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ELECTRIC DISCHARGE APPARATUS

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Fig. 1.

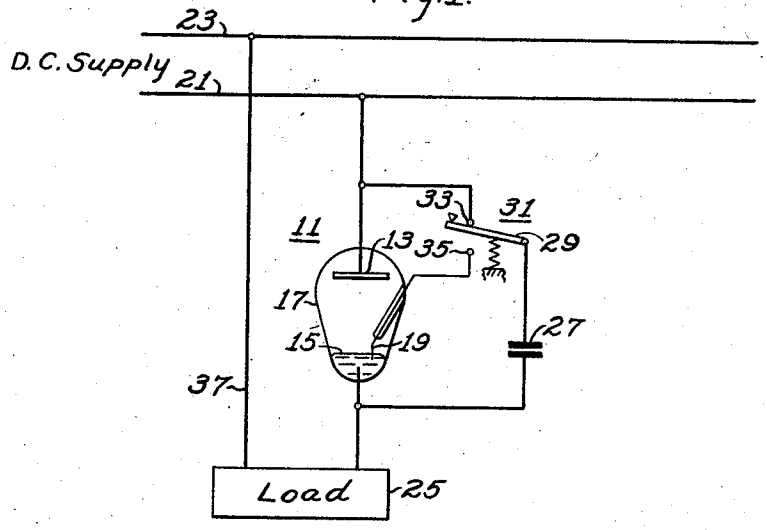
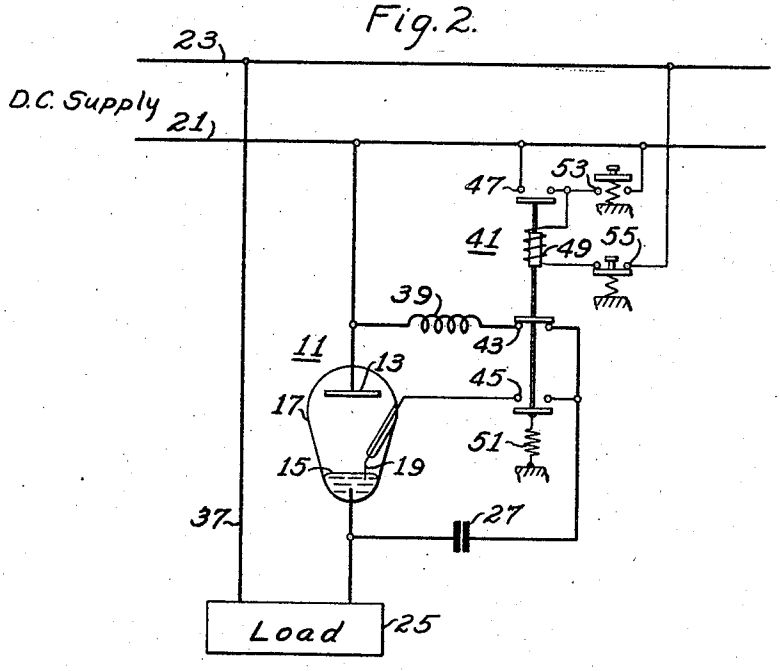


Fig. 2.



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ELECTRIC DISCHARGE APPARATUS

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16 Claims. (Cl. 250—27)

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

Heretofore, electric discharge devices of the type having an arc-like discharge have generally been utilized only in alternating current circuits because of the discontinuous characteristic of the control electrode.

It is accordingly an object of my invention to provide a method and apparatus for controlling the transmission of a direct current through an electric discharge device.

Another object of my invention is to provide apparatus for alternately starting and stopping the flow of direct current through an electric discharge device.

A more specific object of my invention is to provide apparatus for supplying a current impulse of short duration for initiating the flow of direct current through an electric discharge device and for thereafter stopping the flow of direct current through the discharge device at will.

In accordance with my invention unidirectional potential is normally impressed between the principal electrode of an electric discharge device which preferably is of the mercury-pool type but may be of the grid-controlled gaseous hot-cathode type. A charge storing means is disposed to be connected between the starting or ignition electrode and one of the principal electrodes to initiate a discharge between the principal electrodes. Once the discharge has been initiated between the principal electrode the starting electrode is no longer effective because of the discontinuous characteristic of the discharge device.

To stop the flow of current between the principal electrodes the charge storing means is disconnected from the starting electrode and connected between the principal electrodes of the electric discharge device. The current is directed to the charge storing means and the arc between the principal electrodes is extinguished.

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

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

Fig. 2 is a diagrammatic view showing a modification of my invention.

The apparatus shown in Fig. 1 comprises an electric discharge device 11 having an anode 13, and a cathode 15 of mercury or any other vaporizing cathode material disposed in a chamber 17 of glass or other suitable material and that is preferably highly evacuated. If it should be desired that the chamber 17 be of metal, a barrier should be inserted to prevent the cathode spot from reaching the chamber wall. A starting or ignition electrode 19 of suitable resistance material is immersed in the cathode 15. While in the usual practice of my invention the discharge device 11 is of the mercury-cathode type, it may obviously be replaced by a gaseous electric discharge device of the hot-cathode type.

The electric discharge device 11 is supplied with potential from a suitable direct current power source (not shown) through a pair of bus bars or conductors 21 and 23. The anode 13 is connected to conductor 21 and the cathode 15 is connected to conductor 23 through a load 25 of any general character such as a motor or light source that might be energized through the electric discharge device.

A capacitor 27 of any other suitable charge storing means is connected between the cathode 15 of discharge device 11 and moving contact member 29 of multi-contact switching device 31. Switching device 31 may be of any conventional type as this specific structure forms no part of the present invention. Upper stationary contact member 33 of switching device 31 is connected to anode 13. Lower stationary contact member 35 is connected to the ignition electrode 19.

It will readily be understood that the capacitor 27 and the switch 31 may be replaced by means in which a first capacitor which is in a charged condition is connected by a switching means between the ignition electrode 19 and the cathode 15 to initiate the flow of current through the discharge device 11, and a second capacitor, which is in an uncharged condition, is connected by a second switching means between the anode 13 and the cathode 15 to interrupt the flow of current through the discharge device 11.

To start operation of my system direct current power is applied to conductors 21 and 23 in such manner that positive potential is applied to anode 13, while negative potential is applied through load 25 to cathode 15. If the switching device 31 is in the position shown in Fig. 1 the capacitor 27 will be charged through a circuit which extends from the energized conduc-

tor 21, stationary contact member 33, moving contact member 29, capacitor 27, load 25, conductor 37 to energized conductor 23.

To energize the electric discharge device 11 the moving contact member 29 of switching device 31 is actuated so as to open the circuit through contact member 33 and close a circuit through contact member 35. The capacitor 27 then discharegs through an ignition electrode 19 through a circuit which extends from one side of capacitor 27, contact members 29 and 35 of switch 31, ignition electrode 19, cathode 15 to the other side of capacitor 27. A cathode spot is formed on the surface of the cathode 15 thereby causing a discharge between the anode 13 and cathode 15 thus energizing the load 25 through a circuit which extends from energized conductor 21, anode 13, cathode 15, load 25, conductor 37 to the energized conductor 23.

Once initiated, the discharge between the anode 13 and cathode 15 of the discharge device 11 continues as long as sufficient potential difference is maintained therebetween, regardless of the potential impressed upon the ignition electrode.

To deenergize the electric discharge device 11 and thereby interrupt the flow of current through the load 25 the moving contact member 29 of switching device 31 is actuated to open the circuit through contact member 35 and to close the circuit through contact member 33. The capacitor 27, which is now in the discharged condition, is thus connected between the anode 13 and cathode 15. The current passing through the discharge device is diverted through the circuit hereinabove described for charging the capacitor and the arc between the anode 13 and cathode 15 is extinguished. When the capacitor becomes charged flow of current between anode 13 and the cathode 15 is not reestablished because the circuit through the ignition electrode is open and there is no cathode spot on the surface of the cathode to reinitiate the arc.

The capacitor 27 is now charged and the energization of the discharge device 11 may be repeated as hereinabove described.

The size of capacitor 27 must be great enough, and the impedance of the leads connecting it to the anode and cathode of discharge device 11 be small enough, so that the transient current capacitor 27 draws when contact member 29 returns to contact with contact member 33 is substantially greater than the current flowing through discharge device 11 before contact member 29 makes said contact. This relationship can be insured by making capacitor 27 large and by making its connection leads short and of low resistance.

In a system of the type shown in Fig. 1 that I have found particularly useful, the electric discharge device 11 is of the type known as Westinghouse KU–637 and has an average anode to cathode current rating of 20 amperes. A maximum peak current of approximately 25 amperes is required in the circuit of the ignition electrode 19. When the load 25 is such that the load current is 12 amperes, the capacity of capacitor 27 may be substantially 4 microfarads. The potential impressed between the principal electrodes of the discharge device 11 is of the order of 250 volts. The leads to the capacitor 27 may be of number 10 gage B & S copper wire preferably made as short and direct as possible. For instance, I have made installations in which the total length of wire in the path from the anode to the cathode of the discharge device 11 through the capacitor 27 was approximately 2 feet.

It is assumed that the time constant of the circuit in Fig. 1 is sufficient to allow for the deionization of the discharge device 11 while the capacitor 27 is charging. However, if the distributive inductance inherent in the load and load circuit is not sufficient for obtaining the proper time constant, an inductance 39 may be added preferably in the circuit for charging the capacitor 27 as shown in Fig. 2.

In Fig. 2, an electromagnetic device 41 having contact members 43, 45 and 47 and operating coil 49 is utilized in place of switching device 31. A spring 51 may be utilized to insure positive closing of contact members 43 when the operating coil 49 of the electromagnetic device 41 is in the deenergized condition. A start push-button switch 53 is depressed to energized operating coil 49 and thus causes the discharge device 11 to become energized. A stop push-button switch 55 is depressed to deenergized operating coil 49 and thus causes the discharge device 11 to become deenergized. The operation of the system shown in Fig. 2 is substantially the same as that shown in Fig. 1, therefore it is believed that a detailed explanation of the operation is not necessary.

It will readily be understood that the electric discharge device 11 may be utilized as a source of light in which case the load 25 may be replaced by a resistor or reactor if so desired. By moving the contact member 29 into contact with contact member 35 for only brief times, the tube 11 may be made to exert a series of flashes and be used as a signalling system. A somewhat analogous but different signalling system is described and claimed in application Serial No. 103,185, of W. E. Berkey, filed September 29, 1936, and assigned to the Westinghouse Electric & Manufacturing Company.

I do not wish to be restricted to the specific structural details, arrangement of parts or circuit connections herein set forth, as various other modifications thereof may be effected without departing from the spirit and scope of my invention. I desire, therefore, that only such limitations shall be imposed as are indicated in the appended claims.

I claim as my invention:

1. In an electric system for controlling the flow of electric energy from a power source to a work circuit comprising an electric discharge device having a control electrode and a plurality of principal electrodes, a capacitor, means for charging said capacitor, means for discharging the capacitor through the control electrode to initiate a discharge between the principal electrode, and means, including a portion of said charging means, for connecting the capacitor between the principal electrodes to extinguish the arc therebetween and to charge the capacitor.

2. The method of controlling the flow of direct current through an electric discharge device having a pair of principal electrodes and a starting electrode by means of apparatus including a capacitor and means for charging said capacitor, said method comprising discharging the capacitor through the starting electrode and one of the principal electrodes to initiate the flow of direct current through the discharge device, and diverting the flow of direct current from the principal electrodes to charge the capacitor and to stop the flow of direct current between the principal electrodes.

3. The method of controlling the flow of di-

rect current through an electric discharge device having a pair of principal electrodes and a starting electrode by means of apparatus including a capacitor and means cooperatively associated with the discharge device for charging and discharging the capacitor, said method comprising charging the said capacitor, connecting the capacitor between the starting electrode and one of the principal electrodes to discharge the capacitor and to initiate the flow of direct current between the principal electrodes, disconnecting the capacitor from the starting electrode and connecting the capacitor between the principal electrodes to divert the flow of direct current from the principal electrodes.

4. In an electric system for controlling the flow of direct current from a power source to a work circuit comprising an electric discharge device having an anode, a cathode, and a starting electrode in contact with said cathode, a capacitor, means for charging said capacitor, means for discharging the capacitor through the starting electrode and the cathode for initiating the flow of direct current through the discharge device, and means, including a portion of said charging means, for connecting the capacitor between the anode and the cathode to divert and extinguish the flow of current therebetween.

5. In an electric system for controlling the flow of direct current from a power source to a work circuit comprising an electric discharge device having a pair of principal electrodes and a starting electrode in contact with one of said principal electrodes, a charge storing means, means for initially charging said charge-storing means, means for connecting the charge-storing means between the starting electrode and the principal electrode in contact therewith to initiate the flow of direct current through the discharge device, means, including a portion of said charging means, for connecting the charge storing means between the principal electrodes to interrupt the flow of direct current through the discharge device and to charge the charge storing means.

6. Apparatus for controlling the supply of power from a direct current power source to a power-consumption system comprising an electric discharge device having a plurality of principal electrodes and an ignition electrode, means for impressing a potential between certain of the principal electrodes, a capacitor, means for securing an initial charge on said capacitor, means for discharging the capacitor through the ignition electrode to initiate a discharge between certain of the principal electrodes, and means for connecting the capacitor between certain of the principal electrodes to extinguish the discharge therebetween and to charge the capacitor.

7. Apparatus for controlling the supply of power from a direct current power source to a direct current power-consumption system comprising an electric discharge device having a pair of principal electrodes and an ignition electrode, means for impressing a potential between the principal electrodes, a capacitor, means for securing an initial charge on the capacitor, means for discharging the capacitor through the ignition electrode and one of the said principal electrodes to initiate a discharge between the principal electrodes, and means for connecting the capacitor between the principal electrodes to interrupt the discharge therebetween.

8. Apparatus for controlling the supply of power from a direct current power source to a direct current power consumption system comprising an electric discharge device having a pair of principal electrodes and an ignition electrode, means including a capacitor for initiating a discharge between the principal electrodes, and means including said capacitor for interrupting the discharge between the principal electrodes.

9. Apparatus for controlling the supply of power from a direct current power source to a direct current power consumption system comprising an electrode discharge device having a pair of principal electrodes and an ignition electrode, a capacitor, a path for charging said capacitor bridging said principal electrodes whereby a discharge between said principal electrodes if it exists is interrupted and a path for discharging said capacitor including said ignition electrode whereby a discharge is initiated between said principal electrodes.

10. Apparatus for controlling the supply of power from a direct current power source to a direct current power consumption system comprising an electric discharge device having a pair of principal electrodes and an ignition electrode, means for initiating a discharge between the principal electrodes, the said means for initiating a discharge comprising a capacitor, means for charging said capacitor and means for discharging the capacitor through the ignition electrode, and means for interrupting said discharge between the principal electrodes, the said means for interrupting said discharge comprising said capacitor and means, including a portion of said charging means, for connecting the said capacitor between the principal electrodes.

11. Apparatus for controlling the supply of power from a direct current power source to a direct current power consumption system comprising an electric discharge device having a pair of principal electrodes and an ignition electrode, means for initiating a discharge between the principal electrodes, the said means for initiating a discharge including a charge storing means, means for charging said charge storing means and means for connecting the said charge storing means between the ignition electrode and one of the starting electrodes, and means for interrupting said discharge between the principal electrodes, said means for interrupting said discharge including charge storing means and means, including a portion of said charging means, for connecting the said charge storing means between the principal electrodes.

12. The method of controlling the flow of direct current through an electric discharge device having a starting electrode and also having a pair of principal electrodes connected between a power source and a work circuit, said current flow being controlled by means of apparatus including a capacitor having a plurality of plates electrically connected across the said principal electrodes, said method comprising disconnecting at least one plate of the capacitor from one of the principal electrodes, connecting the said one plate of the capacitor to the starting electrode to discharge the capacitor and to initiate the flow of direct current between the principal electrodes, disconnecting the said one plate of the capacitor from the starting electrode, and connecting the said one plate of the capacitor to the said one principal electrode to direct the flow of direct

current from the principal electrodes and to charge the capacitor.

13. The method of controlling the flow of direct current through an electric discharge device having a starting electrode, and also having a pair of principal electrodes electrically connected between a power source and a work circuit, said current flow being controlled by means of apparatus including a capacitor having a pair of plates electrically connected across the said principal electrodes, said method comprising disconnecting one plate of the capacitor from one of the principal electrodes, connecting the said one plate of the capacitor to the starting electrode, disconnecting the said one plate of the capacitor from the starting electrode, and connecting the said one plate of the capacitor to the said one principal electrode.

14. In an electric system for controlling the flow of electric energy from a power source to a work circuit comprising an electric discharge device having a control electrode and a pair of principal electrodes, a capacitor having a pair of plates, means for connecting one plate of said capacitor to one of said principal electrodes, and means for connecting the other plate of said capacitor either to the other of said principal electrodes or to the said control electrode.

15. In combination, an electric discharge device having a pair of principal electrodes and a control electrode, means for impressing a potential between said principal electrodes, a capacitor having a pair of plates, means for connecting one plate of said capacitor to one of said principal electrodes, and means for connecting the other plate of said capacitor at will either to the other of said principal electrodes or to the said control electrode.

16. In an electric system for controlling the flow of electric energy from a power source to a work circuit comprising an electric discharge device having a control electrode and a pair of principal electrodes, a capacitor, and means for alternately connecting the said capacitor between the control electrode and one of the principal electrodes and between the pair of principal electrodes.

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