

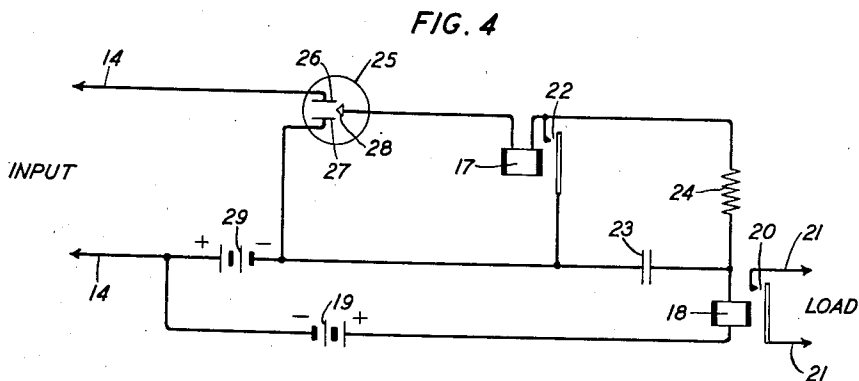
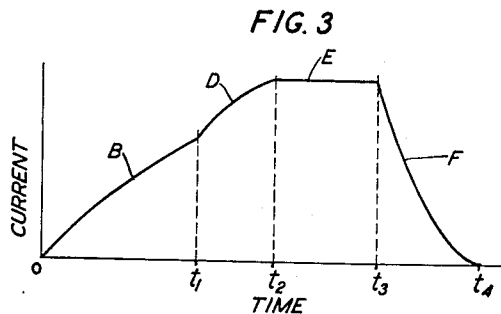
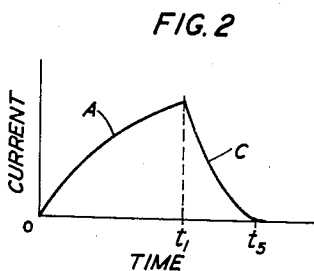
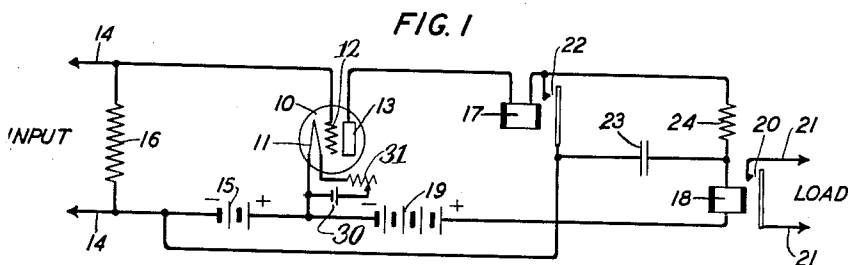
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L. K. SWART

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CIRCUITS FOR RESETTING GASEOUS DISCHARGE DEVICES

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INVENTOR
L. K. SWART
BY
Walter C. Kiesel
ATTORNEY

UNITED STATES PATENT OFFICE

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CIRCUITS FOR RESETTING GASEOUS
DISCHARGE DEVICES

Leland K. Swart, Mountain Lakes, N. J., assignor
to Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

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This invention relates to circuits for resetting gaseous discharge devices of the trigger type and more particularly to such circuits of the general type disclosed and claimed in my Patent 1,977,256, granted October 16, 1934.

In circuits for resetting gaseous discharge or trigger devices such as disclosed in Fig. 10 of my aforesaid patent, the gaseous discharge or trigger device, which has a cathode, a control electrode and an anode, after being operated in response to a critical potential impressed upon the control electrode, is restored to its non-conducting or deionized state, that is the state wherein the control electrode potential is again effective to initiate another discharge, through the operation of a vibrating relay in the output or load circuit of the device. The operation of this relay in effect places a shunt upon the source applying a positive potential to the anode of the device. In such circuits, when the vibrating relay operates, a voltage is induced in the winding thereof which is of a polarity tending to maintain the anode of the trigger device positive with respect to the cathode. This induced voltage will decrease at a rate which is dependent upon the constants of the circuit in which it is effective. It will be apparent that if this induced voltage is of a magnitude such that at its maximum value the potential upon the anode is materially above the critical potential necessary for the maintenance of the trigger device in the conductive or ionized state, the period required for the device to deionize will be relatively long.

In circuits of the type under consideration including an operating relay in the output or load circuit, as the vibrating relay operates and then releases when the trigger device deionizes, a voltage is induced in the winding of the operating relay and this voltage together with the anode potential might cause reionization between the cathode and anode of the trigger device. In order to suppress this induced voltage, a condenser has been utilized in series with the operating relay and the source of anode potential or biasing potential at the input, the condenser being connected also between the contact of the vibrating relay and one end of the winding thereof. The time required for suppression of the induced voltage in the operating relay will be dependent, of course, upon the time required to charge the condenser and this in turn is dependent upon the resistance in circuit with the condenser and the electrical characteristics of the operating relay. The most desirable value of this resistance in order to obtain rapid decrease of the voltage in-

duced in the operating relay and hence to insure rapid release of the operating relay and rapid deionization of the trigger device would be zero. However, inasmuch as the condenser, as noted above, is connected across the contact of the vibrating relay, if the resistance in circuit therewith were unduly low an excessively high current would pass through the contact upon reoperation of the vibrating relay which current might result in welding of the contact and permanent operation of the operating relay.

One object of this invention is to materially decrease the deionization or resetting time for gaseous discharge or trigger devices.

Another object of this invention is to prevent the flow of excessive current across the contact of the vibrating relay while at the same time decreasing the time required for suppression of the voltage induced in the operating relay when the vibrating relay releases.

A further object of this invention is to decrease the period for restoring the operating relay.

In accordance with one feature of this invention, means are provided for applying a negative potential in circuit with the anode of the trigger device when the vibrating relay operates in response to a flow of current therethrough. In one circuit illustrative of an embodiment of this invention, the contact of the vibrating relay is connected to the negative terminal of the source for applying a negative bias to the control electrode of the trigger device so that when the vibrating relay operates a potential in opposition to the potential induced therein is introduced between the cathode and anode of the device whereby rapid deionization or resetting of the trigger device is obtained.

In accordance with another feature of this invention, the discharge condenser is connected in circuit with the operating relay with substantially no resistance in series therewith so that the period required to charge the condenser for suppression of the induced voltage in the operating relay will be relatively short, and a resistance is inserted between the condenser and the contact of the vibrating relay to prevent welding of the contact by discharge current from the condenser.

The invention and the features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing in which;

Fig. 1 shows a circuit illustrative of one embodiment of this invention and including a hot cathode trigger device;

Figs. 2 and 3 illustrate typical time-current

characteristics for the vibrating and operating relays respectively in the circuit shown in Fig. 1; and

Fig. 4 shows a circuit illustrative of another embodiment of this invention and including a trigger device of the cold cathode type.

Referring now to the drawing, the circuit shown in Fig. 1 comprises a gaseous discharge device 10 including a cathode 11, a control electrode or grid 12 and an output electrode or anode 13. The cathode may be of the filamentary type adapted to be heated by direct current, as by a battery 30 in series with a variable resistance 31, or may be of the indirectly heated equipotential type adapted to be heated by either direct or alternating currents. An input or control circuit is connected between the cathode 11 and the control electrode or grid 12 through conductors 14, a suitable source, such as a battery 15, being connected in circuit to apply a negative bias to the control electrode or grid. The input may be from either a direct or alternating current source and an impedance such as a resistance 16 may be connected across the conductors 14.

An output or utilization circuit is connected between the cathode 11 and anode 13 and includes a vibrating relay 17, an electrically operated device such as a relay 18, and a source, such as a battery 19, for applying a suitable positive potential to the anode, the windings of the relays 17 and 18 and the battery 19 being in series. A load, which may be, for example, a voltage recorder, count meter, or the like, is connected across the normally open contact 20 of the operating relay 18 through conductors 21.

The vibrating relay 17 is provided with a normally open contact 22, which is connected between the side of the relay 17 remote from the anode 13 and the cathode 11. A condenser 23 may be connected across the contact 22 and in circuit with the operating relay 18 and serves to suppress the electromotive force induced in the winding of the operating relay when the vibrating relay 17 releases. The condenser may be utilized to control or adjust the vibrating period of the relay 17 so that this period is greater than the deionizing period of the device 10.

The operation of a circuit of this general type is described in detail in my Patent 1,977,256, granted October 16, 1934 and need not, therefore, be set forth in detail here. It may be noted in brief, however, that the gaseous discharge device 10 normally is in its deionized state so that no current is flowing in the output or utilization circuit and the contacts 20 and 22 are open. When a voltage of critical magnitude is impressed between the cathode 11 and control electrode or grid 12, the device ionizes and a current flows in the output or utilization circuit so that the relays 17 and 18 operate and the contacts 20 and 22 are closed. The current through the relays 17 and 18 increases up to a time t_1 as shown respectively by the portions A and B of the curves shown in Figs. 2 and 3. When the contact 22 closes, a shunt is placed between the cathode 11 and anode 13 through the contact 22, batteries 15 and 19 relay 18 and resistance 24 so that the device 10 deionizes and the contact 22 is opened. The current through the relay 17 then decreases as indicated generally by the portion C of the curve in Fig. 2.

When the relay 17 operates to close contact 22, an electromotive force is induced in the winding thereof which is in series aiding with the battery 19 and, therefore, tends to maintain the device 10

in its ionized or conductive state for an unduly long period.

In accordance with a feature of this invention, the objectionable effect of the counter-electromotive force induced in the winding of the vibrating relay 17, when the contact 22 closes, is prevented by introducing in the anode-cathode circuit a potential in opposition to this counter-electromotive force and to the battery 19 with reference to the anode. This may be accomplished, as shown in Fig. 1, by connecting the contact 22 to the negative side of the battery 15. Thus, when the relay 17 operates, the potential of the anode 13 with respect to the cathode 11 is immediately reduced and the counter-electromotive force, induced in the relay 17 when it releases, will not maintain the device 10 in its ionized or conductive state. As a result, the time interval required to deionize or reset the device 10 will be materially reduced.

When the vibrating relay operates to close the contact 22, the battery 15 is connected in series aiding with the battery 19 with respect to the operating relay 18 so that the current through this relay increases in a time interval t_1-t_2 , as shown by the portion D of the curve in Fig. 3. After the relay 17 releases, the condenser 23 becomes charged and the current through the operating relay remains substantially constant for a short time interval t_2-t_3 , as indicated by portion E of the curve in Fig. 3. Operation of the relay 17 shunts out potential of proper polarity between the anode 13 and cathode 11 so that the device 10 deionizes and no current is supplied to the relay 17. When the device 10 is deionized and the contact 22 opens, the current through the winding of the operating relay decreases as indicated generally by the portion F of the curve shown in Fig. 3. This current decrease results in an induced electromotive force in the winding of the operating relay 18, which electromotive force is suppressed by the condenser 23. This current flows in the series circuit including the batteries 15 and 19, holding the relay 18 operated. It will be apparent, therefore, that the rate of decrease in the voltage across the operating relay and the time required to release the relay is dependent upon the rate of charge of the condenser 23 which is dependent in turn upon the resistance in this series circuit. In order to obtain rapid release of the operating relay it is necessary, therefore, that the resistance in series with the condenser be very small. It is essential, however, that sufficient resistance be in circuit with the condenser 23 and the contact 22 to maintain the discharge current through the contact 22 when the relay 17 again operates at a relatively low value in order to prevent welding of the contact 22.

In accordance with another feature of this invention, the desired rapid release of the operating relay and necessary low discharge current through the contact of the vibrating relay are obtained by inserting a resistance 24 in circuit between the vibrating and operating relays. This resistance 24 is sufficiently large to prevent the flow of an excessively large current in the circuit including the resistance, contact 22, and condenser 23 so that welding of the contact 22 is prevented. Preferably the resistance 24 is made as small as feasible to maintain the discharge current from the condenser 23 at a safe value, so that the period required to discharge the condenser 23 is relatively short. It will be noted that in this arrangement, no extraneous

resistance is included in the circuit comprising the batteries 15 and 19, relay 18 and condenser 23, so that rapid suppression of the induced voltage in the relay 18 occurs and quick release of this relay is obtained.

The feature of this invention last described hereinabove may be attained also in trigger circuits including gaseous discharge devices of the cold cathode type. One illustrative circuit is shown in Fig. 4 and includes a gaseous discharge or trigger device 25 having two cold cathodes 26 and 27 and an anode 28. The input circuit is connected between the two cathodes through the conductors 14, a suitable biasing potential being obtained by a source such as a battery 29 connected as shown. The operation of a circuit of this general type is described in detail in my aforesaid Patent 1,977,256 and need not, therefore, be set forth here. It may be noted, however, that the resistance 24 prevents the flow of an excessively large current across the contact 22 of the vibrating relay 17 when the condenser 23 discharges and that the circuit including the condenser 23, the batteries 29 and 19 and operating relay 18 are of relatively low resistance so that the voltage induced in the winding of the relay 18 is quickly suppressed.

Although two specific embodiments of this invention have been shown and described, it will be understood, of course, that modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. In combination, a trigger device having a cathode, a control electrode, and an anode, an input circuit coupled to said control electrode and said cathode, an output circuit coupled to said anode and said cathode, and means operable in response to the flow of current in said output circuit to apply a negative potential to said anode circuit.

2. In combination, a trigger device having a cathode, an anode, and a control electrode, an input circuit coupled to said control electrode, and said cathode, an output circuit coupled to said anode and said cathode and including means for applying a positive potential to said anode, with respect to said cathode, and means operable in response to a flow of current in said output circuit for introducing in said output circuit a potential in opposition to the positive potential of said first means with reference to said anode.

3. In combination, a gaseous discharge device including a cathode, a control electrode, and an anode, an input circuit coupled to said control electrode and said cathode and including a source of potential, the negative terminal of which is connected to said control electrode, an output circuit coupled to said anode and said cathode, said output circuit including means for applying a positive potential to said anode with respect to said cathode and a relay having a normally open contact, and a circuit between said contact and the negative terminal of said source, said relay being operable in response to a flow of current in said output circuit to close said contact whereby a potential in opposition to the positive potential of said means is introduced in said output circuit.

4. In combination, a gaseous discharge device having a cathode, a control electrode, and an anode, an input circuit coupled to said control

electrode and said cathode and including a source of potential applying a negative bias to said control electrode, an output circuit coupled to said anode and said cathode and including a source of potential for applying a positive potential to said anode relative to said cathode, and a relay in said output circuit operable in response to flow of current in said output circuit for shunting said second source with respect to said anode and cathode and connecting said first source in opposition thereto with reference to said anode.

5. In combination, a gaseous discharge device including a cathode, a control electrode and an anode, an input circuit coupled to said cathode and control electrode and including a source of potential for applying a negative bias to said control electrode, said source having its positive terminal connected to said cathode, an output circuit connected between said cathode and said anode and including a vibrating relay, an electrically operated device and a source of potential for applying a positive potential to said anode relative to said cathode, said vibrating relay having a normally open contact connected to said anode, and means serially connecting said contact and the negative terminal of said first source, said vibrating relay being operable in response to the flow of current in said output circuit to close said contact.

6. In combination, a gaseous discharge device including a cathode, an input electrode and an output electrode, an output circuit coupled to said output electrode and said cathode and including a relay, a load, and a resistance between said relay and said load and permanently connected in series therewith, said relay having a contact adapted to be closed in response to the flow of current in said output circuit to complete a shunt circuit across said output circuit, and a condenser in shunt across said contact and said resistance.

7. In combination, a trigger device including an anode and a pair of other electrodes, an input circuit connected to said electrodes, an output circuit connected between said anode and one of said electrodes and including a pair of relays, a resistance between said relays and in series therewith, and means for applying a positive potential to said anode with respect to said one electrode, one of said relays having a contact adapted to be closed in response to the flow of current in said output circuit whereby said means is short-circuited with reference to said one electrode and anode, and a condenser shunted across said contact and said resistance.

8. In combination, a gaseous discharge device including a cathode, an anode, and a control electrode, an input circuit connected between said cathode and said control electrode including a source for applying a negative bias to said control electrode, said source having its positive terminal connected to said cathode, an output circuit between said cathode and anode including a vibratory relay, an electrically operated load, a resistance between said relays and in series therewith, and means for applying a positive potential to said anode with respect to said cathode, said vibrating relay having a contact in series with said resistance and the negative terminal of said source and adapted to be closed in response to the flow of current in said output circuit, and a condenser in shunt with said contact and said resistance.

LELAND K. SWART.