United States Patent

Martyny et al.

[15] **3,706,895**

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[54] **FLUORESCENT LAMP HAVING COATED INLEADS**

[72] Inventors: **William C. Martyny**, Lyndhurst; **Victor W. Miller**, Highland Hts.; **Ronald J. Olwert**, Willoughby, all of Ohio

[73] Assignee: **General Electric Company**

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[52] **U.S. Cl.**....................**313/42,** 313/108 R, 313/178

[51] **Int. Cl.**..**H01j 1/02**

[58] **Field of Search**.....313/42, 108 R, 109, 178, 345

[56] **References Cited**

UNITED STATES PATENTS

2,885,589	5/1959	Wainio et al.	313/345 X
3,237,284	3/1966	Bird	313/345 X
3,069,580	12/1962	Waymouth	313/109
2,930,919	3/1960	Wainio	313/42 X
2,542,352	2/1951	Peters	313/109

Primary Examiner—Roy Lake
Assistant Examiner—James B. Mullins
Attorney—Ernest W. Legree, Henry P. Truesdell, Frank L. Neuhauser, Oscar B. Waddell and Joseph B. Forman

[57] **ABSTRACT**

A fluorescent lamp in which the inleads or clamps of the electrodes are coated with a high temperature plastic containing a filler of an insulating inorganic material. The plastic is not removed by baking but remains in place in the completed lamp. One suitable material consists of an aromatic polyimide wherein the filler is zirconium oxide. The coating eliminates or lessens light-absorbing oxide rings and brown patches which form on the envelope ends as a result of the arc taking off from the inleads instead of from the electrode coil, a condition to which instant start lamps are particularly prone.

7 Claims, 2 Drawing Figures

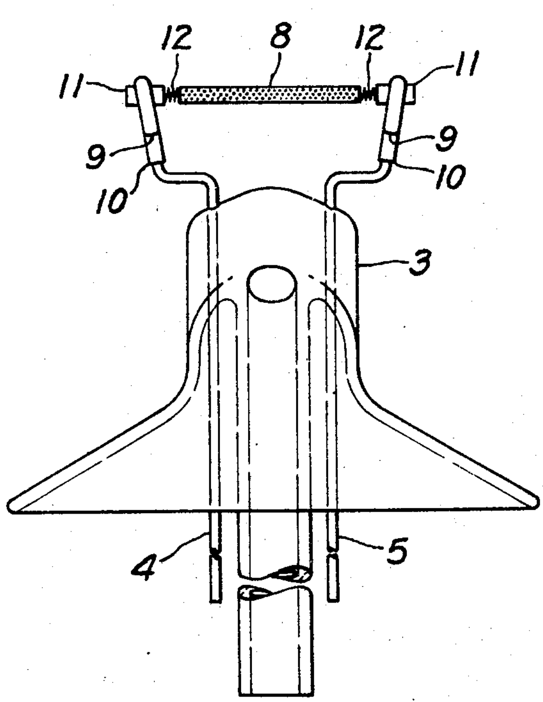

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Fig. 1.

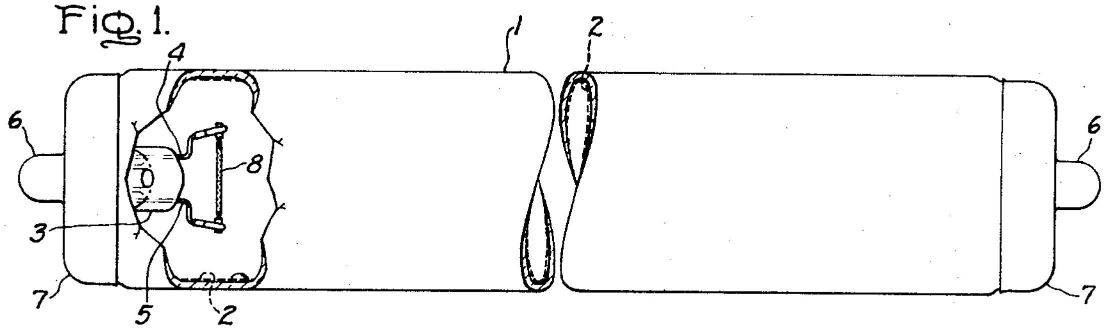
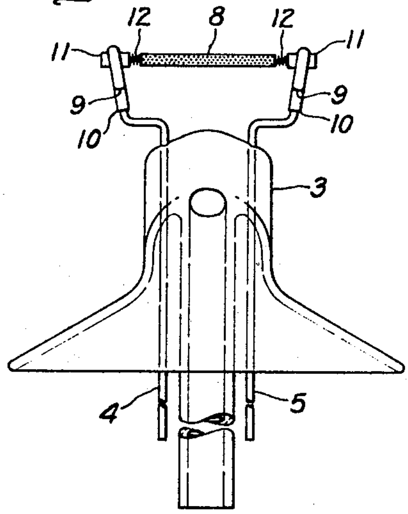


Fig. 2.



Inventors:
William C. Martyny
Victor W. Miller
Ronald J. Olwert
by [signature]
Their Attorney

FLUORESCENT LAMP HAVING COATED INLEADS

BACKGROUND OF THE INVENTION

The invention relates to low pressure discharge lamps such as fluorescent lamps and more particularly to the electrode mounts of such lamps utilizing coiled coil filaments coated with electron emissive material.

A problem encountered with such lamps is the formation of light-absorbing oxide rings and brown patches on the envelopes at the ends close to the electrodes. Typical brown patches vary in size from ¼ to ¾ inch and are located opposite the clamps while oxide rings are located ½ to ¾ inch in front of the cathode coil. They are caused by the arc taking off from the inlead or clamp rather than from the electrode coil. Sputtering or vaporization of the inlead material results which deposits on the envelope wall forming the discoloration. The phenomenon is especially noticeable with instant-start lamps in which the arc is ignited with cold electrodes by the application of high voltage. It is generally believed that emissive material is vaporized from the filament and deposits upon the inleads and clamps with the result that at starting, prior to the heating up of the filament, there is very little to favor the arc taking off from the filament rather than from the clamp or inlead. When the arc strikes on the lead, it tends to move about said spark vigorously until finally it settles on a hot spot on the main body of the coil. In fluorescent lamps wherein current is passed through the filamentary electrode to heat it up in order to facilitate starting, the problem of oxide rings and brown spots is not so serious but it does persist.

It has been proposed in the past to cure the brown patch or end band problem by coating lead wires, clamps, coil tails and anode wires, if any, that is, all interior metal parts except the cathode, with a refractory insulating oxide. For instance U.S. Pat. No. 2,769,112 — Heine et al. proposed applying zirconium oxide as a suspension in isopropyl alcohol which evaporated completely and left no residue. However, this scheme proved impractical in commercial production because the coating would not adhere well to the metal parts and any breaks in the coating make it useless.

Another proposal found in U.S. Pat. No. 3,069,580 — Waymouth et al. is to apply the insulating oxide, for instance aluminum oxide, in a cellulosic lacquer and afterward to remove the cellulose by baking. While this proposal may work well in the laboratory, it is not suitable for production because when the metal parts of the mount are heated to the necessary temperature in air, excessive oxidation occurs and there is no other practical way of doing it.

SUMMARY OF THE INVENTION

We have developed a high temperature insulating coating comprising a polymeric plastic and an inorganic filler for application to the inner lead wires of low pressure discharge lamps. This coating retards end darkening and in particular will reduce or eliminate brown patches which are caused by the discharge taking off from the lead wire. It is particularly useful in instant start or slimline lamps in which the brown spot problem has been particularly acute.

In accordance with our invention, suitable plastic materials are aromatic heterocyclic polymers wherein aromatic rings alternate with ring-shaped molecules of the parent compound, termed heterocyclic rings because they contain a variety of atoms. Preferred materials are aromatic polyimides consisting of two aromatic rings bracketing a heterocyclic ring which includes a nitrogen atom and two pairs of carbon atoms. Such polyimides are stable for indefinite duration at 300°C and have decomposition points of about 900°C. The plastic material is available as a varnish and we add thereto a filler consisting of an inorganic insulating oxide such as zirconium oxide. A slurry of the polyimide-forming varnish and zirconium oxide is made which is applied to the lead wires by surface methods and which is dried and cured by heating for a short period, for instance 300°C for 3 minutes. No high temperature baking to burn out binders is practiced and the film remains extremely flexible so that bending or flexing of the wire does not cause the film to flake off or crack. The film is stable during processing of the lamp as well as in operation and does not release gases which would deleteriously affect the lamp.

DESCRIPTION OF DRAWING

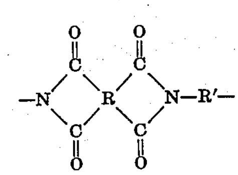
In the drawing:

FIG. 1 shows an instant-start fluorescent lamp in which the invention is embodied.

FIG. 2 is a view to a larger scale of the mount used in the lamp wherein the inner lead wires including the clamps are coated with a high temperature plastic polymeric material.

DETAILED DESCRIPTION

We have found that high-temperature thermo-setting plastics suitable for the binder in our coating are the polyimides described in U.S. Pat. No. 3,179,634 — Edwards, "Aromatic Polyimides and the Process for Preparing Them," assigned to DuPont Company. These polyimides are characterized by a recurring unit having the following structural formula:



wherein R is a tetravalent radical containing at least one ring of six carbon atoms, said ring characterized by benzenoid unsaturation, the four carbonyl groups being attached directly to separate carbon atoms in a ring of the R radical and each pair of carbonyl groups being attached to adjacent carbon atoms in a ring of the R radical; and wherein R′ is a divalent radical containing at least two rings of six carbon atoms, each ring characterized by benzenoid unsaturation, and in which no more than one of the valence bonds is located on any one of said rings of said R′ radical. An example of a polyimide found particularly suitable for the invention is that of pyromellitic dianhydride and 4,4′-diamino diphenyl ether. This particular material is commercially available and is sold by duPont de Nemours and Company, Wilmington, Del. under the designation Pyre-ML varnish (RK–692). The varnish is actually a solution of a compound convertible to the polyimide solely by heat after application. The polyimide itself is stable over an indefinite duration at temperatures up to 300°C and has a decomposition temperature of about 900°C.

First attempts to use the polyimide as such to provide a protective coating on inner lead wires of lamps were unsuccessful. The lead wire next to the hot spot on the cathode where the arc attaches achieves a temperature of approximately 1200°C. At this temperature the plastic film was vaporized off the wire. However, when an insulating refractory inorganic powder such as zirconium oxide was added to the polyimide as a filler, the result was a coating which remained on the wire throughout lamp life.

A suitable method of preparing the material and applying the coating is described below and uses the following ingredients:

100 ml of Pyre-ML varnish (DuPont)

300 gm of Zirconium Oxide (ZrO_2)

Thinner Consisting of N-Methylpyrrolidone and Xylene

The varnish and the zirconium oxide are put into a pebble mill and rolled for a period of 24 hours during which the zirconium oxide becomes finely dispersed. Sufficient thinner is added to bring the viscosity of the slurry to approximately 160 centipoises.

The resulting slurry can be applied to the lead wires by surface methods such as brushing, dipping, rolling, etc. After application, the coating is dried and then cured by heating for a period depending upon the temperature, for example, 3 minutes at 300°C. At lower temperatures, a longer time is required and the period may be shortened if a higher temperature is used.

While the formulation given above is preferred, the proportion of zirconium oxide to varnish may be varied within rather wide limits, for instance from about 100 to 500 grams for the same quantity of polyimide forming varnish. Also other refractory inorganic insulating materials may be used as fillers, for instance aluminum oxide and magnesium oxide.

A lamp embodying the invention is illustrated in FIG. 1 comprising a glass tube **1** carrying a phosphor **2** on its interior surface and containing an ionizable filling including mercury and an inert starting gas such as argon in the usual manner. A stem **3** such as illustrated in FIG. **2**, is sealed to each end of the tube to close it off and lead-in wires **4**,**5** are sealed through the stem. Externally of the tube, the lead-in wires **4**,**5** are connected electrically to the single pin **6** which projects outwardly from the insulating base shell **7** cemented to the tube end. A coiled coil filament **8** of tungsten wire filled and coated with electron-emitting oxides including barium oxide (represented by speckling) is supported near its ends by the lead-in wires **4**,**5** whose ends **9** are bent back on themselves to clamp the filament. The lead-in wires including the clamps are covered by a coating **10** of the polyimide plastic containing zirconium oxide. The coating may extend from the point where the lead-in wires emerge from the glass of the press, or it may extend only from the last bend in the inlead, as shown in the drawing. It should include the entire clamp portion in which the filament is seized. The coating **10** overruns the end portions **11** of the filament outside the space between the lead-in wires **4**,**5**, that is extending beyond the clamps **9**. However, the plastic coating should not overrun the emissive coating on the filament and gaps **12** at least one turn wide should be left between the plastic coating and the emissive oxide coating of the filament. Should the plastic coating be allowed to overrun the emissive oxide coating, it would prevent proper burn-out of the binder in the emissive coating during the activation process, and this would result in deleterious release of gases into the lamp during operation. The plastic coating insulates from the discharge all portions of the electrode and associated metal parts lying as close or nearly as close to the other electrode as the emissive portion of the electrode, and prevents the arc from taking off from any other place than the emissively coated filament.

The major advantage which the material in accordance with our invention has over others proposed in the past is that it avoids the need for high temperature baking to burn out the binders previously used. Also the film is extremely flexible so that bending or flexing of the wire does not cause the coating to flake off or crack. The polyimide is very stable while the lamp is operating and there is no release of gaseous materials into the lamp atmosphere which would deleteriously affect the lamp. We have theorized that immediately next to the hot spot the lead is sufficiently insulated by the zirconium oxide, while at distances more remote from the hot spot where the temperature falls below 900°C, the insulation is provided by both the polyimide coating and the zirconium oxide dispersed in it.

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

1. A low pressure electric discharge lamp comprising a vitreous envelope containing an ionizable medium and filamentary electrodes in the ends thereof mounted on inlead wires sealed through the envelope,

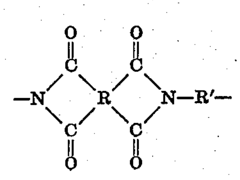
each electrode comprising a refractory metal wire coil supported between said lead wires, the major portion of said coil being filled or coated with electron emitting material,

and an insulating coating over at least the portions of said inleads proximate to said coil and the portions of said coil projecting beyond said inleads,

said coating comprising a high temperature thermosetting polymeric plastic filled with an insulating refractory inorganic powder.

2. A lamp as in claim 1 wherein the polymeric plastic is an aromatic polyimide.

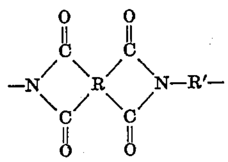
3. A lamp as in claim 1 wherein the polymeric plastic is an aromatic polyimide characterized by a recurring unit having the following structural formula:



wherein R is a tetravalent radical containing at least one ring of six carbon atoms, said ring characterized by benzenoid unsaturation, the four carbonyl groups being attached directly to separate carbon atoms in a ring of the R radical and each pair of carbonyl groups being attached to adjacent carbon atoms in a ring of the R radical; and wherein R' is a divalent radical containing at least two rings of six carbon atoms, each ring characterized by benzenoid unsaturation, and in which no more than one of the valence bonds is located on any one of said rings of said R' radical.

4. A lamp as in claim **1** wherein the polymeric plastic is the polyimide of pyromellitic dianhydride and **4,4'**-diamino diphenyl ether.

5. A lamp as in claim **1** wherein the polymeric plastic is an aromatic polyimide characterized by a recurring unit having the following structural formula:



wherein R is a tetravalent radical containing at least filler ring of six carbon atoms, said ring characterized by benzenoid unsaturation, the four carbonyl groups being attached directly to separate carbon atoms in a ring of the R radical and each pair of carbonyl groups being attached to adjacent carbon atoms in a ring of the R radical; and wherein R' is a divalent radical containing at least two rings of six carbon atoms, each ring characterized by benzenoid unsaturation, and in which no more than one of the valence bonds is located on any one of said rings of said R' radical and wherein the inorganic filler is zirconium oxide or aluminum oxide or magnesium oxide.

6. A lamp as in claim **1** wherein the polymeric plastic is the polyimide of pyromellitic dianhydride and **4,4'**-diamino diphenyl ether and wherein the inorganic filler is zirconium oxide, or aluminum oxide or magnesium oxide.

7. A lamp as in claim **1** wherein the polymeric plastic is the polyimide of pyromellitic dianhydride and **4,4'**-diamino diphenyl ether and wherein the inorganic filler is zirconium oxide provided in a ratio of 100 to 500 grams of filler to 100 milliliters of polyimide-forming varnish.

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