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SWEEP CIRCUITS

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FIG. 1

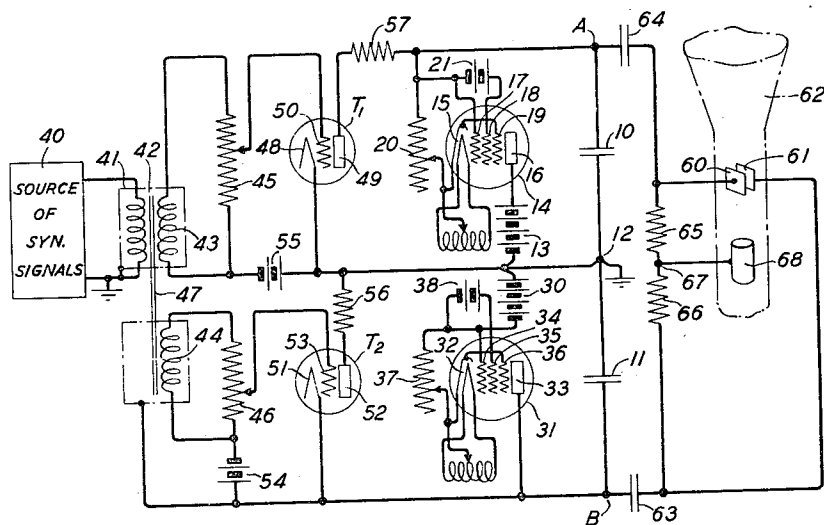
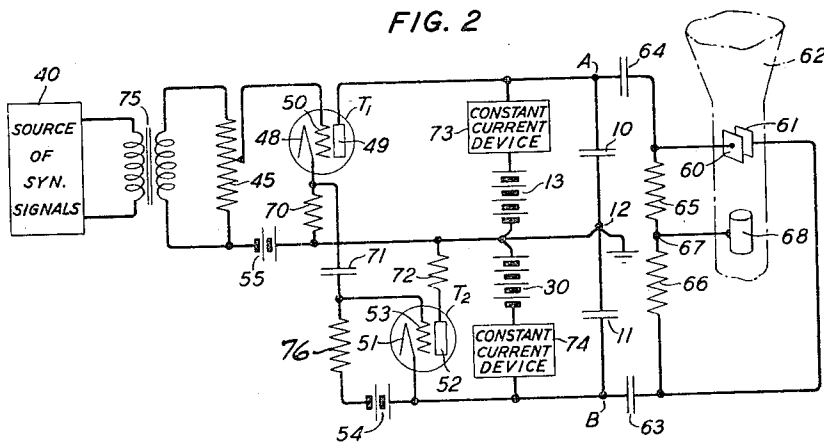


FIG. 2



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SWEEP CIRCUITS

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Application February 25, 1936, Serial No. 65,608

20 Claims. (Cl. 250—36)

This application relates to electric circuits and more particularly to sweep circuits such as those used in television scanning.

In a copending application of Frank Gray, Serial No. 65,606, filed February 25, 1936, there are disclosed a number of sweep circuits for generating saw-toothed wave forms suitable for television scanning in which the generated voltages are balanced with respect to the voltage of an anode of the cathode ray tube. As pointed out in that application marked advantages result from the use of sweep circuits generating balanced sweep voltages some of which are reduction in loss of focus and reduction in distortion. The present application relates to improvements in that type of circuit which produces balanced sweep voltages.

It is an object of this invention to provide an improved balanced sweep circuit.

It is another object of this invention to provide novel circuit arrangements utilizing gas-filled electron discharge devices, suitable for use in sweep circuits.

Carrying these objects into effect, in one embodiment of this invention given by way of example, a "double" sweep circuit is employed, that is, a sweep circuit in which a plurality of gas-filled grid controlled electron discharge devices used for producing the discharge strokes in the generation of the saw-toothed wave forms have their plate circuits in series. By this means the available output voltage may be approximately doubled. Another advantage of this double circuit is that it produces a balanced output without the necessity for amplifiers or a floating power supply. In other words, in this circuit the power supply may be grounded without producing an unbalance. In its preferred form the sweep circuit comprises two condensers in series with their common terminal grounded, a constant current device such as a multi-grid electron discharge device having feed-back circuits on one or more of its grids and a source of current for charging up each condenser in a substantially linear manner with respect to time, and two grid-controlled gas-filled electron discharge devices which may be, for example, of the type generally known as "Thyratron" tubes, having their plate circuits in a series circuit including the condensers, and suitable means such as an impulse transformer having two secondary windings for causing a discharge in two "Thyratron" tubes simultaneously. The change in voltage across the condensers due to their charging and discharging may be applied, for example, across a pair of deflecting plates in a cathode

ray tube through suitable coupling condensers and a coupling resistance, the mid-point of this resistance being connected to the anode of the cathode ray tube.

In a modification of the above arrangement, instead of an impulse transformer having two secondaries, there may be provided a resistance-capacity coupling between the two gas-filled electron discharge devices so that the discharge in one tube causes an immediate energization of the grid circuit of the second tube to cause a discharge in the second tube simultaneously with it.

The invention will be more readily understood by referring to the following description taken in connection with the accompanying drawing forming a part thereof in which:

Fig. 1 shows a balanced sweep circuit involving this invention; and

Fig. 2 shows a modification of the system shown in Fig. 1.

Referring more particularly to the drawing, Fig. 1 shows a balanced sweep circuit, which may be used, for example, as a suitable source to generate saw-toothed voltages to be applied to one pair of deflecting plates of a cathode ray oscillograph to cause deflection of the cathode ray beam in one direction, as for example, in a horizontal direction. A similar circuit, differing only from this one in the value of the circuit constants, may be used to produce vertical deflection of the beam. The circuit comprises condensers 10 and 11 having their common terminal 12 connected to ground, and means for charging and discharging these condensers simultaneously.

The charging circuit for the condenser 10 comprises a source of potential 13 and a constant current device 14 which may be a saturated diode or a pentode. Preferably the device 14 comprises a pentode having a cathode 15, an anode 16, a control grid 17, a screen grid 18 and a suppressor grid 19. In series with the plate circuit of the device 14 is the biasing resistance 20, which may be adjustable. This biasing resistance 20 is also in the input circuit between the cathode 15 and the control grid 17 and by means of this arrangement any decrease in voltage in the plate circuit of the device 14 caused by the increase in charge across the condenser 10 which tends to reduce the plate current will decrease the bias of the control grid 17 and tend to keep the current through the tube at a constant value. Thus the rate of charge of the condenser 10 tends to be constant. The biasing resistance 20 may, if desired, be arranged in a feed-back relation with respect to the screen grid 18. A battery 21 is also used in this circuit to produce a constant

direct current bias between the cathode and the screen grid 18. The effect of the feedback on the screen and control grids is cumulative. For a more complete description and method of operation of pentode tubes having feedback circuits on one or more of their grids to produce a constant condenser charging rate, reference may be made to a copending application of F. R. Norton, Serial No. 65,607, filed February 25, 1936.

The circuit for charging the condenser 11 comprises a battery 30 and a constant current device 31 having a cathode 32, an anode 33, a control grid 34, a screen grid 35 and a suppressor grid 36. A biasing resistor 37 is connected in the plate circuit and also in the circuit between the cathode 32 and the grid 34 in a manner similar to the connection for the resistance 20 described above. This biasing resistance 37 is also connected in a circuit between the cathode 32 and the screen grid 35, this circuit also including a battery 38 which is similar to battery 21 described above. Battery 38 may obviously be a part of battery 30, if desired, and both may be replaced by a rectifier or other source of direct current potential. In order to have a balanced circuit, the capacities between point A and ground and point B and ground represented by the condensers 10 and 11 and including the external connections thereof should be equal and the constant current devices 14 and 31 and their connections should be similar. The circuit for discharging the condensers 10 and 11 at periodic intervals comprises a source of synchronizing signals 40 which is connected to the primary winding 41 of a transformer 42 which has two secondary windings 43 and 44, connected respectively to the grid of "Thyratron" tubes T1 and T2 through potentiometers 45 and 46.

The source 40 may be located at the transmitter or the receiver and may take any of a variety of well-known forms. For example, if the circuit now being described were used in connection with a cathode ray tube at the receiver, and a scanning disc were used to generate the image and synchronizing signals, an arrangement for generating the synchronizing signals may be used similar to the one described in Patent 2,050,363, August 11, 1936, to E. R. Morton. If a cathode ray device is used at the transmitting station, the return pulses of the horizontal or vertical deflecting circuits may be used to generate the synchronizing signals for the corresponding sweep circuits at the receiving station.

When a scanning disc is used to generate the synchronizing signals, the transformer 42 is preferably of the type generally known as an impulse transformer. This transformer has a high permeability core 47 of very small cross-sectional area. The purpose of the impulse transformer is to generate sharp voltage pulses in order to cause discharges in the "Thyratron" tubes, at the correct time intervals. By this means, random variations in the wave shape and amplitude of successive cycles of the synchronizing signals caused by imperfections in the signal generating means are reduced. When an approximately sinusoidal current is applied to the primary winding 41 of the impulse transformer 42, the flux through the core 47 changes slowly during most of the cycle due to saturation. It changes very rapidly when the current is reversed. This rapid change in flux produces a sharp voltage pulse across the secondary windings 43 and 44 which is more nearly in the desired relation to the posi-

tion of the scanning aperture on each successive cycle of the synchronizing signal than the voltages obtained from an ordinary transformer would be. For a more complete description of impulse transformers, reference may be made to Patent 1,936,153 of E. T. Burton, issued November 21, 1933. The "Thyratron" tubes T1 and T2 are of the gas-filled electron discharge type comprising respectively a cathode 48, an anode 49 and a grid 50 for T1, and a cathode 51, an anode 52 and a grid 53 for T2. Batteries 55 and 54 are placed in the grid circuits of the "Thyratron" tubes T1 and T2 respectively and resistances 57 and 56 are placed in the plate circuits of the "Thyratron" tubes T1 and T2 respectively in order to limit the peak discharge current through the "Thyratrons." The plate circuits of the "Thyratron" tubes T1 and T2 are connected in a series circuit including the condensers 10 and 11, and the cathode of the tube T1 and the terminal of the resistance 56 remote from the anode 52 of the tube T2 are connected to ground. By means of this arrangement the voltage between A and B is twice that of the voltage between either of these points and ground.

For coupling the points A and B to the deflecting plates 60 and 61 of a cathode ray tube 62 when the anode of the tube is not at ground potential, coupling condensers 63 and 64 and coupling resistances 65 and 66 are utilized. Condensers 63 and 64 are preferably of equal capacity and resistances 65 and 66 should be equal. The midpoint 67 of the high resistances 65 and 66 is connected to the anode 68 of the cathode ray device 62. By means of this balanced circuit arrangement, the average of the voltages applied to the plates 60 and 61 always substantially equals the potential of the anode 68.

The operation of the circuit shown in Fig. 1 is as follows:

Condensers 10 and 11 are charged at a substantially linear rate by means of suitable potential sources 13 and 30 and the constant current devices 14 and 31. At periodic intervals, as for example, at the end of each scanning line, a synchronizing signal is generated by the source 40 and caused to energize the primary 41 of the transformer 42. Because of the high permeability of the core 47, sharp voltage surges are induced in the secondary windings 43 and 44 which are sufficient to overcome the negative bias on the tubes T1 and T2 causing these tubes to discharge the condensers 10 and 11 simultaneously. The cyclic charge and discharge of the condensers 10 and 11 produces across the points A and B a saw-toothed wave form of the frequency of the synchronizing signals which is applied across the plates 60 and 61 by means of the coupling condensers 63 and 64 and the coupling resistances 65 and 66. This wave form is, as described above, substantially balanced with respect to the potential of the anode 68 and thus eliminates any loss of focus and distortion which would have resulted had the sweep circuit been unbalanced.

It is obvious that for many applications the impulse transformer 42 may be replaced by an ordinary transformer.

In the circuit of Fig. 1, no amplifiers are necessary. Another advantage is that the voltage output is double that which would be produced in single "Thyratron" sweep circuits. This advantage is important because the trend at the moment is toward higher and higher sweep voltages and because the voltage output of the "Thyratron" tube is limited in circuits where the

frequency is so high that the time allowed for deionization is very short. A third advantage is that there is no floating power supply, that is, one terminal of each of the batteries or potential sources 13 and 30 is connected to ground.

The circuit shown in Fig. 2 differs from that described above with reference to Fig. 1 in the manner of discharging the "Thyratron" tubes T1 and T2 simultaneously. The tubes T1 and T2 are so connected that the discharge in tube T1 will initiate practically simultaneously a discharge in tube T2. This is accomplished by applying the potential drop across resistance 70 through coupling condenser 71 and a coupling resistance 76 to the grid 53 of the "Thyratron" T2. The resistance 70 is connected between ground and the cathode 48 of tube T1 and the condenser 71 is connected between the cathode 48 of tube T1 and the grid 53 of the tube T2. A resistance 72 in the plate circuit of the tube T2 balances the resistance 70 in the plate circuit of the tube T1. Grid biasing batteries 55 and 54 similar to those described above with reference to Fig. 1 are used to negatively bias the grids 50 and 53.

The operation of the circuit shown in Fig. 2 is as follows:

Condensers 10 and 11 are charged substantially linearly with respect to time by means of the batteries or other potential sources 13 and 30 operating through constant current devices 73 and 74 which may be, for example, similar in construction and hook up to the pentode devices 14 and 31 respectively of Fig. 1. At periodic intervals, a source 40 generates a synchronizing signal which is transmitted to the grid circuit of the tube T1 by the transformer 75 which may be, for example, an impulse transformer of the type generally disclosed above in connection with Fig. 1. It should be understood that an ordinary transformer may be used or the transformer may even be dispensed with entirely. This synchronizing pulse overcomes the negative bias on the grid 50 due to the battery 55 and causes the tube T1 to discharge through the resistance 70. As the terminal of the resistance 70 remote from the cathode is connected to ground, the cathode 48 assumes a positive potential while T1 is discharging and this positive potential is conveyed by the coupling condenser 71 to the grid 53 of the second "Thyratron" tube T2. This positive pulse overcomes the negative bias on the grid 53 caused by the battery 54, thereby discharging the tube T2 through the resistance 72 simultaneously with the discharge in the tube T1. The discharges through the tubes T1 and T2 cause the condensers 10 and 11 to be discharged until the drop across the discharge path becomes so low that the discharge is stopped. The grids 50 and 53 then regain control of "Thyratron" tubes T1 and T2. There is thus generated between the points A and B a balanced voltage which is applied across the deflecting plates 60 and 61 of the cathode ray device 62 by means of coupling condensers 63 and 64 and the balanced resistances 65 and 66. As in Fig. 1 the common terminal 67 of the balanced resistances 65 and 66 is connected to the anode 68 thus insuring that the average of the voltages supplied to the plates 60 and 61 always equals the anode voltage.

While the circuits shown in Figs. 1 and 2 have been described in connection with electrostatic deflecting plates, it is obvious that the invention may be applied in the case of electromagnetic deflecting means as well.

Various other modifications may be made without departing from the spirit of the invention, the scope of the invention being defined by the appended claims.

What is claimed is:

1. In combination, a transformer having a high permeability core, a primary circuit and two secondary circuits, an input circuit of a gas-filled electron discharge device in each of said secondary circuits, and means for actuating the primary circuit of said transformer to initiate a discharge through said gas-filled electron-discharge devices simultaneously.

2. A cathode ray sweep circuit comprising a condenser, means comprising a source of potential for charging said condenser, a second condenser, means for charging said second condenser, two glow discharge devices having their discharge paths in a series circuit including said condensers, and signal means for initiating a discharge through said glow discharge devices substantially simultaneously to thereby discharge said condensers.

3. A cathode ray sweep circuit comprising a condenser, means comprising a source of potential for charging said condenser, a second condenser, means for charging said second condenser, two glow discharge devices having their discharge paths in a series circuit including said condensers, and signal means comprising a signal operated impulse transformer having a plurality of secondaries for initiating a discharge through said glow discharge devices substantially simultaneously to thereby discharge said condensers.

4. In combination, a transformer having primary and secondary windings, a gas-filled electron discharge device having input and output circuits, said input circuit being connected to the secondary winding of said transformer, a resistance connected in the output circuit, a second gas-filled electron discharge device having input and output circuits, said output circuit being connected in series with the output circuit of said first discharge device, means including said transformer for initiating a discharge through said first gas-filled electron discharge device to thereby cause the flow of current through said resistance, and means for applying the voltage drop across said resistance to the input circuit of said second gas-filled electron discharge device to thereby initiate a discharge through said second gas-filled electron discharge device substantially simultaneously with the discharge through said first gas-filled electron discharge device.

5. In combination, a gas-filled electron discharge device having a discharge path therein, a second gas-filled electron discharge device having a grid, a resistance and capacity coupling between the discharge path of said first discharge device and the grid of said second electron discharge device, and means causing a discharge through said first discharge device for initiating substantially simultaneously therewith a discharge through said second discharge device.

6. A sweep circuit comprising two condensers, means for charging said condensers substantially linearly with respect to time, two electron discharge devices having their discharge paths in a series circuit including said condensers, each of said electron discharge devices having a control element, signal actuated means for initiating a discharge through said first electron discharge device, and means comprising a resist-

ance and capacity coupling between the discharge path of said first electron discharge device and the control element of said second electron discharge device for causing a discharge through said second discharge device substantially simultaneously with the discharge through said first discharge device.

7. A sweep circuit comprising two capacities having a common terminal, means comprising two electron discharge devices for charging said capacities serially and substantially simultaneously, means for maintaining said common terminal at a fixed potential, and means for discharging said capacities substantially simultaneously.

8. A sweep circuit comprising two capacities having a common terminal, means comprising electron discharge devices for charging said capacities serial and substantially simultaneously, means for maintaining said common terminal at a fixed potential, and electron discharge means for discharging said capacities substantially simultaneously.

9. A sweep circuit comprising two capacities in series, means for grounding the common terminal of said capacities, means including two constant current devices each connected between ground and an ungrounded terminal of a respective one of said capacities for charging the capacities substantially together, and means for discharging said capacities substantially simultaneously.

10. A sweep circuit comprising two capacities in series, means for grounding the common terminal of said capacities, means including a constant current device and a source of potential connected between the external terminal of each capacity and ground for charging the capacities together, and means including a plurality of gas-filled electron discharge devices controlled by a common signal for discharging said capacities substantially simultaneously.

11. A sweep circuit comprising a capacity, means comprising an electron discharge device and a source of potential for charging said capacity substantially linearly with respect to time, means comprising a gas-filled grid-controlled electron discharge device for discharging said capacity suddenly in accordance with signals, a second capacity, means comprising an electron discharge device for charging said capacity substantially linearly with respect to time, a second gas-filled electron discharge device for discharging said second capacity suddenly, said capacities being substantially equal and having a common terminal which is grounded, and means electrically connected to both gas-filled electron discharge devices for timing their operation.

12. A sweep circuit comprising a transformer having a primary and two secondary windings, means for applying signals to the primary winding of said transformer, a gas-filled electron discharge device having an anode, a cathode and a grid, means for connecting the grid-cathode circuit of said gas-filled electron discharge device to one of the secondary windings of said transformer, a capacity, means for connecting said capacity in the anode-cathode circuit of said gas-filled electron discharge device, means for grounding the cathode and one terminal of said capacity, a pentode electron discharge device comprising an anode, a cathode and a plurality of control members, a source of potential connected between the anode of said electron pentode discharge device and ground, means for connect-

ing the cathode of said pentode through a resistance to the ungrounded terminal of said capacity, a second gas-filled electron discharge device comprising an anode, a cathode and a grid, means for connecting the grid-cathode circuit of said second gas-filled discharge device to the second secondary winding of said transformer, a second capacity which is substantially equal to said first capacity, means for connecting one terminal of said capacity to ground, means for connecting said capacity in the anode-cathode circuit of said second gas-filled electron discharge device, the anode of said gas-filled electron discharge device being connected to ground through a resistance, a second pentode electron discharge device comprising an anode, a cathode and a plurality of control members, means for connecting the anode of said pentode to the ungrounded terminal of said second capacity, and means for connecting the cathode of said second pentode electron discharge device to ground through a resistance and a source of potential.

13. A circuit comprising a condenser, a gas-filled grid-controlled electron discharge device having input and output circuits, a resistance, means for connecting said condenser in said output circuit, means for connecting said resistance in said output circuit and also in said input circuit, a second gas-filled grid-controlled electron discharge device having input and output circuits, and means for applying the voltage drop across said resistance when said first electron discharge device becomes conducting to the input circuit of said second electron discharge device.

14. A sweep circuit comprising two capacities connected in series so that they have a common terminal, a circuit in shunt with said capacities in series comprising two electron discharge devices and a source of potential, and means for connecting the common terminal of said capacities in series to a mid-tap of said source of potential.

15. A sweep circuit comprising two capacities connected in series so that they have a common terminal, a circuit in shunt with said capacities in series comprising two electron discharge devices and a source of potential, and means for connecting the common terminal of said capacities in series to a mid-tap of said source of potential and also to ground.

16. A sweep circuit comprising a transformer having primary and secondary windings, means for applying signals to the primary winding of said transformer, a gas-filled electron discharge device having an anode, a cathode and a grid, means for connecting the grid-cathode circuit of said electron discharge device to the secondary winding of said transformer, a capacity element in the anode-cathode circuit of said electron discharge device, one terminal of said capacity element being connected to ground and the cathode of said electron discharge device being connected to ground through a resistance, a pentode electron discharge device comprising anode, a cathode, and a plurality of control members, means for connecting the anode of said pentode device to ground through a source of potential, means for connecting the cathode of said pentode device to the ungrounded terminal of said capacity through a resistance, a second gas-filled electron discharge device comprising an anode, a cathode and a grid, the grid-cathode circuit of said second discharge device including a coupling condenser, means for connecting

the cathode of said first gas-filled electron discharge device to said coupling condenser, a second capacity element which is substantially equal to said first capacity element, means for connecting one terminal of said second capacity element to ground, means for connecting said second capacity element in the anode-cathode circuit of said second gas-filled electron discharge device, and a second pentode device comprising an anode, a cathode, and a plurality of control members, the anode of said second pentode device being connected to the ungrounded terminal of said second capacity element and the cathode of said second pentode device being connected to ground through a source of potential and a resistance.

17. The combination with electrostatic storage means, of means for charging said storage means, a plurality of electron discharge devices having their discharge paths connected in a series circuit including said storage means, means for initiating a discharge of said storage means through said series circuit, a work circuit including two conducting elements spaced apart and connected respectively to the terminals of said storage means, and means for utilizing the potential difference between said conducting elements.

18. The combination with electrostatic storage means, of means for charging said storage means, a plurality of grid-controlled electron discharge devices having their discharge paths connected in a series circuit including said storage means, and means including apparatus for applying pulses to the grids of said discharge devices for initiating a discharge of said storage means through said series circuit. 5

19. The combination with electrostatic storage means, of means for charging said storage means, a plurality of gas-filled grid-controlled electron discharge devices having their discharge paths connected in a series circuit including said storage means, and means including apparatus for applying pulses to the grids of said discharge devices for initiating a discharge of said storage means through said series circuit. 10 15

20. A sweep circuit comprising two condensers in series, means for charging said condensers simultaneously, a plurality of grid-controlled gas-filled electron discharge devices having their discharge paths connected in a series circuit including said condensers, and signal means for initiating a discharge through said electron discharge devices substantially simultaneously to thereby discharge said condensers. 20 25

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