

[54] **INSIDE BULB COATING FOR
ULTRAVIOLET LAMP**
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[51] **Int. Cl.**..... **H01j 61/35**
[58] **Field of Search**..... **313/221, 220**

[56] **References Cited**
UNITED STATES PATENTS
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3,474,277 10/1969 Zollweg et al. 313/221
3,609,437 9/1971 Vrijer et al. 313/221

3,617,357 11/1971 Nagg..... 313/221

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[57] **ABSTRACT**

A transparent layer of aluminum oxide is provided on the inside surface of the glass bulb of a gas discharge ultraviolet germicidal lamp. This results in improved starting, particularly under low line voltage conditions, and reduced bulb discoloration during the operating life of the lamp. To make the transparent layer, a coating is applied to the bulb, preferably in the form of aluminum S butoxide, combined with other chemicals to retard premature hydrolysis and/or gelling. After air drying, the coated bulb is lehrd to produce the final coating of aluminum oxide.

3 Claims, 1 Drawing Figure

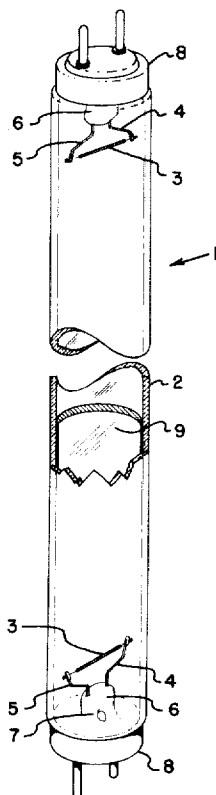
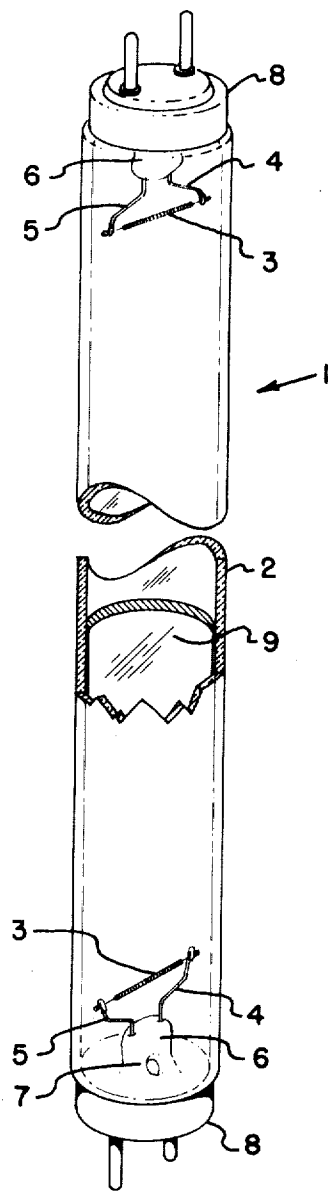


Fig. 1



INSIDE BULB COATING FOR ULTRAVIOLET LAMP

BACKGROUND OF THE INVENTION

The invention is in the field of gas discharge ultraviolet lamps, such as germicidal lamps, and is particularly directed to a beneficial coating on the inside surface of the bulb.

Gas discharge ultraviolet lamps for germicidal purposes are generally similar to conventional fluorescent lamps in that they comprise a pair of spaced apart electrodes near the ends of an elongated glass bulb, and the bulb contains a small amount of mercury to provide a mercury-vapor discharge path between the electrodes which generates ultraviolet radiation. The bulb may also contain argon or other gas to aid in starting the discharge. Unlike fluorescent lamps, however, germicidal lamps usually do not contain a phosphor for converting the ultraviolet radiation into visible light. Also, the bulbs of germicidal lamps have substantially higher concentrations of BaO in their composition which helps to increase the transmission of 2,537 Å germicidal radiation, whereas fluorescent lamp bulbs are usually made from soft lime glass containing sodium alkali and absorb the ultraviolet but transmit the visible light thereby preventing harmful effects which the ultraviolet radiation would cause to people.

U.S. Pat. No. 2,445,692 to Lawrence Porter and Herman Froelich, "Ultraviolet Ray Generator," describes an ultraviolet lamp which generates short ultraviolet radiation directly from the mercury discharge for germicidal purposes, and which contains a phosphor on the inner surface of the bulb for converting some of the "short" ultraviolet into "middle range" ultraviolet radiation for erythema health-ray purposes. Such a lamp is particularly useful in poultry barns. U.S. Pat. No. 2,295,626 to Norman Beese describes an ultraviolet lamp having a glass bulb containing some alkali, and the inner surface of the bulb is coated with pure silica so that, as seen by the mercury-vapor discharge inside the lamp, the bulb is the equivalent of an alkali-free glass and there is no problem of mercury amalgamating with alkali from the bulb material. Such a bulb is intended to be included in the term "alkali-free" glass bulb as used herein.

SUMMARY OF THE INVENTION

Objects of the invention are to provide an improved gas discharge ultraviolet lamp, and to provide such a lamp having improved and reduced starting voltage characteristics and also having a reduced tendency for bulb discoloration to occur during the operating life of the lamp.

The invention comprises, briefly and in a preferred embodiment, a transparent layer of aluminum oxide (Al_2O_3) on the inside surface of an ultraviolet-transmitting glass bulb of a gas discharge germicidal lamp. In a preferred method, the inside bulb surface is coated with a solution of aluminum S butoxide [$\text{Al}(\text{OC}_4\text{H}_9)_3$] combined with acetic acid, butanol, a thinner, and a binder, and the coated bulb is lehrd to form the final Al_2O_3 layer. The term "glass bulb" as used herein is intended to include bulbs of quartz and other suitable vitreous materials or combinations thereof.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE of the drawing is a broken-away perspective view of a preferred embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, there is shown a fluorescent lamp 1 comprising an elongated ultraviolet-transmitting germicidal glass bulb 2 of circular cross section and essentially free of sodium alkali. The lamp has the usual electrode structure 3 at each end supported on in-lead wires 4, 5 which extend through a glass press 6 in a mount stem 7 to the contacts of a base 8 affixed to the end of the lamp. The sealed bulb is filled with an inert gas such as argon or a mixture of argon and other gases at a low pressure, for example about 3 torr, and a small quantity of mercury, at least enough to provide a low vapor pressure of about 6 microns (6 torr) during lamp operation. The inner surface of the glass bulb is provided with a thin transparent layer 9 of aluminum oxide (Al_2O_3). This film is essentially continuous and non-particulate and has a thickness of between 0.1 and 1.0 microns, the thickness preferably lying in the range between 0.2 and 0.5 microns. If the film thickness exceeds one micron, some of the beneficial 2,537 Å germicidal radiation is absorbed by the Al_2O_3 layer, resulting in a less efficient germicidal lamp.

The layer may be formed by applying to the inner surface of the bulb 2, prior to sealing in the end mounts 6 and 7, a coating of the following composition:

140 cc thinner (50% naphtha - 50% butyl acetate)
3 cc concentrated acetic acid
5 cc aluminum S butoxide
140 cc butanol
20 cc binder (ethyl cellulose)

The coated bulb is then lehrd in the usual way at a temperature of about 550° to 600° C for approximately 3 to 5 minutes to decompose the composition and convert it into Al_2O_3 .

It is found that the invention achieves desired improvements of lowering the starting voltage of the lamp and also reducing the tendency for bulb discoloration to occur during operation of the lamp. For example, when the invention is applied to type G8T5 germicidal lamps, their test table starting voltages average about 10 to 20 volts lower than the standard uncoated germicidal lamps. While the exact nature of these improvements is not fully understood, it is believed that the Al_2O_3 internal layer on the bulb surface acts as a getter for absorbing any water vapor, CO_2 , oxygen, or other stray gases that may be within the lamp.

Aluminum oxide layers have been used or proposed for use on the inner surface of fluorescent lamp bulbs made of sodium alkali-bearing compositions, and the purpose of the aluminum oxide layer in such lamps is to act as a barrier between the mercury contained in the lamp and the sodium alkali component of the glass bulb, to prevent the formation of undesirable amalgams of the mercury with the sodium alkali in the bulb material. Examples of such constructions are described in U.S. Pat. Nos. 3,067,356; 3,141,990; and 3,205,394 to John Ray; in U.S. Pat. No. 3,541,377 to Rudolph Nagy; and in U.S. Pat. No. 3,599,029 to William Martyny.

However, such combinations of aluminum oxide layers on sodium alkali-type glass bulbs, for the purpose of acting as a barrier to prevent amalgamation of mercury and sodium alkali, is a different combination, and performs a different function, than the invention disclosed herein of providing a layer of aluminum oxide on the inner surface of an essentially sodium-free glass bulb for the purpose of achieving a lower starting voltage for the ultraviolet lamp and also reducing discoloration of the bulb during lamp operation. Also, the aluminum oxide layer in the above-mentioned fluorescent lamp bulbs is of a particulate type having discrete particles of aluminum oxide, and is of necessity of greater thickness, to perform its function as a sodium alkali barrier, than the thin smooth, continuous and non-particulate aluminum oxide layer of the present invention.

While preferred embodiments of the invention have been shown and described, various other embodiments

and modifications thereof will become apparent to persons skilled in the art, and will fall within the scope of the present invention as defined in the following claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A gas discharge ultraviolet lamp comprising a bulb of substantially sodium-free ultraviolet-transmitting glass and containing mercury vapor at low pressure wherein the improvement comprises a layer of non-particulate aluminum oxide (Al_2O_3) on the inner surface of the bulb.

2. A lamp as claimed in claim 1 in which said layer of aluminum oxide is a non-particulate continuous film having a thickness between 0.1 and 1.0 microns.

3. A lamp as claimed in claim 2 in which said thickness is between 0.2 and 0.5 microns.

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