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CIRCUITS FOR GENERATING ELECTRICAL OSCILLATIONS OF SAWTOOTH WAVEFORM

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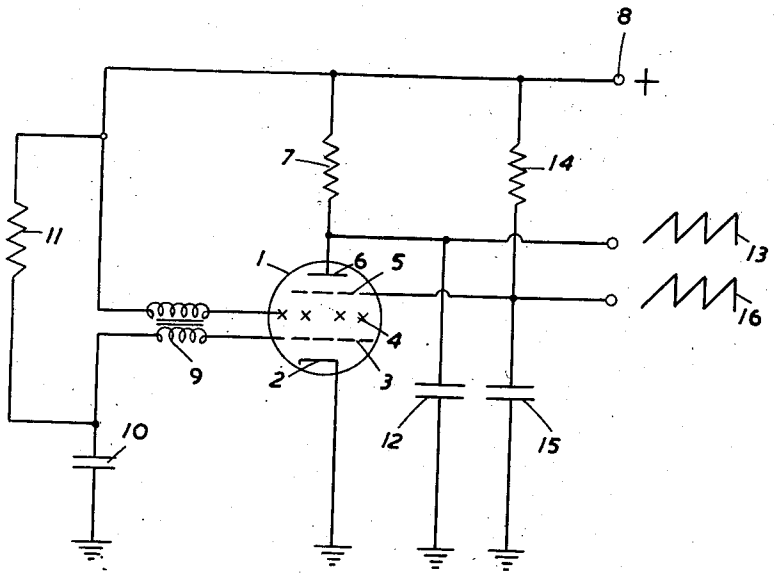

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CIRCUITS FOR GENERATING ELECTRICAL OSCILLATIONS OF SAWTOOTH WAVEFORM

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5 Claims. (Cl. 250—36)

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This invention relates to circuits for producing electrical oscillations of sawtooth waveform, such as are employed for example for deflecting the beam of a cathode ray tube of television apparatus, oscillographs and the like, the circuits being of the type comprising an electron discharge tube of the pentode type having a pair of its electrodes other than its suppressor electrode intercoupled in such manner that on the operation of the circuit said tube is arranged to be rendered alternately conducting and nonconducting, and a capacitor which is arranged to be charged via a charging resistance during the nonconducting periods of said tube to generate the long flanks of a sawtooth voltage waveform and to be discharged via said tube when the latter is rendered conducting whereby to generate the short flanks of the sawtooth voltage waveform.

The object of the invention is to provide an improved circuit of the type referred to and, in accordance with the invention, there is provided a circuit of the type described wherein said suppressor electrode is connected via a resistance to a source of positive voltage whereby to bias said electrode positively, and a further capacitor is provided which is arranged to be charged via said resistance during nonconducting periods of said tube and to be discharged via said tube during conducting periods of said tube.

In order that the said invention may be clearly understood and readily carried into effect, the same will now be more fully described with reference to the accompanying drawing, the single figure of which illustrates an example of a circuit, according to the invention, incorporating an electron discharge tube arranged to function as a "blocking oscillator."

Referring to the drawing, the circuit includes an electron discharge tube 1 of the pentode type having a cathode 2, a control electrode 3, a screen electrode 4, a suppressor electrode 5 and an anode 6. Cathode 2 is connected to ground, and anode 6 is connected via a charging resistor 7 to the positive terminal 8 of a voltage source. Screen electrode 4 is also connected to positive terminal 8, via the primary winding of a transformer 9, the secondary winding of which is included in the circuit of control electrode 3 whereby a regenerative coupling is provided between the control electrode and screen electrode circuits. Said secondary winding is connected between control electrode 3 and one electrode of a capacitor 10 the other electrode of which is connected to ground. The ungrounded electrode of

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capacitor 10 is connected via a resistor 11 to positive terminal 8. A capacitor 12 is connected between anode 6 and ground.

The operation of the circuit as so far described is as follows:

Assuming that control electrode 3 is initially at a negative potential such that tube 1 is nonconducting, capacitor 12 is charged at a relatively slow rate via charging resistor 7, the potential of anode 6 rising in a substantially linear manner as indicated by the long flanks of the sawtooth waveform 13. At the same time capacitor 10 is charged via resistor 11 and the potential of control electrode 3 rises. When the potential of control electrode 3 rises to the extent that current flows in the screen electrode circuit, tube 1 oscillates by reason of the regenerative coupling afforded by transformer 9 so that the control electrode is driven strongly positive, thereby causing the flow of curent in the control electrode circuit, whereby control electrode 3 is driven strongly negative and the flow of current in the control electrode and screen electrode circuits ceases. During the time that current flows in the screen electrode circuit tube 1 is conducting, so that the capacitor 12 is discharged relatively rapidly and the potential of anode 6 falls, as indicated by the short flanks of waveform 13. When control electrode 3 is driven negative capacitor 10 is negatively charged and tube 1 becomes nonconducting and the cycle recommences.

Resistor 7 must be of low value compared with shunt resistances in the circuit to which the output of tube 1 is applied, for example the grid leak resistor of a subsequent tube, in order not to reduce the effective charging voltage of capacitor 12 appreciably below the voltage of terminal 8. Capacitor 12 is preferably arranged to be discharged to a relatively low potential, since for a maximum permitted distortion the amplitude of the generated sawtooth voltage depends on the difference between tne anode supply voltage and the potential to which anode 6 drops during the conducting periods of tube 1. For this and other reasons a relatively large current should flow between cathode 2 and anode 6 when tube 1 is conducting. In order to increase the current flow to the anode, suppressor electrode 5 is maintained at a positive potential at least during the conducting periods of said tube. It is found that the current flow to anode 6 during said periods is thereby appreciably increased. Thus, with a supply voltage of 300 v., anode 6 may be arranged with the arrangement described

to pass up to 80 per cent of the screen electrode current, if electrode 5 is at 30 v. positive whereas with electrode 5 connected to cathode 2, as is usually the case with a suppressor electrode, the anode current may amount only to about 10 per cent of the screen electrode current.

In order to maintain the electrode 5 at said positive potential, it is connected to terminal 8 via a resistor 14 of high value and to ground via capacitor 15. Thus, when the tube 1 is non-conducting, the capacitor 15 is charged from the voltage source connected to terminal 8 and the potential of the electrode 5 rises as the potential of the anode 6 rises. The rise of potential of the electrode 5 is less than that of the anode so that the electrode 5 can still function as a suppressor electrode. Thus, when the tube 1 is rendered conducting, the electrode 5 is at a positive potential for the reason aforesaid. The capacitor 15 is discharged substantially simultaneously with the capacitor 12. This arrangement affords a further advantage in that a second voltage of substantially sawtooth waveform is set up across capacitor 15, as indicated by the sawtooth waveform 16. If it is desired to arrange for the amplitudes of the sawtooth voltages across capacitors 12 and 15 to be independently variable, resistors 7 and 14 may be connected to independently adjustable sources of positive voltage instead of to a common terminal as shown. Said two sawtooth voltages may be employed for example for deflecting the beams of a pair of simultaneously operating cathode ray tubes.

The invention has been described by way of example as applied to a circuit of the "blocking oscillator" type. It will be appreciated however, that the invention can be applied to other types of circuit, for example circuits in which an additional electron discharge tube is provided, in place of the transformer 9, for effecting the phase reversal necessary to cause oscillation.

We claim:

1. A circuit arrangement for producing sawtooth electrical oscillations, comprising an electron discharge tube having an anode and a cathode and further electrodes disposed between said anode and cathode, said further electrodes comprising at least a control electrode, a screen electrode and a suppressor electrode, a capacitor connected in the anode-cathode circuit of said tube, a charging resistor to charge said capacitor, a further capacitor connected to said suppressor electrode, a charging resistor to charge said further capacitor, means for intermittently rendering said tube conducting between said cathode and said anode to discharge said capacitors, and means for maintaining all of said further electrodes at positive potentials with respect to said cathode during conducting periods of said tube.

2. A circuit arrangement according to claim 1, including a source of potential positive with respect to said cathode, said suppressor electrode being permanently connected to said source of potential.

3. A circuit arrangement according to claim 2, including a regenerative coupling between said screen electrode and said control electrode, whereby said control electrode intermittently attains positive potentials with respect to said cathode.

4. A circuit arrangement for producing sawtooth electrical oscillations, comprising an electron discharge tube having an anode and a cathode, a control electrode, a screen electrode and a suppressor electrode, a charging resistor, said anode being connected via said charging resistor to a point of positive potential, said screen electrode being connected to a point of positive potential, and said cathode being grounded, means for intermittently bringing said control electrode to a positive potential with respect to said cathode, a capacitor connected between said anode and ground, a further capacitor connected between said suppressor electrode and ground, and a charging resistor connecting said suppressor electrode to a point at a positive potential with respect to said cathode.

5. A circuit arrangement according to claim 4, said means for intermittently bringing said control electrode to a positive potential with respect to said cathode comprising a regenerative coupling between said screen electrode and said control electrode.

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