FAIL-SAFE ELECTRODE ASSEMBLY FOR FLUORESCENT LAMPS

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This invention relates to fluorescent electric discharge lamps, particularly high and very high output lamps, and its object is to prevent shattering the tubular glass wall of the envelope of such lamps at the end of their useful lives.

Fluorescent lamps depend upon electron discharge between two coated-coiled electrodes which erode slowly during operation. When the coated electrodes are completely eroded away the lamp fails to illuminate properly, but frequently discharge is maintained by the wire leads which support the coated electrodes. Shortly the wire leads overheat and sag against the wall of the glass tube. In some cases the heated lead cracks the wall around the tube and the tube fails away from its fixture. Failures which fracture the tube may result not only after normal erosion, but also from such mishandling of the lamp that one of the coated electrodes or its supporting leads are distorted and cause overheating in early operation.

According to the invention an electrode assembly comprises an insulating support, at least two current conducting leads on said support, an emissive electrode electrically connected between said leads, a conductor held on said assembly close to one of said leads so as to make contact with said one lead on deflection thereof, and an electrical heating element connected between said conductor and the other of said leads, said element extending close to said support and being adapted to thermally fracture said support when current is conducted through said contact and heating element.

For the purpose of illustration a typical embodiment of the invention is shown in the accompanying drawing in which:

FIG. 1 is a side view of a fluorescent discharge lamp partly broken away to show the electrode assembly according to the invention; and

FIG. 2 is an enlarged view of the electrode assembly. As shown in the figures a generally conventional fluorescent lamp comprises an elongate glass tube or envelope 1 with an interior phosphor-coating 2. Each end of the envelope is closed by a glass stem 3 which includes an exhaust tube 4 opening into the interior of the envelope and a stem press 5 through which lead wires 6 and 7 enter the envelope. The lead wires 6 and 7 extend outside the envelope and are connected to contact pins 8 and 9 extending from a base 10. The base 10 covers the end of the tube and insulates the contact pins 8 and 9.

Inside the envelope the lead wires 6 and 7 support a filamentary electrode 11 preferably of coiled-coil or triple-coiled tungsten wire carrying any of various well known electron emitting materials. A similar electrode assembly is located at each end of the tube. The tube is filled with an inert gas such as neon or mixture of inert gases such as neon and a small amount of argon and a small amount of mercury. The two electrodes are resistively heated to emissive temperature whereupon electron discharge occurs between them, one acting as a cathode and the other as an anode during alternate half cycles of the voltage applied across the tube.

A double walled reflecting shield 12 is supported by a feed through insulating thimbles on the inside wire 7 and the other lead wire 6. The shield 12 is somewhat less in diameter than the wall of the envelope 1 and somewhat wider than the stem press, and serves to maintain a cool zone at the end of the lamp by reflecting radiation from the discharge of the emissive electrode. An auxiliary electrode 14 welded to one lead wire 6 extends for most of its length parallel to and slightly beyond the emissive electrode 11 and serves to collect some of the current when the electrode acts as an anode.

In a conventional fluorescent tube, as so far described, the inner lengths of the lead wires 6 and 7 extend close to the tube wall. When the electrode 11 fails to emit and the lead wires emit and overheat, these portions may soften and sag toward the glass wall of the envelope. The contact pins 8 and 9 at each end of the envelope 1 are usually unable to support the heavy weight of the envelope, which is usually mounted horizontally, and security of the pins in the mounting fixture is dependent on the rigidity of the envelope. If the envelope cracks intermediate its ends either or both fractured parts of the lamp may fall from the fixture.

According to this invention such a hazard is prevented by a very simple and inexpensive modification of a conventional lamp. A conducting wire 16, like the lead wires 6 and 7, is embedded in the stem press 5. The end of the conductor 16 is formed into a loop 17 disposed between the lead wire 7 and the wall of the envelope 1, preferably substantially entirely around the wire 7. A resistance heating element 18 is connected by welds 19 to the other lead wire 6 and the conductor 16. Preferably the heating element 19 is a wire of tungsten or other refractory metal wire which is finer and therefore of higher resistance than the lead wires. For example, if the lead wires 6 and 7 have a resistance of one to two ohms. It is also desirable that the heater resistance be greater than the resistance of the conductor 16 and the contact which may be made between the conductor loop 17 and the lead wire 7.

At the end of its rated life, or earlier if it is damaged, the emitting electrode is substantially entirely eroded away and opens the heating circuit through it. When discharge between opposite ends of the lamp is sustained by emission from the lead wires 6 and 7 such that they heat and sag, contact made between wire 7 and the loop 17 throws the filament voltage entirely across the heating element 18. The element immediately heats to incandescence and consequently fractures the exhaust tube 4 admitting air within the envelope 1 which is at a pressure well below atmospheric. Admission of air extinguishes the discharge and prevents further overheating and sagging of the lead wires. The inrushing air also burns out the filamentary heating wire relieving the ballast of that power drain.

The contact conductor and heating element thus guard against fracture of the envelope by adding only one additional wire in the stem press and two additional welds for the heating element. Such a structure will also guard against failure due to severe distortion of the lead wires in shipment or other handling. The loop 17 is preferably spaced from wire 7 a distance such that minor distortion of the wire 7 will not result in contact with the loop, whereas major distortions sufficient to damage the emitting electrode will result in contact. Such major distortion would so substantially shorten the life of the lamp that it would in most cases be advantageous to discover them in the initial operation of the lamp.

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.

1. In an electric discharge lamp, an electrode assembly comprising an insulating support, at least two current-con
ducting leads on said support, an emissive electrode electrically connected between said leads, a conductor held on said assembly close to one of said leads so as to make contact with said one lead on deflection thereof, and an electrical heating element connected between said conductor and the other of said leads, said element extending close to said support and being adapted to thermally fracture said support when current is conducted through said contact and heating element.

2. In an electric discharge lamp having a glass wall envelope, an electrode assembly comprising an insulating support, at least two current conducting leads on said support, an emissive electrode electrically connected between said leads, a conductor held on said assembly and extending at least partly around one of said leads and between said one lead and said glass wall so as to make contact with said one lead on deflection of the lead toward said wall, and an electrical heating element connected between said conductor and the other of said leads, said element extending close to said support and being adapted to thermally fracture said support when current is conducted through said contact and heating element.

3. In an electric discharge lamp, an electrode assembly comprising an insulating support, at least two current conducting leads on said support, an emissive electrode electrically connected between said leads, a conductor held on said assembly and having a portion substantially entirely surrounding one of said leads so as to make contact with said one lead on deflection thereof, and an electrical heating element connected between said conductor and the other of said leads, said element extending close to said support and being adapted to thermally fracture said support when current is conducted through said contact and heating element.

4. In an electric discharge lamp, an electrode assembly comprising an insulating support, at least two current conducting leads on said support, an emissive electrode electrically connected between said leads, a conductor held on said assembly and extending at least partly around and spaced close to one of said leads so as to make contact with said one lead on deflection thereof, and an electrical heating element connected between said conductor and the other of said leads, said element extending close to said support and being adapted to thermally fracture said support when current is conducted through said contact and heating element, said heating element being of high ohmic resistance relative to said conductor and one lead.

5. In an electric discharge lamp, an electrode assembly comprising an insulating support including an exhaust tube, at least two current conducting leads on said support, an emissive electrode electrically connected between said leads, a conductor held on said assembly and extending at least partly around and spaced close to one of said leads so as to make contact with said one lead on deflection thereof, and an electrical heating element comprising a loop of fine refractory metal wire connected between said conductor and the other of said leads, said element extending into said exhaust tube and being adapted to thermally fracture said tube when current is conducted through said contact and heating element.

6. A fluorescent lamp comprising an elongate glass envelope, a base at each end of said envelope for supporting the lamp in a fixture, an electrode assembly at each end of said envelope including an insulating body with a glass exhaust tube sealing the interior of said envelope from the atmosphere, at least two current carrying wire leads carried on said insulating body and extending into said envelope, an emissive electrode electrically connected between said leads, a conductor held on said assembly close to one of said leads so as to make contact with said one lead on deflection thereof toward said envelope, and an electrical heating element connected between said conductor and the other one of said leads, said element extending into said exhaust tube and adapted to thermally fracture said exhaust tube when current is conducted through said contact and heating element.

7. A fluorescent lamp comprising an elongate glass envelope, a base at each end of said envelope for supporting the lamp in a fixture, an electrode assembly at each end of said envelope including an insulating body with a glass exhaust tube sealing the interior of said envelope from the atmosphere, at least two current carrying wire leads carried on said insulating body and extending into said envelope, a coiled electrode electrically connected between said leads, said electrode carrying an electron emitting material which erodes away during operation whereby said wire leads tend to overheat by emission and deflect, a conductor held on said assembly close to one of said leads so as to make contact with said one lead on deflection thereof toward said envelope, and an electrical heating element connected between said conductor and the other one of said leads, said element extending into said exhaust tube and adapted to thermally fracture said exhaust tube when current is conducted through said contact and heating element.

8. In a fluorescent lamp comprising an elongate glass wall envelope, a glass stem at each end of said envelope, each said stem including an exhaust tube sealing the envelope from the atmosphere and said stem terminating inside said envelope in a stem press, at least two lead wires sealed through said stem press and an electrode supported within the envelope electrically connected between said lead wires, the improvement comprising a conductor lead sealed in one of said stem presses and extending close to one of said lead wires so as to make contact therewith on deflection of said one lead wire, and an electrical heating element welded to one of said lead wires and said conductor and extending into said exhaust tube, whereby when said lead is distorted so as to make contact with said conductor, said element heats and fractures the exhaust tube admitting atmosphere to the envelope and preventing thermal fracture of the envelope.

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