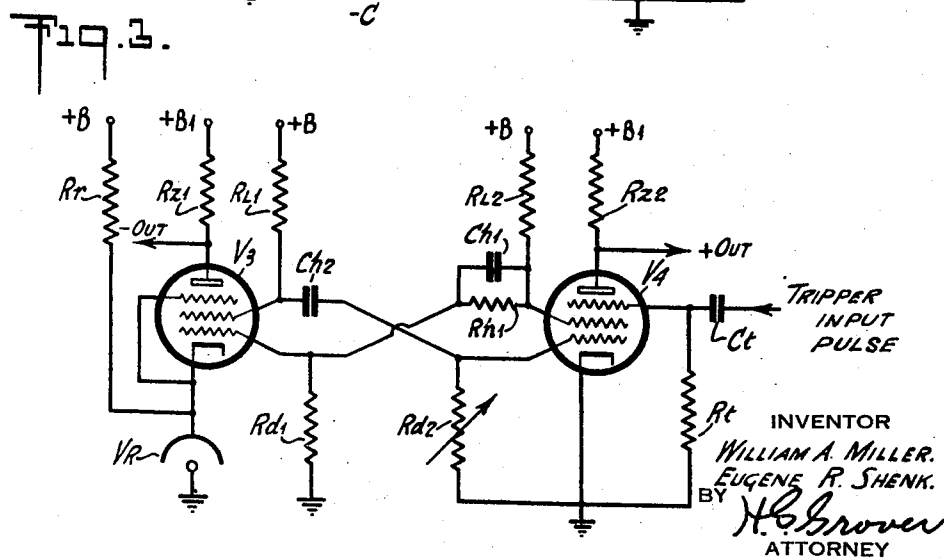
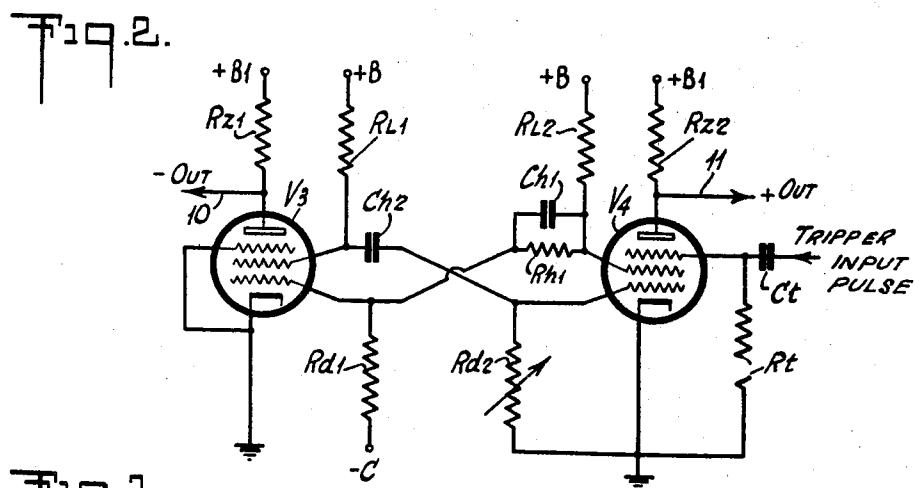
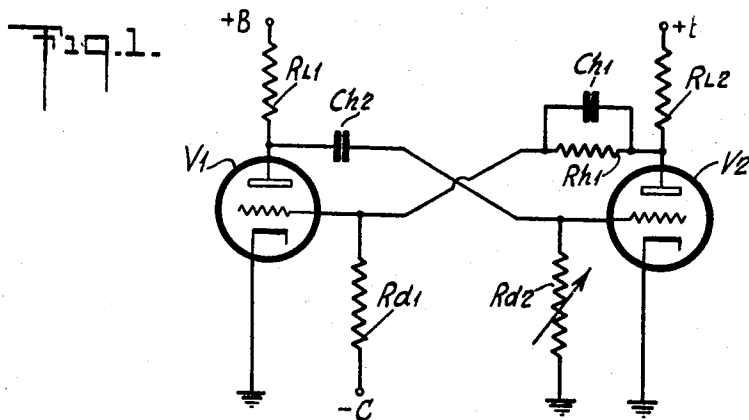


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ELECTRONIC TRIGGER CIRCUIT

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ELECTRONIC TRIGGER CIRCUIT

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This invention relates to electronic trigger circuits.

It is known to employ trigger circuits in the form of a pair of triode electrode structures whose grids and anodes are regeneratively coupled. In such known types of trigger circuits, the length of the output pulse is affected by the following factors: (1) The impedance of the tripping circuit, (2) the impedance of the circuit on which the trigger circuit output is impressed, and (3) the interaction of the trigger function of the vacuum tubes with the tripping and output functions.

An object of the present invention is to provide an electronic trigger circuit in which the input, output and triggering circuits and functions are isolated from one another.

Another object of the invention is to provide a trigger circuit employing multi-grid tubes having certain electrodes regeneratively coupled and in which the output is derived from a different electrode than those which enter into the regenerative circuit.

A further object is to provide a pair of multi-grid vacuum tube electrode structures certain of whose electrodes are coupled regeneratively and other of whose electrodes function as the load or output circuit.

A more detailed description of the invention follows in conjunction with the drawing, wherein:

Fig. 1 shows one type of known trigger circuit, and

Figs. 2 and 3 show different embodiments of the electronic trigger circuit of the present invention.

Referring to Fig. 1, there is illustrated a known type of trigger circuit having one degree of electrical stability. This trigger circuit comprises a pair of vacuum tubes V1 and V2 whose grid and anode electrodes are interconnected to provide a regenerative action. Resistors RL1 and RL2 are connected between the positive terminal +B of a source of anode polarizing potential and the anodes of tubes V1 and V2, respectively. The anode of tube V1 is connected to the grid of tube V2 through a condenser Ch2, while the anode of tube V2 is connected to the grid of tube V1 through a resistor-shunt-condenser arrangement Rb1, Ch1. The grid of tube V1 is connected to the negative terminal -C of a source of biasing potential through a resistor Rd1. The grid of tube V2 is connected to ground through a variable resistor Rd2. Resistors RL1 and RL2 might be relatively small compared to the values of the two grid resistors. Normally, in the operation of the trigger circuit of Fig. 1, tube V1 is non-conductive and biased to or beyond cut-off by means of source -C. Tube V2, however, is

normally in a conductive state and passes current because the grid is maintained at substantially zero bias. This condition of operation wherein tube V1 is normally non-conductive and

5 tube V2 is normally conductive is called the stable state. In the active or unstable state, however, the current passing conditions of the tubes V1 and V2 are reversed from that just described.

10 After an interval of time in the active state, depending in part upon the time constants of the system, the trigger will restore itself to the stable state. In order to change the trigger circuit from the stable state to the active state, it has

15 been customary to apply either a positive pulse to the grid of tube V1 or a negative pulse to the grid of tube V2. The positive tripping pulse should be of sufficient magnitude to overcome the negative bias on the grid of tube V1 and cause the tube V1 to pass current. When tube

20 V1 passes current, by virtue of the regenerative action of the circuit, tube V2 will cease conducting. Similarly, if a negative tripping voltage is applied to the grid of tube V2, it should preferably be of sufficient magnitude to bias the tube

25 V2 to cut-off. As a result, due to regenerative action, the tube V1 will conduct.

In the circuit of Fig. 2 of the invention, the vacuum tubes comprise pentodes V3 and V4. Each pentode comprises an anode electrode, a suppressor electrode, a screen electrode, a first grid and a cathode. The first grid and the screen electrodes of the two tubes are regeneratively coupled together to form with the cathodes a trigger circuit in substantially the same manner

35 illustrated in Fig. 1. The same reference characters have been employed throughout the figures in order to represent the same or equivalent elements. The suppressor grid, however, of the normally non-conducting vacuum tube V3 is connected to the cathode of the same tube, while

40 the suppressor grid of the normally conducting vacuum tube V4 is connected to its cathode through its resistor Rt. The screen and anode electrodes of the vacuum tube V3 are individually supplied with positive polarizing potentials from

45 sources +B and +B1 through resistors RL1 and R21. Similarly, the screen and anode electrodes of tube V4 are individually supplied with positive polarizing potentials from sources +B and +B1 through separate resistors RL2 and R22. Sources

50 +B and +B1 may supply either the same or different potentials to the screen and anode electrodes depending upon the values of the circuit elements employed in the trigger circuit. It

55 should be noted that the first grid of tube V3 is supplied with a negative biasing potential through resistor Rd1 to render it normally non-conducting. It should also be noted that the

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output pulses of either negative or positive relative polarity may be taken from the tubes V3 or V4, respectively, from their anodes by means of leads 10 and 11. In order to trip the circuit, it is proposed to supply a negative pulse to the suppressor grid of tube V4 through condenser Ct.

In the operation of the circuit of Fig. 2, a negative pulse applied to the tube V4 via Ct, of sufficient magnitude to cause the tube V2 to cease conducting (that is, to prevent the electrons from reaching the screen electrode), will trip the circuit and cause the normally non-conducting tube V3 to become conducting. This input or tripping pulse applied to the suppressor grid of tube V4 must be relatively large since enough potential must be supplied to reduce the potential between the cathode and screen grid thereof by an amount sufficient to cause triggering. The anodes of the two tubes are electronically coupled to the rest of the tube structures and thus it will be seen that the output circuit is isolated from the triggering or regenerative circuit and also isolated from the input circuit. In the design of the circuit of Fig. 2, care must be taken to employ the proper values of elements which enter into the regenerative circuit. For example, where direct current anode resistance was employed in the known type of trigger circuit of Fig. 1, we must now employ direct current screen resistance in the embodiment of Fig. 2, etc. The anode resistors R21 and R22 are chosen to best fit the load condition.

Fig. 3 shows a modification of the circuit of Fig. 2, the difference lying primarily in the manner of biasing the tube V3 normally to current cut-off condition. In Fig. 3 there is provided a voltage regulator tube VR between the cathode and ground, and a connection directly from the cathode of V3 to the positive source +B through a resistor Rr. The voltage regulator tube VR will always be lit and the effect of supplying a positive potential to the cathode is the same as applying a negative potential to the first grid, thus biasing the first grid to the cut-off condition. Putting it in other words, the system of Fig. 3 illustrates an alternative method of biasing the tube V3 to below its cut-off potential. Otherwise, the circuit of Fig. 3 functions in substantially the same manner as the circuit of Fig. 2. The average current through the regulator tube VR should not exceed the rated current of this tube, although it can draw greater current than rated for only short intervals. Of course, for the same values of +B and +B1, the screen grid and anode potentials of V3 are reduced due to the fact that the cathode is operated at a positive potential.

Although the principles of the invention have been described with reference to a trigger circuit, it will be understood that they are also applicable to a multivibrator circuit employing pentode vacuum tubes. In utilizing the principles of the invention in connection with a multivibrator circuit, substantially the same circuit as Fig. 2 can be employed with these exceptions: There will not be used any negative biasing potential for vacuum tube V3, nor will there be used the resistor Rt or the resistor R21, or the application of a tripping pulse unless it is desired to synchronize the multivibrator. The suppressor electrode of tube V4 will be connected to its cathode in substantially the same manner as that of tube V3.

What is claimed is:

1. A pulse generating trigger circuit comprising first and second pentode vacuum tube elec-

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trode structures each having a cathode, a control grid, a screen grid, a suppressor grid and an anode, a condenser coupling the screen grid of said first structure and the control grid of said second structure, a condenser shunted by a resistor coupling the screen grid of said second structure and the control grid of said first structure, means for biasing the control grid of one of said structures to below cut-off, a direct connection between the suppressor grid and cathode of one of said structures, a resistor connected between the suppressor grid and cathode of the other of said structures, means for supplying a tripping pulse of predetermined polarity to the suppressor grid of said last structure, separate resistors connecting said anodes and screen grids to the positive terminal of a source of unidirectional potential over separate paths, and an output circuit coupled to an anode of one of said tubes for deriving an output pulse from said trigger circuit for each application of a tripping input pulse.

2. A self-restoring pulse generating trigger circuit comprising first and second pentode vacuum tubes each having a cathode, a control grid, a screen grid, a suppressor grid and an anode, a condenser coupling the screen grid of said first tube and the control grid of said second tube, a condenser shunted by a resistor coupling the screen grid of said second tube and the control grid of said first tube, connections from each of said cathodes to ground, means for biasing the control grid of said first tube to below cut-off, a direct connection between the suppressor grid and cathode of said first tube, a resistor connected between the suppressor grid and cathode of said second tube, separate resistors connecting said anodes and screen grids to the positive terminal of a source of unidirectional potential, whereby said first tube is normally non-conducting and said second tube is normally conducting, means for supplying a tripping pulse of negative polarity to the suppressor grid of said second tube, to thereby reverse the normal current passing states of said tubes, and an output circuit coupled to one or both of said anodes for deriving output pulses from said trigger circuit.

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