

Jan. 25, 1949.

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2,459,852

TRIGGER NETWORK

Filed June 8, 1945

Fig.1.

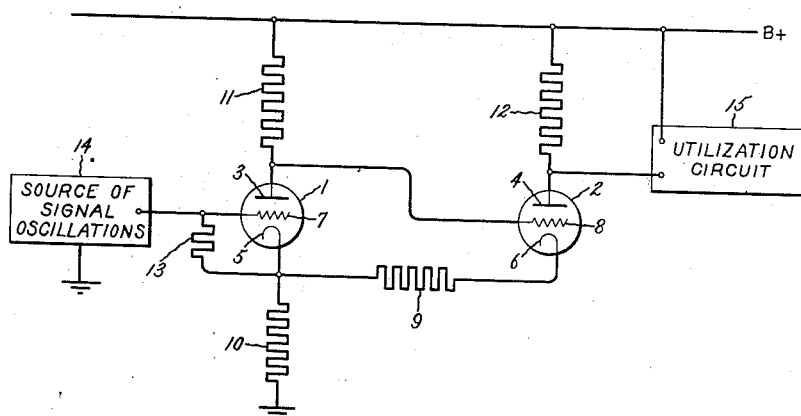


Fig.2.

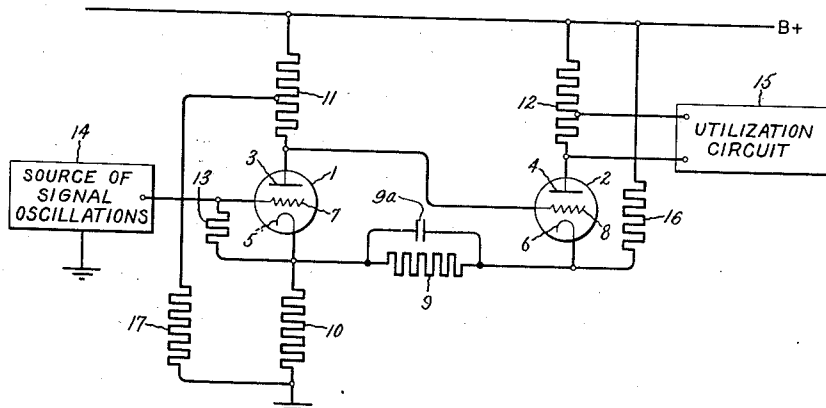
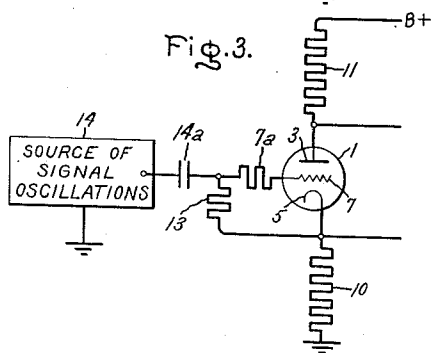


Fig.3.



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UNITED STATES PATENT OFFICE

2,459,852

TRIGGER NETWORK

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Application June 8, 1945, Serial No. 598,361

1 Claim. (Cl. 250-27)

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My invention relates to trigger networks, and particularly to trigger networks suitable for rectangular pulse formation.

It is a general object of my invention to provide a new and improved trigger network having alternative stable conditions of conduction but no natural period of oscillation, and in which switching between conditions is carried out only in response to variation in control or signal potential.

It is a further object of my invention to provide a pulse forming trigger network of the above character which is simple in character and capable of producing output pulses of improved rectangular form.

It is a still further object of my invention to provide new and improved means for converting electric oscillations of fixed or variable frequency and regular or irregular wave shape to substantially rectangular pulses of uniform intensity independent of the intensity of the input oscillations and having a repetition rate determined by the frequency of the input or signal oscillations.

In accordance with my invention, a pair of electron discharge devices are connected to a direct current supply source through a cathode resistor having a common portion and are regeneratively coupled to provide two discontinuous conditions of stable operation. Switching between the two conditions of conduction is controlled directly in accordance with signal oscillations supplied to the control electrode of one of the discharge devices.

The features of my invention which I believe to be novel are set forth with particularity in the appended claim. My invention itself, both as to its organization and manner of operation together with further objects and advantages thereof, may be best appreciated by referring now to the following detailed specification taken in conjunction with the accompanying drawing, in which Figs. 1 and 2 are schematic circuit diagrams of various pulse forming trigger circuits embodying my invention; and Fig. 3 is a fragmentary circuit diagram illustrating modified forms of the circuits of Figs. 1 and 2.

Referring now to the drawing, I have shown a pulse forming trigger circuit comprising a pair of electron discharge devices 1 and 2 containing anodes 3, 4, cathodes 5, 6, and control electrodes 7, 8, respectively. The cathodes 5 and 6 are connected together through a resistor 9 and the cathode 5 is connected to ground through a resistor 10. The anodes 3 and 4 are connected

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through anode resistors 11 and 12, respectively, to a suitable source of unidirectional positive potential indicated upon the drawing by B+. The anode 3 of the discharge device 1 is also connected directly to the control electrode 8 of the discharge device 2. A grid bias resistor 13 is connected between the cathode and control electrode of the discharge device 1. Signal oscillations of fixed or variable frequency from a suitable source 14 are supplied to the control electrode 7 of the discharge device 1, and a suitable pulse utilization circuit 15 is connected across the anode resistor 12 associated with the discharge device 2.

In operation, when no signal potential is supplied to the control electrode 7, the pulse forming circuit of Fig. 1 is in a normal condition with both discharge devices 1 and 2 conducting. The discharge device 1 conducts by reason of the zero bias maintained upon its control electrode 7 through the resistor 13. The discharge device 2 conducts because its cathode 6 is biased to ground potential through the resistor 10 and its control electrode 8 is biased to the positive source potential B+ through the anode resistor 11. With both discharge devices conducting and no signal potential applied, the resistor 13 maintains a positive bias upon the control electrode 7, while the bias upon the control electrode 8 is determined by the tube drop through the discharge device 1 and the characteristics of the resistor 9. It will be evident that the control electrode 8 is maintained at the potential of the anode 3 and is therefore somewhat more positive than the cathode 5 of the discharge device 1, while the cathode 6 of the discharge device 2 is also somewhat more positive than the cathode 5 because of the potential drop across the resistor 9. For stability, the resistor 9 is so proportioned that, when the discharge devices are conducting with no signal potential applied, the potential difference between the cathode 6 and the control electrode 8 is above cutoff potential.

If now a negative signal potential of sufficient intensity is impressed upon the control electrode 7 of the discharge device 1, the discharge device 1 will be cut off and conduction in the discharge device 2 appreciably increased. Thus, as soon as current in the discharge device 1 begins to decrease in response to negative control electrode potential, the potential of the anode 3 increases in a positive sense and therefore increases the positive potential of the control electrode 8 of the discharge device 2. Increasing positive potential upon the control electrode 8 increases

the conduction in the discharge device 2 and thus tends to maintain the current through the resistor 10. Continuance of current through the resistor 10 maintains an appreciable positive potential upon the cathode 5 and therefore aids in rapid cutoff of the tube 1. Further cutoff of the tube 1 further increases the positive potential of the control electrode 8, so that by regenerative feedback switching is accomplished substantially instantaneously. So long as a negative potential in excess of a predetermined value is maintained upon the control electrode 7, the discharge device 1 will remain cut off and the conduction through the discharge device 2 will be a maximum.

As soon as the signal potential from the source 14 changes so that the control electrode potential of the discharge device 1 increases above a predetermined value, the device 1 again becomes conductive, thereby to decrease the control electrode potential of the discharge device 2 and to reduce conduction in the discharge device 2. Thus, by grid and cathode feedback, switching is again rapidly accomplished and the devices 1 and 2 are restored to their initial state of conduction.

It will now be evident that conduction through the discharge devices 1 and 2 changes abruptly between minimum and maximum values in direct response to the periodicity of signal potential from the source 14. The voltage pulses thus produced across the anode resistors 11 and 12 may be utilized as desired. For this purpose, I have indicated conventionally a utilization circuit 15 connected to derive input pulses from the terminals of the resistor 12.

At Fig. 2 I have shown an embodiment of my invention generally similar to that at Fig. 1 but in which means are provided for rendering the discharge devices 1 and 2 alternatively conductive. In Figs. 1 and 2, like parts have been assigned the same reference numerals. At Fig. 2, alternative conduction of the discharge devices is ensured by a pair of additional resistors 16 and 17. The resistor 16 is connected between the cathode 6 of the discharge device 2 and the positive potential source B+. This resistor constitutes, with the resistors 9 and 10, a potential divider between the source B+ and ground, and maintains upon the cathode 6 a bias potential intermediate the source potential and ground in addition to the potential due to the cathode currents of the discharge devices 1 and 2. The resistor 17 is connected between an intermediate point on the anode resistor 11 and ground. The resistor 17 constitutes, with the upper portion of the anode resistor 11, a potential divider of low regulation which has the effect of reducing the supply potential to the anode 3 and therefore maintaining the control electrode 8 of the discharge device 2 at a bias potential less than the potential of the source B+. It will accordingly be understood that, by proper proportioning of the resistors 16 and 17 in conjunction with the resistors 9, 10, and 11, a suitable bias may be impressed between the cathode and control electrode of the discharge device 2 to maintain the device 2 cut off when the device 1 is conductive.

It will now be evident that, when anode potential is supplied to the circuit of Fig. 2 and no signal potential is present, the discharge device 1 will immediately begin to conduct because of the zero bias maintained by the resistor 13. If the discharge device 2 tends to conduct, its cathode potential will be raised by increase of cur-

rent through the resistor 9, thereby tending to cut off the device 2. Simultaneously, conduction in the discharge device 1 lowers the potential of the anode 3 and the directly connected control electrode 8 of the discharge device 2, thereby further to increase the negative bias upon the discharge device 2 and to ensure that this device remains cut off.

If now a negative signal potential is supplied to the control electrode 7 in the circuit shown at Fig. 2, current in the device 1 begins to decrease, thereby to raise the potential of the anode 3 and the control electrode 8. Increasing control electrode potential initiates conduction in the discharge device 2 and, as previously described, feedback through the cathode resistor 10 and the grid connection of discharge device 2 effects rapid switching of conduction from the device 1 to the device 2. Thus, so long as a signal potential of a predetermined negative value is maintained upon the control electrode 7, the discharge device 2 is conductive and the discharge device 1 is non-conductive. As soon as the signal potential increases in a positive sense to a predetermined value, the discharge device 1 again becomes conductive, thereby to cut off the discharge device 2 by imposition of negative potential upon the control electrode 8. Thus, the discharge devices 1 and 2 alternate abruptly between conditions of maximum and minimum conduction, so that a generally rectangular voltage pulse may be derived from the anode resistor 12. As shown at Fig. 2, the voltage pulses appearing across a portion of the resistor 12 are supplied to a utilization circuit 15.

At Fig. 3 I have shown a fragmentary circuit diagram illustrating additional features which may be incorporated in the circuits of either Fig. 1 or Fig. 2. More particularly, a blocking capacitor 14a may be included between the grid 7 and the signal source 14. Also if desired a grid resistor 7a may be included in the grid leak circuit. At Fig. 2 I have also shown a further modification of my invention in which a bypass capacitor 9a is connected in shunt with the resistor 9. Such a bypass capacitor may also be used, if desired, in connection with Fig. 1.

It will now be understood that my invention provides pulse voltages of superior rectangular configuration. One advantageous feature of my circuit is that it involves no time delay capacitor discharge circuits which may cause undesirable voltage peaks to be superposed upon the desired rectangular wave output. According to my invention the discharge devices are switched substantially instantaneously between two alternative conditions of stable operation and directly in accordance with the signal input potential.

While I have shown only a certain preferred embodiment of my invention by way of illustration, many modifications will occur to those skilled in the art and I therefore wish to have it understood that I intend in the appended claim to cover all such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

A pulse forming network comprising, in combination, a direct current supply source having positive and negative terminals, a first electron discharge device having an anode, cathode and control grid, said anode being connected through a first resistor to said positive terminal and said

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cathode being connected through a second resistor to said negative terminal, said control grid being biased so that said device normally draws substantial anode current, a second electron discharge device also having an anode, cathode and control grid, the anode of said second device being connected through a third resistor to said positive terminal and the cathode of said second device being connected through a fourth resistor to the cathode of said first device, a direct connection from the anode of said first device to the control grid of said second device, whereby said second device has a negative bias impressed thereon in response to anode current in said first device, means for increasing said negative bias to maintain said second device normally beyond cut off comprising a fifth resistor connected between said positive terminal and the cathode of said second device and a sixth resistor connected between an intermediate point on said first resistor and said negative terminal, means for impressing a negative pulse on the control grid of said first device

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of sufficient magnitude to initiate an abrupt reversal in the conditions of conductivity of said two devices, and an output load circuit responsive to voltage variations on said third resistor.

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