

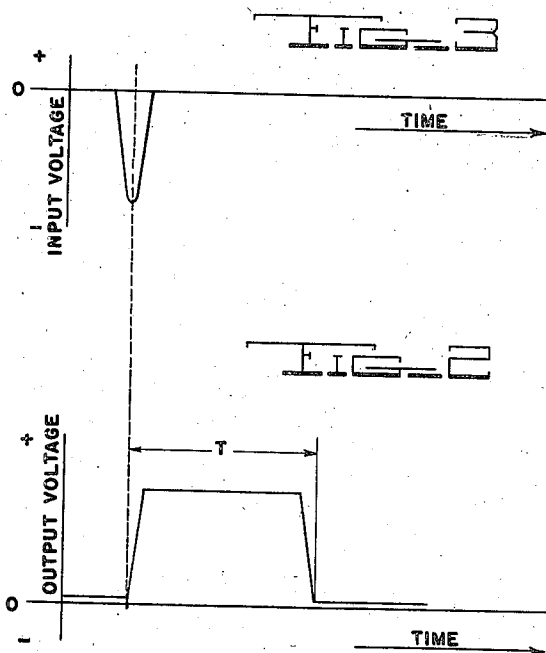
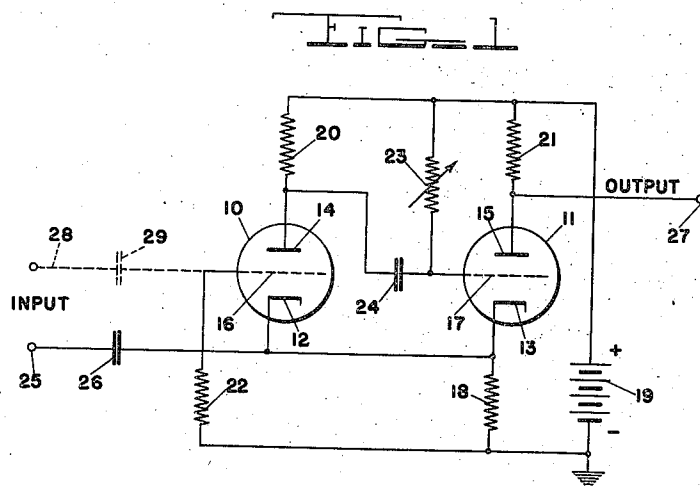
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ELECTRONIC TRIGGER CIRCUIT WITH TIME-DELAY

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ELECTRONIC TRIGGER CIRCUIT WITH
TIME-DELAY

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This invention relates to electrical apparatus for generating rectangular pulses, and more particularly to an apparatus for producing a rectangular pulse upon application of a single momentary pulse thereto.

Various electrical apparatus have been provided heretofore, such as non-oscillating multivibrators, for generating a pulse upon application of a single momentary pulse to the circuit. However, the prior arrangements are not adequate in that the magnitude and time-interval of the produced pulse is either dependent upon the character of the applied pulse or is so limited by inherent characteristics of the circuit that a pulse suitable for numerous applications cannot be obtained thereby. Moreover, the circuits of the prior apparatus are extremely complex which tends to produce excessive regenerative action therein as well as reducing the efficiency and reliability of the apparatus.

It is therefore an object of the present invention to provide an electrical apparatus of such construction to overcome the disadvantages enumerated heretofore.

Another object is to provide an electrical apparatus having novel means for producing a rectangular shaped pulse upon application of a single momentary pulse thereto.

Another object is to provide in an electrical apparatus of the above character novel means for determining the time-interval of the produced pulse independently of the applied pulse.

Another object is to provide an electrical apparatus of comparatively simple construction for reliably producing an electrical impulse upon application of a single momentary pulse to the circuit.

Still another object of the invention is to provide an apparatus of the above type wherein the magnitude and time-interval of the produced pulse are independent of similar characteristics of the applied pulse.

Still another object is to provide an electrical apparatus of the foregoing character wherein the magnitude and time-interval of the produced pulse is determined by certain components of the apparatus and which may be easily varied throughout wide limits.

Still another object is to provide an electrical apparatus for generating an electrical pulse upon application of a single momentary pulse thereto of such construction to reduce regenerative action to a minimum.

Still another object is to provide an electrical apparatus having input and output terminals in-

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cluding novel means wherein the potential of the output terminal abruptly changes, upon application of a momentary voltage at the input terminal, to a value independent of the applied voltage, and wherein the potential of the output terminal remains at such value for a predetermined period of time determined by certain components of the apparatus.

Still another object is to provide an electrical apparatus including a pair of electron discharge devices interconnected in such a manner whereby the potential of the devices is normally maintained at a predetermined value, and wherein the potential of one of the devices abruptly varies upon application of a single momentary pulse thereto to abruptly vary the potential of the other device to a second predetermined value.

Other objects and features of the invention will appear more fully from the following detailed description when considered together with the accompanying drawing which disclosed one embodiment of the invention. It is to be expressly understood, however, that the drawing is designed for purposes of illustration only, and not as a definition of the limits of the invention, reference being had to the appended claims for the latter purpose.

In the drawing:

Fig. 1 is a schematic illustration of an electrical apparatus embodying the principles of the present invention;

Fig. 2 shows the voltage curve of a pulse produced by the apparatus disclosed in Fig. 1, and

Fig. 3 shows the voltage curve of the single momentary pulse applied to the apparatus shown in Fig. 1 to cause generation of the pulse disclosed in Fig. 2.

Referring more particularly to Fig. 1 of the drawing, an electrical apparatus embodying the principles of the present invention is disclosed therein including a pair of electron discharge devices 10 and 11, of the triode type, each respectively having a cathode 12 and 13, an anode 14 and 15, and a control electrode 16 and 17. When a more compact arrangement is desired, the electrodes of devices 10 and 11 may be included in a single envelope, such as a duplex-triode, for example. The cathodes 12 and 13 are connected together and are in turn connected to ground potential through common resistance 18, whereas the anodes of each of the devices are maintained positive with respect to the cathodes by an appropriate source of potential 19, the positive terminal of which is connected to anodes 14 and 15 through resistances 20 and 21 respectively. Con-

control electrode 16, of device 10, is connected to ground potential through resistance 22, while control electrode 17 is connected to the positive terminal of source 19, through variable resistance 23, in order that devices 10 and 11 may be controlled. For a purpose that will appear more fully hereinafter, control electrode 17 is also connected to anode 14, of device 10, through capacitance 24. An input terminal 25 is connected to the cathodes through suitable capacitance 26, and an output terminal 27 is provided which is connected between anode 15 and resistance 21, thus segregating the same from other components of the circuit to thus reduce regenerative action to a minimum.

With the foregoing construction, a positive bias is normally maintained on control electrode 17 of such value that device 11 draws current, and resistance 21 is selected to provide a drop in potential at anode 15 whereby the potential of output terminal 27 will normally be maintained at a substantially zero value. Resistance 18 is properly selected to provide a drop in potential at control electrode 16, when device 11 draws current, so that control electrode 16 is normally biased to a sufficient negative value to cut off device 10 and thus prevent anode 14 from drawing current. Anode 14, therefore, will normally be maintained at high potential, substantially equal to the potential of source 19.

As heretofore stated, the present invention provides means for abruptly varying the potential of device 10 upon application of a single momentary pulse at input terminal 25, to abruptly vary the potential of device 11, and hence output terminal 27, to a second predetermined value. It has been found when a single momentary negative pulse, of any suitable magnitude greater than a few volts, is applied to input terminal 25, the potential difference between control electrode 18 and cathode 12 suddenly changes and allows device 10 to abruptly draw current. At the instant current flows in device 10 a sudden drop in potential at anode 14 occurs because of the drop of the voltage at resistance 20. The extent of such potential drop at anode 14 depends upon resistance 20, which is to be of such value as to provide a comparatively large drop in potential following the instant the input pulse is applied to the input terminal. At the instant the potential of anode 14 drops a large negative pulse is transferred through capacitance 24 to control electrode 17, of device 11, to drive the control electrode sufficiently negative to abruptly cut off this device and abruptly terminate the flow of anode current. When the device 11 ceases to draw current the potential of anode 15, and hence the potential of output terminal 27, will abruptly increase, from the substantially zero value to a high value substantially equal to the potential of source 19. When it is desired to utilize a positive momentary pulse to change the bias on control electrode 16, in order to cause device 10 to abruptly draw current, such input voltage is applied to the control electrode 16 through an input terminal 28 and capacitance 29, shown in broken lines on the drawing.

In accordance with the principles of the present invention means are provided for maintaining the output terminal at a substantially constant high predetermined potential throughout a predetermined period of time, independently of the time-interval of the single momentary pulse applied at input terminal 25, and for abruptly causing the potential of the output terminal to

decrease to a substantially zero value after lapse of such predetermined period of time. As shown in the drawing, such means includes capacitance 24 and resistance 23, which function to maintain control electrode 17 sufficiently negatively biased, following the flow of the large negative pulse thereto, for a period of time equal to the product of the values of the capacitance and resistance. The capacitance and resistance are to be selected to provide the time-delay desired, or to determine the time-interval during which it is desired to maintain the output terminal at a high potential. During such time interval the negative bias on control electrode 17 gradually leaks off, and after lapse of the predetermined period of time, the control electrode will be driven positive, which abruptly allows device 11 to again draw current. At the instant device 11 commences to draw current the potential at the output terminal abruptly drops to a substantially zero value, because of the drop of the voltage at resistance 21. Resistance 23 may be of the variable type, if desired, so that the time-interval of high potential at output terminal 27 may be manually varied throughout certain limits. During the time-interval when device 11 is not passing current, there will be a small drop of voltage at resistance 18, and consequently device 10 will be drawing current throughout such interval. However, at the instant device 11 again commences to pass current, the drop in voltage at resistance 18 will increase to thereby cause device 10 to return to the normal state wherein no anode current is flowing and the anode is maintained at a high potential, substantially equal to the potential of source 19.

With reference to Figs. 2 and 3, curves of the output and input voltages, and the relationships therebetween are respectively shown. The potential of the output terminal is shown at a substantially zero value until the input voltage is impressed on the circuit, at which instant, the output voltage abruptly increases to a predetermined value, determined by certain components included in the circuit, independently of the magnitude of the input voltage. The output voltage then remains substantially constant at the high value for a predetermined time-interval T, such interval being determined by the product of the value of capacitance 24 and resistance 23. When time-interval T lapses, the output voltage abruptly drops to a substantially zero value, and remains at such value until a momentary input voltage is again applied to the circuit, in which case the foregoing operation would reoccur. From the above it can be readily seen that the output voltage, or the potential of the output terminal, is entirely independent of the characteristics of the input voltage, the latter only functioning as a trigger to initiate generation of the output pulse.

The present invention thus provides a novel electrical apparatus for generating a rectangular pulse upon application of a single momentary pulse thereto. The apparatus is of such construction and operates in such a manner that the magnitude and time-interval of the output pulse is entirely independent of magnitude and time interval of the input pulse. The apparatus is further characterized by novel construction wherein the output terminal is not connected adjacent to other components of the circuit thus reducing regenerative action to a minimum, and thus operating at a high efficiency and in a reliable manner.

Although only one embodiment of the present invention has been shown and described in detail heretofore, it is to be expressly understood that various changes and substitutions may be made therein without departing from the spirit of the invention, as well understood by those skilled in the art. Reference therefore will be had to the appended claims as a definition of the limits of the invention.

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.

What is claimed is:

1. In an apparatus for producing a rectangular pulse upon application of a single pulse thereto comprising a pair of electron discharge devices each having at least a cathode, anode and control electrode, an input terminal connected to the cathode of one of said devices, an output terminal connected to the anode of the other device, means normally maintaining the anode of said other device at substantially zero potential, means normally maintaining the anode of said one device at a high potential, means causing a drop in the potential of the anode of said one device upon application of the single pulse at said input terminal, means responsive to the drop in potential at the anode of said one device for causing an increase in the potential of the anode of said other device, and means responsive to a potential increase at the anode of said other device for further reducing the potential at the anode of said one device, the last-named means including a direct connection between said cathodes.

2. In an apparatus for producing a rectangular pulse upon application of a single pulse thereto comprising a pair of electron discharge devices each having at least a cathode, anode and control electrode, an input terminal connected to the cathode of one of said devices, an output terminal connected to the anode of the other device, means normally maintaining the anode of said other device at substantially zero potential, means normally maintaining the anode of said one device at a high potential, means causing a drop in the potential of the anode of said one device upon application of the single pulse at said input terminal, means responsive to the drop in potential at the anode of said one device for causing an increase in the potential of the anode of said other device, means including a resistance common to both of said cathodes for further reducing the potential at the anode of said one device upon said potential increase at the anode of said other device, and means for maintaining the potential of the anode of said other device at said increased value for a predetermined period of time and for abruptly varying the potential thereof to a substantially zero value after lapse of said predetermined period of time.

3. In an apparatus for producing a rectangular pulse in response to a single momentary pulse applied thereto, comprising a pair of vacuum tubes each having a cathode, control electrode and an anode, a source of potential, circuit means connecting said source to said tubes in such a manner to maintain the anodes positive with respect to the cathodes, a resistance in each anode circuit, a resistance common to both cathode circuits, an output terminal connected between the anode and corresponding anode resistance of one of said tubes, means normally applying a positive bias on the control electrode of said one tube whereby the anode draws current and the potential on the output terminal is substantially zero, means maintaining a negative bias on the control electrode of said other tube whereby the anode of said other tube does not draw current and is at a high potential, means applying a single momentary pulse to the cathode of said other tube whereby the anode of said other tube draws current causing a potential drop at the anode thereof, means including capacitance means connecting the control electrode of said one tube to the anode of the other tube whereby a negative bias is applied to the control electrode of said one tube upon drop in potential at the anode of said other tube thus causing an abrupt cessation of current flow therein and abruptly increasing the potential of the anode thereof, and resistance means connected to the control electrode of said one tube for maintaining the negative bias on the control electrode thereof for a predetermined period of time.

4. In an apparatus of the class described, a pair of vacuum tubes each having a cathode, an anode and a control electrode, a source of potential, means including a resistance connected to each of said anodes for applying positive potential from said source to said anodes, resistance means for applying the positive potential of said source to the control electrode of one of said tubes, resistance means applying negative potential from said source to the control electrode of the other tube, means including a resistance connecting both of said cathodes to negative potential of said source, and a condenser coupling the anode of said other tube to the control electrode of said one tube.

5. In apparatus of the class described, a pair of vacuum tubes each having at least a cathode, an anode and a control electrode, means applying a positive potential to said anodes, means including a resistance common to the cathodes of each of said tubes, means biasing the control electrode of one of said tubes negative with respect to its cathode, a condenser coupling the anode of said one tube to the control grid of the other said tube, and means applying a positive bias to the control electrode of said other tube thereby normally sustaining said other tube conducting and said one tube non-conducting.

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