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ELECTRIC DISCHARGE APPARATUS

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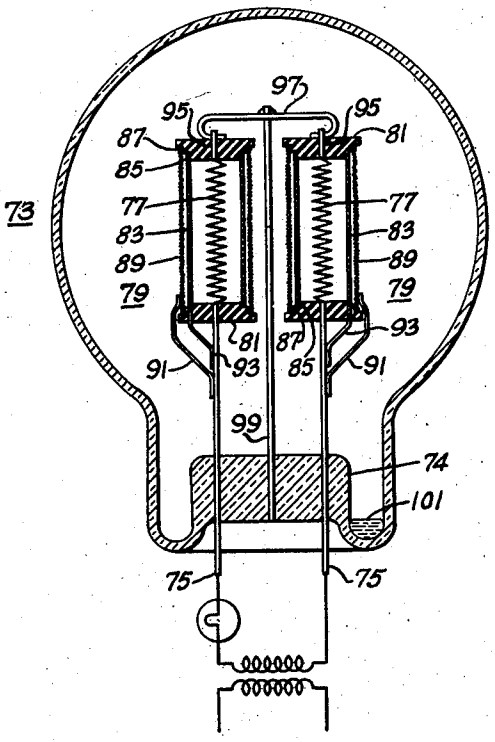

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ELECTRIC DISCHARGE APPARATUS

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6 Claims. (Cl. 176—122)

This application is a division of my copending application Serial No. 43,347, filed October 3, 1935, for Electric discharge apparatus.

My invention relates to electric discharge apparatus and it has particular relation to lamps utilizing heated electrodes operating in a gaseous atmosphere.

One common type of lamp to which the application of the invention pertains is one having similar electrodes coated with a mixture of alkaline earth metal oxides. These similar electrodes are heated and electrons are emitted by the coating. Alternating current is applied to the two electrodes and a discharge takes place through the gaseous medium with first one electrode acting as a cathode and the other an anode and then vice versa. The gaseous medium used is commonly mercury vapor and the ionization of this vapor by the discharge produces a spectrum that is rich in ultra-violet light. These lamps are accordingly rather widely used for the beneficial use of this ultra-violet light.

In these gaseous discharge lamps, however, the electrons emitted by the electrode acting as a cathode react on the gaseous or vapor medium in which the electrodes are immersed to produce positive ions which drift towards this electrode acting as a cathode under the action of the electromotive force impressed between the two electrodes. When this cathode electrode is heated to the proper temperature, sufficient electrons are emitted from its surface to protect the coating from the effects of the positive ions which are drawn thereto. If, however, the cathode electrode is not heated to a sufficiently high temperature at the same time a potential difference is impressed between the two electrodes, the positive ions impinging on the cathode attack the emissive coating. In addition, the arc which is produced under the action of the potential between the electrodes has a comparatively high potential drop by reason of the scarcity of electrons emitted from the cathode electrode. Under such circumstances, hot spots tend to form on the surface of the cathode with the result that considerable portions of the active coating are stripped.

Customarily, the discharge lamp devices of the type involved here are provided with electrodes which must be heated for a considerable interval of time before they are safe from positive ion bombardment. As the current output for which the discharge device is provided increases, the size of the cathode increases and the time required for heating the electrode to the proper temperature correspondingly increases. The necessary time may vary from five seconds to approximately five minutes or more.

It is an object of my invention to provide a lamp discharge device of the hot electrode gas or vapor filled type in which the electrodes shall be protected from damage thereto arising when the potential between the electrodes causes a discharge prior to the time that the electrodes reach a temperature at which their emission equals or exceeds the maximum current through the device.

Another object of my invention is to protect the electrodes from the deleterious effects of premature discharge between the electrodes.

Another object of my invention is to provide an illuminating unit of the glow discharge type that shall be capable of continuous operation over a long interval of time.

According to my invention, the lamp discharge device is provided with screening members or shields which completely enclose the electrodes. The shield is so constructed that electrons from the electrode acting as a cathode may be transmitted through its surface. This object is accomplished either by providing the shield with one or more perforations or by constructing the shield of such thin material that it is punctured by the electrons from the emissive electrode as they move under the influence of the potential between the electrodes. The interior surface of the shield is designed to be thermionically active. However, I have found that the shield, while it may be, need not be coated before it is mounted in the discharge device. An uncoated shield may be mounted adjacent to the electrodes. After the electrodes have operated for a short interval of time, sufficient coating material is projected from the cathode onto the shield to render the interior surface of the latter emissive.

The shield is connected in circuit with the electrode in such manner that when the electrode is below the proper temperature for emission, the shield operates as a blocking control electrode. It is, moreover, disposed in such proximity to the electrode that it is heated thereby. As the temperature of the electrode rises, that of the shield also rises and a continuously increasing stream of electrons is emitted from the interior surface of the shield. The shield member has a space charge that prevents the passage of electrons therethrough. As the shield is heated, the shield emits electrons and these electrons will reduce the thickness of the insulating space

charge layer. This type of electron emission has been designated as a threshhold discharge. This emission will create ionization in the gaseous medium, and when the emission reaches a certain state, the electrons will break through the space charge on the shield and a discharge will occur between the electrodes. The length of time necessary to heat the shield to permit the discharge of electrons through the insulating space charge layer automatically creates a time lag that protects the electrodes from a premature establishment of the discharge between the electrodes.

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 the specific embodiments when read in connection with the accompanying drawing, in which:

The figure is a view in section showing a glow discharge lamp constructed in accordance with my invention.

The lamp comprises an envelope 73 through a reentrant portion 74 of which rods 75 project. A plurality of heating elements 77 suitably supported on rods 75 are disposed within the envelope. Each filamentary element 77 is enclosed within a tube 79 having disks 81 of ceramic or other insulating material at the ends and emissive walls 83 extending between the ends. The disks 81 are provided with shoulders 85 and 87 and the emissive walls 83 are supported between the innermost shoulders 85 of each set of disks. On intermediate shoulders 87 of the disks, screening members 89 are supported. The screening members 89 are preferably composed of perforated sheet cylinders although wire mesh may also be used. Connectors 91 are welded to each of the perforated cylinders or wire meshes 89 and to the rods 75 to connect the screening member 89 and the emitting electrodes. Similar conductors 93 are welded to the emissive walls 83 and the rods 75. The filamentary elements 77 are each welded to a short rod 95 at the top. The rods 95 project through the ceramic disks 81 and are welded to a cross piece 97. The cross piece 97 thus connects the emissive electrodes in series with each other. To support each of the assemblies 77, 79, 89 an upright member 99 sealed in the stem 74 and welded to the cross piece 97 at the center is provided. To provide the necessary vapor atmosphere, a globule of mercury 101 is disposed within the envelope.

Power is supplied to the lamp by connecting the leads 75 to a source of alternating current. The current heats the filaments 77, which are preferably of an alloy comprised of nickel, cobalt and ferro-titanium. The heat energy radiated by these filaments heats up the alkaline earth oxide coating on the walls 83 and produces electrons therefrom. The space charge on the shields or screen members 89 prevents the passage of electrons therethrough. The heating energy is also extended to the shield 89 and gradually heats it to an electron emitting temperature. The emission of these electrons will reduce the thickness of the insulating space charge layer and this type of discharge has been designated as a threshold discharge. The emission will create ionization in the gaseous medium and will result in the electrons breaking through the space charge on the screen member, and the discharge will strike across to the other electrode. Due to the resistance of the heating element 77, the main portion of the current at least will follow the discharge path between the two electrodes.

Due to the fact that the shielding members 89 have a space charge blocking the passage of electrons therethrough when the screening members are cold and not heated to a suitable electron emitting temperature, the discharge will not be prematurely established to deleteriously affect the alkaline earth oxide coating on the members 83.

Although I have shown and described a certain specific embodiment of my invention, I am fully aware that many modifications thereof are possible, especially in the number, shape, arrangement and connections between the various elements. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art.

I claim as my invention:

1. In combination, a first electrode to be heated to emit electrons, a shell completely enclosing said first electrode and having means therein to transmit electrons generated in its interior therethrough, said shell to be heated by the heating energy emitted by said first electrode and being activated for electron emission when heated, a second electrode to be heated to emit electrons, a shell completely enclosing said second electrode and having means therein to transmit electrons generated in its interior therethrough, said last-mentioned shell to be heated by the heating energy emitted by said second electrode and being activated for electron emission when heated, means connecting each of said shells to the emitting electrode that it encloses, a gaseous atmosphere surrounding said electrodes and shells and means for impressing a periodic potential between said electrodes.

2. Apparatus according to claim 1, characterized by the fact that gaseous atmosphere is an atmosphere mercury vapor provided by a globule located near the electrodes.

3. An electric discharge device comprising a casing, a gaseous atmosphere therein, electrodes emitting electrons in response to heating energy, means for applying heating energy to said electrodes, a member disposed adjacent to said emissive electrodes in the path of electrons therefrom and having openings therethrough, said member when cold having a space charge blocking the passage of electrons through said openings, said member receiving heating energy from at least one of said electrons emitting electrodes, said member becoming electron emitting in response to said received heating energy and having a time lag between its cold electron blocking condition and its condition of sufficient electron emission permitting the passage of electrons between said electron emitting electrodes.

4. A lamp having a plurality of similar electrodes therein, means applying heating energy to said electrodes to emit electrons, a member disposed adjacent each of said electrodes in the path of electrons therefrom and having openings therethrough, said members when cold having a space charge blocking the passage of electrons through said openings, said members receiving heating energy from said electrodes, said members becoming electron emitting in response to said received heating energy and having a time lag between their cold electron blocking condition

and their condition of sufficient electron emission permitting the passage of electrons from one of said electron emitting electrodes to another.

5. An electron discharge gaseous lamp comprising at least two similar electrodes for receiving an electron discharge therebetween, a perforated screen surrounding said electrodes and having a space charge when cold preventing the passage of electrons therethrough, means for applying heating energy to said electrodes, said heating energy adapted to remove said space charge on said perforated screen after a time lag.

6. An electron discharge gaseous lamp comprising at least two similar electrodes, a perforated screen between said electrodes preventing, when cold, a discharge between said electrodes, means for applying heating energy to said electrodes, said heating energy heating said perforated screen and permitting said discharge after a time lag.

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