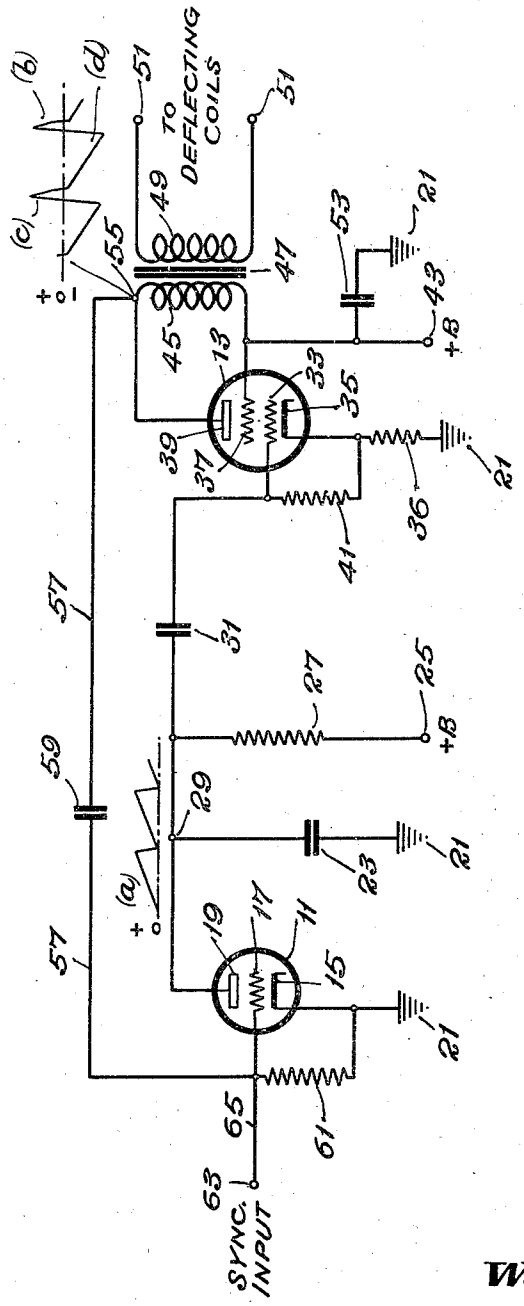
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SELF-SYNCHRONIZED SAW-TOOTH GENERATOR

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SELF-SYNCHRONIZED SAW-TOOTH GENERATOR

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This invention relates to television or oscillographic apparatus, and is particularly concerned with the circuits thereof serving to supply energy to the deflecting coils or plates of a cathode ray tube to deflect the electron beam therein developed across an impacted target area.

Broadly speaking, the invention is concerned primarily with television receiving or transmitting apparatus wherein a cathode ray tube is used either as an image scanning or an image reproducing tube, although the invention also finds application to the usual oscillograph type of apparatus wherein a transient or other phenomena produced on the viewing target by a cathode ray tube is caused to appear at predetermined repetition rates.

In its essence, the invention herein to be disclosed includes the use of a triggering and discharge tube in co-operative relationship with respect to an energy storing element and arranged to co-operate with a suitable output tube which delivers energy to the electron beam deflecting system.

In combination with this arrangement, provision is made for feeding back a portion of the energy from the output tube to the discharge tube to control its operation. Provision is also made for exercising an external control over the rate at which the discharge tube is controlled by the energy feedback from the output tube by means of a synchronizing impulse serving as an auxiliary control to lock definitely the operational cycle to some desired value.

In its essence, the invention herein provided is for the purpose of simplifying previously known circuits and, at the same time, avoiding the use of the frequently used so-called "blocking oscillator" tube normally used to develop energy pulses to control the discharge action of the discharge tube whereby the desired form of sawtooth wave energy is developed.

A still further object of this invention is that of providing a circuit and system which operates efficiently and yet avoids the necessity of heretofore used oscillator tubes incorporating both tube elements, transformers and the like, so that the present invention not only makes provision for reducing the number of tubes heretofore used and required for deflection purposes, but also is of a nature such that the weight of the component parts of the system is reduced by virtue of the complete omission of heretofore used transformers embodying heavy iron cores or the like.

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Other objects and advantages of the invention are those of providing simplifications in circuit arrangements which overcome known defects of prior art systems and which, at the same time, serve to provide improved operation of the complete system.

Other objects and advantages will become apparent from reading the following specification and claims in connection with the accompanying drawing, wherein one form of circuit capable of accomplishing the aims and objects of the invention has been set forth by way of diagrammatic illustration.

Referring now to the drawing, the herein described deflecting circuit comprises essentially two independent tube elements 11 and 13, in which the tube 11 serves as the so-called discharge tube and the tube 13 serves as the so-called output tube which is to deliver the energy to the electron beam deflecting system.

In the arrangement disclosed, the discharge tube 11 comprises essentially an envelope including a cathode 15, a control electrode 17 and an anode or plate electrode 19, with the cathode 15 preferably connected to ground 21 in its normal form of operation, although it is apparent that the connection may be made to any other point of substantially fixed potential.

Connected between the output or anode element 19 and ground 21 is a storage condenser 23 which is adapted to be charged from a source of energy (not shown) but connected to the terminal 25, marked +B (thus representing also a source of plate potential) which charges the condenser 23, preferably through the high resistor 27, so that when the condenser is periodically discharged by conduction within the discharge tube 11, a sawtooth voltage wave, such as that represented at (a), will be produced at the point 29, and represents the potential of the upper plate of the condenser 23 relative to ground 21, for instance. In normal operation, the sawtooth voltage wave (a) appearing at the point 29 is then fed by way of the coupling condenser 31 to the control electrode 33 of the output tube 13, which includes also the cathode 35, the screen electrode 37 and the plate or anode output electrode 39, with the cathode element 35 preferably biased relative to ground 21 by the biasing resistor 36.

The leak resistor 41 connects the control electrode 33 to ground, and the output electrode 39 connects to a source of anode potential (not shown), also represented by +B at the terminal point 43, which connection is made by way of the terminal winding 45 of an output transformer 47.

The secondary winding 49 of the output transformer 47 connects to the deflecting coils (not shown) of the cathode ray tube at the terminal points 51, and this connection may or may not be bridged by a tube of the general type known in the art as a "damping" tube, which will be determined largely in accordance with the frequency of the deflecting energy applied to the deflecting coils.

It will be noted that the screen electrode 37 is also shown as deriving its potential relative to ground 21 by virtue of the connection of the source of energy at the terminal 43. High frequency energy is by-passed to ground 21 from the source connected to the terminal 43 by way of the condenser 53. Thus, voltage for both the screen electrode 37 and the plate or anode electrode 39 is supplied from the terminal 43 and flows through the transformer primary 45.

A connection is provided between the terminal point 55 at the upper end of the transformer primary 45 back to the control electrode 17 of the discharge tube 11 through the conductor 57 in which is provided the capacity element 59. At the same time, a leak resistor 61 is provided between the control electrode 17 of the discharge tube 11 and ground 21.

In case of electrostatic deflection of a cathode ray beam, the transformer 47 may be omitted and the energy output from tube 13 may be fed to the electrostatic deflecting plates (not shown) and a suitable form of differentiating circuit is then included in the line 57 to supply an energy pulse to control the operation of the discharge tube 11, as will hereinafter become more apparent in considering the operation of the system.

Control impulses from any suitable source of synchronization pulses may be applied to regulate the operation of the system from an external source by way of the connection provided at the terminal 63 by way of the conductor 65 to the control electrode 17. As an alternative, the synchronizing control signal may be supplied through a resistor (in a manner customary to apply input signals) or it may be supplied through a coupling condenser to the control electrode 17 of the discharge tube 11, or, alternatively, such synchronizing signal may be fed into the cathode circuit of the discharge tube 11 in known manner.

In the operation of the circuit that is herein disclosed, it is to be understood that it is to accomplish generally the aims and objectives of the usually known deflection circuits in the known types of deflection circuits, wherein a tube of the blocking oscillator type is used. Such a tube operates generally to produce oscillations by virtue of a coupling connection provided between the output and the input circuit through a transformer with the feedback energy adapted to apply a charge to a grid condenser to drive the tube grid positive. At such time, the grid potential becomes quite positive with regard to the cathode of the tube, so that the tube commences to draw grid current and, accordingly, a negative charge is placed on the grid condenser which then tends to block the tube or bias the cutoff. The same potentials which are active upon the control electrode of the blocking oscillator tube are applied to the control electrode or grid of the discharge tube, which would be equivalent to the tube 11 herein disclosed. However, in the circuit herein set forth, it will be noted that there is no blocking oscillator tube included in the system, but, to the contrary, the synchronizing signal input energy which is in the nature of a pulse, it being assumed herein

that the synchronizing signals for controlling the operation of the cathode ray device have been separated from video signals which they accompany, will be applied to the input terminal 63. Let it be assumed, then, that the tube 11 is caused to draw current at such a time.

Prior to the time when the tube 11 draws current, the condenser 23 has been charging through the resistor 27, so that the upper plate of the condenser charges positively relative to ground along the path indicated by the sawtooth wave form (*a*), but as soon as the tube 11 draws current, the charge in the condenser is discharged through the tube and a new charge is built up to form the next cycle of the sawtooth wave form.

The voltage thus appearing at the point 25 is then transferred through the coupling condenser 31 to control the grid of the output tube 13 and to cause it to draw current, with the controlling voltage being of the form shown by the wave (*a*). When the tube 13 draws current, its output energy is fed through the transformer primary 45, but by virtue of the effect of the transformer winding, there is produced not only a sawtooth component, as represented by the wave (*b*), but also an impulse component of opposite polarity, in this instance positive as indicated by the tip portions (*c*) of the wave (*b*), as well as sawtooth component (*d*) herein indicated as being of negative polarity. The impulse component (*c*) is then fed back to the control electrode 17 of the discharge tube 11 through the condenser 59, so that it will serve to trigger the tube 11 and cause it to draw current to discharge the condenser 23 which has acquired a charge intermediate the recordings of each of the impulse components (*c*) and thus another sawtooth of energy is applied to the control electrode 33 of the output tube.

In the case of the transformer shown, the impulse section of the wave is available, as well as the sawtooth section, but if only the sawtooth section were developed, it is apparent that the impulse section could still be made available by feeding a part of the output of the output tube 13 to condenser 59 through any desired type of differentiating circuit.

Whatever charge is built up in the condenser 59 by virtue of the feedback connection (both to cause tube 11 to draw current and later to block it) leaks off within the time cycle measured by the time constant of the condenser 59 and the leak resistor 61, either of which elements may be varied as desired to alter the time constant.

From what has been stated, therefore, it is apparent that the operation of the tubes 11 and 13, taken together, provides a purely automatic means to provide for the generation of sawtooth wave impulses which may be transferred to the output terminals 51 to control the deflecting coils (not shown) for deflecting a cathode ray beam. The rate at which the sawtooth deflection takes place will be determined, generally speaking, by the time constant introduced through the condenser 59 and the resistor 61. However, for the purpose of exercising an auxiliary control, it is apparent that the receipt of synchronizing impulses at the terminal 63 will be adequate to trigger the tube 11, if the time constant of the condenser 59 and the resistor 601 is made equal to, or just very slightly longer, or even just slightly shorter (under some conditions) than the time interval between the receipt of successive impulse synchronizing signal energy at the input terminal 63. Thus, the synchronizing signals, as received, serve to lock the frequency of the sawtooth wave en-

ergy, shown by curve (*a*), to cause the deflection to be completely synchronous with that of the control point, but, in the absence of receipt of synchronizing signals, the circuit functions in purely automatic manner to maintain the continual deflection of the cathode ray beam which is controlled by the deflecting coils not shown.

It is apparent, furthermore, that the charging energy to the condenser **23** may be varied by variation of the value of the resistor **27** so as to control, for instance, either the height or the width of the picture, in accordance with the amplitude of the deflection produced, or this control may be exercised by virtue of a second resistor placed in series with the resistor **27**.

Other and further modifications may be resorted to where such modifications fall within the spirit and scope of what is hereinafter claimed.

I claim, and desire to secure by Letters Patent, the following:

1. A sawtooth wave generating circuit comprising an electrical storage element having one terminal thereof connected to ground, a source of energy and a substantially constant current element connected to the ungrounded terminal of said storage element normally to charge it relatively slowly in the direction of maximum charge, a first thermionic means having an anode, a cathode, and a control electrode, a direct connection from the cathode to ground and a connection from the anode to the ungrounded terminal of said storage element to reduce the charge abruptly substantially to a minimum value during conductive periods of the said thermionic means, a

second thermionic means connected to said energy storage element to produce amplified output energy of a wave form closely approximating that of the electrical charge in said storage element, a differentiating means for developing energy pulses from the amplified output energy at time periods corresponding to the abrupt change in storage element charge, a time constant circuit including a series connected capacity and a resistor element for supplying said developed energy pulses to the first thermionic means to control the operative periods thereof, said time constant period being of the same order as that desired in the developed sawtooth wave, and a utilization circuit connected to respond to the output energy of the second thermionic means.

2. The wave generating circuit claimed in claim 1 comprising, in addition, means for supplying auxiliary control signals of predetermined frequency to said first thermionic means whereby the frequency of the developed sawtooth substantially coincides with that of the control signals.

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