

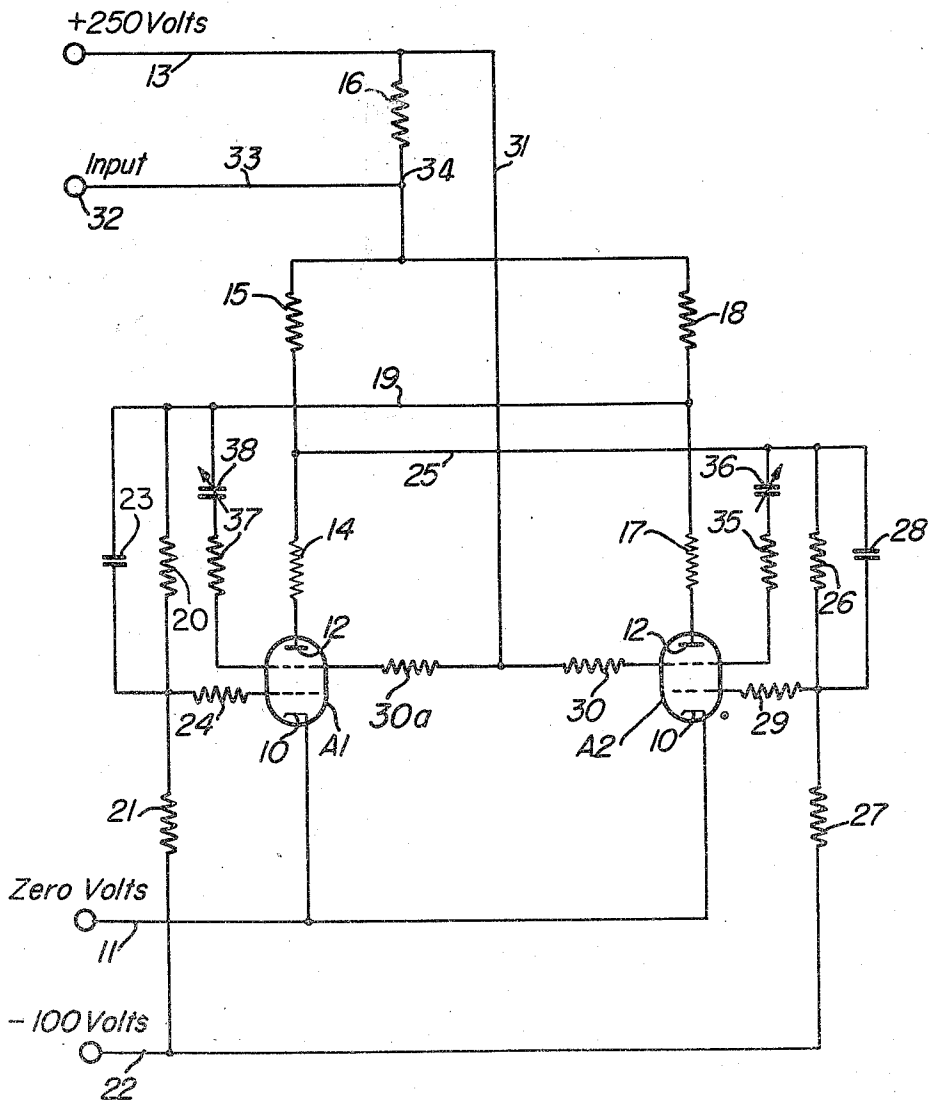
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NEUTRALIZED TRIGGER CIRCUIT

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NEUTRALIZED TRIGGER CIRCUIT

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This invention relates to trigger circuits and more particularly to a trigger circuit operable at very high speeds.

A principal object of the invention is to provide a dual-tube type trigger circuit having an operable speed higher than that of other similar type triggers.

Another object is to provide a novel neutralizing circuit for suppressing parasitic oscillations caused by the interelectrode capacity of the tubes of a dual-tube trigger circuit.

A further object is to provide a novel neutralizing arrangement for neutralizing the interelectrode capacitance of cross-connected tetrode tubes wherein the voltage on the control grid and screen grid of each tube changes simultaneously in the same direction.

A still further object is to provide a neutralizing circuit for neutralizing parasitic oscillations in a dual-tube type trigger circuit using tetrode tubes wherein the effect of the capacity of the neutralizing circuit permits the maximum operating speed of the trigger to be increased.

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

The single figure of the drawing comprises a circuit diagram of the trigger circuit of the invention.

Referring more particularly to the drawing, the trigger circuit comprises two tetrode type tubes A1 and A2, interconnected so that it has two stable conditions alternately assumed, in response to pulses applied thereto. One condition is represented by the conduction of the tube A1 and the simultaneous non-conduction of the tube A2. The other condition is represented by the non-conduction of the tube A1 and the simultaneous conduction of the tube A2.

It is well known that to obtain high operating speeds of trigger circuits and other electronic tube devices it is desirable that the circuit comprise electron tubes having low values of interelectrode capacitance.

Type 807 tetrode tubes because of their low input and output capacitance and high plate and screen grid dissipation ratings were selected as tubes A1 and A2. The input and output capacitance of the particular tubes used was approximately 12 and 7 microfarads respectively, while

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the plate and screen dissipation was approximately 25 and 2.5 watts respectively.

In order to clarify the explanation, the trigger circuit of the invention will be described with reference to the values of applied voltage and the values of resistances and capacitances.

The cathodes 10 of the tubes A1 and A2 are connected to a zero volt line 11. The plates 12 are connected to a +250 volt line 13, the plate of the tube A1 being connected through resistors 14, 15 and 16, in series, and the plate of the tube A2 being connected through resistors 17, 18 and 16, in series, having a combined resistance value equal to that of resistors 14, 15 and 16. The resistors 15, 16 and 18 each have a value of 1000 ohms and the parasitic suppressor resistors 14 and 17 each have a value of 50 ohms.

A lead 19 connected to the resistor 17, thereby connects the plate of the tube A2 to the upper end of a voltage divider consisting of resistors 20 and 21, each of 21,000 ohms. The lower end of this divider is connected to a -100 volt bias line 22. A capacitor 23 of 0.0002 microfarad is connected in parallel with the resistor 20 with its lower end connected through a parasitic suppressor resistor 24 to the control grid of tube A1.

A lead 25 connected to the resistor 14 thereby connects the plate of the tube A1 to the upper end of a voltage divider consisting of resistors 26 and 27, each of 21,000 ohms. The lower end of this divider is connected to the -100 volt bias line 22. A capacitor 28 of 0.0002 microfarad is connected in parallel with resistor 26 with its lower end connected through a parasitic suppressor resistor 29 of 50 ohms to the control grid of tube A2.

The screen grids of the tubes A1 and A2 are respectively connected through resistors 30a and 30, each of 1000 ohms, to one end of a lead 31, connected at its other end to the +250 volt line 13.

As stated, the trigger is stable when in either of two conditions. Merely, for the sake of clarification, it is assumed that the tube A1 is non-conductive and that the tube A2 is conductive as indicated by the dot at the lower right-hand side of A2.

An input terminal 32 is connected by a lead 33 to the point 34, to provide for plate keying of the trigger. Negative pulses, having characteristics suitable to effect a change in the stable condition of the trigger, are applied to the terminal 32. While provision for plate keying the trigger is shown, it is understood that any other well known type keying may be used.

The constants of the trigger circuits and the values of operating voltages are so chosen that positive pulses of an amplitude equal to that of the negative pulses will not switch the trigger.

When a negative pulse is applied to the terminal 32 it causes a decrease in potential, corresponding to its value, at the plates and control grids of the tubes A1 and A2. The decrease at the plate and control grid of the tube A1 has no direct effect because, under the condition as illustrated in the drawing, its control grid is already below cut-off potential. However, the decrease in potential at the plate and control grid of the tube A2 renders it non-conductive. The resulting increase of its plate voltage is transferred via line 19 and the parallel connected resistor 20 and capacitor 23 and the parasitic resistor 24, to the control grid of the tube A1. This action causes conduction through the tube A1 and a corresponding decrease of its plate voltage.

The decrease in the plate voltage of the tube A1 is transferred via line 25 and the parallel connected resistor 26 and capacitor 28 and the parasitic resistor 29 to the control grid of the tube A2, and, in accordance with the well known trigger action, maintains tube A2 non-conductive until the next negative pulse is applied to the input terminal 32. It is seen, therefore, that the first pulse applied renders the tube A1 conductive and the tube A2 non-conductive.

When the second negative pulse is applied to terminal 32 a similar action occurs to render the tube A1 non-conductive and the tube A2 conductive. Subsequent pulses cause a repetition of the operation brought about by the first and second pulses.

During the operation of the circuit arrangement described above, the tubes A1 and A2 provide a plate voltage swing of approximately 100 volts and according to purely theoretical computations should operate at a speed of about 6.4 megacycles.

However, when the arrangement as above described was actually operated, it was disabled by parasitic oscillations. Various known means for suppressing parasitic oscillations were tried without result.

The novel means of this invention for suppressing the parasitic oscillations include a series connected capacitor and resistor between the plate of each tube and the screen grid of the other tube. For example, a resistor 35 and a capacitor 36 are connected via line 25 and resistor 14, between the screen grid of the tube A2 and the plate of tube A1 and a resistor 37 and a capacitor 38 are connected via line 19 and resistor 17 between the screen grid of the tube A1 and the plate of the tube A2. The resistors 35 and 37 each has a value of 2000 ohms and the capacitors 36 and 38 each has a value of 0.000005 microfarad. These novel means do not effect complete neutralization, i. e. they do not suppress all parasitic oscillations, but do permit stable operation of the trigger at a speed of 6.0 megacycles.

It has been found that by omitting the resistors 35 and 37 and providing capacitors 36 and 38, each of a value of 0.000013 microfarad, a substantially complete suppression of parasitic oscillations was obtained. However, because this capacity must be added in parallel with the output capacity of the respective tubes when computing the maximum operating speed of the trigger, the actual operating speed obtained was considerably lower than the 6.0 megacycles obtained by using the complete novel means set

forth above. It is seen, therefore, that the resistor and capacitor values of the novel parasitic oscillation suppression arrangement are such as to provide relatively high speed operation and not necessarily such as will obtain complete neutralization. In other words at high operating speeds the series connection of the resistor and capacitor between the plate of each tube and the screen grid of the other decreases the loading on the plate and permits the higher harmonic frequencies to be applied to the screen grid to maintain the application of substantially square wave voltage pulses thereto.

Satisfactory trigger operation may be obtained by using only the capacitors 36 and 38 for neutralization and eliminating the resistors 35 and 37. It has been found, however, that the use of these resistors, as set forth above, raises, the upper frequency limit of the trigger.

By applying a neutralizing voltage to the screen grid of each tube, from the plate of the other tube, as described above, the voltages of the screen grid and the control grid tend to change in the same direction.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the circuit illustrated and in its 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. A trigger circuit alternately switchable to each of two stable conditions in response to pulses applied thereto including a first and a second tetrode tube, parallel connected capacitive and resistive elements connecting the plate of the first tube to the control grid of the second tube and the plate of the second tube to the control grid of the first tube; a capacitor and a resistor connected in series between the plate of the first tube and the screen grid of the second tube, and a capacitor and a resistor connected in series between the plate of the second tube and the screen grid of the first tube, for causing the voltages on the control grid and suppressor grid of each tube, to change simultaneously in one direction to cause partial suppression of parasitic oscillations normally occurring in said trigger circuit, the values of said capacitors and resistors connected in series being such as to enable the switching of said trigger circuit at a speed higher than that obtainable when parasitic oscillations are suppressed completely.

2. In a circuit including first and second multi-grid tubes, each of which has its plate cross-coupled to the control grid of the other, means for applying operating voltages to the elements of said tubes, connections for applying pulses to the tubes to energize them, and a capacitive-resistive coupling of predetermined value connecting the plate of each tube to the screen grid of the other for conveying a certain voltage to the screen grids, said certain voltage being less than that required for complete suppression of parasitic oscillations.

3. In a trigger circuit having first and second tetrode tubes with the plate of each cross-coupled to the control grid of the other through a capacitive-resistive network, a connection including a capacitor and resistor between the plate of each

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tube and the screen grid of the other, said capacitor and resistor having values such that the limiting of the trigger speed by the output capacity of the trigger circuit is substantially compensated for and the limiting of the trigger speed by the interelectrode capacity of the tubes is reduced thereby causing optimum suppression of parasitic oscillations.

4. A trigger circuit alternately switchable to each of two stable conditions in response to pulses applied thereto including a first and a second tetrode tube; parallel connected capacitive and resistive elements connecting the plate of the first tube to the control grid of the second tube and the plate of the second tube to the control grid of the first tube, each of said tubes having an input and output capacitance of approximately twelve and seven micromicrofarads respectively and a plate and a screen grid dissipation of approximately twenty-five and two-and-one-half watts respectively; a capacitor and a resistor connected in series between the plate circuit of the first tube and the screen grid of the second tube; and a capacitor and a resistor connected in series between the plate circuit of the second tube and the screen grid of the first tube so that harmonic frequencies will pass through said series connected resistors and capacitors to the respective screen grids of the tubes whereby the voltage applied to those screen grids is main-

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tained in the form of a substantially square wave to enable the operation of said trigger circuit at a frequency of approximately six megacycles.

5. A circuit including first and second tubes alternately plate current conductive, each tube having at least first and second grids and its plate circuit cross-coupled to the first grid of the other tube, a source of pulses and a connection therefrom to each tube to apply pulses to the latter; a capacitor and resistor connected in series between the plate circuit of the first tube and the second grid of the second tube; and a capacitor and resistor connected in series between the plate circuit of the second tube and the second grid of the first tube so that harmonic frequencies will pass through said capacitors and resistors connected in series to the respective second grids of the tubes to maintain the shape of the voltage signal applied to said second grid substantially uniform.

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