

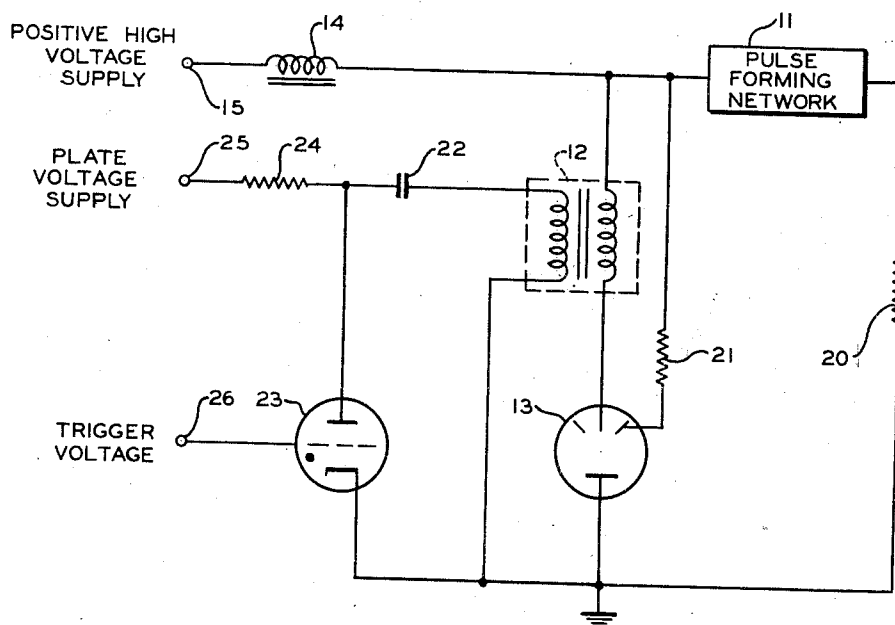
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K. J. GERMESHAUSEN

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TRIGGER CIRCUIT

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INVENTOR

KENNETH J. GERMESHAUSEN

BY

McHale

ATTORNEY

UNITED STATES PATENT OFFICE

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TRIGGER CIRCUIT

Kenneth J. Germeshausen, Newton Center, Mass.,
 assignor, by mesne assignments, to the United
 States of America as represented by the Secre-
 tary of the Navy

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This invention relates to trigger circuits and more particularly to trigger circuits for three electrode triggered gap tubes.

In the usual method of triggering the three electrode triggered gap tube, a trigger voltage is applied to the trigger electrode. Upon the application of this trigger voltage, a discharge starts between the trigger electrode and either the anode or the cathode, depending upon the voltage existing between the anode and the cathode; and then breakdown occurs between the trigger electrode and the other electrode. This means that the discharge is essentially two gaps in series; the anode to trigger electrode, and the trigger electrode to the cathode. With the gaps operating in this manner, the trigger electrode acts as an anode in one gap and a cathode in the other gap resulting in excessive wear of the trigger electrode.

In the present invention a circuit is provided in which the trigger voltage is applied in series with the main discharge circuit and the cathode-anode gap by connecting the secondary of a pulse transformer in the circuit. This pulse transformer has a saturable core that saturates abruptly after the cathode-anode gap has fired and hence offers a low series impedance to the load current. Some advantages of this method of triggering over previously used methods are a much wider range of operating voltage, very low time jitter and greatly reduced wear of the trigger electrode.

A primary object of the present invention is to generally improve spark gap trigger circuits.

Another object of this invention is to provide a triggering circuit for three electrode triggered spark gap tubes that will reduce the wear of the trigger electrode in such a tube.

A further object is to provide a triggering circuit for three electrode triggered spark gap tubes that will permit the use of such tubes over a wide range of operating voltage.

A still further object is to provide a triggering circuit for three electrode triggered spark gap tubes for operation of such tubes with very small time jitter.

These and other objects will be apparent from the following description when taken with the accompanying drawing which is a schematic diagram of one embodiment thereof.

Referring to the drawing, one terminal of pulse forming network 11 is connected through the secondary winding of saturable core pulse transformer 12 to the anode of three electrode triggered spark gap tube 13; and also through in-

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ductor 14 to the positive high voltage supply at terminal 15. The other terminal of pulse forming network 11 connects through the output load represented by resistor 20 to the cathode of tube 13. The trigger electrode of tube 13 connects through resistor 21 to the junction between the secondary of transformer 12 and pulse forming network 11. One end of the primary winding of transformer 12 connects through condenser 22 to the plate of gas triode electron tube 23. The other end of the primary winding of transformer 12 connects to the cathode of gas triode 23 and the cathode of tube 13. The plate of gas triode 23 connects through resistor 24 to the plate voltage supply at terminal 25, and the grid of gas triode 23 connects to a source of trigger voltage at terminal 26.

In the operation of this embodiment of the invention, pulse forming network 11 is charged by the high voltage supply at terminal 15 and condenser 22 is charged by the plate voltage supply at terminal 25. A trigger voltage introduced at terminal 26 to the grid of gas triode 23, causes gas triode 23 to become conducting and results in condenser 22 rapidly discharging through gas triode 23 and the primary winding of pulse transformer 12. This develops a high voltage across the secondary winding of transformer 12 which is applied in series with the cathode-anode gap of tube 13 and also this voltage is applied between the anode and trigger electrode of tube 13. The voltage between anode and trigger electrode of tube 13 produces a trigger spark which along with the overvoltage applied to the anode-cathode gap of tube 13 causes this main gap to break down. With the breakdown of the anode-cathode gap of tube 13, pulse forming network 11 rapidly discharges producing the desired high voltage pulse across load resistor 20. When pulse forming network 11 has become discharged, the voltage of the anode of tube 13 drops so low that the anode-cathode gap ceases conducting and similarly when condenser 22 is sufficiently discharged, gas triode 23 becomes non-conducting. Condenser 22 and pulse forming network 11 are then recharged and are ready for another cycle to be initiated by a trigger voltage applied at terminal 26.

Included in the discharge circuit of pulse forming network 11 is the secondary winding of transformer 12 which must offer a low impedance to the load current. This can be done if the core of transformer 12 can be made to saturate abruptly shortly after the anode-cathode gap in tube 13 has been broken down. The effect of the saturated inductance of the secondary winding of

transformer 12 on the output pulse across resistor 20 is to round off the leading edge of the pulse, and should, therefore, be maintained as low as possible. On the other hand, the unsaturated inductance of transformer 12 should be as large as possible to avoid excessive current being drawn by the primary winding of transformer 12 from the circuit of gas triode 23. In order to secure the maximum ratio between the unsaturated inductance and the saturated inductance a high permeability core is recommended for the core of transformer 12.

The invention described in the foregoing specification need not be limited to the details shown which are considered to be illustrative of one form the invention may take. The scope of the invention is defined by the appended claims.

What is claimed is:

1. Apparatus for periodically discharging pulse forming networks comprising, a trigger spark gap electron tube including an anode, a cathode, and a trigger electrode, a source of periodic low voltage trigger pulses, input means for receiving periodic low voltage trigger pulses from said source, a transformer, the current in the primary winding of said transformer being controlled by said trigger pulses, the secondary winding of said transformers being connected in series with said pulse-forming network and said anode of said spark gap tube, said trigger electrode being resistively connected to the junction of said pulse-forming network and said secondary winding, said secondary winding applying high voltage trigger pulses to said anode causing an electric arc to be established between said anode and said cathode.

2. Modulating apparatus for producing periodic high voltage pulses of short time duration comprising, a condenser, a plate voltage source, a first resistor, said condenser being connected serially for charging with said plate voltage source through said first resistor, a source of trigger voltage, an electron tube having at least a cathode, an anode, and a control grid, a saturable core transformer, the control grid of said electron tube connected to said source of trigger voltage, said condenser being connected between said electron tube anode and one side of the primary of said transformer, the cathode of said electron tube being connected to the other side of the primary of said transformer, discharge of said condenser occurring when said electron tube grid is energized from said trigger voltage source and causing the primary of said transformer to be momentarily energized, a trigger gap spark electron tube having at least a cathode, an anode, and a trigger electrode, the voltage pulse across the secondary of said transformer being applied in series with the cathode-anode gap and the anode-trigger electrode gap of said trigger spark gap tube causing precise breakdown of said cathode-anode gap, a pulse forming network, an inductor, a positive high voltage source, and a

load resistor, said pulse forming network being connected for charging through said inductor to said positive high voltage source, said breakdown of said anode-cathode gap discharging said pulse forming network through said anode-cathode gap, the secondary of the transformer, and said load resistor, producing across said load resistor the desired high voltage pulse, the discharge of said pulse forming network producing saturation of the core of said transformer, and the secondary of said transformer presenting a low inductance in the discharge circuit of said pulse forming network.

3. Apparatus for periodically discharging a pulse-forming network through a load resistor comprising, a circuit for charging said network which includes a positive high voltage supply, an inductor, said network and said load resistor in series, a circuit for discharging said network which includes a spark gap tube having an anode, a cathode and a trigger electrode, and a transformer, the secondary coil of said transformer being connected from the junction of said network and said inductor to the anode of said tube, said trigger electrode being resistively connected to said junction, said cathode being connected through said load resistor to the end of said network opposite said junction, and a circuit for initiating the discharge of said network which includes a gas tube, a condenser, and the primary of said transformer in series connection, and a voltage source for charging said condenser, conduction of said gas tube causing said condenser to discharge through said primary and initiating the discharge of said network.

4. Apparatus for producing high voltage pulses of short duration by the discharge of a pulse-forming network through a spark gap tube comprising, means for charging said network to a high voltage, means for discharging said network periodically, and means for initiating said discharge, said last-mentioned means comprising a transformer having its secondary coil connected between said spark gap tube and said network, a condenser, a voltage source for charging said condenser, and a trigger pulse operated gas tube connected serially with said condenser and said primary for causing a momentary voltage pulse through said transformer when said gas tube conducts allowing said condenser to discharge through said transformer primary.

KENNETH J. GERMESHAUSEN.

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