March 8, 1938. C. W. HUNT 2,110,601

ELECTRODE FOR VAPOR DISCHARGE LAMPS

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Fig. 1.

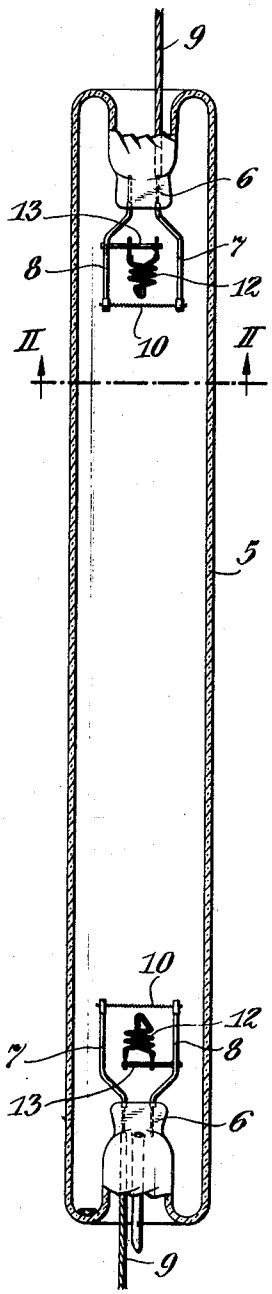
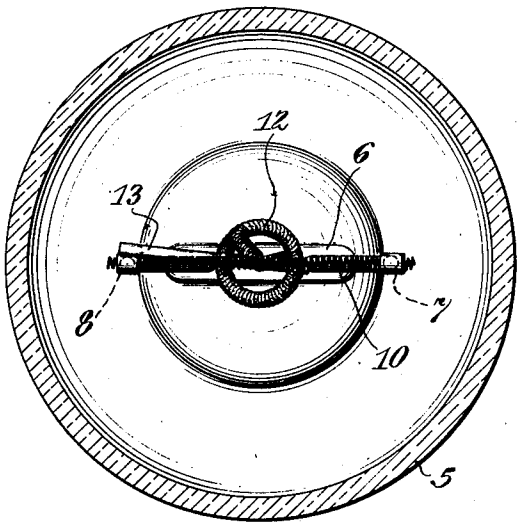


Fig. 2.



INVENTOR
C. W. HUNT.
BY
ATTORNEY

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ELECTRODE FOR VAPOR DISCHARGE LAMPS

Charles W. Hunt, Wyoming, N. J., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

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6 Claims. (Cl. 176—122)

My present invention relates to discharge devices and has particular reference to the electrode construction for lamps utilizing an ionizable medium for supporting a discharge wherein starting of the discharge is facilitated.

In lamps of this type it is customary to employ a vaporizable metal, such as mercury, sodium, cadmium or the like, which becomes vaporized and supports the discharge. However, the vaporizable metal initially may be in a solid state or have a vapor pressure so low as to not support a discharge. Accordingly, it is customary to employ in addition to the vaporizable metal a small quantity of one or more rare gases to facilitate starting of a discharge. During operation of these lamps the vapor pressure may be comparatively high but initially is much lower and rises with the temperature until the vaporizable metal is completely volatilized at which time maximum efficiency of the lamp is obtained.

Despite the filling of rare gas to facilitate starting it is quite difficult to initiate a discharge between the electrodes without utilizing voltages considerably higher than the normal operating voltages. To overcome this disadvantage it has been the practice to employ electrodes made of cores of alkaline earth compounds, such as carbonates, hydroxides, or silicates with or without metal mixtures. Such cores are inserted in sections of highly refractory metal and the oxides activated by heating to a high temperature by the passage of an electrical discharge or in some instances by high frequency induction heating.

Although electrodes constructed in such manner, when energized by the passage of an electrical current cause an initial discharge by reason of the deposit of electron emissive material, which becomes emissive even at low temperature and pressure, together with initial ionization of the rare gases, nevertheless such electrodes are subject to certain inherent disadvantages. Since the electrodes are subjected to high temperature and some bombardment during operation of the tube after volatilization of the vaporizable metal, the oxide surface vaporizes and sputters shortening the life of the tube and also causing a blackening of the envelope.

It is accordingly an object of my present invention to provide an improved form of electrode for a high pressure vapor discharge device.

Another object of my present invention is the provision of an electrode particularly adaptable to high pressure discharge tubes wherein a starting electrode is so connected and positioned relative to the main discharge supporting electrode as to supply a copious flow of electrons for initially ionizing the gaseous medium within the tube and causing a discharge together with a rapid increase in the temperature so that a main discharge results in a comparatively short period of time between the main electrodes.

A further object of my present invention is the provision of an electrode comprising a helical winding having a portion thereof bent upon itself extending axially of the helix and provided with a further helical winding wound transversely to the convolutions of the helix having a coating of high emissive electron material capable of emitting electrons at low temperatures, with the helical electrode positioned rearwardly of the main starting electrode and connected in electrical series relation therewith.

Still further objects of my present invention will become obvious to those skilled in the art by reference to the accompanying drawing wherein:

Fig. 1 is a side elevational view of a discharge device including an electrode constructed in accordance with my present invention, and

Fig. 2 is an enlarged sectional view taken on the line II—II of Fig. 1 looking in the direction indicated by the arrows.

Referring to the drawing in detail I have shown in Fig. 1 a high pressure discharge tube comprising a sealed envelope 5 which is evacuated and sealed with a quantity of rare gas together with a vaporizable metal such as mercury, sodium, cadmium or the like. The envelope 5 is provided at each end with a reentrant stem portion having a press 6. Since the construction of the discharge device is identical at both ends of the envelope, as is likewise the electrode, a detailed description of one should suffice.

In accordance with my present invention a pair of supporting wires 7 and 8 are sealed into the press 6 and connected to one of these supporting wires 7 is a leading-in conductor 9 extending from a suitable source of electrical potential (not shown) for the purpose of energizing the tube during operation. An operating electrode 10 composed of a coil of refractory metal such as tungsten is connected to the extremities of the support wires 7 and 8 so as to be suspended therebetween. In order to facilitate starting of the discharge device without the necessity of applying a relatively high voltage thereto a starting electrode 12 is positioned rearwardly of the operating electrode 10 and is thus disposed on the opposite side of the operating electrode to that from which the arc discharge strikes during operation of the device. The starting electrode

12 comprises substantially a helical winding of a coil of refractory metal such as tungsten having a portion bent upon itself positioned at the axis of the helix. This electrode may be formed of a core of refractory metal and a winding of refractory metal is wound transversely of the core. The ends of the starting electrode are suitably connected to a rod or the like 13, such as by welding, and this rod 13 may in turn be connected to the support wire 8 intermediate its extremity and the press 6. A coating of high electron emissive material is applied to the starting electrode 12 so that a copious flow of electrons emanates from the electrode at comparatively low temperatures.

Accordingly upon the initial application of a suitable voltage and current from the source of supply (not shown) a discharge is initiated between the oppositely disposed starting electrodes 12 owing to the copious flow of electrons as previously stated which ionize the rare gas to initiate the discharge at relatively low temperatures.

Since the metallic vapor may be in a solid state or at a comparatively low vapor pressure an appreciable time elapses before the temperature is sufficiently high to volatilize the vaporizable metal with an attendant increase in the vapor pressure.

However, with my novel construction such time lapse is materially reduced, owing to the fact that the operating electrodes 10 are disposed transversely to the longitudinal axis of the tube and between the starting electrodes. In addition, since the starting electrodes 13 are connected to the support wires 8, which later is merely imbedded in the press 6 and consequently not connected directly to the leading-in conductor 9, the operating electrode 10 and starting electrode 12 are thus in electrical series relationship. In view of this arrangement the operating electrodes 10 are heated not only by the resulting initial discharge between the starting electrodes 12 but in addition are heated by the flow of current through the operating electrodes 10 in passing to the starting electrodes 12 to initiate the discharge. Thus the operating electrodes 10 are heated very rapidly to a high temperature and this, together with the initiation of a discharge, likewise very rapidly raises the temperature of the tube so that the volatilizable metal becomes vaporized with an attendant increase in pressure followed by a sustained arc discharge between the operating electrodes 10.

Upon the operating electrodes 10 assuming the discharge no further discharge occurs between the starting electrodes with the result that they remain relatively cool during continued operation of the device.

Upon a deenergization of the device and a subsequent reenergization thereof the cycle is repeated at which time the electrodes again operate in the manner just described until the temperature and pressure of the device has raised sufficiently for the operating electrodes to take over and sustain the operating discharge.

It can thus be readily seen by those skilled in the art that I have provided an electrode particularly adaptable to discharge devices of the metallic vapor type wherein the operating electrodes are disposed transversely of the longitudinal axis of the device and are interposed between the starting electrodes, the later of which are provided with a coating of high electron emissive material.

Moreover, the operating electrodes are connected in series with the starting electrodes so that the operating electrodes are heated very rapidly not only by the initial discharge between the starting electrodes but also by the flow of current through the operating electrodes. This arrangement not only facilitates the starting of the device, but the assumption of the discharge by the operating electrodes in a very short period of time, results in the starting electrodes remaining substantially cool during operation of the device. Also since the main discharge occurs in such a short period of time and the starting electrodes are employed for such a short period of time, this contributes considerably to the longevity of the starting electrodes.

Although I have shown and described one specific improvement of my present invention, I do not desire to be limited thereto as various other modifications thereof may be made without departing from the spirit and scope of the appended claims.

What is claimed is:

1. An electric discharge device provided with a sealed envelope having an ionizable medium therein, an operating electrode disposed at each end of said envelope and extending transversely of the latter, and a helically wound starting electrode disposed rearwardly of each of said operating electrodes and axially directed toward each other with their axes perpendicular to that of said operating electrodes, and said starting electrodes being coated with a high electron emissive material for supplying a copious flow of electrons to initiate a discharge upon energization of said device.

2. An electric discharge device provided with a sealed envelope having an ionizable medium therein, an operating electrode disposed at each end of said envelope and extending in a direction transverse to the longitudinal axis of said envelope, and a helically wound starting electrode at each end of said envelope in back of said operating electrode having a coating of high electron emissive material, said starting electrodes being axially directed toward each other and operable to initiate a discharge upon energization of said device.

3. An electric discharge device provided with a sealed envelope having an ionizable medium therein, an operating electrode disposed at each end of said envelope and extending transversely to the longitudinal axis of said envelope, and a helically wound starting electrode having a coating of high electron emissive material disposed at each end of said envelope in back of said operating electrode with its axis perpendicular to that of said operating electrode, and said starting electrodes being connected in electrical series with their adjacent operating electrodes for the purpose of heating said operating electrodes by the resulting discharge between said starting electrodes with the axis of the discharge being perpendicular to that of said operating electrodes and also for heating said starting electrodes by the flow of current through said operating electrodes to cause a rapid rise in temperature upon energization of said device.

4. An electric discharge device provided with a sealed envelope having an ionizable medium therein, an operating electrode disposed at each end of said envelope and extending in a direction transverse to the longitudinal axis of said envelope, and a helical wound starting electrode at each end of said envelope in back of said operating electrode having a coating of high electron

emissive material, and said starting electrodes being axially directed toward each other and connected in electrical series relationship with their adjacent operating electrode in order that said operating electrodes are rapidly heated by the resulting initial discharge between the starting electrodes and also by the flow of electrical current therethrough upon energization of said device.

5. An electric discharge device provided with a sealed envelope having a reentrant press, a pair of support wires sealed into said press and connected to a leading-in conductor for supplying electrical energy to said device, an operating electrode supported by said support wires within said envelope with the axis thereof disposed transverse to the longitudinal axis of said envelope, and a starting electrode disposed adjacent said operating electrode with its axis perpendicular to the latter and connected to one of said support wires for supporting said starting electrode and connecting the same in electrical series relationship with said operating electrode.

6. An electric discharge device provided with a sealed envelope having a reentrant press, a pair of support wires sealed into said press, a leading-in conductor connected to one of said support wires for supplying electrical energy to said device, an operating electrode within said envelope and suspended between said support wires at the extremities thereof, and a helically wound starting electrode supported by said support wire other than the one to which the said leading-in conductor is connected and intermediate said press and the extremity thereof.

CHARLES W. HUNT.