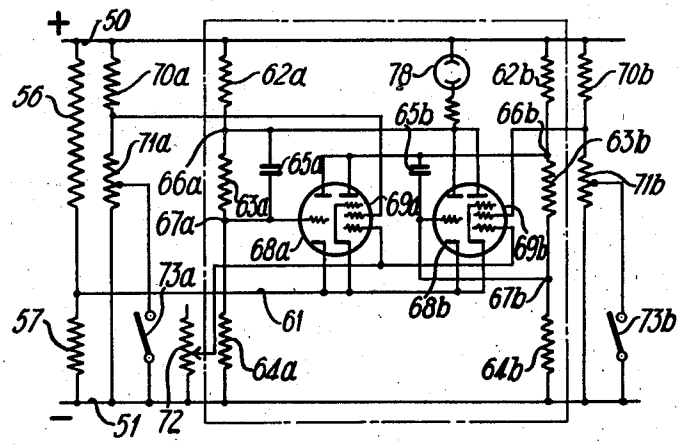
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ELECTRONIC TRIGGER

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Fig. 1.



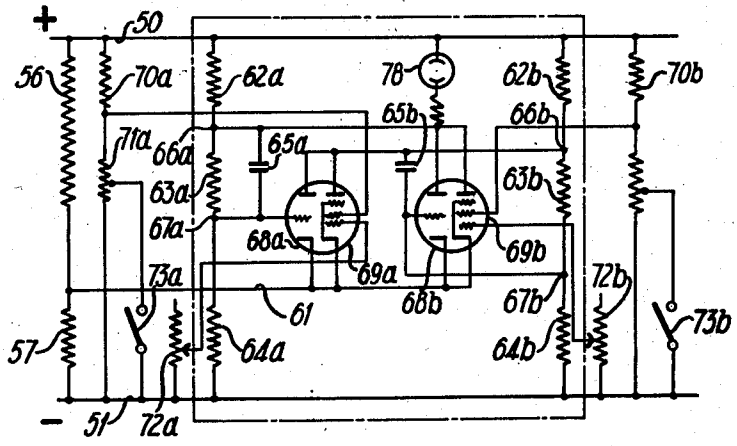


Fig. 2.

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ELECTRONIC TRIGGER

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Application June 28, 1947, Serial No. 757,766, which is a division of application, Serial No. 394,881, May 23, 1941. Divided and this application August 24, 1948, Serial No. 45,924

2 Claims. (Cl. 250—27)

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The present invention relates to electronic trigger means and more particularly to selectively operated electronic trigger means.

More particularly, the present invention is a division of applicant's copending application Serial No. 757,766 filed June 28, 1947, now Patent No. 2,514,036, dated July 4, 1950, entitled "Electronic Pulse Producer" which itself is a division of applicant's copending application Serial No. 394,881 filed May 23, 1941 entitled "Accounting Apparatus," the present application being directed to the electronic trigger means of said two prior applications.

One of the objects of the present invention is to provide a trigger circuit operable to one condition and back to an initial condition and timing means determining the time duration of one of said conditions.

Another object is to provide a novel trigger circuit of two inherent stable conditions comprising a triode and a multi-grid electronic device for establishing one of said stable conditions and a triode and a multi-grid electronic device for establishing the other of said stable conditions.

Still another object is to provide a novel trigger circuit comprising a pair of cross-coupled triodes and a multi-grid electronic device for each of said triodes for selectively rendering its triode effective.

Still a further object is to provide a novel trigger circuit operative to either of two conditions provided with selection means to determine which condition will be assumed by said trigger.

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

In the drawings:

Fig. 1 is a basic wiring diagram of the novel trigger circuit employed in the invention.

Fig. 2 is a wiring diagram of a modification of the trigger circuit of Fig. 1.

Referring to the drawings and more particularly to Fig. 1, this discloses a basic circuit comprising vacuum tubes interconnected by resistances and condensers, as shown. Two triodes of the four vacuum tubes shown are so interconnected in a trigger unit and operate in such a manner that the trigger assumes two conditions of stability. When one of the triodes is conducting, a large amount of current flows through it and the other triode is at shut-off. In

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other words, in one condition of stability, one of the triodes has a relatively low impedance and the other has a relatively high impedance. In the other condition of stability, the respective conditions of the two triodes is reversed. Controlling impulses are applied to the other two vacuum tubes, which are pentodes, comprising the trigger unit to cause the shift from one condition of stability to the other. Every second impulse brings the trigger to the original condition of stability.

Referring to Fig. 1, voltage of the polarity indicated is supplied to lines 50 and 51 and to a voltage divider consisting of resistances 56 and 57. Voltage is also supplied by means of the divider to line 61, its potential being positive with respect to line 51.

The trigger circuit comprises two impedance networks. One network includes resistances 62*a*, 63*a* and 64*a*, resistance 63*a* being shunted by coupling condenser 65*a*. Vacuum tubes 68*b* and 69*b* shown in one envelope, in Fig. 1, are connected in parallel between point 66*a*, located between resistances 62*a* and 63*a*, and line 61. The second impedance network consists of resistances 62*b*, 63*b*, and 64*b*, resistance 63*b* being shunted by coupling condenser 65*b*. Vacuum tubes 68*a* and 69*a*, also shown in one envelope in Fig. 1 are connected in parallel between point 66*b*, located between resistances 62*b* and 63*b*, and line 61. Resistances 62*a* and 62*b* are equal in value as are resistances 63*a* and 63*b*, and resistances 64*a* and 64*b*. The capacities of condensers 65*a* and 65*b* are also equal. In actual practice an efficient combination was found when the values of resistances 62*a* and 64*a* were each approximately one-third the value of resistance 63*a*. A suitable value for the capacity of the condenser 65*a* is of the order of a few hundred micromicrofarads.

Assuming that the grid of triode 68*a* is substantially at the same potential as line 61, its grid bias will be substantially zero. With resistance 62*b* properly chosen, triode 68*a* has an impedance relatively low as compared to that of resistance 62*b* and its anode and point 66*b* to which the anode is connected will have a voltage which is not much greater than that of line 61 with large current flow through triode 68*a*. With resistances 63*b* and 64*b* properly chosen, the potential drop across 63*b* is great enough to maintain point 67*b* and hence the grid of triode 68*b*, negative with respect to line 61. With triode 68*b* negatively biased, it has an impedance greater than that of resistance 62*a*. Hence the anode of triode 68*b* and point 66*a* to which the

anode is connected are at a high enough potential so that the voltage drop across resistance 63a will not force the potential of point 67a below that of line 61.

The foregoing describes one condition of stability in which triode 68a has a large current flow therethrough and triode 68b is at shut-off, hence with no current flow therethrough, and point 66a is at a higher potential with respect to lines 61 and 51, than is point 66b. The manner of switching the trigger circuit to the other condition of stability, is as follows.

In order to shift the trigger from one stable condition to the other, pentodes 69a and 69b may be employed. The screen grid (hereinafter designated as a screen) of pentode 69a is connected to a point on a voltage divider consisting of resistors 70a and 71a. The potential of this point being positive with respect to line 61, the screen voltage of pentode 69a is positive with respect to its cathode. The screen of pentode 69b is connected to a point on a voltage divider consisting of resistors 70b and 71b. The voltage of this point is likewise positive with respect to line 61, so that the screen potential of pentode 69b is positive with respect to its cathode. The control grid (hereinafter designated as the grid) of pentode 69a is connected to the control grid of 69b and both are connected to a resistance 72, to which positive pulses are applied in a manner described, for example, in application Serial No. 757,766 filed June 28, 1948.

In the absence of any pulse on resistor 72, the negative grid bias of pentodes 69a and 69b is the potential difference between lines 61 and 51 and is sufficiently great to maintain pentodes 69a and 69b at shut-off.

When, however, a positive pulse is applied to resistance 72, there is a simultaneous negative bias reduction of the grids of both pentodes 69a and 69b, but since the anode of pentode 69a is directly connected to that of triode 68a and since the plate voltage of triode 68a and point 66b is very low, this particular bias reduction is ineffective to increase current flow through pentode 69a and thus has no effect on the trigger circuit. The anode of pentode 69b, however, is directly connected to that of triode 68b and to point 66a, and since the potential of this point, with respect to line 61, is relatively high, the simultaneous bias reduction of pentode 69b causes a current flow as follows: From line 50, resistor 62a, pentode 69b, line 61, resistance 57 to line 51, thus causing point 66a to suddenly drop in potential, producing a negative pulse. This negative pulse is fed through condenser 65a to the grid of triode 68a, effecting a sudden increase in the negative grid bias thereof, and reducing current flow through triode 68a and resistance 62b. Point 66b, accordingly, rises in potential, with respect to line 61, to produce a positive pulse which is fed through condenser 65b to the grid of triode 68b, changing its grid bias to substantially zero. Since now the potential of point 66b has risen and that of point 66a has dropped, triodes 68a and 68b assume another condition of stability which is the reverse of that originally described, namely, triode 68a is now shut-off while triode 68b passes a large amount of current. This new status of the trigger circuit will be maintained until another positive pulse is applied to resistance 72. When this occurs, the resulting negative grid bias reduction of pentode 69b is ineffective while that of pentode 69a is effective to increase current flow therethrough, and the trigger is returned to the condition of stability originally described.

It may be noted that to best achieve the operations as described above, the pulses applied to the grids of pentodes 69a and 69b should be of steep wave form. Preferably the R. C. product of the value of resistance 72 and the value of the capacity of any associated condenser should not exceed one-fifth the R. C. product of resistance 63a and condenser 65a. It should also be noted, that negative pulses, applied to the grids of pentodes 69a and 69b, are ineffective, to cause the shifting action explained above, in the particular trigger just described.

Novel means are now provided for rendering the trigger action selective. In the foregoing description, it is assumed that switches 73a and 73b are in open position, as shown. The closure of switch 73a, shunts out a portion of resistance 71a, thus reducing the screen potential of pentode 69a to substantially that of line 61. Assuming that the trigger condition of stability is such that point 66b is at a high potential, this screen potential reduction prevents any negative grid bias reduction of pentode 69a from being effective in bringing about increased current flow therethrough. Therefore, until switch 73a is opened, successive applications of positive pulses to resistance 72 are ineffective to change the status of the trigger from that condition in which points 66b and 66a are at high and low potentials, respectively.

Similarly, the closure of switch 73b shunts out a portion of resistance 71b, thus reducing the screen voltage of pentode 69b to substantially that of line 61. Such screen voltage reduction, when point 66a is at high potential, prevents any negative grid bias reduction of pentode 69b from being effective in bringing about increased current flow therethrough. Therefore, under these conditions, until switch 73b is opened, successive applications of positive pulses to resistance 72 are ineffective to change the status of the trigger from that condition in which points 66a and 66b are at high and low potentials, respectively. Switches 73a and 73b, therefore, comprise parts of selection means whereby selectivity in operation is obtained.

The condition of the trigger may be determined by observation of a glow discharge (neon) tube 78, which is connected in series with a current limiting resistor, between line 50 and point 66a. When point 66a is at a high potential with respect to line 61, the difference in voltage between it and line 50 is insufficient to ignite tube 78. When point 66a, however, is at a low potential (point 66b at high potential), the difference in voltage is great enough to cause neon tube 78 to fire. This indicates that the trigger, as a whole, is "on."

That portion of the circuit of Fig. 1 within the broken line enclosure finds extensive use in various portions of the electronic pulse producer of application Serial No. 757,766 filed June 28, 1948. For purposes of simplicity, this enclosed portion will be hereinafter termed a trigger element and it will also be understood as described in connection with the ignition of neon tube 78 that when points 66b and 66a are respectively at high and low potentials, with respect to lines 61 and 51, the trigger element is on an "on" status and that when the potentials of points 66b and 66a are respectively low and high, with respect to lines 61 and 51, the trigger element is in an "off" status. The voltages which exist at points

of the trigger such as points 66*b* and 66*a*, and which vary in accordance with the conditions of stability, are employed for many control purposes, as explained in said application Serial No. 757,766.

The circuit of Fig. 2 also relates to a triggering circuit, which is substantially similar to that just described in connection with Fig. 1. Portions of this circuit, which correspond in character and function to portions of the circuit of Fig. 1, are given the same reference characters. With regard to the arrangement of Fig. 2, it also may have two conditions of stability, but in lieu of deriving pulses from a common source and applying them to two circuit points to shift the condition of stability, two sources of pulses, such as resistances 72*a* and 72*b* are employed. It is assumed that such pulses do not occur simultaneously. The grid of pentode 69*a* is connected to resistance 72*a* and whenever a positive pulse, occurring at one time, on 72*a* is applied to the grid of 69*a*, there is an increased current flow through 69*a*, assuming that triodes 68*a* and 68*b* have high and low impedances, respectively, and the circuit shifts to a stable condition in which points 66*b* and 66*a* are at low and high potentials, respectively. With the circuit in this last status, a positive pulse occurring, at another time, on resistor 72*b* reduces the negative grid bias of pentode 69*b* causing increased current flow therethrough and the trigger is shifted to the opposite condition of stability, wherein points 66*b* and 66*a* are at high and low potentials, respectively, or in other words the trigger, as a whole, is "on." The manner in which the circuit shifts from one condition of stability to the other is similar to that described in connection with the circuit in Fig. 1. Selection means, as in the circuit of Fig. 1, are provided, since it is obvious that closure of switch 73*a* (Fig. 2) prevents pulses applied to resistor 72*a* from being effective while the closure of switch 73*b* prevents pulses applied to resistor 72*b* from being effective. Manipulation of switches 73*a* and 73*b*, therefore, permits selective operation of the circuit. This modification of the triggering circuit, which includes the two sources of pulses, is employed extensively in the circuits of the electronic pulse producer of said application Serial No. 757,766. That portion of the Fig. 2 circuit within the broken line enclosure, is identical in structure to that portion in Fig. 1 within the broken line, except that the control grids of pentodes 69*a* and 69*b* are not interconnected. This portion, therefore, is called a trigger element, and it, along with its two sources of pulses forms the basis of the electronic commutator described in said application Serial No. 757,766.

While tubes 69*a* and 69*b* have been shown as pentodes in the circuits of Figs. 1 and 2, it will be understood that one or both of these vacuum tubes may be triodes, like tubes 68*a* and 68*b*. When tubes 69*a* and 69*b* are triodes, however, no screen grids are available to afford the trigger circuit the novel feature of selectivity provided by the selection means as set forth above.

Novel electronic trigger means having two conditions of equilibrium are therefore provided and novel means are also provided in combination therewith for producing selective control of a selected one of said conditions.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to preferred embodiments, it will be understood that various omissions and substitutions and changes in the form and details of the devices illustrated and in their 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. An electronic trigger comprising a pair of tubes cross-coupled to form a trigger having two conditions of equilibrium, a multi-grid tube in parallel with one of said pair of tubes and switching means connected to a grid of said multigrid tube for altering the bias thereon for selectively determining which of said conditions of equilibrium will be assumed.

2. An electronic trigger comprising a pair of triodes, means electrically cross coupling the input of each of said triodes and the output of the other of said triodes, a pentode connected in shunt with each of said triodes and switching means connected to a grid of each of said pentodes for selectively determining which sustained condition of said trigger will be assumed when pulses are applied to said trigger.

ARTHUR H. DICKINSON.

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