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FLUORESCENT LAMP WITH NOBLE METAL AMALGAMATED ELECTRODE

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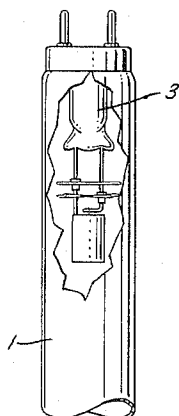
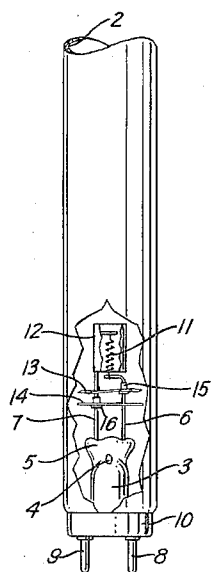


FIG. 1

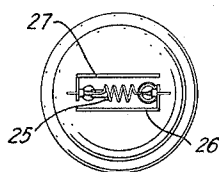


FIG. 5

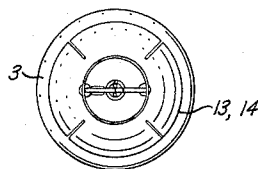


FIG. 3

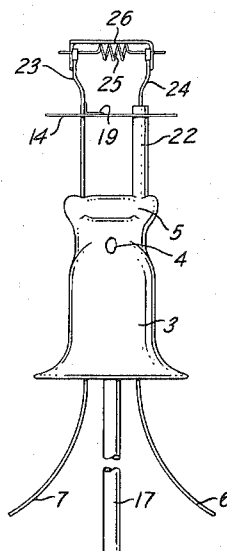


FIG. 4

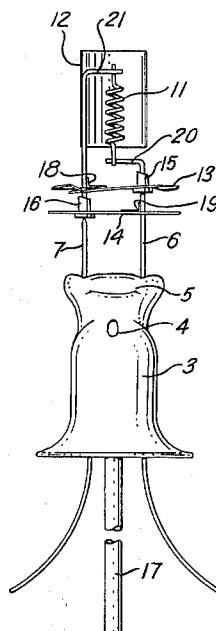


FIG. 2

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**FLUORESCENT LAMP WITH NOBLE METAL
AMALGAMATED ELECTRODE**

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This invention relates to an improved electrode structure for alternating current electron discharge devices such as fluorescent lamps and mercury rectifier tubes.

Fluorescent lamps, for example, comprise emissively coated cathodes spaced apart in a phosphor lined envelope containing mercury. An alternating thermionic electron discharge between the electrodes causes the mercury to vaporize and emit ultraviolet radiation which excites the phosphor to fluorescent. The cathodes are mounted on a conductive structure including lead wires and auxiliary electrodes. In very high output (VHO) lamps it is also advantageous to include on the conductive structure heat shields which provide at the ends of the lamp cool chambers which increase the efficiency of the lamp.

On one half cycle of the applied alternating current the electrode structure will go positive and act as an anode. On the alternate half cycle it will go negative, and, although the conductive anodic structure is far less emissive than its associated cathode, it will tend to emit electrons. Such emission is undesirable not only because it causes sputtering and rapid deterioration of the anodic structure, but also because when a lamp is started emission can establish a glow current between the spaced structures which robs the cathode of current which would heat the cathode to normal emissivity. Consequently establishment of arc current between cathodes is delayed, and in VHO lamps glow current from the heat shields may even prevent the main arc current from starting.

It has been suggested that the metal surface of the anodic structure be purified so that it will not emit electrons readily. Such surfaces do not long remain purified and tend to outgas under ion bombardment during starting. Purification also alters the crystal structure of the metal; in the case of nickel it becomes soft and difficult to handle.

The object of the present invention is to provide an anodic structure with substantially reduced electron emission characteristic, which characteristic endures and is renewed by operation of the electron discharge device.

According to the invention an alternating electron discharge device comprises an envelope containing mercury, spaced electrodes adapted to provide an electric discharge between said electrodes after a heating period, at least one conducting anodic structure electrically connected to one of said electrodes, and a coating of mercury-amalgamative, noble metal covering the major surface portion of the anodic structure so as substantially to inhibit electron emission from said surface portion.

Other objects, features and advantages of the invention will be apparent from the following specification, taken in connection with the accompanying drawing, in which:

FIG. 1 is a view of a lamp according to one embodiment of the invention;

FIG. 2 is a view showing the mount structure of said embodiment in greater detail;

FIG. 3 is a top view of the mount structure of FIG. 3;

FIG. 4 is a view of another mount structure; and

FIG. 5 is a top view of the mount structure of FIG. 4.

In the lamp of FIG. 1, a glass tube 1 has a coating of phosphor on its inside surface, and is hermetically sealed at each end to a stem 3. The latter has an opening 4 leading to the usual exhaust tube (not shown in FIG. 1)

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through which the lamp is exhausted during manufacture, but which is sealed in the completed lamp.

The lead-in wires 6, 7, sealed through the press 5 of stem 2, extend outside the lamp to make contact with the contact pins 8, 9 extending from the base 10, which is cemented to the end of tube 1. The base 10 can be of the usual metal type, with an insulated portion (not shown) carrying the pins 8, 9.

Inside the tube the lead-in wires support the filamentary electrode 11, which can be a coiled tungsten wire, preferably of the coiled-coil or triple coil well-known in the art, and carrying a quantity of electron-emitting substances such as the usual alkaline earth oxides, preferably with the addition of a small quantity of zirconium dioxide.

In FIGS. 1 and 2, the filamentary coil 11 is preferably placed with its axis substantially along the axis of the tube 1, and is held by the lead-in wires 6, 7, each being bent toward the axis in order to hold the filament in preferable position. The axial position reduces the amount of heat radiation from the filament toward the end of the lamp.

The heavy current of the very-high-output lamp may cause some disintegration of the filamentary coil or of its coating, and so the cylindrical metal shield 12 is placed around the coil, but spaced therefrom, and connected to lead-in wire 7. The shield 12 reduces the current to the coil during the half-cycle when the filament coil 12 is the anode, and also collects any particles disintegrated from the cathode.

The reflecting shields 13, 14 can be of aluminum, for example, and are supported from the lead-in wires 6, 7. Each shield should be insulated from at least one of the lead-in wires, to prevent short-circuiting them. The shield 13, for example, can be metallically connected to lead-in wire 7 by being welded thereto, and can be insulated from lead-in wire 6 by the insulating ceramic bushing 15. Similarly, shield 14 can be insulated from lead-in wire 6 by the insulating ceramic bushing 16 and metallically connected to lead-in wire 7. Both shields may be electrically connected to the same lead-in wire if desired, and both insulated from the other lead-in wire, although it is preferred to have them oppositely connected as described. Nickel and other reflecting metals can also be used for the shields.

The shield construction is shown in greater detail in FIG. 2, which also shows the exhaust tube 17 extending from the exhaust opening 4. The L-shaped tabs 18, 19 are welded to the lead-in wires 6, 7 respectively, tab 19 being also welded to shield 14 and tab 18 being welded to shield 15, to support them. The leads 6, 7, shields 12, 13 and 14, and tabs 18 and 19 comprise an anodic structure, that is, a structure electrically connected to the electrode 11 and able to collect electron current on the anode half-cycle of operation.

According to the invention a major part of the above described anodic structure is coated with a thin plate of a noble metal, preferably gold. The noble metals are considered to comprise the gold family, which includes silver, and the platinum family, which includes palladium. These metals are wetted by the mercury in the lamp and form an amalgam with the mercury which is available in excess. For example, a 200 watt VHO lamp contains about 50 milligrams of mercury, approximately twice as much as is needed for ionization.

The mercury amalgam need not be formed prior to installation of the lamp. But preferably, upon completion of its manufacture, the lamp is started several times under test conditions. The mercury is thereby vaporized and condenses on the anodic structure as the lamp cools. The amalgamated surface of the plated anodic

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structure is then in a negligibly electron emissive state for the next starting.

Although some of the mercury will vaporize from the anodic structure during operation, it will recondense on the plating when lamp operation is stopped. Thus the amalgam is repeatedly renewed during the life of the lamp, and the inhibiting of electron emission does not decrease.

In the lamp of FIGS. 1 to 3 the shields 12, 13 and 14 have a large surface area and are preferably entirely coated with gold or another noble metal. It is also advantageous to coat the remaining anodic structure including the leads 6 and 7.

In FIGS. 4 and 5, a different mount structure is shown. The stem 3, press 5, exhaust tube 17, and lead-in wires 6 and 7 are the same as in FIGS. 2 and 3. Only a single reflecting shield 14 is used, however, and while connected to lead-in wire 7 by a tab 19 as before, is insulated from lead-in wire 6 by a glass tube 22.

The lead-in wires 6, 7 are bent outwardly at 23, 24 and their ends are clamped over the ends of a filamentary electrode 25, which can be of the type now in commercial use in 100-watt, 4 foot, 1½ inch diameter fluorescent lamps. One of a pair of auxiliary electrodes 26, 27, each comprising a wire which for most of its length is parallel to and slightly above the filamentary electrode 25, is welded to each of the lead-in wires 6, 7 to collect some of the current when the electrode acts as anode, during alternate half-cycles of the alternating current generally used through the discharge. The auxiliary electrodes 26, 27 are thus part of the anodic structure. Preferably the entire surface of the shield 19 is plated with gold or other noble metal, and amalgamated with the mercury fill of the lamp.

While both illustrated forms of the invention embody shields, these shields may be omitted in some fluorescent lamps, and the major portion of the remaining anodic structure may be coated with mercury-amalgamative, noble metal to take advantage of the invention.

In any of the described forms coated anodic structures will increase the speed of starting and the life of the lamp, while reducing cathode contamination and deterioration of the associated anodic structure.

It should be understood that this disclosure is for the purpose of illustration only and that the present invention includes all modifications and equivalents falling within the scope of the appended claims.

I claim:

1. An alternating current electron discharge device comprising an envelope containing mercury, spaced electrodes adapted to provide an electric discharge between said electrodes after a heating period, at least on conducting anodic structure electrically connected to one of said electrodes, and a coating of mercury-amalgamative, noble metal covering the major surface portion of the anodic

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structure so as substantially to inhibit electron emission from said surface portion.

2. A device according to claim 1 wherein said coating comprises a superficial amalgam of said metal and mercury.

3. A device according to claim 1 wherein said coating is a thin plate of gold.

4. A device according to claim 1 wherein said coating is a thin plate of silver.

5. A fluorescent lamp comprising an elongate, tubular glass envelope having an internal phosphor coating and containing mercury, electron emissively coated electrodes at each end of said envelope, said electrodes being adapted after a period of heating to emissive state to provide an alternating electron discharge and a mercury ion counterflow which excites said phosphor to fluorescence, and a conducting anodic structure supporting and electrically connected to each coated electrode, the major surface portion of each said anodic structure being covered with a coating of noble metal.

6. A fluorescent lamp comprising an elongate, tubular glass envelope having an internal phosphor coating and containing mercury electron emissively coated electrodes at each end of said envelope, said electrodes being adapted after a period of heating to emissive state to provide an alternating electron discharge and a mercury ion counter flow which excites said phosphor to fluorescence, and a conducting anodic structure supporting and electrically connected to each coated electrode, the major surface portion of said anodic structure being covered with a coating of noble metal at least partly superficially amalgamated with mercury.

7. A fluorescent lamp comprising an elongate, tubular glass envelope having an internal phosphor coating and containing mercury, electron emissively coated electrodes at each end of said envelope, said electrodes being adapted after a period of heating to emissive state to provide an alternating electron discharge and a mercury ion counterflow which excites said phosphor to fluorescence, and a conducting anodic structure supporting and electrically connected to each coated electrode, said structure including a shield having a large surface area substantially entirely covered with a coating of noble metal at least partly superficially amalgamated with mercury.

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