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CIRCUIT FOR PHOTOTUBE CONTROL OF GRID GLOW TUBES

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Fig. 1.

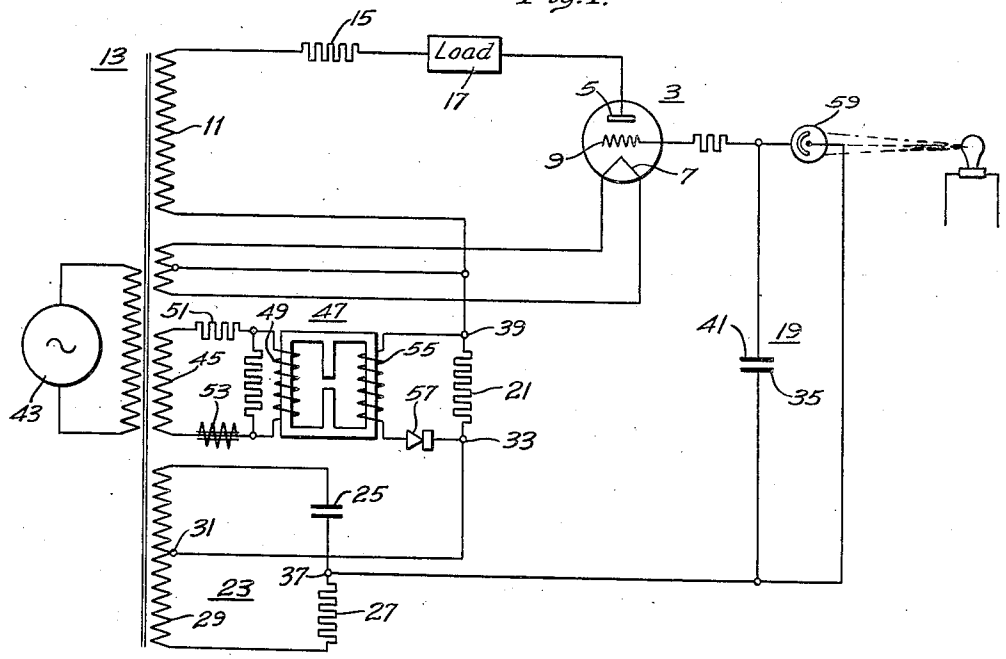
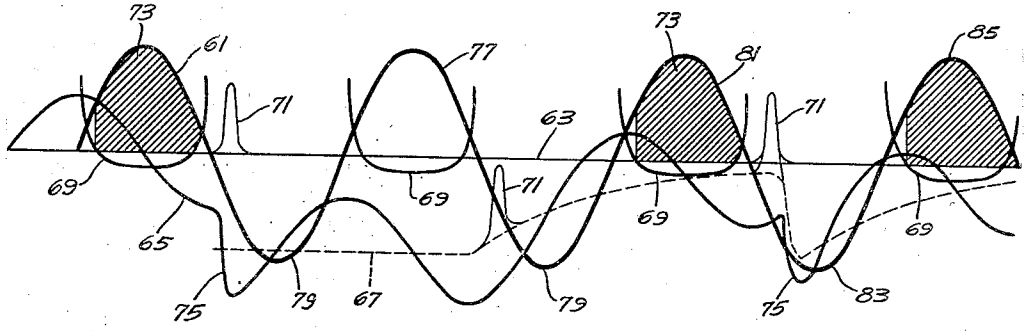


Fig. 2.



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CIRCUIT FOR PHOTOTUBE CONTROL OF GRID-GLOW TUBES

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19 Claims. (Cl. 250—27)

My invention relates to electric discharge apparatus and it has particular relation to control apparatus for an electric discharge device.

It is an object of my invention to provide a highly sensitive system that shall operate in response to an external disturbance to control an electric discharge device.

Another object of my invention is to provide apparatus for controlling the transmission of current through an electric discharge device of the gaseous type that shall operate in response to an external disturbance of relatively small magnitude.

A more specific object of my invention is to provide a highly sensitive light responsive system.

More concisely stated, it is an object of my invention to provide apparatus that shall operate in response to small variations in light intensity.

In accordance with the preferred practice of my invention an electric dischage device having an anode, a cathode, a control electrode and a gaseous medium is controlled. While my invention is thus particularly applicable to a gaseous electric discharge device, it may be, under certain circumstances, applied to the control of a high vacuum discharge device, and such use is contemplated as within the scope of my invention.

Alternating potential is normally impressed between the anode and the cathode of the discharge device, and to control it a negative potential is impressed between the control electrode and the cathode at the beginning of each of the half cycles during which the anode is negative with respect to the cathode. This potential is impressed so that it can persist for a finite time interval as for example by depositing a charge on a capacitor. During the remainder of the negative half cycle, the negative control potential may be counteracted as, for example, by permitting the charge deposited to leak away through a photo-sensitive device or a high resistor such as would be provided by the deposit of moisture on a surface. The leakage is thus cumulative during the negative half cycle and even for a comparatively small leakage effect the cumulation is such that at the beginning of the half cycle during which the anode is positive and the cathode is negative, the condition of the discharge device is changed.

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 be understood from the following description of a specific embodiment when read in connection with the accompanying drawing, in which:

Figure 1 is a diagrammatic view showing a preferred embodiment of my invention; and,

Fig. 2 is a graph illustrating the operation of Fig. 1.

The apparatus shown in Fig. 1 comprises an electric discharge device 3 preferably having an anode 5, a hot cathode 7, a control electrode 9 and a gaseous medium. While in the usual practice of my invention the discharge device 3 is of the hot-cathode type, it may obviously be replaced by a mercury pool device such as an ignition tube or a grid controlled device with a continuous keep-alive electrode.

An alternating potential is impressed between the anode 5 and the cathode 7 of the discharge device 3 from a secondary section 11 of a suitable transformer 13 through a current limiting resistor 15 and the load 17 which is to be supplied by the discharge device. Between the control electrode 9 and the cathode 7 a capacitor 19 is connected through a suitable high resistor 21 and a source of dephased alternating potential derived from a dephasing circuit 23 of the usual type. The dephasing circuit 23 may consist of a capacitor 25 and a resistor 27 connected across another secondary section 29 of the transformer 13. The secondary section 29 is provided with an intermediate tap 31 to which one terminal 33 of the high resistor 21 is connected, while one plate 35 of the capacitor 19 is connected to the junction point 37 of the capacitor and the resistor. The other terminal 39 of the high resistor 21 is connected to the cathode 7 and the other plate 41 of the capacitor 19 is connected to the control electrode 9.

Across the resistor 21 a uni-polar potential of short duration compared to a half cycle of the source 43 whereby the transformer 13 is supplied is impressed. The potential is derived from a further secondary section 45 of the transformer 13 and is impressed across the resistor 21 through a saturable transformer 47. The primary 49 of a saturable transformer is supplied from the section 45 through a resistor 51 and a reactor 53. The secondary 55 of the saturable transformer 47 on the other hand, is connected across the resistor 21 through a rectifier 57 preferably of the dry-disc type. The connection of the rectifier 57 is such that the polarity of the potential impressed renders the terminal 39 of the resistor 21 that is connected to the cathode 7 negative and

the terminal 33 connected to the intermediate tap 31 of the secondary section 29 positive.

The saturable transformer 47 operates to convert the potential derived from the source into impulses of short duration compared to the alternations of the source 43. The rectifier 57 in the secondary circuit of the saturable transformer operates to permit an impulse of the one polarity mentioned only to appear acrosss the resistor 21 and to be impressed between the control electrode 9 and the cathode 7 of the discharge device 3. The capacitor 19 is charged negative under the influence of the impulses thus produced and by reason of the rectifying properties of the control-electrode-cathode circuit of the discharge device 3, the charge remains on the capacitor until it is removed by some external electrical leakage element.

To produce the necessary electrical leakage a photo-sensitive device 59 may be connected across the capacitor 19. As long as the photo-sensitive device 59 is unenergized, the charge remains on the capacitor 19. When the photo-sensitive device is energized by light or other radiations, the charge leaks away from the capacitor and decreases the negative potential impressed between the control electrode 9 and the cathode 7. Since the capacitor 19 is charged negative at the beginning of each negative half cycle of the alternations of the source 43, the photo-sensitive device 59 may have a considerable impedance and still produce the necessary discharge as the discharge is distributed over substantially a complete half cycle. Accordingly, to operate the system the photo-sensitive device 59 need not be very highly illuminated. The dephased network 23 operates to superimpose on the potential impressed through the capacitor 19 an alternating potential which renders the control electrode 9 sufficiently positive relative to the cathode 7 when the capacitor is discharged to energize the discharge device.

The operation of the system is illustrated graphically in Fig. 2 in which current or potential magnitudes are plotted vertically and time is plotted horizontally. The heavy sine curve 61 represents the anode-cathode potential impressed on the discharge device 3. The cathode is to be taken as the reference point for potential and its potential is represented by the abscissa 63. The medium continuous curve 65 represents the dephased potential superimposed on the potential impressed through the capacitor 19. The potential impressed by the charge on the capacitor is represented by the broken line curve 67. The U-shaped curves 69 of medium intensity represent the critical potential of the discharge device 3. The light peaked curves 71 represent the potentials impressed through the saturable transformer 47 and the rectifier 57.

Assume that the main switch for the system is closed at an instant corresponding to the extreme left-hand of Fig. 2, and that at this instant the photo-sensitive device is deenergized. At this instant, the dephased potential 65 is positive and the discharge device 3 is energized for a half cycle as is indicated by the shaded half wave 73 on the extreme left. However, the system incorporating the saturable transformer 47 is so adjusted that a peak 71 of potential is impressed in the control circuit of the discharge device 3 at the beginning of the subsequent (negative) half cycle. At this point, the capacitor is suddenly charged so that its upper plate 41 becomes negative and its lower plate 35 positive, and the charge appears as an abrupt drop 75 in the medium curve 65 since the negative potential is now superimposed on the dephased potential. Since the photo-sensitive device 59 is still deenergized and the control curve 69 is not intersected by the curve 65, the discharge device 3 now remains deenergized during the next positive half cycle. It will, of course, remain in this condition indefinitely unless the photo-sensitive device is energized. Additional impulses impressed from the saturable transformer 47 have no effect on the charge on the capacitor 19 since they are now superimposed on a potential negative by such an amount that the control electrode 9 does not become positive, and, therefore, there is no current flow between the control electrode and the cathode 7.

Assume now that near the end of the last mentioned positive half cycle 77 the photo-sensitive device 59 is energized. The charge on the capacitor 19 now leaks off as indicated by the rising portion of the broken line curve 67. The peak 71 impressed by the saturable transformer 47 has no effect because it does not rise above the abscissa 63. The discharge of the capacitor 19 thus continues during the remainder of the negative half cycle 79 and at the end of this half cycle, the potential represented by the curve 67 has risen to such a value that the dephased potential 65 is positive and during the next half cycle 81 the discharge device 3 is energized. At the end of this positive half cycle an impulse 71 is impressed by the saturable transformer 47. This causes the negative charge to again accumulate on the capacitor 19. However, the charge immediately begins to leak away through the energized photo-sensitive device 59 and continues to leak away for the remainder of the negative half cycle 83. At the beginning of the susequent positive half cycle 85, the dephased potential is again positive and the discharge device is again energized.

It is to be noted that the sensitivity of a system in accordance with my invention increases as the time during which the capacitor 19 may discharge increases, and, therefore the sensitivity increases as the frequency of the source 43 decreases. Advantages may be taken of this feature by providing a source 43 of variable frequency and suitably adjustable impedances; 25, 27, 51, 53, etc. In such a case the sensitivity of the system may be varied by varying the frequency of source 43 and properly adjusting the impedances.

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. Translating apparatus comprising an electric discharge device having a control electrode and a plurality of principal electrodes, means for impressing an alternating potential between said principal electrodes, means functioning dynamically for impressing between said control electrode and one of said principal electrodes a potential such as to block a current flow between said principal electrodes, the dynamic operation of the last said means taking place during the intervals during which the potential impressed between said principal electrodes is such as to preclude a discharge therebetween, and control

means for counteracting said blocking potential, said control means operating to counteract said blocking potential at least during the said intervals.

2. Translating apparatus comprising an electric discharge device having a control electrode, a plurality of principal electrodes and a gaseous medium, means for impressing an alternating potential between said principal electrodes, means functioning dynamically for impressing between said control electrode and one of said principal electrodes a potential such as to block a current flow between said principal electrodes, the dynamic operation of the last said means taking place during the intervals during which the potential impressed between said principal electrodes is such as to preclude a discharge therebetween, and control means for counteracting said blocking potential, said control means operating to counteract said blocking potential at least during the said intervals.

3. Translating apparatus comprising an electric discharge device having a control electrode, a plurality of principal electrodes, and a gaseous medium, said principal electrodes being of such structure that the conductivity of the discharge device is asymmetric, means for impressing an alternating potential between said principal electrodes, means functioning dynamically for impressing between said control electrode and one of said principal electrodes a potential such as to block a current flow between said principal electrodes, the dynamic operation of the last said means taking place during the intervals during which the potential impressed between said principal electrodes is such as to preclude a discharge therebetween, and control means for counteracting said blocking potential, said control means operating to counteract said blocking potential at least during the said intervals.

4. Translating apparatus comprising an electric discharge device having a control electrode and a plurality of principal electrodes, means for impressing an alternating potential between said principal electrodes, charge storing means functioning dynamically for impressing between said control electrode and one of said principal electrodes a potential such as to block a current flow between said principal electrodes, the dynamic operation of the last said means taking place during the intervals during which the potential impressed between said principal electrodes is such as to preclude a discharge therebetween, and control means for counteracting said blocking potential, said control means operating to counteract said blocking potential at least during the said intervals.

5. Translating apparatus comprising an electric discharge device having a control electrode, a plurality of principal electrodes, and a gaseous medium, said principal electrodes being of such structure that the conductivity of the discharge device is asymmetric, means for impressing an alternating potential between said principal electrodes, charge storing means functioning dynamically for impressing between said control electrode and one of said principal electrodes a potential such as to block a current flow between said principal electrodes, the dynamic operation of the last said means taking place during the intervals during which the potential impressed between said principal electrodes is such as to preclude a discharge therebetween, and control means for counteracting said blocking potential, said control means operating to counteract said blocking potential at least during the said intervals.

6. Translating apparatus comprising an electric discharge device having a control electrode and a plurality of principal electrodes, means for impressing an alternating potential between said principal electrodes, means for impressing between said control electrode and one of said principal electrodes a potential such as to block a current flow between said principal electrodes, the last said means including charge storing means and means for charging said charge storing means, at the beginning of the intervals during which the potential impressed between said principal electrodes is such as to preclude a discharge therebetween, for a time that is short compared to the length of the said intervals, and control means for counteracting said blocking potential, said control means operating to counteract said blocking potential during substantially the whole of said intervals.

7. Translating apparatus comprising an electric discharge device having a control electrode, a plurality of principal electrodes, and a gaseous medium, said principal electrode being of such structure that the conductivity of the discharge device is asymmetric, means for impressing an alternating potential between said principal electrodes, means for impressing between said control electrode and one of said principal electrodes a potential such as to block a current flow between said principal electrodes, the last said means including charge storing means and means for charging said charge storing means at the beginning of the intervals during which the potential impressed between said principal electrodes is such as to preclude a discharge therebetween for a time that is short compared to the length of the said intervals, and control means for counteracting said blocking potential, said control means operating to counteract said blocking potential during substantially the whole of said intervals.

8. Apparatus according to claim 7 characterized by the fact that the means for charging the charge storing means includes a saturable transformer, the primary of which is supplied from an alternating source and the secondary of which is coupled to said charge storing means.

9. Apparatus according to claim 7 characterized by the fact that the means for charging the charge storing means includes a saturable transformer, the primary of which is supplied from an alternating source and the secondary of which is coupled to said charge storing means through means for blocking the passage of current that is of such polarity that said charge storing means would be charged thereby in a sense to apply a potential between the control electrode and the one principal electrode such as to permit the passage of current between the principal electrodes.

10. Apparatus according to claim 7 characterized by the fact that the means for charging the charge storing means includes a saturable transformer, the primary of which is supplied from an alternating source and the secondary of which is coupled to said charge storing means through a rectifier for blocking the passage of current that is of such polarity that said charge storing means would be charged thereby in a sense to apply a potential between the control electrode and the one principal electrode such as to permit the passage of current between the principal electrodes.

11. Apparatus according to claim 6 characterized by the fact that the control means includes

means for discharging the charge storing means.

12. Apparatus according to claim 6 characterized by the fact that the control means includes means responsive to an external physical disturbance for discharging the charge storing means.

13. Apparatus according to claim 6 characterized by the fact that the control means includes means responsive to an external physical disturbance for discharging the charge storing means, and means for superimposing on the potential produced by said charge storing means a periodic potential of the same frequency as said alternating potential but dephased relative thereto.

14. In combination, an electric discharge device having an anode, a cathode and a control electrode and a gaseous medium, means for impressing an alternating potential between said anode and cathode, a capacitor connected between said control electrode and cathode through an element whereby a potential, of short duration relative to a half-cycle of said source and of a polarity such that current flows between said control electrode and cathode, is impressed between said control electrode and cathode, thereby to charge said capacitor, and means responsive to an external disturbance for discharging said capacitor.

15. Apparatus according to claim 14 characterized by the fact that the connection between the capacitor and the control electrode and the cathode includes means for superimposing on the potential impressed by the element a periodic potential of the same frequency as the alternating potential but dephased relative thereto.

16. Apparatus according to claim 14 characterized by the fact that the element is of such structure and is so connected that the potential of short duration is impressed at the beginning of the half cycles of the alternating potential during which the anode is negative and the cathode is positive.

17. Apparatus according to claim 14 characterized by the fact that the responsive means has the properties of a high impedance which is varied by the external disturbance.

18. Apparatus according to claim 1 characterized by means for impressing an alternating potential of adjustable frequency between the principal electrodes.

19. Apparatus according to claim 6 characterized by means for impressing an alternating potential between the principal electrodes the frequency of which may be varied to vary the sensitivity of the response of the translating apparatus.

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