

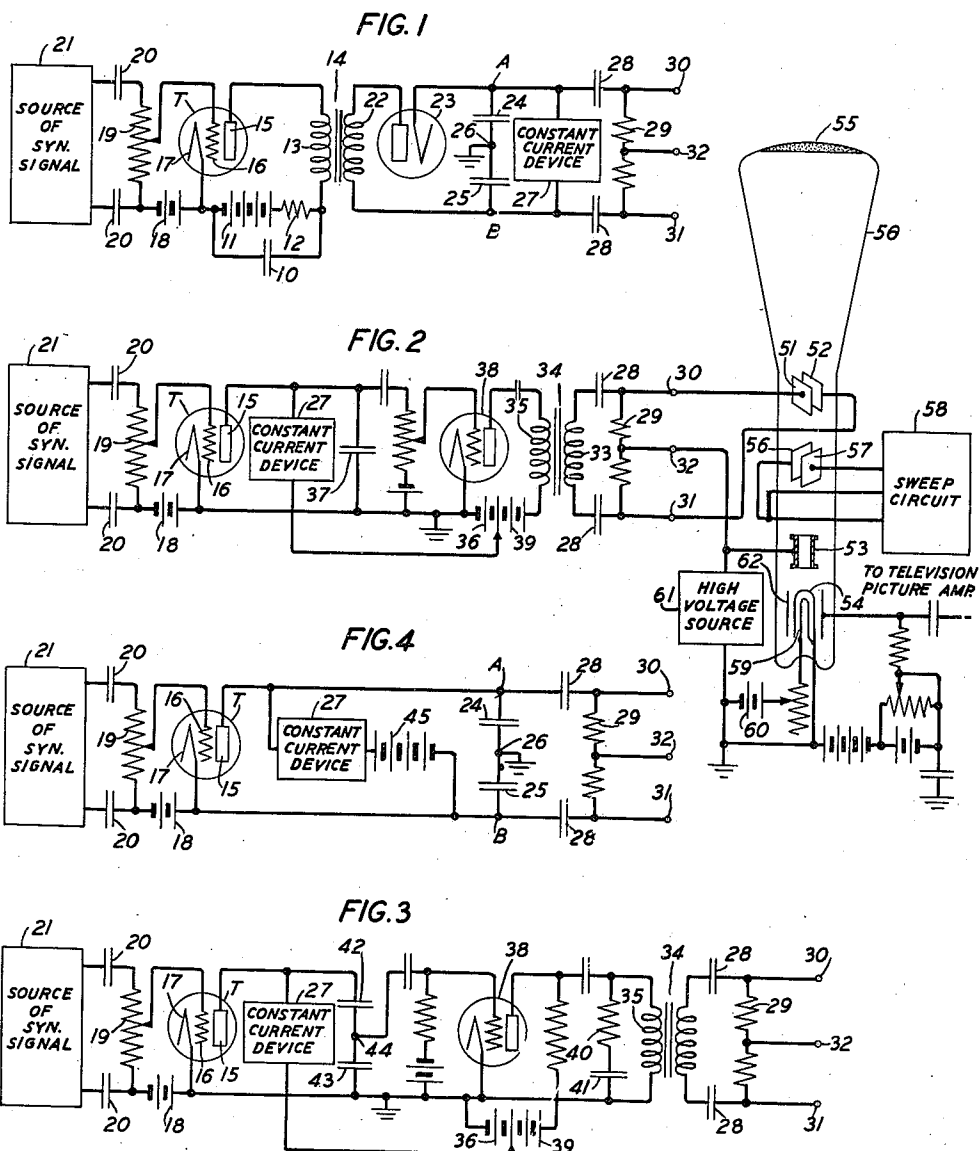
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CATHODE RAY SWEEP CIRCUIT

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CATHODE RAY SWEEP CIRCUIT

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This case relates to cathode ray devices and more specifically to cathode ray sweep circuits suitable for television scanning.

In the operation of cathode ray tubes suitable for television scanning, the sweep circuits used have been of a form in which there is an unbalance, i. e., the average of the voltages generated by each of the sweep circuits and applied to the deflecting plates of the cathode ray tube does not equal or substantially equal the potential of the accelerating anode of the cathode ray tube at all times. It has been found that this is the cause of the field on the screen of the cathode ray tube being somewhat wedge-shaped and so producing a distorted image, the reason therefor being that the velocity of the beam depends upon the average potentials applied to the sweep plates and hence the deflection in certain beam positions when these averages are not constant is greater or less than it should be. This unbalance also accounts for an unwanted intensity deviation and a loss of clear focus in parts of the image. These three manifestations are all due to the change in velocity of the beam.

It is an object of this invention to overcome the above-mentioned defects by providing sweep circuits for generating balanced sweep voltages for cathode ray tubes.

It is another object of this invention to provide novel forms of saw-toothed wave generators.

Several embodiments of this invention are herein described by way of example. In the first of these, a condenser is charged by a battery through a resistance and is discharged periodically by the action of a suitable gas-filled electron discharge device of the general type known by the name of "thyatron." Whenever the grid of the Thyatron is made more positive by a received signal, such as a synchronizing signal, the discharge circuit is completed through the tube. The surge of current caused by the discharge of the condenser is stepped up by a transformer and rectified and the resultant high voltage used to charge up almost instantaneously two equal condensers which are connected in series with their mid-point grounded. A thermionic leak, such as a saturated diode or a pentode, is shunted across the two equal condensers so as to give a discharge which varies linearly with respect to time. As the two last named condensers and their associated connections have equal capacities and their common terminal is grounded, there results a balanced sweep circuit which may be connected to the deflecting plates of a cathode ray tube through equal series condensers and a high resistance connected

between the plates, the mid-point in this resistance being connected to the anode. This circuit, as well as the other circuits described herein, produces a voltage wave shape of the well-known saw-tooth form.

A second circuit for producing balanced sweep voltages comprises a battery for charging up a condenser through a constant current device, such as a saturated diode or a pentode, a Thyatron or "trigger" tube for discharging the condenser in accordance with synchronizing signals, an amplifier for amplifying the sweep voltage, and a transformer for coupling the sweep circuit to the deflecting plates through series condensers. As in the circuit described above, a high resistance is connected across the deflecting plates, the mid-point of which is connected to the anode. As a modification of this circuit, a resistance and a capacity may be placed in parallel with the primary of the transformer to compensate for the inductance in the transformer in order to eliminate distortion of the wave shape.

In a third circuit for producing balanced sweep voltages the single wave generating condenser and the transformer coupling of the second circuit is replaced by two condensers in series with their mid-point grounded.

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

Fig. 1 shows a circuit for producing balanced sweep voltages;

Fig. 2 shows another circuit for producing the same result;

Fig. 3 is a modification of the circuit shown in Fig. 2; and

Fig. 4 shows a third circuit for producing balanced sweep voltages.

Referring more particularly to the drawing, Fig. 1 shows a sweep circuit for producing balanced voltages of saw-tooth wave form for application to the deflecting plates of a cathode ray tube to cause the cathode ray beam generated therein to scan in turn all of the elemental areas of a screen. One portion of the circuit comprises a condenser 10 which is charged by means of the battery 11 through the resistance 12. The condenser 10 is connected in series with the primary winding 13 of a transformer 14 which is connected in the plate circuit of a gas-filled electron discharge device T comprising an envelope enclosing an anode 15, a grid 16 and a cathode 17. The device may be of the type generally known as a Thyatron or trigger tube. The grid 16 of the

device 15 may be negatively biased with respect to the cathode 17 by any suitable means, such as, for example, a battery 18. Also included in this circuit between the grid 16 and the cathode 17 is a resistance 19 (which may be variable) which is coupled by means of coupling condensers 20 to a source 21 of synchronizing signals. This source 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 is used in connection with a cathode ray tube at the receiver, and a scanning disc is 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, Aug. 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 circuit at the receiving station.

When the source 21 generates a synchronizing signal, the potential of the grid 16 is made more positive, thus allowing the gas-filled tube T to fire which in turn allows the condenser 10 to discharge through the circuit including the primary winding 13 of transformer 14 and the discharge path of the Thyatron tube T. The surge as the condenser 10 discharges is stepped up by the transformer 14. In the circuit including the secondary winding 22 of the transformer 14 is a device 23 for rectifying the high voltage surge induced in the secondary winding 22 and the balanced condenser arrangement comprising condensers 24 and 25 of equal capacity connected in series with each other. The mid-point 26 of these condensers 24 and 25 may be connected to ground.

Shunted across the condensers 24 and 25 is a suitable thermionic leak or constant current device 27 which may be, for example, a saturated diode or a pentode. Preferably the device 27 comprises a pentode having an anode, cathode, control grid, screen grid and suppressor grid and having circuits so arranged that the current through the tube varies the bias of one or more of the grids so as to produce a constant flow of current through the tube regardless of voltage changes. Such a constant current device is fully described in and reference should be made to Patent 2,180,364, issued Nov. 21, 1939 to Frank R. Norton.

For coupling the sweep circuit to the deflecting plates 51 and 52 of the cathode ray oscillograph 50 (see Fig. 2) coupling condensers 28 and high resistance 29 are used. The terminals 30 and 31 of said resistance are connected to the deflecting plates 51 and 52 of the device 50. The mid-point 32 of the resistance 29 is connected to the accelerating anode 53 of the cathode ray device 50. The description of the cathode ray device 50 is amplified and its operation brought out in greater detail below in connection with Fig. 2.

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

The condenser 10 is charged by means of the battery 11 through the resistance 12, there being no discharge through the Thyatron tube T because of the negative bias on the grid 16 produced by the battery 18. At periodic intervals, as, for example, at the end of each line of the scanned object at the transmitter, a synchronizing signal is generated by the source 21 which is sufficient to overcome the negative bias on the

grid 16 and initiate a discharge in the Thyatron or trigger tube T. This discharge through the Thyatron T discharges the condenser 10 which produces a sudden surge in the primary winding 13 of the transformer 14 which in turn induces a surge of higher voltage in the secondary winding 22. The rectifying device 23 permits one-half of the surges to become effective in charging instantaneously the condensers 24 and 25. After the surge has passed, the rectifying device 23 will prevent the condensers 24 and 25 from discharging through the circuit including the secondary winding 22 of the transformer 14. The charge across the condensers 24 and 25 is slowly dissipated through the constant current device 27. If the constant current device is a pentode electron discharge device having a feedback on one or more of its grids as described in the above-mentioned Norton patent, the rate of discharge will be substantially linear. It should be noted that the wave form produced by this sweep circuit differs from that produced by most of the well-known sweep circuits in the past in that it has an almost instantaneous charge and a slow discharge instead of a slow charge and an almost instantaneous discharge. It is, of course, obvious that both types of circuits may be utilized with equal ease to produce linear scanning of the screen in a cathode ray tube. By means of the transformer 14, a very high voltage can be induced in the secondary circuit including the condensers 24 and 25 in series and the value of this voltage is not determined by the voltage limitations of the discharge tube T. The maximum voltage obtainable across a Thyatron tube is frequently limited in circuits in which only a small period of time is allowed for deionization, as in the case in high frequency sweep circuits. In this circuit a higher voltage can be obtained across the condenser than would be possible with a Thyatron tube alone. The mid-point 26 of the equal capacity condensers 24 and 25 is connected to ground and as the coupling condensers 28 are of equal capacity and the anode 53 of the cathode ray oscillograph is connected to the mid-point 32 of the high resistance 29, the sweep potentials applied to the deflecting plates 51 and 52 of the device 50 are substantially balanced with respect to the potential of the anode 53, that is, the average of the potentials applied to the two plates at all times is substantially equal to the anode voltage. By means of the balanced sweep voltages, there is no loss of focus or distortion which would otherwise result if the sweep voltages were unbalanced. Furthermore, a square or rectangular pattern is produced on the screen of the tube in place of the wedge-shaped pattern which would be produced with unbalanced sweep voltages.

Fig. 2 shows another sweep circuit for producing balanced sweep voltages in which a transformer 34 is used to insulate the deflecting plates from a circuit having one side grounded. In this circuit equal coupling condensers 28 and coupling resistances 29 are used which are similar to those described above in connection with Fig. 1. The coupling condensers are necessary in order to insulate the transformer from the deflecting plates as the insulation between the primary and secondary windings of the transformer 34 is not able to withstand the high anode voltage. The secondary side 33 of the transformer 34 is thus balanced. If an unbalanced sweep circuit were connected directly to the coupling condensers 28, the resulting sweep voltage applied across the deflecting plates 51 and 52 would also be unbalanced

because one plate would remain at a potential which is fixed with respect to ground. This difficulty is avoided by using the transformer 34 to insulate the unbalanced sweep circuit on the primary side 35 of the transformer 34 from the coupling condensers 28 on the secondary side of the transformer.

The circuit of Fig. 2 comprises a means such as source of potential 36 and a constant current device 27 which may be for example similar to the one described above in connection with Fig. 1, for charging a condenser 37 linearly with respect to time. The means for discharging the condenser 37 is the same as that used in Fig. 1 and comprises a source of synchronizing signals 21 adapted to overcome at periodic intervals the negative bias of the grid 16 of the trigger tube T to cause a discharge therethrough which discharges with it the condenser 37. The resulting sweep voltage is amplified by means of a suitable electron discharge device 38 which has an output circuit including the primary winding 35 of the transformer 34 and batteries 36 and 39 in series to produce suitable plate potential. As the secondary circuit of the transformer 34 including the secondary winding 33 of the transformer, coupling condensers 28 and high resistance 29 is balanced with respect to the anode 53 of the cathode ray tube 50, and as no point in the secondary circuit other than the mid-point of the resistance 29 is at a fixed potential with respect to any point in the primary circuit of the transformer 34, the resultant sweep voltage applied to the deflecting plates 51 and 52 of the cathode ray tube 50 is substantially balanced with respect to the potential of the accelerating anode 53. In other words, the transformer 34, with its balanced secondary circuit, overcomes the effect of the unbalanced primary circuit and thus causes balanced sweep voltages to be applied across the deflecting plates 51 and 52 of the cathode ray tube 50.

The cathode ray device 50 comprises a means, such as a cathode 54 for generating an electron beam, proper focusing means (not shown) for giving this beam the proper diameter and for accelerating it toward a fluorescent screen 55, an accelerating anode 53, and two sets of deflecting plates 51, 52 and 56, 57 for causing the beam to scan in turn every elemental area of the screen 55. Across deflecting plates 51, 52 is connected a sweep circuit such as is described in this specification for generating saw-toothed wave forms. Across the other set of plates 56, 57 is connected a sweep circuit 58 which is similar to that connected to the plates 51, 52 except that the frequency of oscillations is different, which difference causes the resulting circuit constants to be also different. To better understand this, let it be assumed that one of the circuits described in Figs. 1, 2, 3, is connected to the plates 51, 52 and is adapted to deflect the beam horizontally across the screen 55. A synchronizing signal is generated at the conclusion of every scanning line and the frequency of oscillations is thus the number of frames scanned per second times the number of elemental lines. The sweep circuit 58 may be used to produce vertical deflection and its source of synchronizing signals (not shown) then generates a signal once every frame. The lower frequency of oscillation thus resulting causes necessary changes in the capacity of the condensers and the inductance of the transformer to correspond to the lower frequency.

The cathode 54 of the cathode ray device 50 is heated by any suitable means such as a heater

59 receiving current from a suitable source such as the battery 60. The cathode 54 may be placed at ground potential and the high voltage source 61 connected between the cathode 54 and the accelerating anode 53. Any suitable means such as the modulating member 62 may be used to change the intensity of the cathode ray beam in accordance with the varying intensity of the image current transmitted from the transmitting station.

While the cathode ray device 50 was described above in connection with television reception, it is of course to be understood that a sweep circuit embodying this invention may be used with cathode ray transmitting tubes or with similar tubes for oscillographic or other purposes requiring balanced sweep voltages.

The circuit shown in Fig. 3 is a modification of the circuit of Fig. 2. The circuit of Fig. 3 differs from that of Fig. 2 in that there is provided in the primary circuit of the transformer 34 a resistance 40 and a condenser 41 the purpose of which is to increase the low frequency range of the transformer 34. The resistance 40 and the capacitance 41 thus tend to correct for the distortion introduced by the inductance of the core of the transformer 34. Another difference existing between the circuits of these two figures is that the condenser 37 of Fig. 2 is replaced by the condensers 42 and 43 in series, which may or may not be of equal capacity, the common terminal 44 of which is connected to the grid circuit of the amplifying tube 38. The condensers 42 and 43 are used to reduce the voltage applied to the amplifying tube 38 as only a fraction of the saw-toothed voltage is tapped off.

Various modifications may obviously 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 a sweep circuit, a condenser, means for charging said condenser, means for discharging said condenser at predetermined intervals, means for utilizing the discharge of said condenser to charge up two condensers in series having a common terminal at a fixed potential, and means for discharging said condensers in series at a substantially constant rate to produce a sweep potential wave which is balanced with respect to said fixed potential.

2. In a sweep circuit, a condenser, means for charging said condenser, signal responsive means for periodically discharging said condenser to produce pulses, means for transforming said pulses to produce high voltage surges, a second condenser, means for causing said second condenser to be almost instantaneously charged by each of said surges, and means for discharging said second condenser at a substantially constant rate.

3. Means for producing a pulsating current which alternately abruptly rises and slowly falls comprising a gas-filled discharge tube, a condenser connected between an anode and cathode of said tube, means for charging said condenser, signal responsive means for periodically impressing a potential upon said tube which results in ionization therein to cause said condenser to discharge therethrough, a second condenser under control of the current resulting from said discharge so that it is charged when said first condenser is discharged, and means not in circuit with said first condenser for slowly discharging said second condenser so as to cause the potential

thereacross to decrease at a substantially uniform rate.

4. In a sweep circuit, a condenser, means for charging said condenser, means for periodically discharging said condenser, means including a transformer having a primary and secondary for utilizing the discharge of said condenser to charge up two condensers in series, means for discharging said condensers in series at a substantially constant rate, and means for preventing the discharge of said condensers in series from passing through the secondary winding of said transformer.

5. In a sweep circuit for a cathode ray device having a cathode, a beam accelerating anode and a pair of beam deflecting elements, a condenser, means comprising a source of potential for charging said condenser, means comprising a gas-filled electron discharge device for discharging said condenser at predetermined intervals, a transformer comprising primary and secondary windings, means for connecting the primary winding of said transformer in circuit with the discharge path of said discharge device and said condenser, means for connecting the secondary winding of said transformer in circuit with a unilaterally conducting electron discharge device and two equal capacities in series, means for connecting the common terminal of said capacities to a point of fixed potential, means in parallel with said equal capacities in series for discharging said capacities at a substantially constant rate, and means for connecting the external terminals of said capacities to said pair of deflecting elements.

6. A sweep circuit for producing balanced sweep voltages for scanning in a cathode ray tube comprising a condenser, means for charging said condenser, signal actuated means for periodically and quickly discharging said condenser, means for transforming the discharge voltage of said condenser, means for rectifying the transformed voltage, means for applying said rectified voltage to the external terminals of two equal capacities connected in series with their common terminal connected to a point of fixed potential in order to quickly charge said capacities, and means comprising an electronic discharge device in parallel with said capacities for discharging said capacities at a substantially constant rate.

7. In a saw-tooth wave generator, a circuit network including an inductor, a rectifier, and a capacitor in series, a resistor connected in shunt relation to the capacitor and means separate and distinct from said rectifier for periodically causing an abruptly changing potential to appear across the inductor, said capacitor and said resistor having relative values such that substantially the entire voltage appearing across said resistor has a saw-tooth wave form.

8. In a sweep circuit, a condenser, means for charging said condenser, means for periodically discharging said condenser, means including a transformer having a primary and secondary for utilizing the discharge of said condenser to charge up a second condenser, means for discharging said second condenser at a substan-

tially constant rate, and means for preventing the discharge of said second condenser from passing through the secondary winding of said transformer.

9. In a sweep circuit, a source of periodic voltage, means for generating peaked voltage pulses spaced apart in time under control of said periodic voltage, a step-up transformer of the inductive type upon which said pulses are impressed, a condenser in series with the secondary of said transformer whereby said condenser is abruptly charged by each pulse in a given direction within a relatively small portion of each sweep cycle, and means for causing said condenser to discharge at a slower rate than it was charged.

10. In a sweep circuit, means for generating peaked voltage pulses spaced apart in time, said means including a condenser, a source of charging current for said condenser and means for abruptly discharging said condenser, a step-up transformer of the inductive type upon which said pulses are impressed, a second condenser in series with the secondary of said transformer whereby said second condenser is abruptly charged by each pulse in a given direction within a relatively small portion of each sweep cycle, and means for causing said second condenser to discharge at a slower rate than it was charged.

11. In a sweep circuit, a source of periodic voltage, means for generating peaked voltage pulses spaced apart in time under control of said periodic voltage, a step-up transformer of the inductive type upon which said pulses are impressed, a condenser and a rectifier in a series circuit including the secondary of said transformer whereby said condenser is abruptly charged by each pulse in a given direction within a relatively small portion of each sweep cycle, and means for causing said condenser to discharge at a slower rate than it was charged, said rectifier acting to prevent said condenser from discharging through said transformer.

12. In a saw-tooth wave generator, a transformer, means for periodically and abruptly building up a current through the primary of said transformer to thereby develop a high potential across the secondary of said transformer, said means including an electric discharge tube having an input circuit across which is connected a source of synchronizing signals and having an output circuit in which the primary of said transformer is included, a capacitor, means for utilizing the high potential in a given direction to apply a charge to the capacitor, and means for causing the charge to leak off at a relatively slow rate whereby a saw-tooth wave appears across said capacitor.

13. The invention set forth in claim 12 additionally characterized in that said second means includes a rectifier in series with said capacitor.

14. The invention set forth in claim 12 additionally characterized in that said second means includes a rectifier in series with said capacitor and in that said last means is a resistor in shunt relation to said capacitor.

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