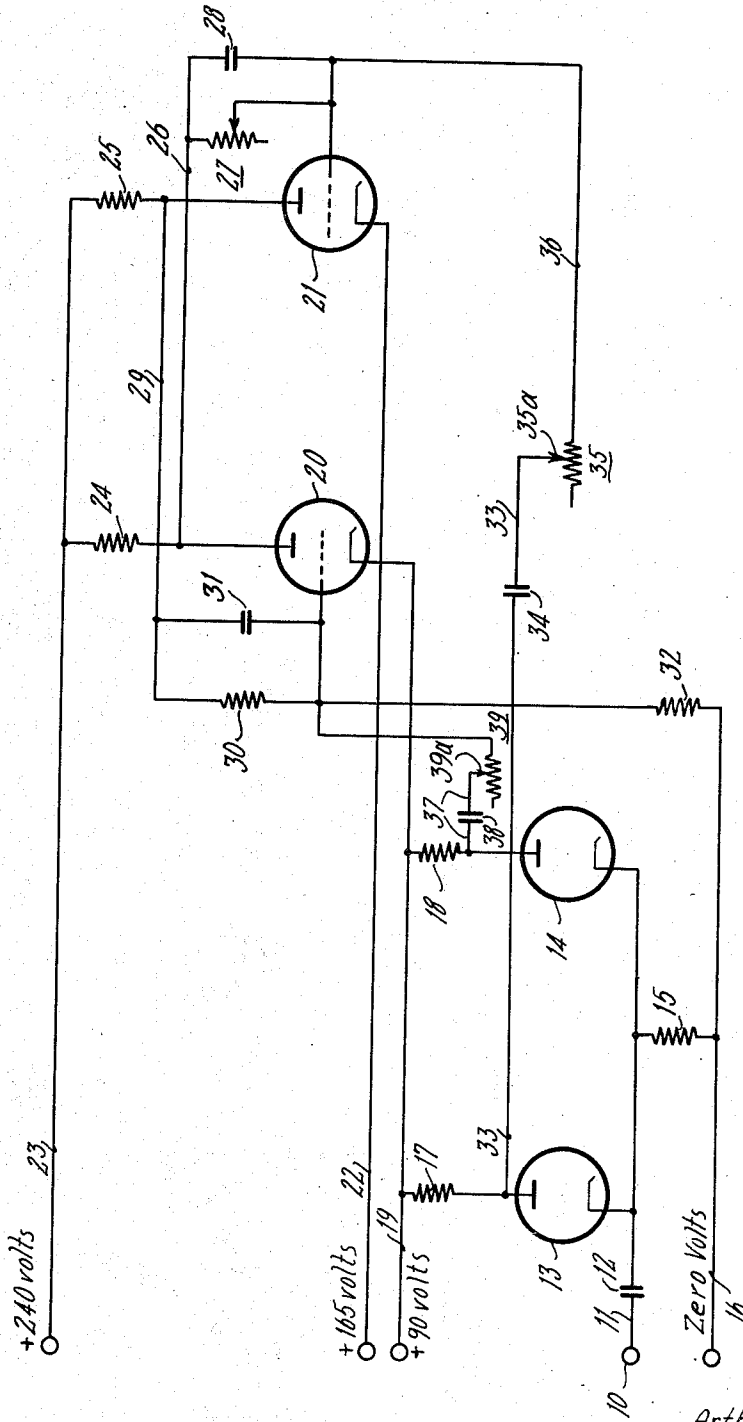


May 1, 1951

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ASYMMETRICAL TRIGGER CIRCUIT

2,551,104

Filed Jan. 12, 1949



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UNITED STATES PATENT OFFICE

2,551,104

ASYMMETRICAL TRIGGER CIRCUIT

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Application January 12, 1949, Serial No. 70,495

2 Claims. (Cl. 250—27)

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This invention relates to trigger circuits employing two grid controlled tubes switchable to either of two stable conditions alternately and more particularly to such a trigger circuit which is asymmetrical.

In trigger circuits having two stable conditions and employing two grid controlled tubes, it is conventional to connect the plate of each to the control grid of the other through symmetrical portions of symmetrical fixed impedance networks. In such circuits the control grids of the tubes are frequently connected to a common source of pulses and the trigger switched from each stable condition by the application of the pulses simultaneously to the control grids of the two tubes.

One of the objects of this invention is to provide additional electron tubes, intermediate the control grids of the electron tubes of the trigger and the common source of pulses, for switching the trigger by supplying simultaneously, separate pulses to said control grids from the common source of pulses.

Another object is to provide an electrical circuit for providing from a common source of pulses two series of pulses, each independent of the amplitude of the other, to the control grids of the respective tubes of a trigger circuit.

Still another object is to provide an asymmetrical trigger circuit having two stable conditions and switchable from either condition to the other in response to pulses from a common source of pulses.

A further object is to provide a trigger circuit having two similar grid controlled tubes with the plate of each connected to the control grid of the other, the potential applied to the electrodes of each tube being of a different value from that applied to the corresponding electrode of the other tube.

A still further object is to provide a dual tube trigger circuit having two stable conditions alternately assumed, the control grid bias of one tube being determined by the plate voltage of the other.

Another object is to provide a dual-tube trigger circuit having two stable conditions alternately assumed wherein only one fixed impedance network is employed.

Still another object is to provide a trigger

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circuit switchable to one stable condition in response to an increased impedance in a variable impedance network and switchable to the other stable condition in response to an increased impedance in a variable impedance.

A further object is to provide an improved trigger circuit of the grid controlled dual-tube type arranged asymmetrically and switchable to either of two stable conditions alternately in response to pulses applied to the control grids of the grid controlled tubes.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawing, which discloses, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

The drawing is a circuit diagram illustrating the principles of the invention.

Referring more particularly to the drawing, an input terminal 10 is connected by a conductor 11 and a capacitor 12 of 0.00005 microfarad to the cathodes of diodes 13 and 14 which are of the 6H6 type. These cathodes are connected through a resistor 15 of 100,000 ohms to a zero volt line 16. The plates of the diodes 13 and 14 are connected through resistors 17 and 18, respectively, each of 100,000 ohms to a plus 90 volt line 19. Triodes 20 and 21 together comprise one 6SN7 dual-type tube and are connected to form the trigger circuit of the invention. The cathodes of triodes 20 and 21 are connected respectively to the plus 90 volt line 19 and a plus 165 volt line 22 and the plates to a plus 240 volt line 23 through a resistor 24 of 100,000 ohms and a resistor 25 of 45,000 ohms, respectively.

The plate of triode 20 is also connected, through a conductor 26 and parallel connected potentiometer 27 and capacitor 28 of 0.00005 microfarad to the control grid of triode 21. The plate of triode 21 is connected through a conductor 29 and parallel connected resistor 30 of 400,000 ohms and capacitor 31 of 0.00015 microfarad to the control grid of triode 20. A bias resistor 32 of 270,000 ohms is connected between the control grid of the tube 20 and the zero volt line 16.

The plate of the diode 13 is also connected, through a conductor 33, a capacitor 34 of 0.00005 microfarad, a potentiometer 35 and a conductor 36 to the control grid of the triode 21. The plate

of the diode 14 is also connected, through a conductor 37, a capacitor 38 of 0.00005 microfarad, a potentiometer 39 and a conductor to the control grid of the triode 20.

The diodes 13 and 14 and associated circuit serve to supply simultaneous but separate pulses to the control grids of the triodes 20 and 21, from a common source connected to input terminal 10 supplied with a series of negative pulses. When a source of negative pulses is applied to the terminal 10, they are transferred through the conductor 11 and capacitor 12 to the cathodes of the diodes 13 and 14 to render their cathodes sufficiently negative to cause conduction there-through. As a result, the voltage at the plates of diodes 13 and 14 decreases. This decrease or negative pulse at the plate of diode 13 is transferred through the conductor 33, capacitor 34, potentiometer 35 and conductor 36, to the control grid of triode 21 while the negative pulse at the plate of diode 14 is transferred through the conductor 37, capacitor 38, and potentiometer 39 to the control grid of triode 20.

It is apparent that the amplitude, duration and repeat frequency of the pulses, applied to the terminal 10, may vary within wide limits. But, it is essential that the pulse amplitude be large enough to cause sufficient conduction through diodes 13 and 14 to produce, at their plates, negative pulses having sufficient amplitude to effect a switching of triodes 20 and 21, from the conductive to the non-conductive condition.

Potentiometer arms 35a and 39a respectively associated with the potentiometers 35 and 39 are provided to adjust the amplitude of the negative pulses applied to the control grids of triodes 20 and 21 for optimum trigger operation. However, it will be understood that the adjustment of pulse amplitude is not essential to a practice of the invention, the only requirement being that the negative pulses, applied to the control grids of triodes 20 and 21, be of sufficient amplitude to effect a switching of these triodes from the conductive to the non-conductive condition.

For purposes of explanation the trigger is assumed to be in the "off" condition at starting in which condition triode 20 conducts and triode 21 is non-conducting. The dot at the lower right-hand side of triode 20 indicates that it is conducting and thus that the trigger is "off." When triode 20 becomes non-conductive and triode 21 conductive, the trigger is referred to as being "on."

When the first negative pulse is applied to the input terminal 10, a negative pulse is there-upon transferred over the conductor 36 to the control grid of the non-conductive triode 21 but is ineffective as it merely tends to make this control grid still more negative. Simultaneously, a negative pulse is transferred from the plate of the diode 13 through the potentiometer 39 to the control grid of the conductive triode 20 and drives its control grid bias toward the cut off value. As a result of the decreased conduction of triode 20, its plate becomes more positive and the positive pulse thus formed is transferred over conductor 26 and the parallel connected potentiometer 27 and capacitor 28 to the control grid of triode 21. This renders its control grid sufficiently positive to start conduction there-through. When this conduction occurs, its plate becomes less positive and the negative pulse, thus formed, is transferred over conductor 29 and the

parallel connected resistor 30 and capacitor 31 to the control grid of triode 20, to render that grid, still more negative, to thus decrease the conduction therethrough still more. Again the positive pulse formed at its plate is transferred to the control grid of triode 21 to cause it to become more conductive. The resulting negative pulse formed at the plate of the triode 21 is transferred to the control grid of triode 20 to render it less conductive. This cumulative action continues until triode 20 becomes non-conductive and 21 becomes fully conductive thereby placing the trigger in the "on" condition.

When the second negative pulse is applied to the terminal 10, the negative pulse thereupon applied to the control grid of the non-conductive triode 20 is ineffective to render it conductive. However, the negative pulse applied over conductor 36 to the control grid of the conductive triode 21 renders it less conductive. The resulting positive pulse at the plate of triode 21 is transferred over conductor 29 and the parallel connected resistor 30 and capacitor 31 to the control grid of triode 20 thereby rendering it conductive. The resulting negative pulse at its plate is transferred over conductor 26 and the parallel connected potentiometer 27 and capacitor 28 to the control grid of triode 21 to render it less conductive. Again, the positive pulse formed at its plate is transferred over conductor 29 and the parallel connected resistor 30 and capacitor 31 to the control grid of triode 20 to render it more conductive. The resulting negative pulse at its plate is transferred to the control grid of triode 21 to render it still less conductive. This cumulative action is continued, until the trigger is returned to the starting or "off" condition, in which triode 20 is conductive and triode 21 non-conductive as illustrated.

In the same manner, succeeding negative pulses applied to the terminal 10 cause the trigger to switch "on" and "off" alternately.

It is seen from the above explanation that when the impedance of the conducting triode of the trigger changes as exhibited by a decrease in its conduction, the resulting increased voltage at its plate is transferred over the parallel connected resistor and capacitor to the control grid of the non-conducting triode to render it conductive. The network consisting of the resistors 25, 30 and 32 and the capacitor 31 is a fixed impedance network. Such a fixed impedance network is conventional in such triggers, the resistor 25 serving as a plate load, the resistor 30 and the capacitor 31 coupling the plate of one tube and the control grid of the other and the resistor 32 serving to place the proper bias on the control grid of one tube. In the conventional trigger, a similar fixed impedance network is associated with each grid controlled tube to provide a symmetrical circuit for assuring the alternate switching of the trigger to the two conditions of stability. Also, like voltages are applied to the corresponding electrodes of the grid controlled tubes of the trigger. The novel trigger of this invention however is not dependent on either of these conditions and effects a saving of circuit components. This novel trigger is asymmetrical and is switched to its stable conditions in a novel manner.

In the conventional trigger, the resistor 24, potentiometer 27, capacitor 28 and a resistor between the control grid of triode 21 and the zero volt line 16 would comprise a second fixed impedance network for performing functions simi-

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lar to those performed by the fixed impedance network of triode 20. In this novel trigger, no connection is required between the control grid of triode 21 and the zero volt line and, as explained hereinafter, potentiometer 27 may be eliminated and the control grid of triode 21 connected conductively to the plate of triode 20 thereby eliminating both the potentiometer 27 and the capacitor 28.

Whether potentiometer 27 and capacitor 28 be used or not does not change the principle of operation, since in either event the only bias supplied to the control grid of triode 21 is the voltage transferred to it from the plate of triode 20.

A resistor and a capacitor between the plate of each triode of the trigger and the control grid of the other are ordinarily provided to limit the objectionable effects of the interelectrode capacity of the tubes. In choosing this resistor and capacitor for use in a trigger to be operated over a wide range of repeat frequencies, it is difficult to obtain such values as will effectively limit or neutralize the interelectrode capacity of the tubes and not cause objectionable exponential variations in the voltages and currents produced by the tubes. Because of these operational difficulties, the potentiometer 27 and the capacitor 28 are provided to be adjusted or eliminated entirely as found necessary to obtain optimum operation of the trigger.

In addition to the use of only one fixed impedance network and one bias resistor, the asymmetry of the trigger circuit is further accentuated by the difference in the values of the load resistors 24 and 25 and the different voltages applied to the cathodes of the tubes. The load resistor 24 has a value of 100,000 ohms and 90 volts are applied to the cathode of triode 20 while the load resistor 25 has a value of only 45,000 ohms and 165 volts are applied to the cathode of the tube 21.

For the purpose of explaining more clearly the operation peculiar to my trigger, the resistors 25, 30 and 32 with the capacitor 31, will be referred to as the fixed impedance network, triode 20 and the resistor 24 as the variable impedance network, and triode 21 as the variable impedance. Since the potentiometer 27 and the capacitor 28 are not essential to the invention, reference thereto will be omitted in the subsequent explanation and a simple conductor will be assumed as substituted therefor between the plate of triode 20 and the control grid of triode 21.

Now, when the first negative pulse is applied to the control grids of triodes 20 and 21, the increase in the impedance of the variable impedance network causes a transfer of a positive pulse over conductor 26 to the variable impedance, to institute the switching of the trigger. The resulting decrease in value of this variable impedance causes a transfer of a negative pulse over the fixed impedance network to the control grid of triode 20 to increase further the impedance of the variable impedance network. This action is continued until the trigger is switched "on." Hence, as the trigger is switched "on," an increase in the variable impedance network controls the variable impedance to decrease its value and the variable impedance utilizes the fixed impedance network to increase further, the value of the variable impedance network.

When the second negative pulse is applied to the control grids of triodes 20 and 21, the increase in the variable impedance causes a transfer of a positive pulse through the fixed imped-

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ance network to decrease the impedance of the variable impedance network. This decrease causes a transfer of a negative pulse to the variable impedance to increase further its impedance.

This action is continued until the trigger is switched "off." Hence, as the trigger is switched "off," an increase in the impedance of the variable impedance, controls through the fixed impedance network, the impedance of the variable impedance network which further increases the value of variable impedance.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. A circuit comprising a pair of diodes having a common cathode connection and conductive in response to a source of pulses applied thereto, a plate load resistor for each diode, a trigger circuit having first and second grid controlled tubes and "on" and "off" conditions of stability, a single fixed impedance network coupling the plate of the first grid controlled tube to the control grid of the second grid controlled tube; a potentiometer and capacitor connected in parallel between the plate of the second grid controlled tube and the control grid of the first grid controlled tube, a capacitor and potentiometer connected in series between the plate of one diode and the control grid of the first tube for transferring a negative pulse to the control grid of the first tube to lessen conduction therethrough, and a capacitor and potentiometer connected in series between the plate of the other diode and the control grid of the second tube for transferring a negative pulse to the control grid of the second tube to lessen conduction therethrough.

2. An asymmetrical trigger circuit comprising first and second grid control tubes having two conditions of stability alternately assumed; a plate load for each of said tubes; a fixed impedance network including the plate load of the second tube, a parallel connected resistor and capacitor joining the plate of the second tube to the control grid of the first tube and a bias resistor for the control grid of the first tube; a potentiometer and a capacitor connected in parallel from the plate of the first tube to the control grid of the second tube, the only bias voltage on the control grid of the second tube being that transferred from the plate of the first tube, said potentiometer enabling adjustment of said trigger circuit for optimum operation; a pair of diodes arranged to be normally non-conducting and having a common cathode connection so that said diodes are rendered simultaneously conductive in response to negative pulses applied to said common connection; a capacitor and a potentiometer connected in series between the plate of one diode and the control grid of the first tube for transferring a negative pulse to the control grid of the first tube to lessen conduction therethrough and a capacitor and potentiometer connected in series between the plate of the other diode and the control grid of the second tube for

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transferring a negative pulse to the control grid of the second tube to lessen conduction there-through.

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