

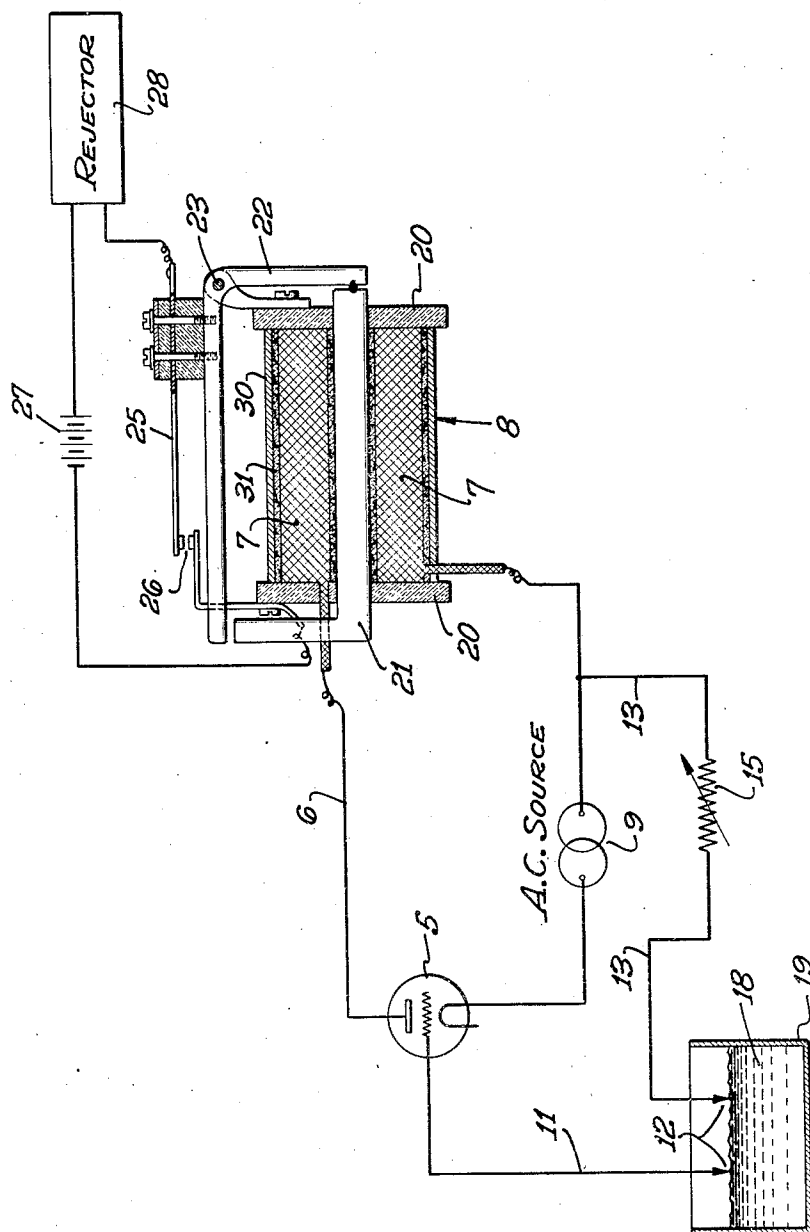
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ELECTRONIC TRIGGER METHOD AND CIRCUIT

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ELECTRONIC TRIGGER METHOD AND
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This invention relates to electrical control circuits and particularly to small input trigger circuits for controlling operations requiring considerable power.

The use of alternating current operated relays in the output circuit of thermionic discharge tubes, such as high vacuum, gas-filled, hot or cold cathode electronic devices, are well-known. Generally, the elements of such circuits are energized with alternating current, which current is rectified by the action of the tube and then passed through the windings of the relay. It is common practice to shunt the windings of the relay with a condenser to by-pass the alternating current component. When the positive voltage on the control electrode of such a tube is increased, sufficient anode current flows through the relay to actuate its armature and close or open a contact in the circuit being controlled. Usually, the relays and tubes are chosen to provide a high degree of current sensitivity. However, the use of a shunting condenser often has an effect opposite to that desired in that the reactance of the combined relay coil and shunt capacitor may be greater than that of the relay coil alone, which results in a lower anode current and reduced sensitivity.

The use of a shunting condenser also causes false triggering which is the result of the anti-resonant circuit building up a voltage on the tube higher than the normal plate supply voltage. In gaseous discharge tube circuits, the point of triggering is a function of both the anode and grid voltage and the phase relationship therebetween. The use of a shunting condenser can cause a shift of phase of the relay coil voltage relative to the line voltage to the extent that the anode voltage, which is the sum of the anode supply voltage and the voltage on the relay coil, exceeds the line voltage. To obtain high sensitivity, it is customary to adjust the relays and the voltages on anode and control electrodes just below the triggering point; thus, a phase shift between these voltages will increase the anode voltage and produce false triggering.

This condition is further aggravated by the fact that the inductance of the relay varies with the position of its armature, the inductance increasing as the armature approaches the poles. The effect of anti-resonance due to the parallel combination of the capacitance and the relay coil inductance is to increase the reactance of the plate circuit. This effect is often offset by increasing the applied voltage. However, when the relay closes, the inductance changes, reducing

the anti-resonance and consequently increasing the current. This current increase is often so great that the relay is held in its actuated position even after the control voltage is removed from the control electrode of the tube.

The present invention, therefore, provides a triggering circuit which substantially eliminates undesired reactance in the anode circuit of the tube and permits the maximum of alternating current and consequently the maximum of direct current to flow through the winding of the relay, when the tube is triggered, thus increasing the sensitivity of the circuit.

This is accomplished by the use of a closed secondary circuit surrounding the winding in the form of a sleeve positioned closely adjacent the winding to provide the greatest amount of mutual coupling between the relay winding and the sleeve. The sleeve may either surround the winding or be interleaved among the layers of the winding. The use of a ring having a large cross-section and low resistance positioned closely adjacent the air gap is known in the art for the purpose of producing a delay action of a mechanical relay. It is realized that the use of such a ring may also provide to a small degree the effect of a sleeve surrounding the windings, and that the use of the sleeve might introduce a slight delay action. Such a ring prevents the building up of the magnetic field at the air gap, which introduces the delay action, but the ring does not provide the greatest reduction of self inductance of the winding to permit the maximum amount of current to flow through the relay winding. This is because of the loose coupling between the ring and the winding, leaving a residual or leakage inductance which is objectionable for reasons described above.

The principal object of the invention, therefore, is to improve the operation of an electronic trigger circuit.

Another object of the invention is to provide an improved gaseous type trigger circuit which will not function unless the control circuit is closed.

A further object of the invention is to provide a gaseous tube trigger circuit which has maximum sensitivity.

A further object of the invention is to stabilize the operation of a thermionic trigger tube circuit.

A still further object of the invention is to insure that the relay circuit will be restored to its normal condition when the control circuit is actuated.

Although the novel features which are believed to be characteristic of this invention will be

pointed out with particularity in the appended claims, the manner of its organization and the mode of its operation will be better understood by referring to the following description read in conjunction with the accompanying drawing forming a part hereof in which: the single figure is a combination schematic and diagrammatic view of a system embodying the invention.

Referring now to the drawing, a gaseous electronic tube 5 which may be a thyratron or similar form of electronic device, has its anode connected over conductor 6 to the winding 7 of a mechanical relay 8 in series with the alternating current source 9 forming the anode circuit of the tube 5. The control electrode circuit of the tube 5 is over conductor 11 to a pair of contacts 12 and then over conductor 13, control resistor 15, and over the alternating current source 9 to the cathode of tube 5. Although various types of input circuits may be utilized to trigger the system, the form illustrated is one wherein the level of a solution 18 when reaching a certain predetermined level in a tank 19, interconnects the contacts 12. When the contacts are so connected, a predetermined voltage from the source 9, determined by the adjustment of the resistor 15 is impressed on the control electrode of the tube 5. This increased potential on the control electrode will reduce the anode-cathode impedance of the tube 5 to increase the flow of current through the winding 7 of the relay 8.

Referring now to the relay 8, the winding 7 is mounted upon a spool 20 through which a magnetic L-shaped core 21 passes. The magnetic circuit of the relay is completed by an armature 22 pivoted at point 23 and upon which is mounted a movable contactor element 25. When the horizontal section of the armature 22 is rotated downwardly, contact is made at 26 which will close a circuit to a rejector 29 through an energy source 27.

Surrounding the coil 7 of the relay 8 is a copper sleeve 30 separated from the winding 7 by only a small thickness of insulating material 31. As mentioned above, it is desirable to locate the copper sleeve 30 as close to the winding 7 as possible. Thus, the sleeve 30 could be interleaved with the winding, part of the winding being within the sleeve and the other portion of the winding outside of the sleeve. In this manner, the greatest amount of mutual inductance between the winding 7 and the sleeve 30 is obtained which reduces the reactance of the winding to the alternating current and consequently permits the maximum of rectified current to flow through the winding. Thus, the maximum in sensitivity of the system is obtained.

Furthermore, since the arrangement of the armature 22 is such that as one air gap increases in length, the other decreases, and a more stable magnetic circuit is provided since the inductance of the winding is not varied when the contact 26 is in either its open or closed position. The circuit, of course, avoids the use of a condenser in shunt to the winding 7 and thereby eliminates any anti-resonant circuit to build up a higher voltage on the anode of the tube 5 than that provided by the source 9 to cause false triggering. Also, by the elimination of practically all elements from the anode and control electrode circuits which would have a tendency to shift the phase between the voltage impressed on the anode and that impressed on the control electrode, this cause of false triggering is removed. The elimination of anti-resonance per-

mits the system to restore itself to normal upon the immediate removal of the trigger voltage on the tube 5.

Although the invention has been shown in a system having an input circuit in which a fluid is utilized as the contact device for triggering the tube 5 and the relay 8 controls a rejector, it is to be understood that the input circuit may include any type of contactor under control of elements such as thermostats, photocells, or manually operated switches. Furthermore, the relay 8 may control various types of operational circuits such as safety relays in high frequency generator systems.

I claim as my invention:

1. In a gaseous tube trigger circuit, a vacuum tube having a control electrode, anode, and cathode, an alternating current source for supplying anode and control electrode voltages, a mechanical relay, the winding thereof being connected in the anode circuit of said tube, a movable armature for said relay, means for reducing the reactance of said windings to the alternating current flow between said anode and said source, and means for mounting said armature to maintain the reluctance of the magnetic path through said armature substantially constant during movements thereof.

2. A trigger circuit comprising a vacuum tube having a control electrode, anode, and cathode, an alternating current source for supplying an alternating current voltage to said anode, said source also supplying an alternating current voltage to said control electrode, a mechanical relay, the winding thereof being connected between said anode and said source, a closed electrical circuit immediately adjacent and surrounding said coil, and means for decreasing the alternating current bias on said control electrode for correspondingly increasing the flow of rectified current through said coil.

3. A trigger circuit in accordance with claim 2 in which said closed circuit comprises a copper sleeve surrounding said coil.

4. A trigger circuit comprising a vacuum tube having an anode, control electrode and cathode, an alternating current source, a mechanical relay having its winding connected in the anode circuit of said tube, a movable armature for said relay, a circuit interconnecting said control electrode and said source, a short circuited electrical circuit surrounding and immediately adjacent the winding of said relay, and means for mounting said armature to maintain the reluctance of the magnetic path through said armature substantially constant during movements thereof.

5. A trigger circuit comprising a vacuum tube having an anode, control electrode and cathode, an alternating current source, a mechanical relay having its winding connected in the anode circuit of said tube, a circuit interconnecting said control electrode and said source, and a short circuited electrical circuit surrounding and immediately adjacent the winding of said relay, said winding having a metallic magnetic circuit with a pair of air gaps therein, actuation of the armature of said relay simultaneously increasing one air gap and decreasing the other air gap.

6. The method of obtaining maximum sensitivity of a trigger circuit for actuating a relay comprising impressing an alternating current on said relay circuit, rectifying said current and reducing the normal reactance in said relay circuit by reducing the self inductance of the winding of said relay.

7. The method in accordance with claim 6 in which the reluctance of the magnetic circuit of said relay is maintained substantially constant during operation thereof.

8. A trigger circuit comprising a vacuum tube 5 having an anode, control electrode and cathode, a source of alternate current voltage, a relay having a winding and an armature forming a part of the magnetic path of said relay, an anode circuit including said source and said winding, 10

a resistor, a control electrode circuit including said source and said resistor, and a copper sleeve immediately adjacent and surrounding said winding.

9. A trigger circuit in accordance with claim 8 in which a magnetic core is provided for said relay, a pair of air gaps being provided between said core and said armature.

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