for example, be of the 652C5 type and 653C9 type, respectively, being oppositely poled. The diode D₂ is connected between ground and, through a resistor 29, the point P. A by-pass capacitor 12 shunts the diode D₁. The point P, in turn, is connected to the input terminal 4. The ground terminal, of course, connects with the other input terminal 6. The diode D₁ is also connected between ground, and through a reversely poled further diode D₃, to the point P. The upper terminals of the respective diodes D₁ and D₂ will thus be oppositely biased, the diode D₁ being biased, for example, at a potential of the order of plus five volts, and the diode D₂ being biased at a potential of minus eight volts, thereby to hold the point P within the desired polarity and amplitude restrictions.

It will conduce to explanation if the sweep circuit associated with one of the pair of tubes 1 and 1' is first described. For this purpose, it is preferred to treat with the tube 1. The screen-grid electrode 7 of the tube 1 is decoupled to ground through a capacitor 31 and is supplied with screen voltage through a circuit traceable from a resistor 33 through a potentiometer 14, a pair of resistors R₁' and R₁, a switch S' and, by way of conductors 4' and 17 and resistor 15' to the B+ terminal. It should be observed that the screen electrode 7' of the other tube 1' is connected by the tap 39 of potentiometer 37 and a resistor 35 to the potentiometer 14, also, so that a common source of screen voltage is employed for both tubes, adjustable by adjustment of the potentiometer 14. The screen grid 7' is similarly decoupled by a capacitor 10. The secondary electron-emitting dynode 13 of the tube 1 is connected by conductor 47 through a resistor 49 and a potentiometer 49' to positive terminals 51 of different potential, which supply the necessary operating potential therefor. The lower potential terminal 51 may, for example, be of the order of 105 volts positive, while the upper terminal may be of the order of 150 volts.

The conductor 47 is also connected to a further conductor 53 which connects with a switch S. The switch S, in turn, connects with any of capacitors C₁, C₂, C₃, C₄ or C₅, the opposite terminals of which are grounded. The capacitors C₁ through C₅ are the sweep capacitors of different values depending upon the time constant of sweep desired. A vacant switch terminal 55 may provide stray capacitance C₆, illustrated dotted, for a very small sweep time constant, say, of the order of ten micro-seconds. The large capacitor C₁, on the other hand, may produce a sweep of the order of five micro-seconds. The sweep capacitor C₁, will, of course, charge in the circuit traceable from ground through the capacitor C₁, the switch S, through conductors 53 and 47, through the space between the second electron-emitting dynode 13, and the anode 11 of the tube 1, and through resistor 15 to the B+ anode supply terminal. When a positive trigger pulse I is applied upon the control grid 5 by feeding the same to the input terminals 4 and 6, the tube 1 may be caused to conduct causing the sweep capacitor C₁ to discharge from the secondary electron-emitting dynode 13 through to the cathode 3, thus prod-

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using a positive-going sweep voltage V that is fed by output coupling condenser C to one of the deflection means of a cathode-ray tube and the like. It is necessary, however, that during this discharge, the secondary electrons that also reach the anode 11, do not cause effective variation of the anode potential. To this end of holding the anode electrode 11 at substantially constant potential during the passage of current in the tube 1 and in the discharge circuit including the capacitor C_1 and the secondary emitting electrode 13, a high-frequency by-pass capacitance 57 is provided connected between the anode 11 and ground. This by-pass 57 has the effect of extending the voltage swing of the anode 11 and is particularly advantageous for short-time constant sweeps, as before mentioned.

The other electron tube 1', however, is somewhat differently connected. Its anode 11' is connected by the beforementioned conductor 4' to the switch S' that may be ganged with the switch S , as indicated by the dotted connection therebetween. From the switch S' , the connection continues to the respective sweep condensers C_1' , C_2' , C_3' , C_4' , C_5' and C_6' , the latter of which, like capacitance C_6 , is shown dotted to indicate stray capacitance for the shortest sweep. In such case, it is important to insure that the dynode 13' does not appreciably alter its potential during the discharge of the capacitor C_1' through the tube 1' between the anode 11' and the cathode 3'. To this end, the dynode electrode 13', which receives its operating potential through the resistor 6, conductor 41 and potentiometer 45, the latter of which is connected between positive terminals 43 that may correspond to the terminals 51, before-mentioned, is provided with an appropriate shunt capacitance 8 to ground. This capacitance 8 must be larger than any of the capacitors associated with the switch S' in order to hold the secondary electron-emitting dynode 13' at substantially constant potential during the discharge of the sweep capacitor C_1' through the tube 1'. The resultant capacitance of the large by-pass capacitors 8 may be of the order of one-tenth of a microfarad to accomplish this purpose, as may the previously mentioned high-frequency by-pass capacitors 57 utilized to maintain the anode 11 of the tube 1 at substantially constant potential.

Each of the un-grounded terminals of the capacitors C_1' through C_6' is connected through corresponding fixed and variable resistors R_1 — R_1' through R_6 — R_6' , respectively, to a common point P' at the upper terminal of the screen-voltage supply potentiometer 14, before described. Through the expedient of having the same circuit that supplies screen potential to the screen-grid electrode 7 and 7' of the tubes 1 and 1', serve to charge the capacitors C_1' through C_6' , a single control at 14 can be used to adjust the sweep rate of the circuits associated with both the sweep-generators. There will result at the lower output coupling capacitor C' , connected to the anode 11' of the tube 1', an inverted or push-pull sweep voltage V' that may be applied to the opposite deflection means to that receiving the sweep voltage V . Horizontal positioning voltage for the sweep may be applied at the terminals 16 through respective resistors 18 and 18'.

There will thus result a positive sweep pulse V from the secondary electron-emitting dynode 13 of the tube 1, and a negative sweep pulse V' from the anode 11' of the other sweep tube 1' that may be used for push-pull deflection operation. These tubes 1 and 1' produce a linear rise in voltage because they have, in effect, the high dynamic resistance characteristic of a pentode tube, and, therefore, charge the respective sweep capacitors C_1 through C_6 and C_1' through C_6' at an essentially constant rate. The sweep rate is adjustable in the circuit by means of the before-mentioned potentiometer 14 and potentiometers R_1' through R_6' , which also fix the screen-grid voltages of the sweep tubes 1 and 1'. This is an extremely economical feature in that it enables the use of a single switch wafer S — S' to switch in the required

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sweep capacitors and, at the same time, to vary the voltage to the screen grids of both of the tubes 1 and 1'.

Further modifications will occur to those skilled in the art and all such are considered to fall within the spirit and scope of the invention, as defined in the appended claims.

What is claimed is:

1. A sweep circuit having, in combination, a multi-electrode electron tube having a control grid, a cathode, and a pair of electrodes serving as an anode and a secondary-electron-emitting electrode, an input circuit connected across the control grid and the cathode for applying input pulses to the tube to cause the tube to conduct, biasing means connected across said control grid and said cathode to permit conduction within the tube only during the application of said input pulses, sweep capacitor means connected in a circuit to one of the said pair of electrodes, and means for holding the other electrode of the said pair at substantially constant potential during the passage of current through the tube and in the said circuit including the capacitor means and the said one electrode of the pair.

2. A sweep circuit having, in combination, a multi-electrode electron tube having a control grid, a cathode, and a pair of electrodes serving as an anode and a secondary-electron-emitting electrode, an input circuit connected across the control grid and the cathode for applying input pulses to the tube to cause the tube to conduct, biasing means connected across said control grid and said cathode to permit conduction within the tube only during the application of said input pulses, sweep capacitor means connected in a circuit to the secondary-electron-emitting electrode, and means for holding the anode at substantially constant potential during the passage of current through the tube and in the said circuit including the capacitor means and the secondary-electron-emitting electrode.

3. A sweep circuit having, in combination, a multi-electrode electron tube having a control grid, a cathode, and a pair of electrodes serving as an anode and a secondary-electron-emitting electrode, an input circuit connected across the control grid and the cathode for applying input pulses to the tube to cause the tube to conduct, biasing means connected across said control grid and said cathode to permit conduction within the tube only during the application of said input pulses, sweep capacitor means connected in a circuit to the secondary-electron-emitting electrode, and means comprising a high-frequency bypass capacitor connected with the anode for holding the same at substantially constant potential during the passage of current through the tube and in the said circuit including the capacitor means and the secondary-electron-emitting electrode.

4. A sweep circuit having, in combination, a multi-electrode electron tube having a control grid, a cathode, and a pair of electrodes serving as an anode and a secondary-electron-emitting electrode, an input circuit connected across the control grid and the cathode for applying input pulses to the tube to cause the tube to conduct, biasing means connected across said control grid and said cathode to permit conduction within the tube only during the application of said input pulses, sweep capacitor means connected in a circuit to the anode electrode, and means for holding the secondary-electron-emitting electrode at substantially constant potential during the passage of current through the tube and in the said circuit including the capacitor means and the anode.

5. A sweep circuit having, in combination, a multi-electrode electron tube having a control grid, a cathode, and a pair of electrodes serving as an anode and a secondary-electron-emitting electrode, an input circuit connected across the control grid and the cathode for applying input pulses to the tube to cause the tube to conduct, biasing means connected across said control grid and said cathode to permit conduction within the tube only during

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the application of said input pulses, sweep capacitor means connected in a circuit to the anode electrode, and means comprising a relatively large by-pass capacitor connected with the secondary-electron-emitting electrode for holding the same at substantially constant potential during the passage of current through the tube and in the said circuit including the capacitor means and the anode.

6. A circuit for generating a pair of matched sweep signals having, in combination, a pair of multi-electrode electron tubes each having a control grid, a cathode, and a pair of electrodes serving as an anode and a secondary-electron-emitting electrode, an input circuit connected across the control grid and the cathode of both tubes for applying input pulses to both tubes substantially simultaneously to cause both tubes to conduct, biasing means connected across the control grid and the cathode of each tube to permit conduction within the tubes only during the application of said input pulses, a pair of sweep capacitor means one of which is connected in a circuit with one of the said pair of electrodes of each tube, means for holding the other electrode of the said pair of electrodes of each tube at substantially constant potential during the passage of current through each tube and in the said circuit including the capacitor means and the said one electrode of the pair of electrodes of each tube, and means for extracting substantially simultaneous sweep outputs from the said one electrode of each of the pair of tubes.

7. A circuit for generating a pair of sweep signals each being substantially a mirror image of the other, having, in combination, a pair of multi-electrode electron tubes each having an anode, a secondary-electron-emitting electrode, a control grid and a cathode; an input circuit connected across the control grid and the cathode of both tubes for applying input pulses to both tubes substantially simultaneously to cause both tubes to conduct, biasing means connected across the control grid and the cathode of each tube to permit conduction within the tubes only

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during the application of said input pulses; a pair of sweep capacitor means, one of which is connected in a circuit with the anode of one tube and the other of which is connected in a circuit with the secondary-electron-emitting electrode of the other tube; means for holding the secondary-electron-emitting electrode of the said one tube and the anode of the said other tube at substantially constant potential during the passage of current through each tube and in each of the said circuits including the capacitor means; and means for extracting substantially simultaneous sweep output signals from the anode of the said first tube and the secondary-electron-emitting electrode of said other tube.

8. A sweep circuit as claimed in claim 7 and in which the holding means comprises a high-frequency by-pass capacitor connected with the anode of the said other tube.

9. A sweep circuit as claimed in claim 7 and in which the holding means comprises a relatively large by-pass capacitor connected with the secondary-electron-emitting electrode of the said one tube.

10. A sweep circuit as claimed in claim 7 and in which each of the tubes is provided with a screen grid and a common source of screen potential, and the sweep capacitor means of the said one tube is energized by the said source of screen potential.

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