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BISTABLE CATHODE COUPLED SWITCHING GATE GENERATOR

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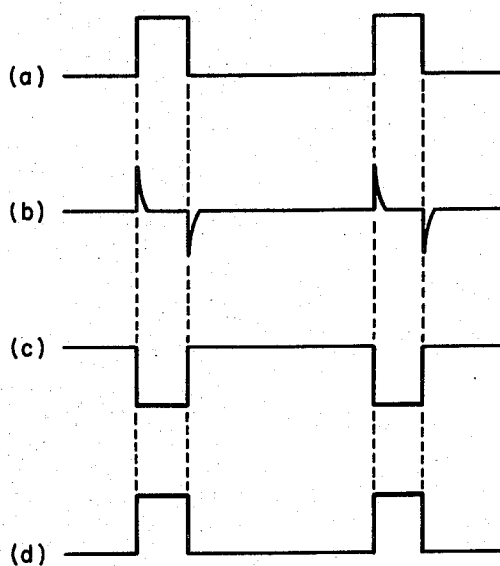
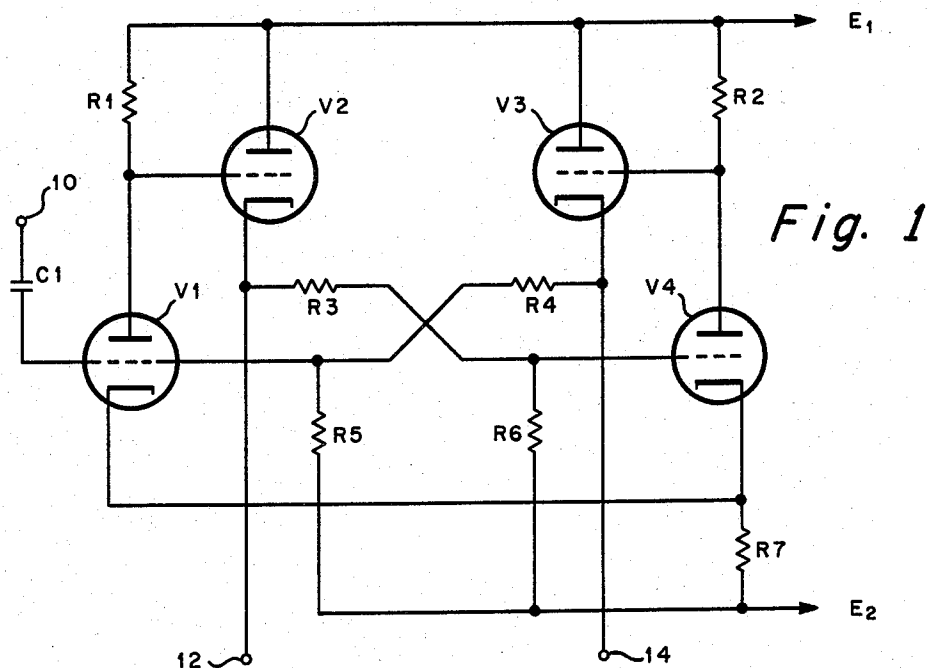


Fig. 2

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BISTABLE CATHODE COUPLED SWITCHING GATE GENERATOR

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2 Claims. (Cl. 250-27)

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to a bi-stable cathode-coupled switching gate generator lacking time constant networks for insuring an output which is free of charge and discharge slopes.

One prior arrangement for performing the function of this invention consists of two separate cathode followers connected with their plates to a source of positive voltage and their cathodes connected through independent cathode resistors to a source of negative voltage. Each grid is connected to a source of switching voltage through individual coupling condensers, and individual resistors are used as grid return paths to the source of positive voltage. The time constants of the grid networks are designed to allow an undistorted wave form to pass through them to the grid. The output wave forms at the cathodes are similar to the input wave forms with the exception that the D.C. levels have been shifted allowing excursions both above and below ground potential. This circuit in general meets the requirements of timing and voltage excursions. However, any current drawn from the outputs will cause a resultant drop in voltage. The poor regulation makes it impossible to switch more than one circuit, and when other sets of cathode followers are paralleled to give additional outputs, the unwanted signals are fed back from circuits being switched to the grid networks and appear in new outputs. The output wave form does not have a flat top on the positive excursion due to grid current flow while the coupling condensers discharge. This arrangement cannot respond over wide ranges of time intervals without changing the values of the grid coupling networks. And finally, when the input switching voltage to these cathode followers fail, both of them come to rest in the "on" position. It is more desirable to have one stop on the "off" position and one on the "on" position from considerations of circuit and application.

The cathode follower principle is followed in this invention in which two dual triodes are used to form a bi-stable switching generator. However, the arrangement is such that there is no need for and therefore there is a complete absence of time constant networks. This of course will insure an output which is free of charge and discharge slopes. In addition, the inventive circuit will follow a chain of pulses regardless of their timing interval. If a connection is made to one grid only of one of the triodes, the circuit will respond to the first positive or negative pulse, depending upon which stable condition is present, and will not respond to successive pulses of the same polarity until the stable condition is changed by an intervening pulse of opposite polarity. This feature is useful in count down applications. Other advantages of the inventive circuit include that many of these circuits can be driven from a trigger source and no interaction will take place. The circuit can also readily be stopped in

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either of its stable states by connecting one or the other of the grids to the source of negative voltage and the circuit will come to rest with the same output voltages as are experienced while it is in operation. The circuit being switched can be conveniently monitored while in its static state. Finally, the circuit can also be driven by any wave form capable of being differentiated.

It is thus a first object of the present invention to provide a novel bi-stable switching gate generator capable of producing an output which is free of charge and discharge slopes.

A further object of the present invention is the provision of a cathode-coupled switching gate generator which will follow a chain of pulses regardless of their timing interval and regardless of their shape providing the wave form is capable of differentiation.

Another object is to provide a bi-stable cathode-coupled switching gate generator which is capable of a wide variety of applications and capable of producing a perfect square wave characteristic in the output.

A final object of the present invention is the provision of a bi-stable, cathode-coupled, switching gate generator for producing a perfect square wave characteristic in the output and capable of following a chain of pulses regardless of their timing interval, and which will not respond to a succeeding pulse of the same polarity until the stable condition is changed by an intervening pulse of opposite polarity.

The exact nature of this invention as well as other objects and advantages thereof will be readily apparent from consideration of the following specification relating to the annexed drawing in which:

Fig. 1 shows schematically a preferred embodiment of the instant invention.

Fig. 2 shows graphically the wave forms at various points in the circuit.

Referring to Fig. 1, there is shown the switching gate generator consisting of triodes V_1 , V_2 , V_3 and V_4 . The plates of V_1 and V_4 are connected through resistors R_1 and R_2 , respectively, to a source of positive voltage E_1 . The grids of triodes V_2 and V_3 are connected directly to the plates of V_1 and V_4 , respectively, while their plates are connected directly to E_1 . The cathode of triode V_2 is connected through resistor R_3 to the grid of V_4 . The cathode of triode V_3 is connected through resistor R_4 back to the grid of triode V_1 . The control grids of triodes V_1 and V_4 are connected through resistors R_5 and R_6 , respectively, to a negative voltage source E_2 . The cathodes of triodes V_1 and V_4 are also connected through a common resistor R_7 to said negative voltage source E_2 .

The input to the pulse generator is from terminal 10 through an input capacitor C_1 to the grid of V_1 . Of course, it is understood the input through a similar arrangement may be made into the grid of triode V_4 . The output of the generator may be taken at either the cathode of triode V_2 or the cathode of triode V_3 , or both, on output terminals 12 and 14, respectively.

Figure 2 shows the various waveforms at several points in the bi-stable generator of Fig. 1. The input signal having the shape shown in Fig. 2(a) is delivered at terminal 10. After differentiation by the action of capacitor C_1 and resistors R_4 and R_6 , the signal placed on the grid of triode V_1 resembles the signal shown in Fig. 2(b), as is understood in the art. The output waveforms Figs. 2(c) and 2(d) appear on terminals 12 and 14, as described further below.

The generator shown in Fig. 1 operates as follows:

Upon the initial energization of the circuit, assume that conduction is taking place in the triode V_2 . Since the plate of this tube is connected to the positive voltage E_1 , the cathode of V_2 will rise instantly in potential and cur-

rent will flow through resistors R_3 and R_6 . The connection to the grid of V_4 from the junction of the resistors R_3 and R_6 causes the voltage level on said grid to rise also, and conduction will then also take place in triode V_4 . The voltage at the plate of V_4 will thereby drop due to the voltage drop in resistor R_2 . Through the plate connection to the grid of triode V_3 , conduction is reduced through triode V_3 . Due to this reduction, the cathode of triode V_3 will drop in potential because of current reduction through resistors R_4 and R_5 . This will result in a voltage drop on the grid of triode V_1 thereby causing a reduction of current flow through this tube. The plate voltage on triode V_1 will then rise and hence assist conduction through triode V_2 , as was assumed in the beginning.

The foregoing described action occurs virtually instantaneously by virtue of the lack of time constant networks to introduce condenser charging and discharging factors. Therefore, the cathode potentials of triodes V_2 and V_3 will resemble that shown in Figs. 2(c) and (d), respectively. The various wave forms illustrated in Fig. 2 are arranged to show their relative synchronization.

The value of the common cathode resistor R_7 in Fig. 1 is chosen to allow a positive bias to be present on the cathodes due to current flow through one or the other triodes V_1 and V_4 . The division of resistance of the networks R_3 , R_6 and R_4 , R_5 has been selected to allow cutoff of one section of the triode pair consisting of V_1 and V_4 when its associated cathode follower V_2 or V_3 is at its negative extreme. It is evident that as the process described above continues, the circuit becomes stable with V_2 and V_4 conducting and V_1 and V_3 non-conducting. The same reasoning could be applied to show V_1 and V_3 "on" and V_2 and V_4 "off," thus revealing the bi-stable characteristics of the circuit.

When a positive trigger is applied to the grid of the "off" triode V_1 , the circuit is changed to its alternate stable state. A negative trigger applied to the "on" triode V_4 will serve the same purpose. It is obvious, therefore, that triggers can be applied to either or both grids of triodes V_1 or V_4 and may be of either positive or negative polarity. The circuit will immediately fall into synchronism with the incoming triggers and will follow any changes in timing interval.

It is seen that the generator described above is capable of following a chain of pulses regardless of their timing interval, or, in other words, the generator is not limited to any particular range of frequencies. In addition, it is seen that the circuit provided is responsive only to the next pulse which is different in polarity from the last pulse that changed the state of the generator. This feature is especially useful in count down applications.

There are several other distinct advantages of this circuit. The absence of all time constant networks insures that there will always be an output which is free of slopes due to charge and discharge of condensers, and hence, always a perfectly formed square wave output. Since the triodes are cathode-follower types, the output will be of low impedance which is suitable for switching screen grids, plates and control grids of subsequent stages. Other advantages of this circuit are readily apparent. A plurality of these circuits can be driven from one trigger source without any interaction taking place in view of the absence of time constant networks. The generator can readily be stopped in either of its stable states by connecting one or the other of the grids of triodes V_1 or V_4 to the source of negative voltage and the circuit will then come to rest with the same output voltages which are experienced while it is in operation. Circuits being switched can be conveniently monitored while in its static state. Finally, the circuit is capable of being driven by any wave form capable of being differentiated.

It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention and that numerous modifications or alterations may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims. For example, the circuit may be adjusted for any desired output voltage, impedance value, etc. for a particular application. In addition, the circuit can very easily be made free-running rather than bi-stable by the addition of the appropriate time constant network. Hence, it is intended that all matter contained in the above description as shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A bistable, switching gate generator comprising, in combination, first, second, third and fourth trigger means, each provided with at least an anode, cathode, and control element, first and second substantially resistive load means connected between said first and fourth trigger anodes, respectively, and a positive source of voltage, third substantially resistive means connecting said first and fourth trigger cathodes to a negative source of voltage, means applying said positive source of voltage to said second and third trigger anodes, fourth substantially resistive means between said second trigger cathode and said negative source of voltage, fifth substantially resistive means between said third trigger cathode and said negative source of voltage, means connecting said first trigger anode to said second trigger control element, means connecting said fourth trigger anode to said third trigger control element, and means connecting said first and fourth trigger control elements to intermediate points in said fifth and fourth resistance means, respectively, thereby permitting successive positive and negative pulses applied to said first trigger control element to cause conduction alternately in said first and third trigger means and said second and fourth trigger means, respectively.

2. A bistable, switching gate generator comprising, in combination, first, second, third and fourth trigger means, each provided with at least an anode, cathode, and control element, first and second substantially resistive load means connected between said first and fourth trigger anodes, respectively, and a positive source of voltage, third substantially resistive means connecting said first and fourth trigger cathodes to a negative source of voltage, means applying said positive source of voltage to said second and third trigger anodes, fourth substantially resistive means between said second trigger cathode and said negative source of voltage, fifth substantially resistive means between said third trigger cathode and said negative source of voltage, means connecting said first trigger anode to said second trigger control element, means connecting said fourth trigger anode to said third trigger control element, means connecting said first and fourth trigger control elements to intermediate points in said fifth and fourth resistance means, respectively, thereby permitting successive positive and negative pulses applied to said first trigger control element to cause conduction alternately in said first and third trigger means and said second and fourth trigger means, respectively, and output means on said second trigger cathode.

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