Aug. 22, 1939. H. W. LORD 2,170,457

ELECTRIC DISCHARGE APPARATUS

Filed Dec. 20, 1938

Fig. 1.

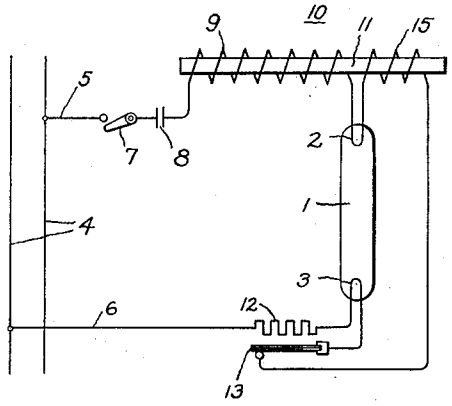
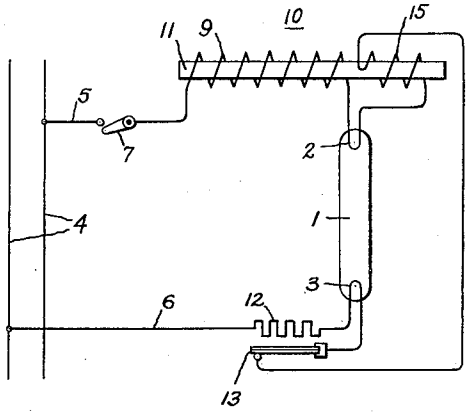


Fig. 2.



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ELECTRIC DISCHARGE APPARATUS

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6 Claims. (Cl. 176—124)

My invention relates to gaseous electric discharge devices and apparatus for operating the same from alternating current circuits particularly when one or both of the electrodes of the devices are constructed and arranged to be preheated.

In the past the electrodes of such a device have been preheated preparatory to the starting of the discharge therein by initially short circuiting the device in such a manner that the short circuit current would pass through the electrodes. In certain cases, as for example, when the device is connected with the source of current supply through a ballast reactor or through ballast comprising a reactor and a capacitor, the short circuit current has been insufficient to produce the desired preheating of the electrodes since the current flow through the ballast in those cases is approximately constant whether the device is operating or is short circuited. It is the object of my invention to provide apparatus of the character described whereby the above mentioned difficulty is overcome.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 is a circuit diagram illustrating one embodiment of my invention and Fig. 2 is a like diagram illustrating a modification.

While my invention is applicable to apparatus employing various forms of electric gas discharge devices, it is of particular interest and has been especially developed for use in connection with low pressure discharge devices which are employed to give light. A preferred form of such device is a lamp of the positive column type comprising a tubular envelope having electrodes at its ends and containing a gaseous atmosphere such as a few millimeters of a rare gas, for example argon, and a small quantity of a vaporizable metal such as mercury. Preferably the envelope is coated internally with a suitable fluorescent material in order that the electric discharge, which in itself may be scarcely visible, shall produce the desired high degree of illumination. The coating may also contain a suitable material to cause the lamp to continue to give light during the intervals of current reversal therein. In the description to follow, therefore, I shall refer to the discharge devices as lamps.

Referring to Fig. 1, I have shown the electric discharge device or lamp at 1 the same being provided at its ends with the thermionic electrodes 2 and 3 which are constructed and arranged to be preheated to an electron emitting temperature by passing a current through them. The lamp is shown connected with the source of supply 4 of alternating current which, for example, may be 60 cycle, 115 volt lighting circuit, by the connections 5 and 6. In the connection 5 between one side of the source of supply and one end of the electrode 2 I have shown the control switch 7, the capacitor 8 and the reactor 10 comprising the winding 9 on the core 11. The relative amounts of capacitance and inductance provided by the capacitor 8 and the reactor are such that the circuit thereof including the lamp 1 is only partly tuned to the frequency of the source of supply, the circuit being operated well below the resonance peak, there being a preponderance of capacitative reactance in the circuit. In the connection 6 I have shown the resistance heater 12 adjacent to which is a bimetallic switch 13 which when heated by the resistor 12 is warped to open circuit position, the switch and the resistor being connected with opposite ends of the electrode 3.

Should the other end of the electrode 2 be directly connected with the switch thereby forming a short circuit across the lamp controlled by the switch, the heating current which would traverse the electrodes 2 and 3 prior to the starting of the discharge may not be sufficient adequately to preheat them. In order to increase the electrode preheating current to insure adequate preheating of the electrodes, I have provided the reactor 10 with the additional winding 15 which is included in the short circuit connection controlled by the switch 13. The additional winding 15 is so connected in this circuit that it constitutes an auxiliary winding on the reactor, namely it produces flux in the reactor core in the same direction as that produced by the winding 9; in other words, it has an additive polarity; hence the total inductance of the circuit traversed by the electrode heating current is the sum of the inductances of the reactor and the winding 15 plus the mutual inductance thereof. The effect of this arrangement is that before the discharge starts in the lamp and while the switch 13 is still closed the electrode heating circuit including the capacitor, the reactor, and the auxiliary winding 15 as the reactive elements is more nearly tuned than the aforesaid lamp circuit including merely the capacitor and the reactor as the reactive elements. The resulting increased heating current

is sufficient to produce the desired preheating of the electrodes.

This greater current in passing through the resistor 12 heats the bi-metallic switch 13 whereby it warps and opens the circuit of the winding 15 after the electrodes have become sufficiently heated. The inductive kick due to the opening of the switch causes a discharge to start in the lamp, the flow of the lamp current through the resistor 12 thereafter being sufficient to hold the switch in open position. The lamp then continues to operate with a ballast comprising the reactor 10, namely the winding 9, and the capacitor 8.

In the modification illustrated by Fig. 2 the ballast for the lamp comprises simply the reactor. In this case the electrode preheating current is increased by reducing the amount of inductance in the circuit traversed thereby. The additional winding 15 of the reactor is connected in the shunt circuit controlled by the switch 13 in the reverse manner to that shown in Fig. 1 to oppose the reactor, that is, it has a subtractive polarity whereby the total inductance of the circuit traversed by the electrode heating current is the sum of the inductances of the reactor and the winding 15 minus the mutual inductance thereof. As a result of this arrangement there is a less amount of inductive reactance and hence less impedance in the preheating circuit of the electrodes when the switch 13 is closed and before starting occurs whereby a greater preheating current flows therein. This greater current, as in Fig. 1, warps the bimetallic switch 13 to open the circuit of the winding 15 after the lamp electrodes are sufficiently heated whereby the discharge starts in the lamp, the switch being kept open during the operation of the lamp.

While I have shown and described the switch 13 as being bimetallic and being heated by the resistor 12, it will be understood that I may employ in lieu thereof an electromagnetic switch or any other suitable circuit opening device.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In combination, a source of alternating current supply, a reactor, a gaseous electric discharge device connected with said source through said reactor, one of the electrodes of said device being adapted to be preheated and being connected at one end thereof with one of the connections to said source, a connection between the other end of said electrode and the other electrode of said device and means in said connection comprising additional turns on said reactor for increasing the flow of current through said one electrode at starting.

2. In combination, a source of alternating current supply, a reactor, a gaseous electric discharge device connected with said source through said reactor, one of the electrodes of said device being adapted to be preheated and being connected at one end thereof with one of the connections to said source, a connection between the other end of said electrode and the other electrode of said device and inductive means in said connection having a flux path common to that of said reactor for increasing the flow of current through said one electrode at starting.

3. In combination, a source of alternating current supply, a reactor, a gaseous electric discharge device connected with said source through said reactor, one of the electrodes of said device being adapted to be preheated and being connected at one end thereof with one of the connections to said source, a connection between the other end of said electrode and the other electrode of said device and inductive means in said connection arranged in flux interlinking relation with said reactor for increasing the electrode preheating current at starting.

4. In combination, a source of alternating current supply, a capacitor, a reactor, a gaseous electric discharge device connected with said source through said capacitor and reactor, one of the electrodes of said device being adapted to be preheated and being connected at one end thereof with one of the connections to said source, a connection between the other end of said electrode and the other electrode of said device and an additional winding arranged on said reactor to have an additive polarity relative thereto and included in said connection for supplementing the reactor at starting.

5. In combination, a source of alternating current supply, a reactor, a gaseous electric discharge device connected with said source through said reactor, one of the electrodes of said device being adapted to be preheated and being connected at one end thereof with one of the connections to said source, a connection between the other end of said electrode and the other electrode of said device and inductive means in said connection arranged to oppose the flux of said reactor thereby to increase the electrode preheating current at starting.

6. In combination, a source of alternating current supply, a reactor, a gaseous electric discharge device connected with said source through said reactor, one of the electrodes of said device being adapted to be preheated and being connected at one end thereof with one of the connections to said source, a connection between the other end of said electrode and the other electrode of said device and an additional winding arranged on said reactor to have a subtractive polarity relative thereto and included in said connection whereby at starting a lower impedance in the electrode heating circuit is obtained.

HAROLD W. LORD.