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2,097,261

LIGHTING DEVICE

Original Filed April 30, 1929

Fig. 1.

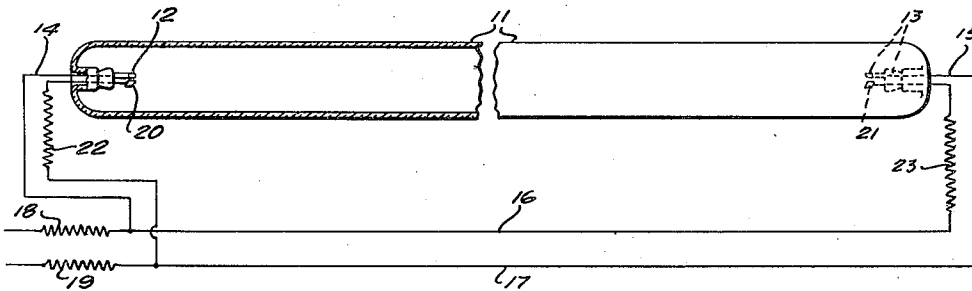


Fig. 2.

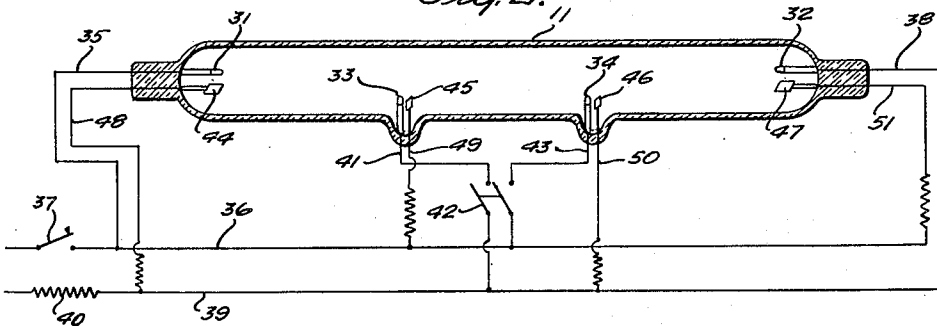
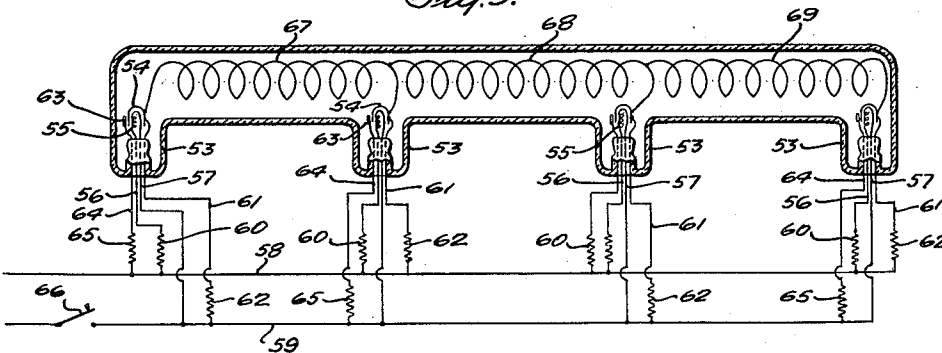


Fig. 3.



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LIGHTING DEVICE

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Original application April 30, 1929, Serial No. 359,330, now Patent No. 1,969,765. Divided and this application August 14, 1934, Serial No. 739,817. In Germany September 24, 1928

11 Claims. (Cl. 176—124)

This application is a division of the application Serial No. 359,330, filed by applicant and Ulrich Doering on April 30, 1929, and on which Patent No. 1,969,765 was granted August 14, 1934.

5 This invention relates to gas discharge devices, especially to those devices in which a gas discharge takes place in a glass tube and which are suitable for illuminating purposes. More particularly the invention relates to such devices
10 which operate with glowing and emitting cathodes.

The present invention has for its object the production of a satisfactory gas discharge device suitable for operation directly from a low voltage
15 supply circuit. In order to more clearly explain the invention, reference is made to the following description of different embodiments thereof taken in connection with the accompanying drawing in which

20 Figure 1 is a longitudinal elevation partly in section of a discharge device, the external connections being shown in diagrammatic form;

Figure 2 is a longitudinal section of another form of gas discharge device with special means
25 for changing from starting to running operation; and

Figure 3 is a longitudinal section of still another form of gas discharge device.

The reference character 11 indicates a glass
30 tube having electrodes 12 and 13 positioned in the ends thereof. These electrodes are preferably of a glowing and emitting type and may be maintained at a temperature sufficiently high to give the desired emissivity by the heating action
35 of the gaseous discharge itself. As examples of substances suitable for rendering the electrodes highly emissive may be mentioned barium, strontium, calcium, caesium and rubidium either in metallic form or as compounds. Among the compounds suitable for the purpose may be mentioned phosphates and double silicates. The emissive substance may have associated therewith an anhydride of an amphoteric compound such as aluminum oxide or zirconium oxide which gives
45 greatly increased resistance to disintegration. These electrodes are connected through leading-in wires 14 and 15 to conductors 16 and 17 of a suitable supply circuit. Current limiting or ballast impedances 18 and 19 are connected in the
50 conductors 16 and 17 to give to the tube suitable operating characteristics, the gaseous discharge path alone having a so-called negative characteristic. Auxiliary electrodes 20 and 21 may be positioned adjacent to the electrodes 12 and 13
55 respectively, and are connected to the conductors

17 and 16 respectively through high resistances 22 and 23. For obtaining special effects fluorescing glass such as lead glass or scandium glass may be employed.

In operation, the line switch is closed and
5 thereafter a discharge is set up between the main electrode 12 and the auxiliary electrode 20 at one end of the tube and between the main electrode 13 and the auxiliary electrode 21 at the
10 other end of the tube. Because of the high value of the resistances 22 and 23, the current flow through these discharge paths of short length is limited and the discharge is transferred for the most part to the path which lies between the two
15 main electrodes 12 and 13.

In the form shown in Figure 2, electrodes 31
and 32 are positioned in the ends of the tube 11 and other electrodes such as 33 and 34 are positioned in intermediate positions in the tube. The electrode 31 has a leading-in wire 35 connected
20 to a line conductor 36 controlled by a switch 37. The electrode 32 has a leading-in wire 38 connected to a line conductor 39 in which is inserted a current limiting resistance 40. The electrode
25 33 has a leading-in wire 41 which is connected through one side of a double pole switch 42 to the line conductor 39 and similarly the electrode 34 has a leading-in wire 43 which is connected
30 through the other side of the double pole switch to the line conductor 36. The electrodes 31, 33, 34, and 32 may have positioned adjacent thereto auxiliary electrodes 44, 45, 46, and 47 respectively. Each of these electrodes has a leading-in
35 wire 48, 49, 50, and 51 which is connected in each instance to the opposite line conductor from that to which its adjacent main electrode is connected.

In operation, the line switch 37 is closed and also the double pole switch 42. This places substantially the full line potential across adjacent
40 main electrodes. Also substantially full line voltage is impressed between each main electrode and its adjacent auxiliary electrode. Because of the shorter distance between each main electrode and its auxiliary adjacent electrode, the discharge is first set up through these short paths, but because of the high resistance in series with these
45 discharge circuits the discharge almost immediately passes over to the longer path between adjacent main electrodes. After the tube is operating, the switch 42 may be opened and the discharge thereafter passes from the electrode 31
50 to the electrode 32, all the gas discharge paths 31—33, 33—34, and 34—32 being in series.

In the form shown in Figure 3, the tube 11 is provided with a plurality of chambers 53 ex- 55

tending at right angles from the main tube so as to be out of the main discharge path within the tube and in each of these chambers is positioned an electrode which may comprise an outer emissive coating or shell 54 within which is positioned a heating coil 55. Each heating coil 55 has leading-in wires 56 and 57 which are connected to opposite conductors 58 and 59 of a supply circuit. A suitable resistance 60 may be connected in each heating circuit to limit the current flowing in the heating coil or, if preferred, the heating coil may be so designed that the resistance may be dispensed with and the full line voltage impressed directly on the heating coils. Each shell 54 is provided with a leading-in wire 61 and these leading-in wires are connected to the conductors 58 and 59 of the supply circuit, adjacent electrodes being connected to the opposite conductors. Each leading-in wire 61 is provided with a high impedance 62, which may be resistance on direct current and resistance or inductance on alternating current, so as to give stability to a suitable current flow through the gaseous discharge path. To facilitate starting of the gaseous discharge, auxiliary electrodes 63 may be provided adjacent to each main electrode. Each auxiliary electrode 63 has a suitable leading-in wire 64 connected through a high impedance 65 to the opposite side of the line from that to which the adjacent main electrode is connected. The operation of the tube may be controlled by a suitable line switch 66 in the conductor 59. The starting of the gaseous discharge may also be materially assisted by connecting adjacent electrodes by a conductive path, such as a filament of wire, which may be in the form of a coil or helix as indicated at 67, 68, and 69.

The resistances of the coils 67, 68, and 69 may be so chosen that the current drawn through the coils is very small but by a suitable arrangement and proportioning of these coils, the discharge may be caused to first start between an electrode and the adjacent portion of the coil, the discharge thereafter extending itself until it reaches from one main electrode to another. While both auxiliary electrodes and conductive connections between electrodes have been described as being of assistance in starting the discharge, it is to be understood that both are not necessarily employed in every discharge tube, as one only may be sufficient or even preferable under a given set of conditions.

In the operation of the form shown in Figure 3, the shells of the electrodes are gradually heated by the passage of the current through the heating coils 55. The initial discharge first takes place either to an auxiliary electrode as 63, or to a portion of one of the conductive coils connecting the electrodes. The conductive coils 67 and 69 may be omitted, if desired, as the discharge readily starts in adjacent sections of the tube after it has been set up in the middle portion so that the conductive coil 68 in the middle section may be sufficient.

It will be seen from the foregoing description that simple and effective means have been provided for such devices which enable them to be formed readily into letter and into special bent and angular forms.

I claim:

1. In a radiant electrical discharge device which comprises an envelope permeable to at least a part of the radiation from the discharge, an ionizable filling therein adapted to carry the discharge, a plurality of electrodes spaced apart

therein, a cathode which comprises a metallic support and a coating thereon comprising an activating metal of the electropositive group Ba, Sr, Ca, Cs, Rb, in a silicate material given strength and resistance to disintegration by heating, and in which the activating coating also comprises a refractory amphoteric oxide besides the silica.

2. In a radiant electrical discharge device which comprises an envelope permeable to at least a part of the radiation from the discharge, an ionizable filling therein adapted to carry the discharge, a plurality of electrodes spaced apart therein, a cathode which comprises a metallic support and a coating thereon comprising an activating metal of the electropositive group Ba, Sr, Ca, Cs, Rb, in a silicate material given strength and resistance to disintegration by heating, and in which the activating coating also comprises zirconium oxide.

3. In a radiant electrical discharge device which comprises an envelope permeable to at least a part of the radiation from the discharge, an ionizable filling therein adapted to carry the discharge, a plurality of electrodes spaced apart therein, a cathode which comprises a metallic support and a coating thereon comprising an activating metal of the electropositive group Ba, Sr, Ca, Cs, Rb, in a silicate material given strength and resistance to disintegration by heating, and in which the activation coating is formed from a double silicate of the activating metal.

4. In a radiant electrical discharge device which comprises an envelope permeable to at least a part of the radiation from the discharge, an ionizable filling therein adapted to carry the discharge, a plurality of electrodes spaced apart therein, a cathode which comprises a metallic support and a coating thereon comprising an activating metal of the electropositive group Ba, Sr, Ca, Cs, Rb in a phosphate material given strength and resistance to disintegration by heating.

5. In a radiant electrical discharge device as defined in claim 4 a cathode as therein defined in which the activating coating comprises free metal of said electro-positive group.

6. A radiant electrical discharge device comprising an envelope permeable to at least a part of the radiation from the discharge, a gaseous filling therein adapted to carry the discharge, a plurality of electrodes spaced therein, and a spiral conductor between the electrodes, close to the wall of said envelope, surrounding the discharge.

7. A radiant electrical discharge device comprising an envelope permeable to at least a part of the radiation from the discharge, a gaseous filling therein adapted to carry the discharge, a plurality of spaced electrodes therein, and a high resistance thermionic conductor connected between said electrode and extended for a substantial distance along and near the inner surface of said envelope.

8. A radiant electrical discharge device comprising an envelope permeable to at least part of the radiation from the discharge, a gaseous filling therein adapted to carry the discharge, a plurality of principal electrodes spaced therein, a conductor within said envelope between said electrodes extended along the path of the discharge and associated with the electrodes so as to be maintained at potentials between those of the electrodes, and an auxiliary electrode near a principal electrode and means for maintaining a greater potential on said auxiliary electrode, relative to the principal electrode, than upon any

part of said conductor which is equally near the principal electrode, whereby to protect said conductor against injury by arcing from the principal electrode.

5 9. The combination of a radiant electrical discharge device comprising an envelope permeable to at least a part of the radiation from the discharge, a gaseous filling therein of material adapted to provide a gaseous atmosphere for the
10 discharge, a plurality of electrodes positioned therein, at least two of which are far apart and at least two of which are positioned intermediate said first two along the path of the discharge, and means for energizing a discharge therein com-
15 prising a source of potential, means for connecting one side of said source to alternate electrodes and for connecting the other side of said source to the other alternate electrodes in the discharge device, and means in the connections to the in-
20 termediate electrodes for disconnecting said intermediate electrodes after the discharge is started, whereby the discharge may continue thereafter directly between the electrodes which are far apart.

25 10. A radiant electrical discharge device comprising an envelope permeable to at least a part of the radiation from the discharge, a filling therein adapted to provide a gaseous atmosphere

for the discharge, a plurality of electrodes spaced therein, and a high resistance thermionic conductor extended along the space between the electrodes and adapted to be heated to thermionic temperature by the current passing therethrough, and a source of current in circuit with such conductor adapted to provide current sufficient to heat the conductor to thermionic temperature and at a potential greater than the striking potential of a discharge between the ends of said
5 conductor in the ionized filling, whereby the conductor upon reaching a temperature of thermionic emission sufficient to ionize the gas automatically short circuits itself by initiating a discharge at lower potential in the gas. 10

11. A radiant electrical discharge device as defined in claim 10 in which one of the electrodes is an activated cathode and the thermionic conductor is connected to opposite electrodes, whereby substantially the full potential imposed on the
15 principal electrodes for starting of the discharge is imposed upon the high resistance conductor and the automatic short-circuiting of the conductor by a discharge establishes the discharge immediately and directly between the principal
20 electrodes. 25

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