

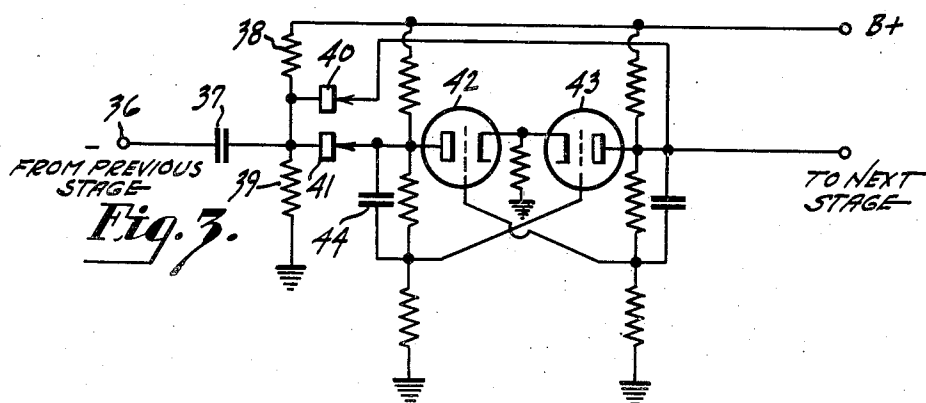
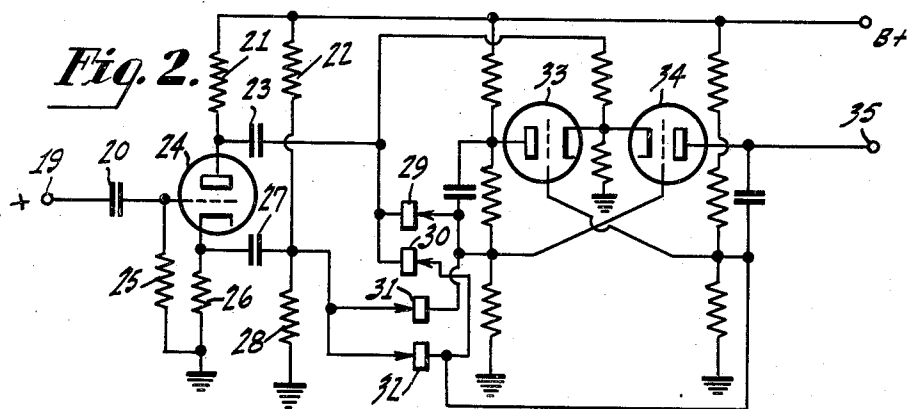
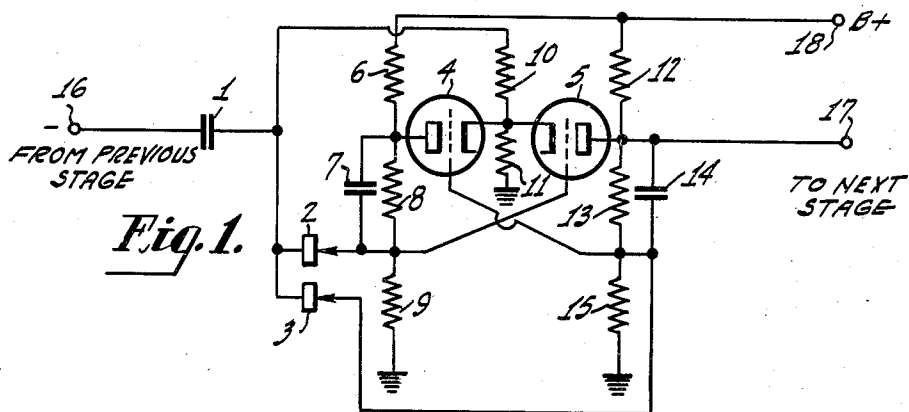
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TRIGGER CIRCUIT DRIVE

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TRIGGER CIRCUIT DRIVE

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This invention relates to trigger circuits wherein a pair of electron discharge devices have their cathodes connected to a common terminal, have their grids each cross connected to the anode of the other and have operating potential applied to their anodes through separate impedance devices or resistors. Under these conditions, current is conducted by only one of the electron discharge devices at a time and current conduction is transferred from one of the devices to the other in response either to the application of a negative pulse to the grid of the device which is conducting current or to the application of a positive pulse to the grid of the device which is not conducting current. The pulse which functions to transfer current conduction from one of the devices to the other usually is designated as the driving pulse.

In the operation of trigger circuits of this type, it has been customary to apply the same driving pulse simultaneously to the grids of both the devices. This is undesirable for the reason that it drives the grid of the non-conducting device in the negative direction at the same instant that it is about to be driven in the positive direction by the regenerative trigger action of the circuit. The result is less positive triggering action of the circuit.

In accordance with the different modifications of the present invention, this difficulty is avoided by interposing in each of the grid circuits of the electron discharge devices a unilaterally conducting device. Such unilaterally conducting devices are connected in the trigger circuit in such a way that there is always applied to the unilateral conductor in the grid circuit of the non-conducting electron discharge device an inverse bias potential so that a negative driving pulse is applied only to the grid of the conducting electron discharge device.

In accordance with one modification of the invention (Fig. 2) a positive driving pulse is applied to the grid of the non-conducting electron discharge device at the same time that the negative pulse is applied to the grid of the conducting electron discharge device.

In accordance with another modification of the invention (Fig. 3), a negative driving pulse is applied to the anode of the non-conducting electron discharge device and to the grid of the conducting electron discharge device.

If the unilaterally conducting devices of these various modifications have a low impedance such as that of the crystal rectifier having the trade designation 1N34, the drive pulses are applied

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to the grids of the electron discharge devices through very low impedance paths. These rectifiers are very small physically and have very low terminal to terminal capacitance. This low capacitance is important because it allows the rectifiers to be connected directly to the grids of the electron discharge devices without producing undesirable coupling between the grids. The use of these crystal rectifiers to transmit driving pulses to and between the successive stages of a counter including a plurality of concatenated trigger circuits makes it possible to operate such counters (1) more reliably without resorting to interstage amplifiers and (2) at speeds higher than heretofore attainable.

It is the principal object of the invention to provide an improved trigger circuit and method of operation whereby the maximum operating speeds of such a circuit and of a counter including a plurality of such circuits connected in cascade are greatly increased. Other objects are the provision of an improved trigger circuit which has a more direct and more reliable action than those previously available; the provision of a trigger circuit wherein a negative driving pulse is applied only to the grid of the non-conducting electron discharge device; and the provision of a trigger circuit wherein the driving pulses are applied through a low impedance path.

The invention will be better understood from the following description considered in connection with the accompanying drawings and its scope is indicated by the appended claims.

Referring to the drawings:

Figure 1 is a wiring diagram of a modification wherein a negative driving pulse is applied only to the control grid of the current conducting electron discharge device of the trigger circuit.

Figure 2 is a wiring diagram of a form of the invention designed to apply simultaneously a negative driving pulse to the grid of the conducting electron discharge device and a positive driving pulse to the grid of the non-conducting electron discharge device, and

Figure 3 is a similar diagram of a trigger circuit wherein a negative pulse is applied simultaneously to the anode of the non-conducting device and to the grid of the conducting device.

In Figure 1, vacuum triodes 4 and 5 comprise an Eccles-Jordan trigger circuit which has two stable, static conditions. For purposes of explanation, it may be assumed that triode 5 is conducting while triode 4 is non-conducting. In this first static condition the control grid of triode 5 is at the same potential (approximately)

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as the common cathode point. For a typical case this potential would be +60 volts. The grid potential of the non-conducting triode 4 would be well below the cutoff points; for instance, +40 volts.

When the first trigger pulse is applied to the circuit tube 4 becomes conducting and tube 5, non-conducting. This is the second static condition and the two values of potential cited above would be reversed; that is, the grid of tube 4 10 would be at +60 volts while the grid of tube 5 would be at +40 volts. As successive pulses are applied, the circuit shifts alternately from one static condition to the other.

The triggering or drive pulses are applied to the control grids through the crystal rectifier elements 2 and 3 and a common series input condenser 1. The left hand or negative terminals of the rectifiers are maintained at the same average potential as the common cathode point by the connection through resistor 10. This maintains a D.-C. potential of +60 volts on the negative side of the rectifiers. The positive or right hand side of the two rectifiers are connected, each to a control grid of a trigger tube 25 and consequently, assume the same average potentials existing at these grids.

For the initial condition of the trigger circuit, tube 5 conducting and tube 4 non-conducting, it is evident from the numerical values of potential given that rectifier 2 has both sides at the same potential of +60 volts. However, rectifier 3 has an inverse or bias voltage of 20 volts across it, since its left side is at +60 volts and its right side is at +40 volts.

The circuit is non-responsive to positive polarity pulses applied at the input terminal since these are blocked or stopped by the rectifiers 2 and 3. If a negative polarity pulse having an amplitude of 20 volts or less is applied, it will be passed through rectifier 2, to drive the grid of tube 5 momentarily negative. At the same time, rectifier 3 will not pass or transmit this drive pulse because of the 20 volts bias on this rectifier.

This action of applying a negative trigger pulse to the grid of conducting tube 5 without also applying a negative pulse to the grid of non-conducting tube 4, triggers the circuit easily and definitely into its other stable condition. This type of drive action is good. It is undesirable to drive the grid of the non-conducting tube in the negative direction at the same instant that it is about to be driven in the positive direction, by the regenerative trigger action of the circuit.

By a slight modification, the circuit can be set up to be driven by positive input pulses. In this case the terminals of the rectifier elements 2 and 3 would have to be reversed and the input side of the rectifiers would have to be biased at +40 volts (the grid potential of the non-conducting trigger tube). This arrangement is shown in Figure 2 if rectifiers 31 and 32 are considered.

The principal purpose of Figure 2 is to illustrate a modified version of the invention in which push-pull drive action is produced. Elements 33 and 34 are the trigger triodes. Crystal rectifiers 29 and 30 are arranged to handle negative drive pulses in the same manner as in Figure 1. Rectifiers 31 and 32 are arranged to handle positive polarity drive pulses as suggested above.

Assuming that tube 34 is conducting and tube 33 is non-conducting, the triggering action is accomplished as follows; a positive drive pulse applied at terminal 19, passes through a coupling

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and inverter tube 24. This delivers a positive polarity output pulse through condenser 27 and, simultaneously a negative polarity output pulse through condenser 23. The negative pulse is passed on through condenser 23. The negative pulse is passed on through rectifier element 29 to drive the grid of tube 34 in the negative direction. The positive pulse is passed on through rectifier 32 to drive the grid of tube 33 in the positive direction. Rectifiers 30 and 31 do not pass the pulses at this time because of the inverse or bias voltages across them.

This double or push-pull drive on the trigger tubes produces even more direct and reliable triggering action than in the single drive case. As successive drive pulses arrive they are distributed by the rectifiers so that the more positive trigger grid is always driven negatively while at the same time the more negative trigger grid is always driven positively.

Figure 3 illustrates a modification of the invention in which the drive pulses are applied through rectifier elements to the plates of the trigger triodes 42 and 43. For the arrangement shown, negative drive pulses are used and resistors 38 and 39 must have suitable values to bias the input side of the rectifiers to the same potential as that of the anode of the non-conducting tube.

The operation of the circuit is essentially the same as in the case of Figure 1. Assuming triode 43 to be conducting and triode 42 to be non-conducting, and input pulse of negative polarity passes through rectifier 41 but not through rectifier 40. Coming out of rectifier 41, the negative drive pulse is applied to the plate of tube 42 and through condenser 44, to the grid of tube 43. Tubes 42 and 43 are thus triggered into the opposite stable condition.

The high speed trigger circuit or counter unit of the present invention is thus characterized by the provision of a driving pulse input connection which is of relatively low impedance and functions to apply successive driving pulses selectively so that a negative driving pulse is never applied to the grid of the non-conducting tube or electron discharge device.

I claim as my invention:

1. The combination of a trigger circuit including a pair of triodes which (1) have operating potential applied to their anodes through separate impedance elements, (2) have their grids each connected to the anode of the other and (3) have a common cathode terminal, a driving pulse input terminal, means for biasing said input terminal to the same average potential as that of said common cathode terminal, means connected between said input terminal and said grids for applying a negative driving pulse only to the grid of the one of said triodes which is conducting current, and means for applying a positive driving pulse only to the grid of the one of said triodes which is not conducting current.

2. The combination of a trigger circuit including a pair of triodes which (1) have operating potential applied to their anodes through separate impedance elements, (2) have their grids each connected to the anode of the other and (3) have a common cathode terminal, a driving pulse input terminal, means for biasing said input terminal to the same average potential as that of said common cathode terminal, unilaterally conductive low impedance elements each connected between said input terminal and a different one of said grids to apply a negative driving pulse

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only to the grid of the one of said triodes which is conducting current, and unilaterally conductive low impedance elements each connected to a different one of said grids for applying a positive driving pulse only to the grid of the one of said triodes which is not conducting current.

3. The combination of a trigger circuit including a pair of triodes which (1) have operating potential applied to their anodes through separate impedance elements, (2) have their grid each connected to the anode of the other and (3) have a common cathode terminal, an input tube having resistors connected in its anode and cathode leads and having a grid to which positive pulses are to be applied, a driving pulse input terminal coupled to the anode of said input tube, means for biasing said input terminal to the same average potential as that of said common cathode terminal, means connected between said input terminal and said grids to apply a negative driving pulse only to the grid of the one of said triodes which is conducting current, and means connected between the cathode of said input tube

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and the grids of said triodes to apply a positive driving pulse only to the grid of the one of said triodes which is not conducting current.

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