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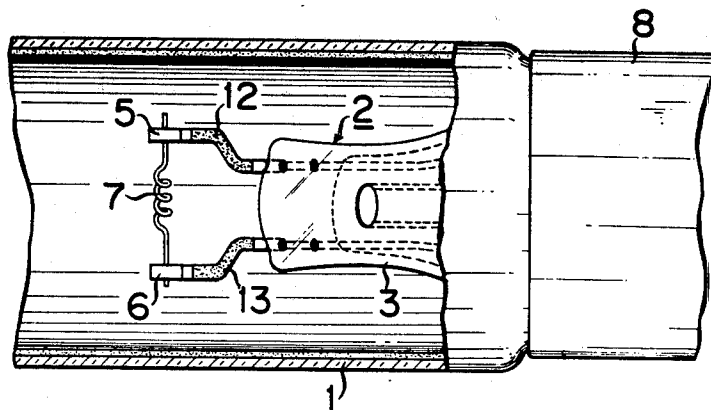
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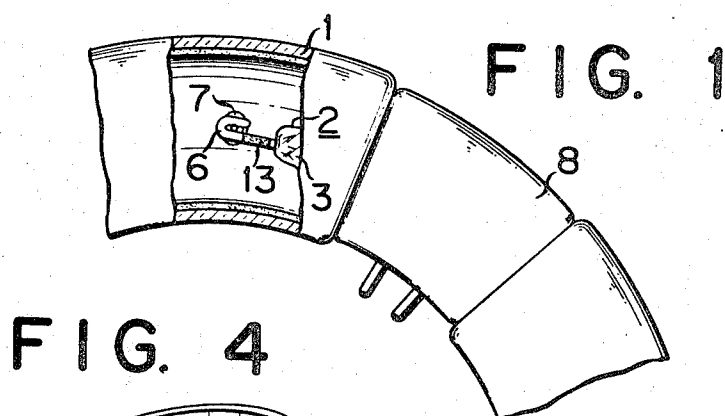
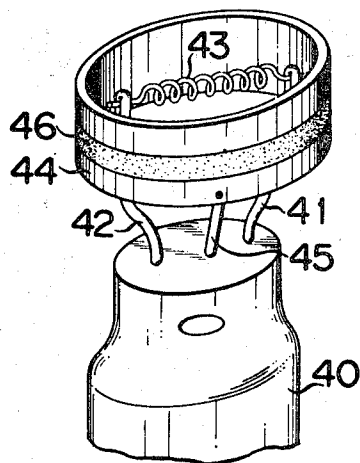
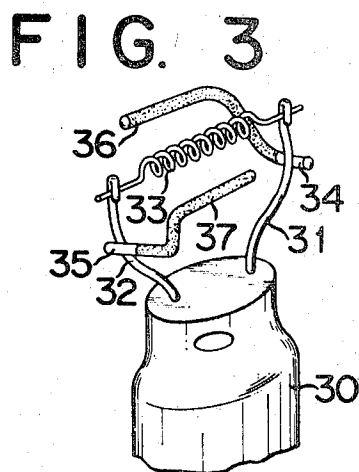
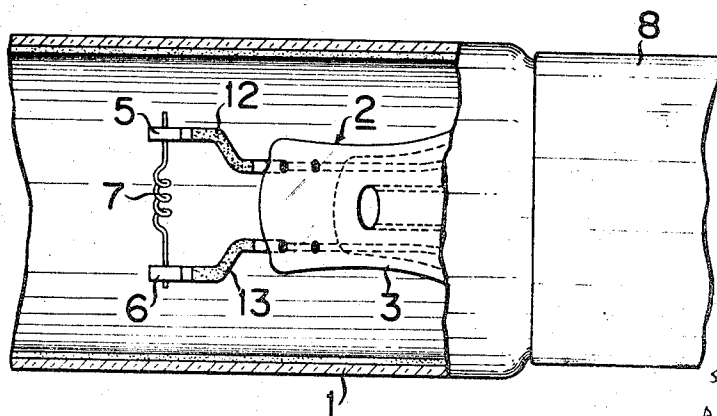
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[54] **LOW PRESSURE MERCURY VAPOUR
DISCHARGE LAMP INCLUDING AN ALLOY TYPE
GETTER COATING**
8 Claims, 4 Drawing Figs.

[52] U.S. Cl..... 313/178,
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ABSTRACT: A low pressure mercury vapor discharge lamp with reduced generation of end bands and with no increase in the occurrence of anode spots, including a getter comprising an alloy of at least one selected from a first group consisting of nickel, cobalt, iron, aluminum and copper and at least one selected from a second group consisting of titanium, zirconium, hafnium, thorium, vanadium, niobium, tantalum, scandium, cerium and tungsten, said alloy excluding a titanium-nickel alloy.





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LOW PRESSURE MERCURY VAPOUR DISCHARGE LAMP INCLUDING AN ALLOY TYPE GETTER COATING

This invention relates to low-pressure discharge lamps and more particularly to a low-pressure mercury vapor discharge lamp having getters which reduce the formation of an end band and which prevent the formation of an anode spot from being increased.

Among low-pressure mercury vapor discharge lamps are an ordinary fluorescent lamp for illumination, black light lamps, sterilization lamps, erythral fluorescent lamps and the like, which are discharge lamps operative under low-pressure mercury vapor.

In the low-pressure mercury vapor discharge lamp of this nature, blackenings are caused at the ends of the sealed envelope. Such phenomena are classified into an end band and an anode spot. The former is caused when a mercury oxide formed by the reaction of mercury with the oxygen ejected from an electron-emitting substance during lighting of the lamp is deposited on that part of the inner surface of the sealed envelope which faces a Faraday's dark space having a small potential gradient, while the latter phenomenon is caused by the spattering of the electron-emitting substance on that part of the inner surface of sealed envelope which faces the electrodes.

This blackening damages the appearance of a low-pressure mercury vapor discharge lamp and reduces an available amount of light. The inventors have previously proposed the use of an alloy which acts as a getter and which includes major components of titanium and nickel with a view to eliminating the above drawbacks and to reduce the generation of the end band without accelerating the generation of the anode spot. It has been found through experiments that various alloys can be employed as getters for use in a vapour mercury vapor discharge lamp in addition to a titanium-nickel alloy.

An object of this invention is to provide a low-pressure mercury vapor discharge lamp including getters formed of an alloy other than a titanium-nickel alloy and which adsorb the oxygen generated from an electron-emissive material during lighting of the lamp, to reduce the formation of an end band and yet to avoid an increase in the formation of an anode spot.

This invention thus provides a low-pressure mercury vapor discharge lamp comprising a light-transmissive sealed envelope, a quantity of mercury and starting rare gas sealed in said envelope, and a pair of electrode mounts sealed to both ends of said envelope, said electrode mounts each supporting a filament coated with activated electron-emitting materials, by comprising a getter including an alloy which is formed of at least one selected from a first group consisting of nickel, cobalt, iron, aluminum and copper and at least one selected from a second group consisting of titanium, zirconium, hafnium, thorium, vanadium, niobium, tantalum, scandium, cerium and tungsten, said alloy excluding a titanium-nickel alloy, said getter being disposed on said mounts except those portions thereof which are coated with the activated electron-emitting materials and those portions thereof which are maintained at operation temperatures lower than 300° C. and higher than the melting point of said alloy.

According to the feature of the invention, getters are formed of an alloy including main components of at least one metal selected from a first group consisting of nickel, cobalt, iron, aluminum and copper, and at least one metal selected from a second group consisting of titanium, zirconium, hafnium, thorium, vanadium, niobium, tantalum, scandium, cerium and tungsten, said alloy excluding a titanium-nickel alloy, and such getters are disposed on portions of electrode mounts or in the vicinity thereof other than those coated with an electron-emissive substance, and which are held at temperatures higher than 300° C. and lower than the melting point of the alloy.

The metals falling under said first group have a good electrical conductivity, and those belonging to said second group have a strong activity and a getter action. A low-pressure mercury vapor discharge lamp having getters formed of an alloy of metals in these two groups eliminates or reduces the formation

of an end band and keeps the formation of an anode spot to an extent not exceeding that in a prior art low-pressure discharge lamp using no getters.

The invention can be more fully understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a schematic plan, partly in section, of a circular fluorescent lamp embodying the low-pressure mercury vapor discharge lamp of this invention;

FIG. 2 is a side elevation, partly in section, of a part of the lamp shown in FIG. 1 to illustrate an electrode mount;

FIG. 3 is a perspective view of a modification of the electrode mount; and

FIG. 4 is a perspective view of a further modification of the electrode mount.

The low-pressure mercury vapor discharge lamp shown in FIGS. 1 and 2 is illustrated as a circular fluorescent lamp having a rated wattage of 30 w. The fluorescent lamp comprises a cylindrical glass envelope 1 having an inner wall surface deposited with fluorescent materials, and a pair of electrode mounts 2 (one of them is shown in the FIGS.) sealed to both ends of said envelope 1, each said electrode mount including a flared glass stem 3 hermetically sealed to said envelope 1, and a pair of lead-in wires 5 and 6 which penetrate through said stem 3 so that their inner ends define inner-lead wires. The inner-lead wires mechanically clamp a filament 7 which is coated with an activated electron-emitting material such as BaO-SrO-CaO containing MgZrO₃. A base shell 8 having two pairs of base pins (Only one of each pair is shown in FIG. 1.) is fitted to the outer portion of the stem 3, and the lead-in wires 5 and 6 are respectively connected to one pair of the pins. Getters 12 and 13 are disposed on the surfaces of the inner-lead wires at predetermined portions thereof. The getter consists of an alloy, as preferred examples thereof are hereinbelow mentioned, comprising at least one metal selected from a first group consisting of nickel, cobalt, iron, aluminum and copper, and at least one metal selected from a second group consisting of titanium, zirconium, hafnium, thorium, vanadium, niobium, tantalum, scandium, cerium and tungsten. (a titanium-nickel alloy being excluded.) Deposition of the alloy may be carried out by first pulverizing the alloy, and then allowing the alloy powder obtained to be suspended in a binder solution consisting of nitrocellulose and butyl acetate. The suspension is deposited on the surface of the inner-lead wires 5 and 6 along predetermined lengths thereof.

FIG. 3 shows a modification of the electrode mount employed in the discharge lamp of this invention. The mount illustrated comprises a flared glass stem 30, a pair of lead-in wires 31 and 32 penetrating through the stem 30 and connected to base pins mounted on a base shell (not shown), a filament 33 bridged between the lead-in wires 31 and 32 with its ends clamped at the inner ends of the lead-in wires 31 and 32, and wire anodes 34 and 35 attached to the lead-in wires 31 and 32. On the wire anodes 34 and 35 are coated with getters 36 and 37.

FIG. 4 shows a further modification of the electrode mount, in which are provided a flared stem 40, a pair of lead-in wires 41 and 42 and a filament 43. In this modification, a shield electrode 44 is disposed such that it surrounds the filament 43. The shield electrode 44 is planted in the stem 40 by a support wire 45, and has a getter 46 coated on the surface thereof.

Places upon which the getter is formed are not limited to those shown in the foregoing examples. The getter may be formed on the surface of the flared stem 3, 30 or 40.

The getter in accordance with this invention is formed of an alloy of at least one metal selected from a first group consisting of nickel, cobalt, iron, aluminum and copper, and at least one metal selected from a second group consisting of titanium, zirconium, hafnium, thorium, vanadium, niobium, tantalum, scandium, cerium and tungsten, said alloy excluding a titanium-nickel alloy. The metals belonging to the first group are good electrical conductors, while the metals falling in the second group have a strong activity and hence a getter action.

An alloy consisting of metals in the both groups eliminates or reduces the formation of an end band in a low-pressure mercury vapor discharge lamp and does not tend to increase an anode spot.

In contrast, when at least one metal selected only from the second group is employed as a getter, such will not only be ineffective to the reduction of the end band but also accelerate the production of the anode spot. This is believed due to the following reasons.

The metals belonging to the second group have a gas adsorption property. But, when these metals only are used as getters in a low-pressure mercury vapor discharge lamp, the getter thus formed adsorbs both gases ejected from fluorescent materials and the envelope during the fabricating process of the lamp and, in particular, during the evacuation process thereof, and gases produced at the time of decomposition of electron-emissive materials, and no longer has an adsorption power as it is saturated by the time the manufacturing process of the lamp is complete. Further, the metal forming the getter spatters when fired and is deposited on the fluorescent materials, thus giving rise to the formation of the anode spot. Even if the metal is prevented in adsorptivity from being saturated, free barium in the electron-emissive material will become excessive since the metal is strongly deoxidizing, whereby the formation of the anode spot is accelerated.

In case, as in the present invention, there is employed an alloy of at least one metal of strong activity, selected from the first group and at least one metal selected from the second group, since the latter group metals are good electrical conductivity, generation of end bands is decreased while that of anode spots is prevented from increasing, for the reasons set forth below.

The getter action of the second group metal, namely, an oxygen adsorbing action in this case, is suitably controlled by the interposition of a metallic powder of the first group metal, so that no saturation of the getter takes place during the evacuation process of the lamp. Further, the adsorbed oxygen is gradually diffused into the interior of the deposited getter due to the metallic powder of the first group metal, with the result that the adsorption power at the surface layer portion of the getter is recovered thereby causing the getter to always exhibit its oxygen adsorption power. This is believed to be effective for preventing the formation of the end band. It is also believed that, since the metallic powder of the second group metal is surrounded by the first group metal having a high electrical conductivity, a temperature rise in an anode cycle can be suppressed whereby an excess temperature rise of the cathode spot in cathode cycle is avoided to give no adverse effect on the anode spot.

An alloy formed of at least one metal selected from the first group and at least one metal selected from the second group forms no amalgam when it reacts with the mercury contained in the sealed envelope, and is resistive against electron or ion bombardment.

The alloy formed in accordance with this invention must be disposed on such places that are on or in the vicinity of the electrode mounts excepting portions coated with electron-emissive material, and that are kept during operation at temperatures higher than 300° C. and lower than the melting point of the alloy. If the alloy is disposed or applied on a portion coated with the electron-emissive material, electron emissivity will be hindered. Similarly, when the alloy is deposited on a place whose operation temperature is lower than 300° C. the alloy has a small gas adsorption power and does not adsorb a required amount of the oxygen emitted during lighting, so that no expected result is obtained. On the other hand, depositing the alloy on a portion above the melting point of the alloy will cause the alloy to eject gases and then to vapor to be deposited on the fluorescent layer, thus accelerating the formation of an anode spot. In order to eliminate these defects, portions to be coated with the alloy should preferably be those maintained at a temperature lower than the melting point of the alloy by more than about 100° C. Selection of places whose tempera-

ture in the operation of the lamp is within the range of 400° C. and 800° C. generally achieves good results for this purpose. The alloy may be deposited on the inner-lead wires of electrode mounts, the leg portions of an electrode coil, or where an anode or a shield is employed, on the surface thereof, or on other members provided separately from electrode mounts.

The table below shows examples of the alloy, in which the term "end band index" represents the degree of formation of an end band by way of 10-point method. Index 10 thus represents the complete absence of the end band; index 7 represents that the formation of the end band is clearly observed; and index 5 or smaller represents that the lamp in operation is considerably detracted in visual appeal due to the prominent formation of the end band. All the samples in the table are circular fluorescent lamps having a rated wattage of 30 w.

Example No.:	Alloy composition, weight percent	Melting temperature, ° C.	Lighting period, hours	End band index
1	Al 11, Zr 89	1,350	6,000	10
2	Co 38, Ti 62	1,070	6,000	9-8
3	Cu 60, Ti 40	975	3,000	10
4	Ni 50, Ta 50	1,545	6,000	8
5	Ni 65, W 35	1,505	6,000	8
6	Zr 76, Ni 24	1,200	3,000	10
7	Th 66, Ni 34	1,150	6,000	9-8
8	Zr 32, Cu 68	1,115	3,000	10
9	Ce 56, Fe 44	1,180	3,000	10

For the purpose of comparison, a lamp deposited with a Ti powder was produced. It showed an end band index of 10 after a lighting period of 100 hours, but a considerable amount of anode spot was formed.

Similarly, a lamp fabricated without the deposition of the getter alloy exhibited an end band index of 8 to 7 after a lighting period of 2,000 hours, and an end band index of 5 to 4 after a lighting period of 6,000 hours.

As will be appreciated from the comparisons given above, a low-pressure mercury vapor discharge lamp including getters formed of an alloy as specified herein has improved characteristic regarding the formation of an end band, and yet has a similar property to that of a conventional discharge lamp with no getter disposed, regarding the formation of an anode spot.

It was observed that discharge lamps in examples 3, 6, 8 and 9 produced anode spots to a similar extent to that in a prior art low-pressure mercury discharge lamp.

Alloys used in the foregoing examples are those formed of one metal selected from the first group and one metal selected from the second group. But more than one metal selected from either one of the groups or from the both groups may be alloyed to form getters.

We claim:

1. A low-pressure mercury vapor discharge lamp comprising a light-transmissive sealed envelope, a quantity of mercury and starting rare gas sealed in said envelope, and a pair of electrode mounts sealed to both ends of said envelope, said electrode mounts each supporting a filament coated with activated electron-emitting materials, characterized by comprising a getter including an alloy which is formed of at least one selected from a first group consisting of nickel, cobalt, iron, aluminum and copper and at least one selected from a second group consisting of titanium, zirconium, hafnium, thorium, vanadium, niobium, tantalum, scandium, cerium and tungsten, said alloy excluding a titanium-nickel alloy, said getter being disposed on said mounts except those portions thereof which are coated with the activated electron-emitting materials and those portions thereof which are maintained at operation temperatures lower than 300° C. and higher than the melting point of said alloy.

2. The low-pressure mercury vapor discharge lamp according to claim 1, said alloy consisting of 11 percent by weight of aluminum and 89 percent by weight of zirconium.

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3. The low-pressure mercury vapor discharge lamp according to claim 1, said alloy consisting of 38 percent by weight of cobalt and 62 percent by weight of titanium.

4. The low-pressure mercury vapor discharge lamp according to claim 1, said alloy consisting of 50 percent by weight of nickel and 50 percent by weight of tantalum.

5. The low-pressure mercury vapor discharge lamp according to claim 1, said alloy consisting of 65 percent by weight of nickel and 35 percent by weight of tungsten.

6. The low-pressure mercury vapor discharge lamp according-

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ing to claim 1, said alloy consisting of 66 percent by weight of thorium and 34 percent by weight of nickel.

7. The low-pressure mercury vapor discharge lamp according to claim 1, said getter being disposed on a pair of anode wires which are provided on each of said mounts.

8. The low-pressure mercury vapor discharge lamp according to claim 1, said getter being disposed on a shield electrode which is provided on each of said mounts.

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