Oct. 19, 1954 J. J. MASON 2,692,347

METALIZED STEMS FOR LOW-PRESSURE DISCHARGE TUBES

Filed March 28, 1951

Fig. 1.

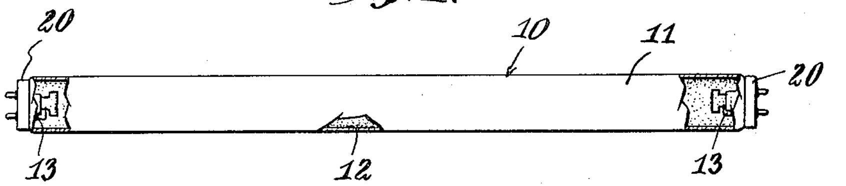


Fig. 2.

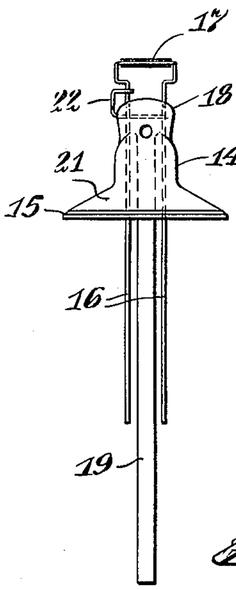


Fig. 3.

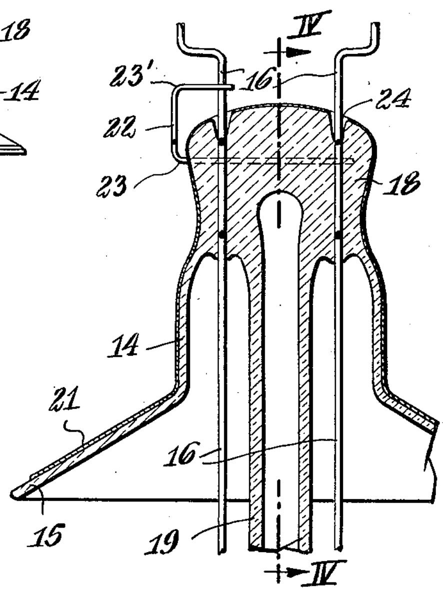


Fig. 4.

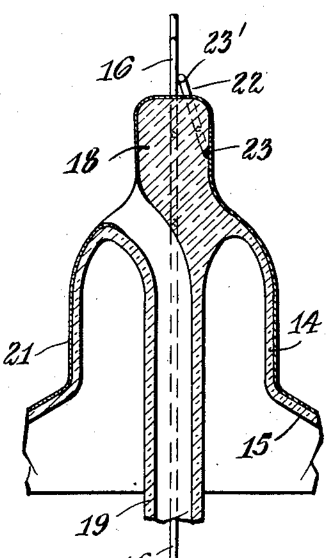
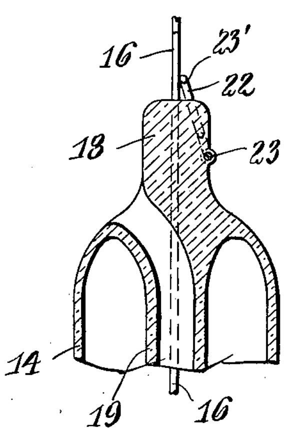


Fig. 5.



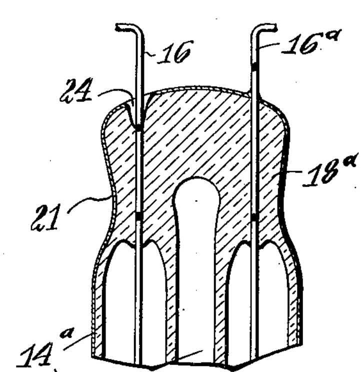


Fig. 6.

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METALIZED STEMS FOR LOW-PRESSURE DISCHARGE TUBES

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2 Claims. (Cl. 313—109)

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This invention relates to stems and, more particularly, to metallized stems for fluorescent lamps and other low pressure discharge tubes of the positive column type.

An example of a low pressure discharge tube of the positive column type is the fluorescent lamp which is essentially an electric discharge source consisting of a tubular envelope having electrodes sealed into each end and containing mercury vapor at low pressure and a small amount of an inert gas, such as argon, as an aid in starting. The inner walls of the envelope are coated with fluorescent powders which give off light when activated by ultraviolet energy radiated at 2537 A. U. When the proper voltage is impressed on the electrodes, a flow of electrons is driven from one electrode and attracted or pulled to the other. As these electrons speed through the tube, they collide with the mercury atoms, causing a state of excitation which produces the desired ultraviolet radiation. The fluorescent powders, commonly known as phosphors, absorb this invisible energy and radiate visible light.

During the half cycle of operation on alternating current in which one electrode of a fluorescent lamp is functioning as an anode, a deficiency of positive ions occurs near this electrode or anode and a negative space charge builds up thereabout. An anode voltage drop results from this space charge and is a measure of the energy which must be imparted to the electrons in order to overcome the repelling force of the space charge. Reducing the anode drop in a fluorescent lamp and consequently the power input increases the luminous efficiency, namely lumens of light output per watt of power input. It has been found that to efficiently draw the required lamp current from the random electrons in the positive column and thus substantially minimize anode voltage drop a fairly large anode area of low work function material is required.

In the conventional lamp the discharge path is substantially limited to the region between the small electrodes which extend inwardly from each of the lamp, leaving some end darkness which impairs lamp appearance. If large anode structures are inserted into the lamp for the purpose of reducing the anode voltage drop, the brightness at the ends of the lamp will be further reduced, due to shielding and absorption by said anodes. By the means to be disclosed the anode drop can be reduced and this appearance defect can be alleviated by increasing the

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length of the discharge path and by reflecting from the lamp ends the radiations which otherwise would be absorbed therein.

Hence it has been found advantageous according to my invention to improve both lamp efficiency and lamp appearance by coating the outside surface of the electrode stems which are exposed to the lamp interior with a light reflecting film of a metal, such as aluminum, and electrically connecting said coating to one of the electrode leads to serve as additional anode area behind the conventional anode.

The aluminum coating provides a large additional anode area of low work function behind the small conventional anode and thereby serves both to reduce the anode voltage drop and to increase the length of the discharge. This coating further increases the light output at the ends of the lamp by reflecting ultra-violet and visible radiation which would otherwise be absorbed by the lamp stem and base. In addition, an evaporated aluminum coating provides gettering action for deleterious residual gases released from lamp parts during the operative life of the lamp.

In its general aspect the present invention has the object of overcoming the aforementioned disadvantages of the prior art fluorescent lamps.

Specifically, an object of the present invention is to provide on a stem for a lamp or tube a large anode area with a low work function to reduce anode voltage drop.

Another and specific object is to provide on a stem for a lamp a large anode area to increase light output due to a longer discharge path to said anode.

Another object is to provide a reflecting surface for ultra-violet light which will reflect radiations normally lost therethrough.

An additional object is to provide on a stem for a lamp a reflecting surface for visible light which will reflect visible radiations which might otherwise be lost therethrough.

A further object is to provide a coating on a stem for a lamp or tube which will act as a getter for deleterious gases released by parts of said lamp or tube during operation.

Other objects and advantages of the invention will appear to those skilled in the art to which it appertains as the description proceeds, both by direct recitation and by implication from the context.

Referring to the accompanying drawing in which like numerals of reference indicate similar parts throughout the several views:

Fig. 1 is an elevational view of a fluorescent lamp with the fluorescent coating on the envelope broken away to show the filamentary electrode mounts at each end;

Fig. 2 is an elevational view of an electrode mount having the vitreous stem coated with a film of aluminum;

Fig. 3 is a sectional view of the vitreous stem of Fig. 2;

Fig. 4 is a sectional view of the stem along line IV—IV of Fig. 3;

Fig. 5 is a sectional view similar to Fig. 4 showing a method of affixing an electrical connector to the stem press prior to aluminizing.

Fig. 6 is a sectional view similar to Fig. 3, showing a modification of the method of electrically connecting an aluminum film on the stem to the filamentary electrode.

In Fig. 1, the reference numeral 10 designates a tubular vitreous envelope of a fluorescent lamp 11. While a fluorescent lamp has been selected as an embodiment of the present invention, it will be understood that the invention is not restricted to use with fluorescent lamps. This envelope 10 is coated on its inner surface wtih a fluorescent material 12 and has a filamentary electrode mount 13 sealed into each end. Such a mount comprises a stem 14, consisting of a flare 15 and two leading-in conductors 16 sealed to said flare by means of a press and a filamentary electrode 17 mounted on said conductors, as shown in Fig. 2.

It will be understood that in a conventional fluorescent lamp employed here as illustrative of a low pressure gaseous discharge tube of the positive column type that the filamentary electrode 17 serves as cathode on one half cycle and as anode on the other half cycle of operation on an alternating current system.

The flare 15 is a piece of tubing, commonly soft glass, having one end flared axially outwardly and having the sealing portions, suitably "Dumet," of conductors 16 sealed through a press 18 at the other end. "Dumet" is the trade name for leading-in conductors comprising a chrome iron core enclosed in a copper sheath having a total thickness approximately 25% of the finished conductor diameter. One of the electrode mounts 13 has a suitable tubulation 19 for evacuating the envelope and the admission of argon and mercury during the exhaust of said lamp 11. After an exhaust which may consist of preliminary evacuation, bake, electrode treating, mercury and argon fill, and tip off, bases 20 are affixed to the lamp 11 at both ends of the envelope.

According to my invention, the outside surface of each of the stems 14 is provided with a light reflecting metallic film, such as aluminum 21, which is electrically connected to one of the leading-in conductors 16 by a two piece metallic connector 22, suitably "Dumet" and nickel. This connector 22 may be U-shaped in configuration having one elongated side leg of "Dumet" for sealing to the press 18 of stem 14 and another leg 23' of nickel.

To prepare stem 14 for aluminizing, the elongated side leg 23 of connector 22 is covered with a thin bead of soft glass, suitably the same as the stem glass, and is then partially embedded substantially along its length into the side wall of the press 18, as shown in Fig. 5. The portions of the thin bead and the connector protruding from the side wall are ground, as by an abrasive wheel, flush with said side wall, thus exposing a reasonably large and firmly affixed metallic surface of the connector upon which evaporated aluminum may be deposited. The nickel side leg 23' of connector 22 is joined, as by welding, to one of the conductors 16 of the stem as shown in Fig. 4.

To aluminize the stem 14, said stem is first cleaned and dried to remove dirt and dust and surface alkalis on the glass which might impair the coating. The stem is then baked above 100° C. to remove water vapor from the glass. A suitable shield, such as a wide rubber band, may be positioned along the sealing edge of the flare 15 of stem 14. Said stem is then mounted within a suitable vacuum bottle between four flashing filaments (not shown) which are appropriately arranged so that condensation of the vaporized metal occurs uniformly over the entire unshielded outside surface of the stem. The metal to be evaporated, in this case aluminum, may be placed on the flashing filaments in the form of U-shaped shavings or crimped aluminum ribbon. After the bottle has been evacuated, the filaments are heated quickly by the application of an appropriate voltage, thus vaporizing the aluminum from the filaments and onto the entire unshielded outside surface of the stem.

The aluminum coating does not electrically short the leading-in conductors 16 because in conventional fluorescent lamps the "Dumet" sealing portion of said conductors does not extend to the top of press 18. The weld knot between the "Dumet" portion and the nickel portion of said conductor 16 is buried in the press. The nickel portion, not being wet by the glass, forms a crater 24, as shown in Fig. 3, extending from the weld knot to the top of the press. The aluminum coating does not bridge this gap between the press glass and the nickel portion of the conductor.

In Fig. 6, is shown an alternative method of electrically connecting the aluminum coating to a modified leading-in conductor 16ᵃ. By extending the length of the "Dumet" portion of one of the conductors 16 such that the weld knot between the "Dumet" and the nickel portion is out of the press, a conductor such as 16ᵃ of Fig. 6 is formed. In the case of conductor 16ᵃ a cavity 24 such as is formed about the other and conventional conductor 16 is not produced and the stem glass wets the conductor throughout its length in the press 18. When the stem 14ᵃ of Fig. 6 is aluminized, the uniform light reflecting film of aluminum 21 makes electrical connection with conductor 16ᵃ but not with conductor 16.

If polarization of the anode of the fluorescent lamp is desired, the coating may be split, suitably by proper shielding means prior to coating, or by scribing the coated surface into two handily symmetrical sections insulated from each other by an appropriate narrow band of the vitreous surface of the stem. Each section is electrically connected to an individual leading-in conductor by either of the methods described above.

After aluminizing the stem in both of the above-mentioned embodiments, the rubber band shield along the sealing edge of flare 15 is removed, and the filamentary electrodes 17 are mounted on the aluminized stems to form mounts 13. Said mounts are sealed into the envelope 10, and the lamp is exhausted and based as explained above.

Thus, it is seen from the foregoing description that a preferred embodiment of my invention achieves a metallized stem for a low pressure gaseous discharge tube or lamp. The metal coating on said stem serves both as additional anode area and as a reflector of ultra-violet and/or visible radiation. It will be understood, however, that the functions of providing additional anode area and reflectivity need not be combined. A metal stem coating may serve as a reflector without electrical contact being made to an electrode and, as such, it is not restricted to use in gas discharge light sources, but may be employed in any luminescent device having a suitable stem, such as an incandescent lamp. Also for the purpose of increased anode area, an electrically conductive coating which need not be metallic or suitably reflective, may be applied to the stem and electrically connected to the electrode.

It will be further understood that the electrically conductive and/or light reflective coating may be applied to the stem by means other than evaporation, such as by the use of suitable paints. Also, a metallic sheath, suitably, .005'' or less thick, having a configuration similar to that of the stem might be fitted over said stem.

Although embodiments of my invention have been disclosed, it will be understood that modifications may be made within the spirit and scope of the appended claims.

I claim:

1. A fluorescent lamp having a phosphor coated envelope, an ionizable medium within said envelope, a stem in each end of said envelope, said stem comprising a flare and a plurality of leading-in conductors sealed thereto by means of a

press, each of said flares having a light reflecting and electrically conducting metallic anode film on its interior surface extending inwardly from a seal between said flare and said envelope, said film being in electrical contact with one of said conductors and serving as an anode during operation of said lamp and a filamentary cathode electrode on said conductors.

2. An electrode mount for a fluorescent lamp having a stem, said stem comprising a flare and a plurality of leading-in conductors sealed thereto by means of a press, said flare having a light reflecting and electrically conducting metallic anode film on the outer vitreous surface thereof, and extending outwardly from the portion of said flare to be sealed to an envelope, said film being in electrical contact with one of said conductors for use as an anode, and a filamentary cathode electrode on said conductors.

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