March 16, 1937. W. A. TOLSON 2,074,033

IMPULSE GENERATOR

Filed March 22, 1934 2 Sheets-Sheet 1

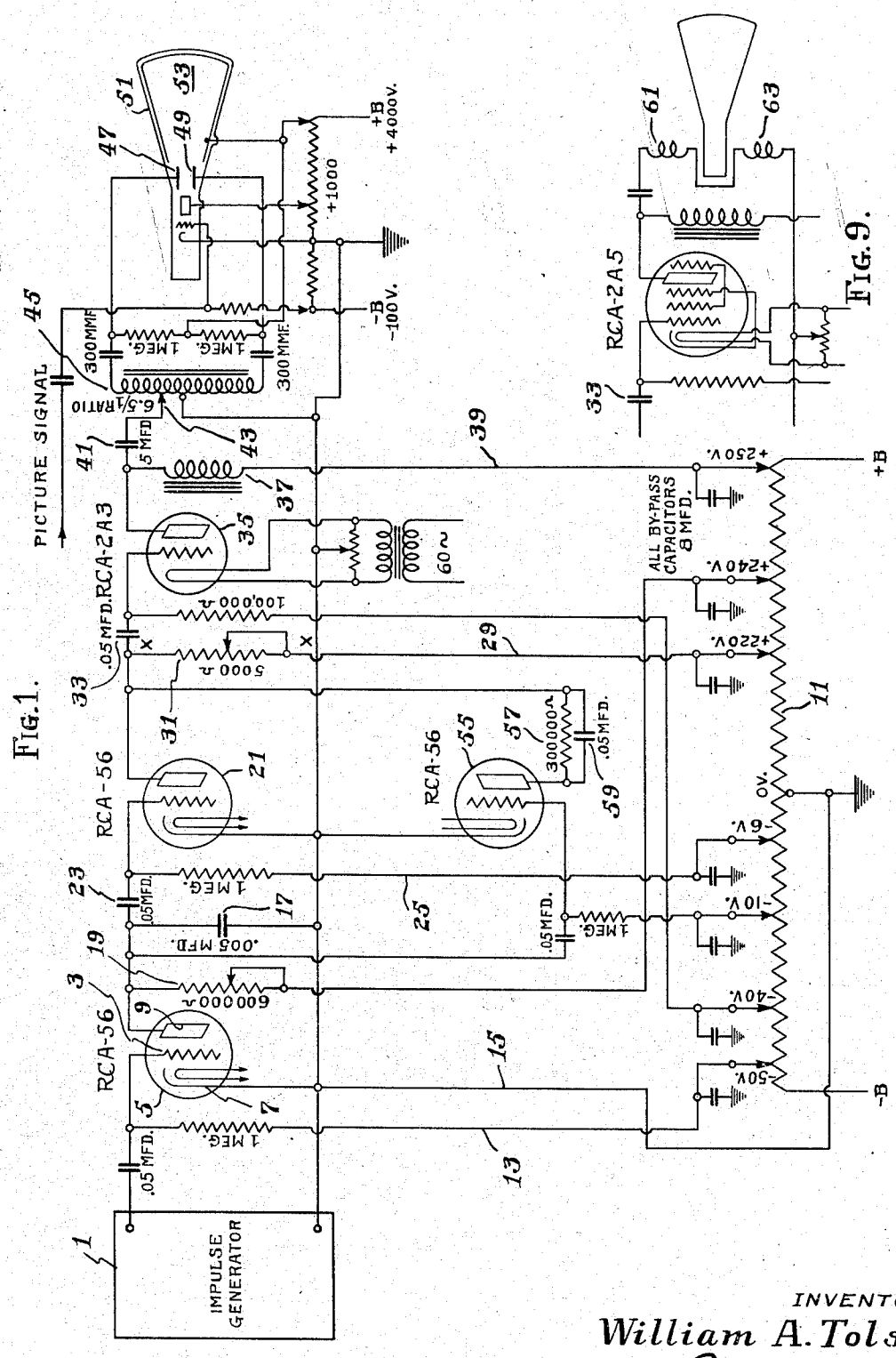


FIG. 1.

FIG. 9.

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FIG. 2

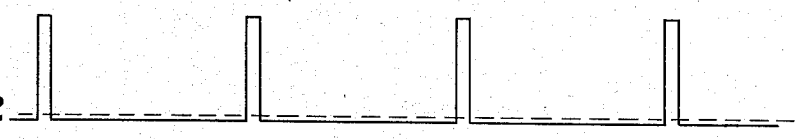


FIG. 3

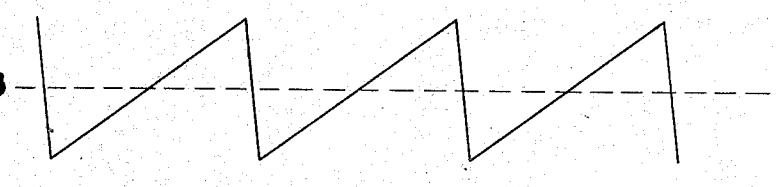


FIG. 4

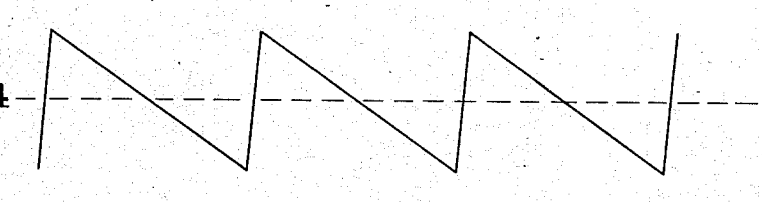


FIG. 5

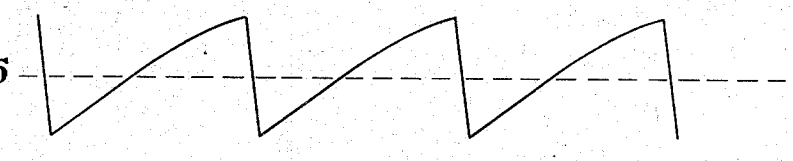


FIG. 6.

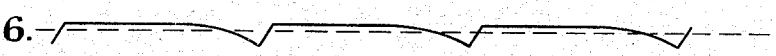


FIG. 7.

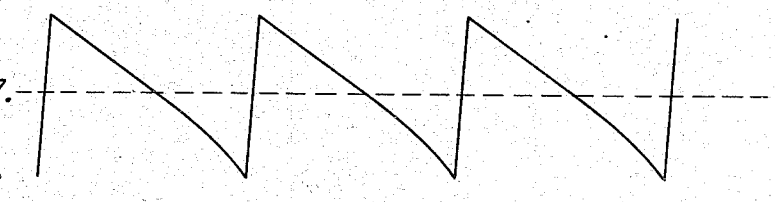
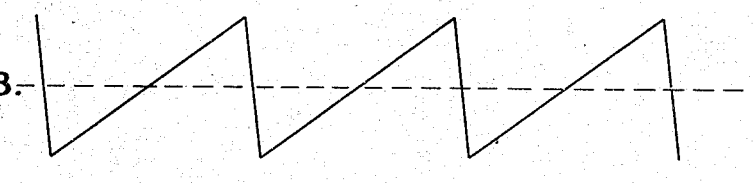


FIG. 8.



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2,074,033

IMPULSE GENERATOR

William A. Tolson, Westmont, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application March 22, 1934, Serial No. 716,839

8 Claims. (Cl. 250—36)

My invention relates to impulse generators and more particularly to generators of the type adapted to provide either saw-tooth current waves or saw-tooth potential waves.

In television receivers of the type utilizing cathode ray tubes as translating devices for rendering visible incoming radio signals representative of a view at a distant transmitter, it is expedient, for ray-deflection, to apply across the path of the electron stream a flux or a potential that periodically increases uniformly from a negative to a positive value and then decreases rapidly to the starting potential or vice versa. By reason of the fact that the graph of the flux or potential amplitude, if plotted against time, resembles the edge of a saw the phrase "saw-tooth" wave has been generally adopted in the art as describing either the current or the potential wave and it is to generators of waves of this type that my invention pertains.

The ideal wave shape for ray deflection or scanning purposes in a cathode ray tube should be such that the slope of each portion thereof, corresponding to a scanning period, with respect to a reference axis is constant. Such wave shapes can be obtained with generators of known types but it has been noted that when an effort is made to utilize either a potential or a current saw-tooth wave in utilization networks such as on the deflecting plates or in the deflecting coils associated with the cathode ray tube, distortion is introduced so that the actual fluctuating potential appearing across the plates or the actual fluctuating intensity of the magnetic flux departs from ideal conditions.

It is, accordingly, the principal object of my invention to provide a saw-tooth wave generator wherein the ideal output wave shape is distorted to compensate the distortion caused by a utilization network, and from which the output potential or current may be utilized directly upon the deflecting plates in a cathode ray tube or in the deflecting coils for deflection purposes.

The novel features which I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawings, in which:

Figure 1 is a diagrammatic view of a portion of a television receiving system including a saw-tooth wave generator constructed according to my invention,

Figures 2 to 8, inclusive, are wave-form graphs to which reference will be made in explaining the operation of my improved generator, and

Figure 9 is a diagrammatic view illustrating the application of my invention to a generator that supplies saw-tooth waves to electromagnetic deflection coils associated with a cathode ray tube.

Referring now to Figure 1 of the drawings, a saw-tooth wave generator, to which my invention is applicable, includes an impulse source 1, preferably supplying periodically recurring positive impulses to the grid 3 of a thermionic driver tube 5 with respect to the cathode 7 thereof. The grid, cathode and anode 9 of the driver-tube are connected to appropriate points on a bleeder resistor 11 which is connected across the terminals of a direct current source (not shown).

By reason of the grid and cathode connections 13 and 15, the driver-tube is biased negatively considerably beyond the cut-off point and normally draws no current between impulses from the impulse source. During the period between positive impulses, therefore, a condenser 17, effectively connected in parallel across a resistor 19 in the anode circuit of the driver-tube and a portion of the potential source, acquires a positive charge at a relatively slow rate. Each positive impulse applied to the grid of the driver-tube abruptly reduces its plate impedance and the charge on the condenser is dissipated substantially instantaneously.

The positive potential impulses and the potential appearing across the output resistor of the driver tube, plotted with respect to the same time-axis, are exemplified by Figures 2 and 3 in the drawings. It will be noted that the output potential appears as a saw-tooth wave. These graphs, as well as the additional graphs in the drawings, are for the purpose of illustrating waveforms only; they do not illustrate comparative amplitudes.

The input circuit of a wave-amplifier tube 21 is connected across the driver-tube output resistor 19, a stopping condenser 23 being included in the connecting network. Connections 25, 15 and 29 extending from the grid, cathode and anode of the wave amplifier tube, respectively, to the bleeder resistor, supply the tube with appropriate operating potentials. The recurrent potentials across a resistor 31 included in the output circuit of the wave-amplifier tube are exemplified by Figure 4 of the drawings and such potentials are impressed, through a stopping con-

denser 33, across the input circuit of a third thermionic device 35, hereinafter referred to as the output tube. The same bleeder resistor 11 supplies energizing potentials to the output tube 35 as shown in the drawings, a choke-coil 37 being included in the anode-supply connection 39.

A connection, including a stopping condenser 41, extends from the anode of the output tube to a point 43 on an auto-transformer 45, displaced somewhat from the electrical center thereof, and the terminals of the auto-transformer are connected, respectively, to the horizontal deflecting plates 47 and 49 in a cathode ray receiving tube 51.

The deflecting circuit for the deflecting plates which includes the auto-transformer and the associated elements is described and claimed in my copending application Serial No. 737,163, filed July 27, 1934, and assigned to the Radio Corporation of America.

The function of the deflecting plates is to cause the electron stream in the tube to move horizontally across a fluorescent screen 53 in one direction at a rate corresponding to the slope of the saw-tooth wave in the periods between positive impulses to the generator from the impulse source and to rapidly return to its starting point upon the occurrence of the impulse. For this purpose, the ideal potential wave on the plates should correspond in shape to the potential appearing across the output resistor 19 of the driver-tube. Unfortunately, however, by reason of inherent limitations encountered in the design of wave-utilization networks, the potential appearing across the deflecting plates in the tube, when plotted along the same time-axis hereinbefore referred to, appears as shown in Figure 5, wherein it will be noted that the wave shape, at one side of the zero axis, differs from that on the other side of the axis in that the slope is not constant. Heretofore, all efforts to secure wave-form correction through modification of the constants of the various elements described, have been substantially unsuccessful although many attempts have been made in that direction.

For example, keeping in mind that a saw-tooth wave, when analyzed into a Fourier series, is composed of a large number of sine waves, I have obtained approximate compensation through frequency discriminating networks in the amplifier and/or networks which introduce a certain amount of phase shift. The results, however, have not been satisfactory since, as stated, the compensation is only approximate and nothing short of exact compensation will prevent distortion in the received picture.

In accordance with my invention, therefore, I depart from the usual practice of trying to secure correction in the output circuit of the generator or in the coupling networks therein and, instead, I introduce a corrective potential early in the system.

Specifically, I connect the input circuit of a wave correction tube 55 in parallel with the input circuit of the wave amplifier tube 21 and I also connect the output circuit thereof in parallel with the output circuit of the said amplifier tube. The grid and cathode of the wave correction tube are also connected, as shown in the drawings, to appropriate points on the bleeder resistor 11 for the purpose of supplying a fixed bias potential thereto.

The function of the wave correction tube is to supply recurrent potential increments and to introduce these increments into the output circuit of the wave-amplifier tube at such times as will give rise to a composite potential wave across the resistor 31, the wave having such form that, when it is applied to the output tube it causes an output wave therefrom which is corrected to compensate the distortion introduced by subsequent wave utilization networks.

More particularly, I so connect the grid of the wave correction tube to the bleeder resistor 11 that it is normally negatively biased beyond the cut-off potential. When, therefore, the wave correction tube is energized, in phase with the wave-amplifier tube, only the positive peaks of the energizing potential wave give rise to periodic increments of current in the output circuit thereof which current increments, as will be noted from the drawings, must also flow in the output resistor 31 of the wave-amplifier tube. The periodic increments of potential appearing across the said output resistor are exemplified by Figure 6 of the drawings and the composite potential wave across the said resistor is exemplified by Figure 7.

It will be noted from an inspection of Figure 7 that the slope of the wave at one side of the reference axis is not constant and that the departure from linearity is the inverse of the departure from linearity of the wave exemplified by Figure 5, it, of course, being understood that the relative positions of the said waves, with respect to the reference axis, are reversed.

When the distorted composite wave is impressed upon the output tube the output potentials therefrom correspond thereto and the output potential wave is, therefore, corrected in the direction to compensate for the distorted wave, exemplified by Figure 5 which otherwise would be impressed upon the deflecting plates. Such being the case the actual potential wave impressed upon the deflecting plates takes a form exemplified by Figure 8 of the drawings, thus being truly saw-tooth in shape.

Under certain circumstances the potentials appearing across the output resistor of the driver-tube may not be great enough to drive the grid of the highly biased wave correction tube sufficiently positive to enable proper derivation of the correction potentials. In such event, it is quite feasible to interpose a voltage lowering resistor 57, shunted by a bypass condenser 59, in the anode supply circuit of the wave correction tube. When this resistor is present the characteristic curve of the tube is shifted in the zero direction, as is well known to those skilled in the art, thus enabling smaller positive potentials applied to the grid thereof to cause plate current increments even though the tube is biased to the cut-off point.

In a specific embodiment of my invention, now in everyday operation, the circuit components have values as shown in the drawings.

I also wish to make it perfectly clear at this point that my improved generator may be utilized for the purpose of supplying a compensated saw-tooth wave to electromagnetic deflecting coils or the like. For this purpose it is only necessary to interpose an additional stage of resistance-condenser coupled, class A, amplification (not shown, but exemplified by *x*, *x*, in Figure 1) between the wave-amplifier tube and the output tube and to connect the output circuit of the output tube to the coils 61 and 63 as shown in Figure 9. Preferably, the output tube for supplying the

deflecting coils is of the power amplifier pentode type commercially known as RCA 2A5.

From a consideration of the foregoing, it will be apparent that I have provided an improved saw-tooth wave generator wherein a correction factor is so introduced that true saw-tooth wave potentials or currents may be applied therefrom to the ray-deflecting devices associated with a cathode ray tube or to other utilization networks.

Although I have chosen a specific embodiment of my invention for purposes of explanation, many modifications thereof will be apparent to those skilled in the art. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and the spirit of the appended claims.

I claim as my invention:

1. In combination, a wave-utilization network, a source of periodically recurrent impulses, means for deriving a saw-tooth wave from said impulses, means for amplifying said saw-tooth wave, and means for introducing distortion into the wave to compensate wave distortion in said wave-utilization network, said distortion-introducing means comprising an electric discharge tube normally biased to beyond the cut-off potential, connections whereby the saw-tooth wave is impressed on the grid thereof with the proper polarity to compensate said wave distortion, and means for impressing said distorted wave upon said wave utilization network.

2. In combination, means for producing a saw-tooth voltage, an electric discharge tube having an input circuit and an output circuit which includes a plate impedance unit, means for impressing said voltage upon said input circuit, and a second electric discharge tube having an input circuit connected in parallel with said first input circuit and an output circuit connected in parallel with said plate impedance unit, said second tube being so biased that current flows in its output circuit only when said saw-tooth voltage is above a predetermined instantaneous value.

3. In combination, means for producing a saw-tooth voltage, a wave utilization network, means including an electric discharge tube for coupling said means to said network, a second electric discharge tube having an input circuit and an output circuit, and means for impressing said saw-tooth voltage upon said input circuit, said output circuit being so connected to a point in said coupling means between said first discharge tube and said network that the outputs of said two discharge tubes add, said second tube being so adjusted that its output is changed only when said saw-tooth voltage is above a predetermined instantaneous value whereby there is compensation for distortion produced in said network.

4. In combination, a wave-utilization network for utilizing saw-tooth waves, means for producing voltage waves having at least approximately a saw-tooth wave form, and a pair of electric discharge tubes having input circuits and output circuits connected in parallel, said input circuits being coupled to said wave producing means and said output circuits being coupled to said network, said tubes being adjusted to have unlike outputs of such character that they add to produce a substantially perfect saw-tooth wave in said network.

5. Apparatus according to claim 4, characterized in that one of said tubes is biased to function as a substantially non-distorting amplifier while the other of said tubes is biased at least to cut-off.

6. In combination, means for producing a saw-tooth voltage, an electric discharge tube which is so biased as to function as a substantially non-distorting amplifier, a second electric discharge tube which is biased at least to cut-off potential, said two tubes being connected in parallel, means for impressing said saw-tooth voltage upon the input circuits of said tubes, and means for supplying the output of said tubes to a wave-utilization network.

7. In combination, means for producing a saw-tooth voltage, a wave-utilization network, means including an electric discharge tube for coupling said means to said network, a second electric discharge tube having an input circuit and an output circuit, and means for impressing said saw-tooth voltage upon said input circuit, said output circuit being so connected to a point in said coupling means between said first discharge tube and said network that the outputs of said discharge tubes add, said second tube being so adjusted that said outputs add to produce a saw-tooth wave having distortion therein which compensates for distortion produced in said network whereby a substantially perfect saw-tooth wave appears in said network.

8. Apparatus according to claim 7, characterized in that said second tube is biased at least to cut-off.

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