June 30, 1953 W. S. DOUGLAS 2,644,094

PULSE GENERATOR

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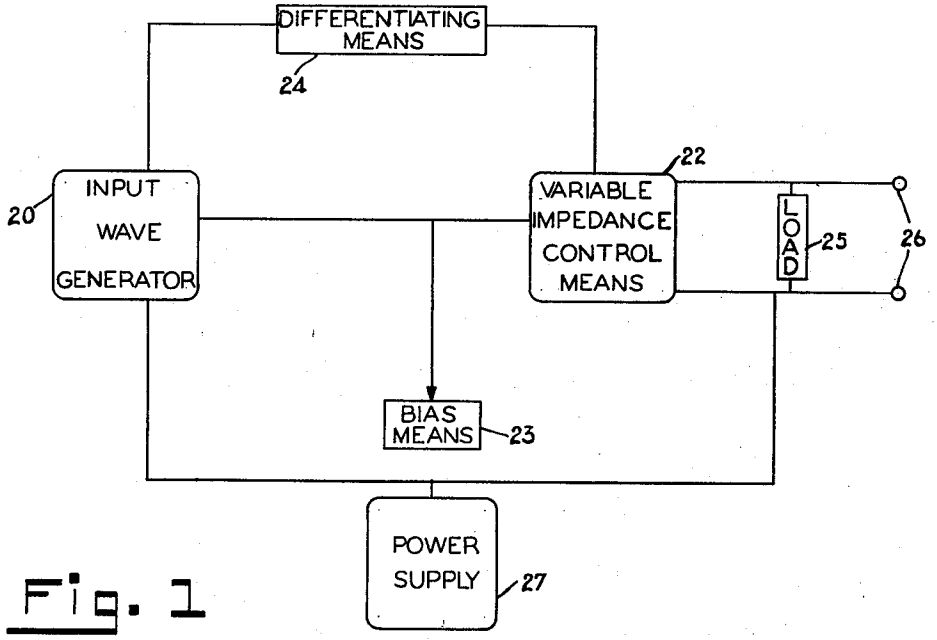

Fig. 1

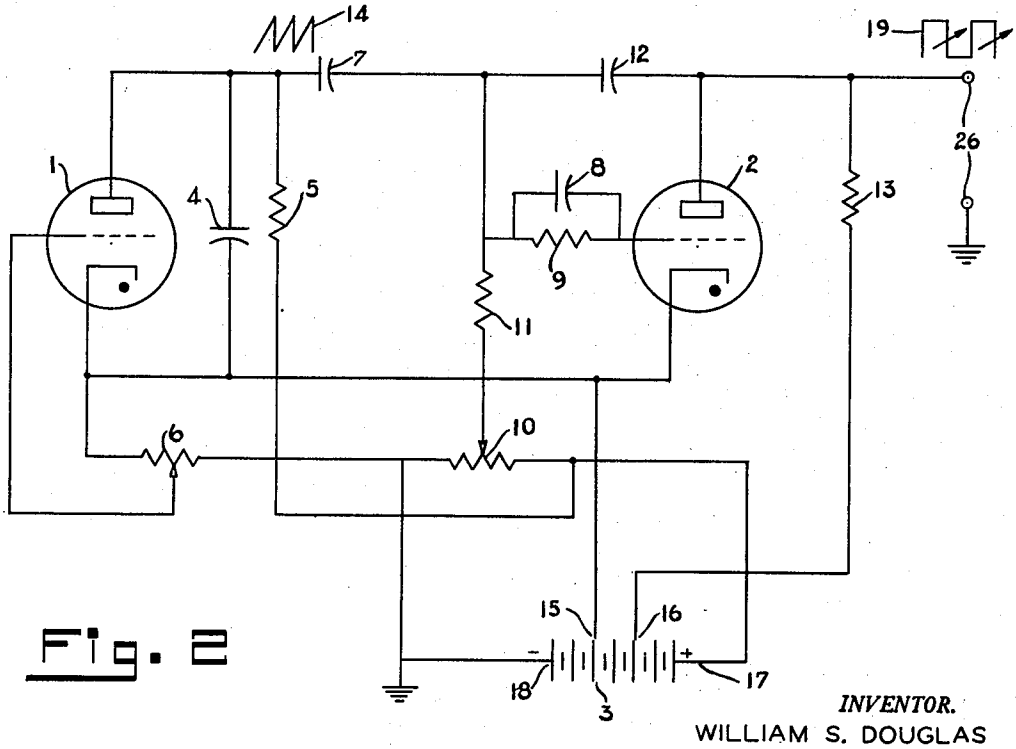

Fig. 2

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PULSE GENERATOR

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3 Claims. (Cl. 250—36)

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This invention relates to electronic apparatus for producing wave forms or pulses having a substantially rectangular shape and more particularly to the type of apparatus having means for controlling the width of the wave form or pulse while a predetermined frequency or repetition rate is maintained.

It is a primary object of the present invention to provide a novel means and method for producing a substantially rectangular, cyclically recurring, voltage variation, the width of which is controllable over a portion of the cycle.

It is a further object of my invention to provide an apparatus which operates on a voltage of saw-tooth wave form to produce an output having a substantially rectangular wave form of the same frequency as the saw-tooth wave voltage and a width controllable over a portion of the cycle.

It is a still further object of the present invention to provide apparatus of the above nature which is simple in construction and reliable in operation.

Further objects and advantages of the invention will be apparent from the following description of a preferred form of the invention and from the drawings in which:

Fig. 1 is a block diagram illustrating the general form of the invention; and

Fig. 2 is a circuit diagram of a specific and preferred form of the present invention.

The apparatus of this invention may have application in many fields (e. g. television), where the requirement exists for the production of a series of rectangular wave forms or pulses of adjustable width, which can be locked to a series of synchronizing pulses.

Fig. 1 shows an input wave generator 20, which can be of any type to produce an output of a substantially saw-tooth wave form and which may also be of the type that can be synchronized in frequency by a series of voltage pulses. "Saw-tooth wave" as used in this application is to be taken broadly to mean any wave having a gradual slope or build-up time over a portion of its cycle and a fast decay or "fly-back" at some other point in its cycle. The output of the input wave generator 20 is fed to the variable impedance control means 22, which is usually a thyratron tube or similar grid controlled, electron discharge device. Bias means 23 normally maintains the variable impedance control means 22 in a non-conducting state until the bias voltage is overcome by the output of the input wave generator 20. The variable impedance control means

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then conduct at a constant value until differentiating means 24 acts on the output of the input wave generator 20 to produce a voltage to stop conduction.

The variable impedance control means 22 then remain cutoff until the output of the input wave generator 20 again overcomes the bias voltage. Load 25 is a resistor which carries the current that flows through the variable impedance control means 22. The output developed across terminals 26 is a rectangular shaped wave, the width of which may be varied over part of the cycle by adjusting the bias means 23 and so changing the point on the saw-tooth cycle at which the bias voltage is overcome. Power supply 27 may be any source of electrical energy which will furnish the voltages required by the circuit.

Fig. 2 shows conventional thyratron tubes at 1 and 2 supplied with operative voltages from battery 3. Thyratron 1, condenser 4, plate load resistor 5, and biasing potentiometer 6 comprise a conventional saw-tooth generator, whose frequency can be varied by adjusting potentiometer 6. It may also be synchronized in frequency in any conventional manner, e. g. by a series of positive voltage pulses superimposed on the bias voltage. This generator is shown merely for illustration and any other means for obtaining a saw-tooth voltage wave could be used.

The saw-tooth wave is applied to the grid of thyratron 2 through coupling condenser 7 in series with condenser 8 and resistor 9 in parallel. Resistor 9 acts in the conventional manner as a grid current blocking resistor to prevent excessive grid current. Potentiometer 10 provides the means for adjusting the bias voltage for thyratron 2 and the grid return is completed through resistor 11.

Instead of having the differentiating means completely separate from the variable impedance control means as shown in the block diagram of Fig. 1, components are saved by using elements in the differentiating network which also perform other circuit functions. The differentiating network which produces a voltage proportional to the rate of change of the applied voltage consists of condenser 12 in series with the plate resistance of thyratron 2 and plate load resistor 13 in parallel. When thyratron 2 is conducting, its low plate resistance effectively shorts out any positive voltages superimposed by the differentiating network but it offers a high resistance to negative voltages and so has little effect on them.

Thyratron 2 is maintained in a non-conducting state by the negative bias voltage from potentiometer 10 until the superimposed saw-tooth wave is essentially as shown at 14, overcomes it and causes thyratron 2 to conduct. Because of the inherent characteristics of thyratron tubes or other gaseous switch tubes, the current is independent of the grid voltage once the tube has started to conduct. Thyratron 2 then continues to conduct at a steady value until it is cut off by the negative pulse on the plate which is produced by the action of the differentiating circuit on the sharp decay or "fly-back" of the saw-tooth wave. The grid then resumes control and keeps thyratron 2 cut off until the saw-tooth voltage again overcomes the bias voltage and the cycle is repeated.

Battery 3 has taps at 15, 16, 17 and 18 to provide the different values of voltage required at different parts of the circuit.

The setting of potentiometer 10 determines the bias voltage and, therefore, the point on the cycle at which thyratron 2 begins to conduct and so the relative widths of the positive and negative going parts of the output wave, shown at 19, which is taken between terminals 30.

The apparatus may be operated as a self-contained rectangular wave generator of predetermined frequency and variable width, or it may be synchronized in frequency by an external source, with the output remaining adjustable in width, or it may operate at a predetermined rate while a signal from another source controls the width of the output wave by being superimposed on the bias of thyratron 2.

It will be understood by those skilled in the art that the present invention is capable of various modifications and should not, therefore, be restricted to the particular details shown and described but only within the scope of the appended claims.

What is claimed is:

1. In a system for generating substantially rectangular voltage pulses of predetermined frequency, the combination of a periodic wave source, a gaseous switch tube having an anode and a control grid, biasing means for said control grid, said source being connected to said control grid, said source in addition being connected to said anode through a capacitor, a resistive load in the anode circuit, said capacitor being in series with the anode resistance of said tube and said resistive load in parallel and forming a differentiating network, and means to supply direct current to said system.

2. In a wave generating system for producing flat topped pulses of constant period and of variable width, the electrical circuit which consists of a source of saw-tooth waves controlled with respect to frequency, a thermionic tube including an anode and a control grid, said source being connected to said grid through a circuit consisting of a resistor and capacitor in parallel, means for negatively biasing said grid, said source also being connected to said anode through a capacitor, a supply of direct current for said system and a resistive load in said circuit connected to said anode and forming a differentiating means with said last mentioned capacitor.

3. A rectangular wave generating apparatus comprising a saw-tooth voltage generator, a biased, grid controlled, gaseous switch tube, means connecting said generator to the grid of said tube for causing said tube to conduct when the output of said generator overcomes the bias on said tube, a plate load resistor for said tube, a differentiating network, composed of a condenser in series with the plate resistance of said tube and said plate load resistor in parallel, comprising means for receiving the output of said generator and for superimposing on the plate of said tube a voltage which is proportional to the rate of change of said output, whereby a negative pulse corresponding to rate of change of the sharp decay or "flyback" portion of said output makes the plate negative, causing said tube to be cut off, means for varying the bias on said tube for adjusting the point on the saw-tooth cycle at which said bias is overcome, and a power supply for said apparatus.

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