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Willems

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[54] **DISCHARGE TUBE CONTAINING MERCURY**

[75] Inventor: **Henricus Gerardus Antonius Willems,** Terneuzen, Netherlands

[73] Assignee: **U.S. Philips Corporation,** New York, N.Y.

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[58] **Field of Search** 313/218

[56] **References Cited**

UNITED STATES PATENTS

2,065,947 12/1936 Nauth 313/218

Primary Examiner—R. V. Rolinec

Assistant Examiner—Darwin R. Hostetter

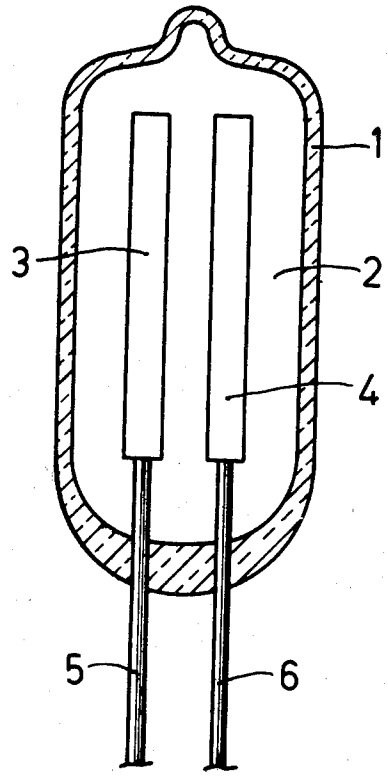
Attorney, Agent, or Firm—Frank R. Trifari; Robert S. Smith

[57] **ABSTRACT**

The invention relates to a discharge tube in which mercury is present in the discharge space and in which the lead-through conductor to an electrode of this lamp consists of copper-clad wire.

According to the invention, the copper-clad wire is electrically oxidised. As a result, a lamp is produced whose lead-through conductor is substantially not attacked by mercury.

3 Claims, 2 Drawing Figures



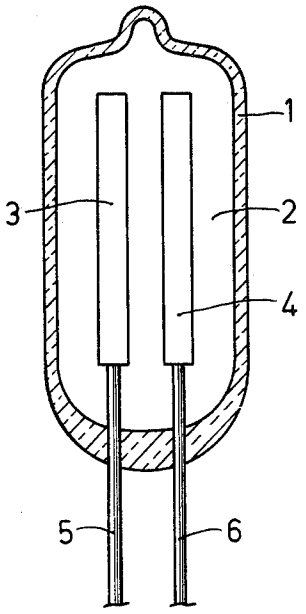


Fig.1

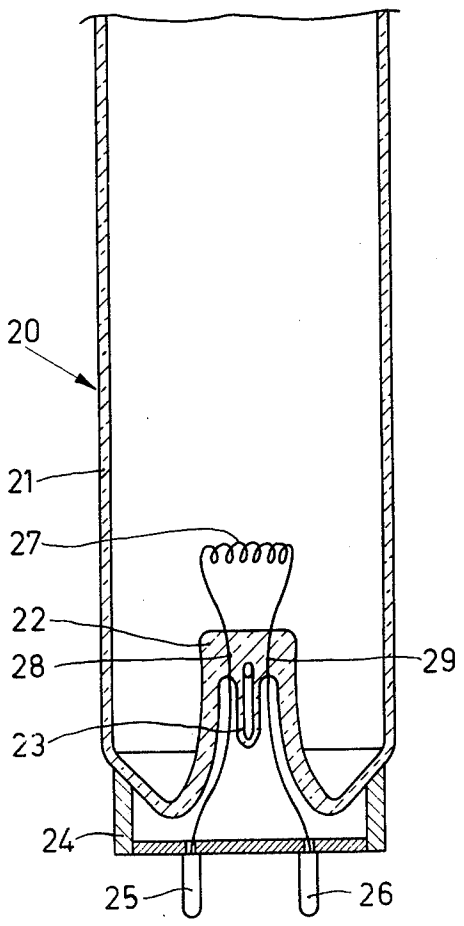


Fig.2

DISCHARGE TUBE CONTAINING MERCURY

The invention relates to a discharge tube having a wall of glass, which tube contains at least mercury and is furthermore provided with an internal electrode which is connected to an electrical lead-through conductor mainly consisting of copper-clad wire, the part of said electrical lead-through conductor located between the electrode and the glass wall being provided with an oxide coating, which coating is in direct contact with the discharge space of the discharge tube.

Glow discharge tubes of the above-mentioned kind have been manufactured. In these tubes the oxide coating consisted of chromium oxide. This coating served to prevent attack of the copper-clad wire by the mercury present in the discharge tube. A drawback of the aforementioned glow discharge tube was its time-consuming manufacture due to the extra provision of chromium oxide.

In a further known discharge lamp, namely a low-pressure mercury vapour arc discharge lamp, an electrical lead-through consisting of two different wire pieces has been used in which the connexion, for example, a welded connexion, of these two wire pieces was located in the wall of the discharge tube and in which the wire piece remote from the discharge space was copper-clad wire and the other piece consisted, for example, of nickel or another mercury-resistant material. A drawback thereof was that the manufacture of the electrical lead-through conductor was complicated and this because use had to be made of these two wire pieces of different material and because furthermore a welded joint had to be provided between these wire pieces.

It is an object of the invention to manufacture in a simple manner a discharge tube of the kind described in the preamble, and to make this tube in such a manner that mercury substantially does not attack the lead-through conductor in the completed tube.

According to the invention, a discharge tube having a wall of glass, which tube contains at least mercury and is furthermore provided with an internal electrode which is connected to an electrical lead-through conductor consisting mainly of copper-clad wire, and in which at least the part of said electrical lead-through conductor located between the electrode and the glass wall is provided with an oxide coating, which coating is in direct contact with the discharge space of the discharge tube is characterized in that the said part of the lead-through conductor consists of a copper-clad wire which is surrounded by a Cu_2O coating, the lead-through conductor being manufactured in known manner from a copper-clad wire of which part of the copper is oxidised during heating by electrical process.

An advantage of a discharge tube according to the invention is that no oxide coating of a metal other than copper such as, for example, a chromium oxide coating, need be provided on the copper-clad wire. In fact, when electrically oxidising copper-clad wire in known manner, a satisfactory oxide skin is produced such that it is also resistant to mercury present in the discharge tube.

The device consists in principle of a supply reel containing metal wire to be treated. The metal wire is guided into a cylindrical tube over a contact roller. This tube may be, for example, a glass tube which is provided with a rubber stopper having an aperture through which the wire can be guided into the tube with an ample amount of play, a side tube for introducing gas, and a constriction. The wire is then guided into a reservoir containing water round a contact roller and is then reeled on the supply reel.

Copper core wire may be provided with a Cu_2O layer by means of said device: copper core wire built up from a core, diameter 400 microns, consisting of a nickel-iron alloy having nickel content of 42 percent by weight and a copper sheeth, thickness 50 microns, is guided through the tube at a rate of 100 metres per minute. A gas mixture consisting of nitrogen with 4 percent by volume of oxygen is introduced into the tube through a side tube at a rate of approximately 3 litres per minute. The wire is heated by the direct passage of current at a temperature of 950°C. For that purpose, a voltage difference of approximately 40 V is set up between the contact rollers. The wire is loaded with 1.5 kW. The contact roller with which the wire is last in contact during the passage, is arranged in running water so that a very rapid cooling from the oxidation temperature is obtained.

In this manner an even Cu_2O layer is formed, thickness approximately 1 micron. This layer is red-coloured and CuO can not be demonstrated in it.

A further advantage of a tube according to the invention is that a welded joint is absent in the lead-through conductor at the area of the wall of the discharge tube.

The discharge tube may be, for example, a low pressure mercury vapour discharge lamp in which the discharge is an arc discharge.

In a preferred embodiment of a discharge tube according to the invention, the tube is a glow discharge lamp.

An advantage of this preferred solution is that also in these generally very small lamps extra materials such as chromium oxide or extra welded joints in the wall are not required.

In a further preferred embodiment of a tube according to the invention, the connexion between the electrode and the lead-through conductor is a welded joint established electrically.

An advantage of this preferred embodiment is that also the welded joint is satisfactorily mercury-resistant. This would be the case to a much lesser extent when a welded joint had been made in which the heat treatment would have been effected through gas flames, namely because the oxide skin of the copper-clad wire would have been attacked to a stronger extent.

The invention will further be described with reference to a drawing.

FIG. 1 shows a glow discharge lamp according to the invention;

FIG. 2 shows an end part of a low-pressure mercury vapour discharge lamp according to the invention, which lamp has an arc discharge in the operating condition.

In FIG. 1, 1 is a glass envelope of a discharge space 2. This space accommodates two electrodes 3 and 4. These electrodes are made of a mercury-resistant electrode material, for example, molybdenum. The electrodes 3 and 4 are cylindrical. 5 and 6 denote two supply wires of copper-clad wire having a core of an iron alloy. These supply wires are electrically oxidised. They pass through the glass wall 1. The supply wire 5 is connected to electrode 3 and supply wire 6 is connected to electrode 4. The connexions between the supply wires and the electrodes are obtained by means of an electri-

cal welding process. The discharge space contains a rare gas, for example, neon or a combination of neon and argon, to which mercury has been added. A luminescent coating, for example, of willemite was present on the inner wall of the glass envelope (1).

Experiments have proved that these lamps did not exhibit any attack of the copper-clad wire by the mercury, even after storage for one year. In a gas-oxidised copper-clad wire an attack of the copper-clad wire was already found after two weeks.

In FIG. 2, 20 denotes an end part of a low-pressure mercury vapour arc discharge lamp which is provided with a glass wall 21. A coating of a luminescent material was present on the inner side of the wall 21. 22 denotes a pinch and 23 is a closed exhaust tube. 24 denotes a metal ring having connections pins 25 and 26 arranged insulated therefrom. One end of an electrode 27 is connected through an electrically oxidised copper-clad wire 28 to the connexion pin 25. The other end of the electrode 27 is connected through an electrically oxidised copper-clad wire 29 to the connexion pin 26. These copper-clad wires 28 and 29 pass through the glass wall of the discharge tube at the area of the pinch 22. Thus, 28 and 29 are the electrical lead-through conductors.

Likewise as in the lamp of FIG. 1, the copper-clad wires in the case of the lamp part of FIG. 2 are also resistant to mercury present in the discharge tube.

Also in the case of the lamp part shown in FIG. 2, the connexions between the copper-clad wires 28 and 29 and the electrode 27 are obtained by an electrical welding process.

What is claimed is:

1. A discharge tube having a wall of glass, which tube contains at least mercury and is furthermore provided with an internal electrode which is connected to an electrical lead-through conductor consisting mainly of copper-clad wire, and in which at least the part of said electrical lead-through conductor located between the electrode and the glass wall is provided with an oxide coating, said coating being in direct contact with the discharge space of the discharge tube, wherein said part of the lead-through conductor consists of a copper-clad wire which is surrounded by a Cu_2O coating, the lead-through conductor being manufactured in known manner from a copper-clad wire of which part of the copper has been oxidised during heating by an electrical process.

2. A discharge tube as claimed in claim 1, wherein the tube is a glow discharge lamp.

3. A discharge tube as claimed in claim 2, characterized in that the connection between the electrode and the lead-through conductor is a welded joint established by electrical process.

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