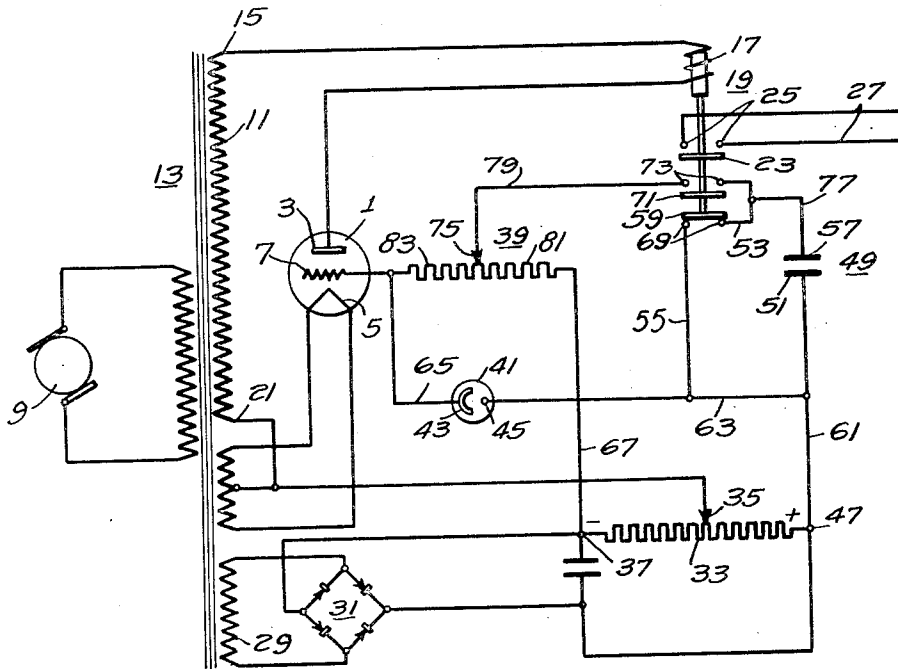


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ELECTRIC DISCHARGE APPARATUS
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WITNESSES:

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ELECTRIC DISCHARGE APPARATUS

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My invention relates to electric discharge apparatus, and it has particular relation to control apparatus incorporating electric discharge devices.

It is an object of my invention to provide a system that shall be actuable by a physical disturbance of relatively short duration to produce a response of relatively long duration.

Another object of my invention is to provide a system that shall be actuable by a physical disturbance to produce a response persisting for a predetermined interval of time substantially independent of the time during which the disturbance persists.

A further object of my invention is to provide an electronic timing relay that shall be actuable either by a short impulse or by a disturbance persisting for a relatively long interval of time.

A more specific object of my invention is to provide a system that shall be actuable when under the influence of radiant energy to produce a response persisting for a predetermined interval of time.

According to my invention, I provide a system incorporating an electric discharge device having a control electrode and a plurality of principal electrodes. Normally, the control electrode is maintained at a potential relative to the principal electrodes such that the conductivity of the discharge device is relatively small. In the control circuit of the discharge device an element responsive to a physical disturbance,—for example a photo-sensitive device,—is provided. When the disturbance occurs, the conductivity of the discharge device is increased. In addition, I provide a capacitor which is connected in the control circuit of the discharge device when its conductivity is increased and gradually charged in such manner that after a predetermined interval of time the conductivity of the discharge device is again decreased. The current charging the capacitor produces a potential drop tending to maintain the higher conductivity of the discharge device, so that even if the physical disturbance persists for only a relatively short interval of time the conductivity of the discharge device remains at its increased value for the interval of time predetermined by the charging of the capacitor.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be un-

derstood from the following description of a specific embodiment when read in connection with the accompanying drawing, in which the single figure is a diagrammatic view showing an embodiment of my invention.

The apparatus shown in the drawing comprises a discharge device 1 having an anode 3, a hot cathode 5 and a control electrode 7 and preferably, though not necessarily, a gaseous medium. Anode-cathode potential is provided for the discharge device 1 from a suitable alternating source 9 through a secondary section 11 of a supply transformer 13. One terminal 15 of the secondary section 11 is connected to the anode 3 through the exciting coil 17 of a relay 19 that is to be actuated by the discharge device and the other terminal 21 is directly connected to the cathode 5. When the discharge device 1 is non-conductive, the relay 19 is deenergized and its upper moveable contactor 23 is maintained disengaged from a plurality of fixed contacts 25 to which the conductors 27 of an operating circuit, such as a burglar alarm system, for example, are connected. When the discharge device 1 is rendered conductive, the relay 19 is energized and the operating conductors 27 are connected.

Normally, the discharge device 1 is maintained deenergized by a suitable biasing potential. The potential is derived from the alternating source 9 through another secondary section 29 of the transformer 13, a rectifier 31 and a voltage divider 33. The movable tap 35 of the voltage divider 33 is connected directly to the cathode 5 of the discharge device 1 and its negative terminal 37 is connected to the control electrode 7 through a suitable resistor 39. Thus, a negative biasing potential is impressed between the control electrode 7 and the cathode 5.

It is to be noted that while my invention is herein shown as applied to a discharge device in which a negative potential must be impressed between the control electrode and the cathode to maintain it in a substantially non-conductive condition, it is equally as well applicable to a system incorporating a discharge device which is maintained non-conductive when zero potential is impressed between the control electrode and the cathode or by a positive potential impressed between the control electrode and the cathode. If a discharge device of this type is utilized, the proper connections may, of course, be made at the voltage divider 33.

To control the conductivity of the discharge device, a photo-sensitive device 41 is provided. The cathode 43 of the photo-sensitive device is

connected directly to the control electrode 7 and its anode 45 is connected to the positive terminal 47 of the voltage divider 33. To time the operation of the apparatus, a capacitor 49 cooperates with the resistor 39. One plate 51 of the capacitor is connected to the positive terminal 47 of the voltage divider 33.

When the photo-sensitive device 41 is deenergized or the radiant energy impinging thereon is relatively small, the negative potential impressed from the voltage divider 33 between the control electrode 7 and the cathode 5 predominates and the discharge device 1 is non-conductive. With the discharge device in this condition, the capacitor 49 is short circuited by a pair of conductors 53 and 55 connected to its plates 51 and 57 and interconnected with each other by the lower moveable contactor 59 of the relay 19.

When sufficient radiant energy impinges on the cathode 43 of the photo-sensitive device 41 even for a short interval of time relative to the periodicity of the source 9, an instantaneous current flows in a circuit extending from the positive terminal 47 of the voltage divider 33 through a conductor 61, a conductor 63, the photo-sensitive device 41, a conductor 65, the resistor 39 and a conductor 67 to the negative terminal 37 of the voltage divider. The potential drop across the resistor 39 produced by the current flow through the photo-sensitive device 41 increases the potential of the control electrode relative to the cathode, thus rendering the discharge device 1 conductive for at least the interval of time that the photo-sensitive device 41 is subjected to radiant energy. If the discharge device 1 is of the gaseous type, it will, in general, be energized for a substantial portion of a half period of the source 9 and the relay 19 even if it is of ordinary structure will be actuated. If the discharge device 1 is of the high vacuum type, it will remain energized only as long as the photo-sensitive device is subjected to radiant energy. In such a case it is desirable to provide a sensitive relay that is actuated when current flow through it persists for only a short interval of time.

Regardless of the character of the discharge device 1 when the relay 19 is actuated, its upper moveable contactor 23 engages the pair of operating contacts 25 while the lower moveable contactor 59 disengages its cooperative fixed contacts 69 to remove the short circuit from the capacitor 49. On the other hand, its central moveable contactor 71 engages a pair of cooperative fixed contacts 73 connecting the upper plate 57 of the capacitor 49 to a moveable tap 75 of the resistor 39. Since the lower plate 51 of the capacitor is permanently connected to the positive terminal 47 of the voltage divider 33, charging current now flows to the capacitor in a circuit extending from the positive terminal of the voltage divider through the conductor 61, the capacitor 49, a conductor 77, the conductor 53, the moveable contactor 71 of the relay 19, a conductor 79, the portion of the resistor between the moveable tap 75 and its right-hand terminal, and the conductor 67 to the negative terminal 37 of the voltage divider. The charging current which now flows produces a potential drop across the portion 81 of the resistor 39 between the movable tap and the right-hand terminal which maintains the discharge device 1 conductive and the relay 19 actuated. At the same time the upper plate 57 of the capacitor 49 which is connected to the control electrode 7 through the

remaining portion 83 of the resistor 39 is charged negative while the lower plate 51 is charged positive. The flow of current persists until the capacitor 49 becomes charged to a predetermined difference of potential such that the negative potential impressed between the control electrode 7 and the cathode 5 of the discharge device 1 is sufficient to maintain it deenergized. At this time the discharge device 1 is rendered non-conductive, the relay 19 is deenergized, the capacitor 49 is discharged and the system is thus prepared for another operation.

It is to be noted that the system operates in the manner just described regardless of whether radiant energy continues to impinge on the photo-sensitive device or not. If the radiant energy persists for only a portion of the time, the difference of potential impressed on the capacitor is somewhat smaller than it is when the radiant energy persists during the whole interval of operation. However, if a capacitor 49 of proper magnitude is selected, the time will be substantially the same.

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. In combination an electric discharge device having a control electrode and a plurality of principal electrodes, means for maintaining said control electrode at a potential relative to one of said principal electrodes such that said discharge device passes a relatively small current, means in circuit with said control electrode and one of said principal electrodes responsive to an external disturbance for substantially increasing the current transmitted by said discharge device and a capacitor in circuit with said control electrode and one of said principal electrodes only to be charged only after said current is increased for decreasing said current to a considerably smaller value after a predetermined interval of time.

2. In combination an electric discharge device having a control electrode and a plurality of principal electrodes, means for maintaining said control electrode at a potential relative to one of said principal electrodes such that said discharge device passes a relatively small current, means in circuit with said control electrode and one of said principal electrodes, responsive to an external disturbance persisting for only a short interval of time for substantially increasing the current transmitted by said discharge device, a capacitor in circuit with said control electrode and one of said principal electrodes only and means for maintaining said capacitor discharged and charging said capacitor only after an increase in the current transmitted by said discharge device to maintain the current at the increased value for a predetermined interval of time in spite of the fact that said disturbance no longer persists and thereafter to decrease said current to a smaller value.

3. In combination an electric discharge device having a control electrode and a plurality of principal electrodes and a gaseous medium, means for maintaining said control electrode at a potential relative to one of said principal electrodes such that said discharge device is non-conductive, means in circuit with said control electrode and one of said principal electrodes, responsive to an external disturbance for rendering said

discharge device conductive, a capacitor in circuit with said control electrode and one of said principal electrodes only and means for maintaining said capacitor discharged and charging said capacitor only after said discharge device has been rendered conductive to render said discharge device non-conductive after a predetermined interval of time.

4. In combination an electric discharge device having a control electrode and a plurality of principal electrodes and a gaseous medium, means for maintaining said control electrode at a potential relative to one of said principal electrodes such that said discharge device is non-conductive, means in circuit with said control electrode and one of said principal electrodes, responsive to an external disturbance for rendering said discharge device conductive, a capacitor in circuit with said control electrode and one of said principal electrodes and means responsive to said discharge device when rendered conductive for charging said capacitor only after said discharge device has been rendered conductive to render said discharge device non-conductive after a predetermined interval of time.

5. In combination an electric discharge device having a control electrode and a plurality of principal electrodes, a first source of potential, means for deriving a potential from said source and impressing it between said principal electrodes, a second source of potential, means for deriving a potential from said second source and impressing it between said control electrode and one of said principal electrodes, a photo-sensitive device in circuit with said second source and connected between said control electrode and said one principal electrode, a capacitor and means actuated by a change in the current flow through said discharge device for connecting said capacitor in circuit with said second source and said control electrode.

6. In combination an electric discharge device having a control electrode, an anode and a cathode and a gaseous medium, means for impressing an alternating potential between said anode and said cathode, a source of direct current potential having a positive terminal and a negative terminal, means including a resistor for connecting said negative terminal to said control electrode and said positive terminal to said cathode, a photo-sensitive device having an anode and a cathode, means for connecting said anode of said photo-sensitive device to said positive

terminal and said cathode of said photo-sensitive device to said control electrode, a capacitor and means for connecting said capacitor between said positive terminal and said resistor.

7. In combination an electric discharge device having a control electrode, an anode and a cathode and a gaseous medium, means for impressing an alternating potential between said anode and said cathode, a source of direct current potential having a positive terminal and a negative terminal, means including a resistor for connecting said negative terminal to said control electrode and said positive terminal to said cathode, a photo-sensitive device having an anode and a cathode, means for connecting said anode of said photo-sensitive device to said positive terminal and said cathode of said photo-sensitive device to said control electrode, a capacitor and means responsive to said discharge device when it becomes energized to connect said capacitor between said positive and said negative terminals at least through a portion of said resistor and when it becomes deenergized to short-circuit said capacitor.

8. In combination an electric discharge device having a control electrode, an anode and a cathode, means for impressing a potential between said anode and said cathode, a source of direct current potential having a positive terminal and a negative terminal, means including a resistor for connecting said negative terminal to said control electrode and said positive terminal to said cathode, means for connecting said anode of said photo-sensitive device to said positive terminal and said cathode of said photo-sensitive device to said control electrode, a capacitor and means for connecting said capacitor between said positive terminal and said resistor.

9. In combination an electric discharge device having a control electrode, an anode and a cathode, means for impressing a potential between said anode and said cathode, a source of potential having a first terminal and a second terminal, means, including a resistor for connecting said first terminal to said control electrode and said second terminal to said cathode, a photo-sensitive device having a pair of electrodes, means for connecting one of said electrodes of said photo-sensitive device to said control electrode, a capacitor and means for connecting said capacitor between said second terminal and said resistor.

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