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LAMP COATING APPARATUS

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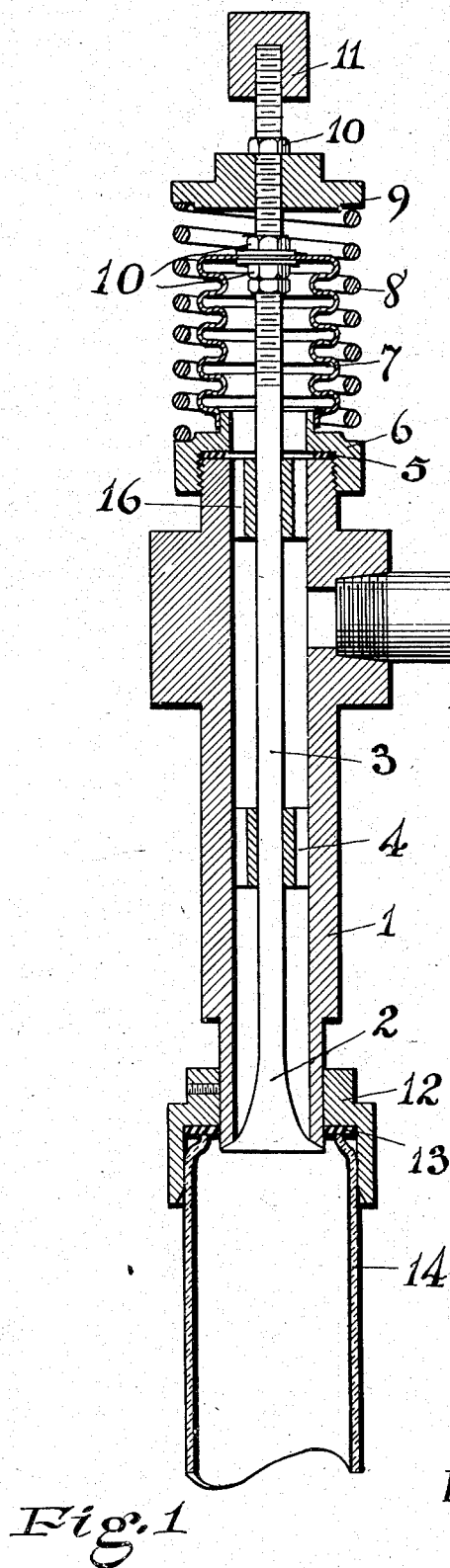


Fig. 1

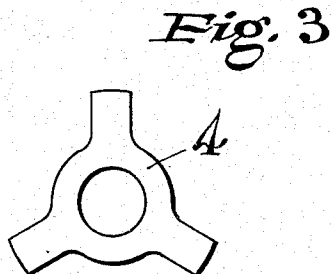


Fig. 3

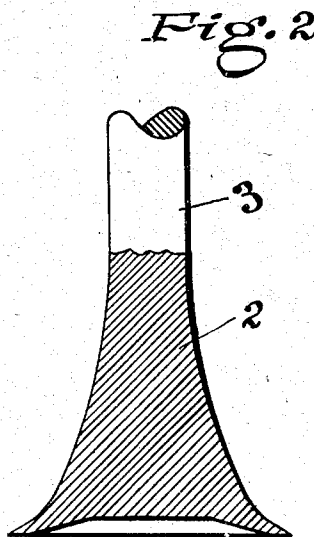


Fig. 2

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UNITED STATES PATENT OFFICE

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LAMP COATING APPARATUS

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Application February 28, 1942, Serial No. 432,896

7 Claims. (Cl. 91-44)

The present invention relates to the manufacture of fluorescent lamps and more particularly to apparatus for applying a coating of luminescent material thereto.

It has been found after a study of the down flush method of coating the inside of elongated glass tubes, that any means used to encourage stream-lined, instead of turbulent, flow of the coating material through the apparatus and ejection in a continuous hollow cone would improve the smoothness and evenness of the coating.

Therefore, an object of our invention is to provide an apparatus that will eject a solution of luminescent material with a minimum of turbulence, and in a continuous hollow cone.

Another object of our invention is to have the apparatus so constructed that the possibility of excess solution accumulating and dripping thus causing streaks on the newly coated surface of the tube is minimized.

Further objects, advantages and features will be apparent from the following specification and accompanying drawing, in which:

Figure 1 is a side elevation in section of the apparatus of our invention.

Figure 2 is a cross section of the flanged plug.

Figure 3 is a detail of the rod guide.

In the manufacture of fluorescent lamps, one of the most troublesome problems has been that of applying the fluorescent material to the walls of the elongated tube which forms a part of the lamp. Many methods and systems have been devised, including the application of two coats of solution, the inversion of the tube before it completely dries so that it will drain partly from one end and partly from the other, and artificial drying of the end first coated to prevent the coating at that end from becoming too thin as a result of the draining process. However, for the most part, these methods and systems have failed to reach the heart of the problem and have merely provided a temporary mitigation of the difficulty. They have failed in the sense that they have not, in a practical sense, shown any degree of uniformity in eliminating, uneven coating, streaky coating, coarse coating and other undesirable conditions which mar the appearance thereof. The apparatus of this invention has proven eminently superior because it has been designed to prevent the creation of those circumstances which cause the above-mentioned undesirable characteristics to appear. Thus a smooth, uniform, even coating of fluorescent material, free from streaks and coarseness is at-

tained without the necessity of coating the elongated tube twice or inverting it during drainage or both.

In Figure 1, the bonnet 1 is connected to the supply of luminescent material solution through the line 15 tapped into the side thereof. The rod 3, internally concentric with the bonnet 1, extends longitudinally therethrough. The bottom extremity of said bonnet is beveled to an angle which coincides with that of the flanged deflector plug 2 which forms the lower extremity of the rod 3 so that said flanged portion may be seated firmly therein, thus forming a plug for the opening in the bonnet. The unique contour of this plug is critical for purposes and reasons hereinafter disclosed. The guides 4 and 16 keep the rod centered at all times and are insurance against wobbling when said rod is moved reciprocally along its longitudinal axis. Said guides are of the open configuration shown in Figure 3. This contour of the upper guide 16 allows the free passage, through its channels, of the solution which otherwise would be forced between the moving parts, the abrasive quality of said solution causing considerable wear. On the lower guide 4, these channels serve still another purpose. As the solution under pressure flows from the line 15 into the bonnet, the change of direction tends to impart turbulent action thereto. The channels of said guide tend to correct the flow from turbulent to stream-lined. Because of this influence, the position of the lower guide becomes critical. It must be near enough to the deflector plug to function properly as a guide yet far enough away from said plug to allow the solution to merge before leaving the bonnet. If either the turbulence were not corrected or the solution were not completely merged beyond the guide, the coating applied to the glass envelope would not be satisfactory. These guides may be fixed to the rod or to the bonnet.

The bellows 7 are sealed to the cap 6 which is tapped to the bonnet 1 with the washer 5 therebetween for pressure-tight construction. The top of the bellows is adjustably fixed to the rod 2 by the nuts 10, so that the rod may move along its axis without leakage through the upper end of the chamber. The spring 8 is held between the cap 6 and the collar 9 which is held on the rod 1 by a nut 10. Therefore, the tension on said spring holds the flanged end of the rod tightly against the beveled end of the bonnet thus forming a chamber therein. The tension on the spring may be adjusted according to the pressure of the solution by moving nut 10. The cap 11

is tapped to the top of the rod. It is through this cap that the apparatus may be activated by moving the solution deflector plug 2, which is the flanged end of the rod 3, away from its position against the end of the bonnet, allowing the solution to flow through the opening.

The collar 12 is fixed around the bonnet 1. In this position it serves as a stop, so that when the neck of the glass tube 14 is placed against the washer 13, it is in proper position for flushing. It will be noticed that there is very little tolerance between the said collar and the glass tube. This condition centers said tube so that all sides will be evenly coated.

It has been found that if the solution does not flow smoothly in the form of a continuous cone through the opening made by the movement of the plug away from the bonnet, the glass envelope is not satisfactorily coated, as turbulence causes an uneven distribution of the solution. Therefore, by designing the deflector plug as shown in Figure 2, there is a gradual transition from the vertical rod to the edge of said deflector plug which may be made of abrasive-resistant material for longer wear. This plug may be an extension of said rod or a separate member joined thereto.

The angle at which the coating solution leaves the plug is a vital factor in the attainment of a smooth even coating free from undesirable coating appearance characteristics. It has been found that the discharge angle of the plug should be between approximately 30° to 35° above horizontal. If the angle is much less than 30°, the solution will strike the walls of the glass tube with excessive force, the impact causing the coating near the top of the glass envelope to assume a mottled appearance, and also resulting in some of the coating solution being forced up over the top and down the outside walls of the glass tube. Neither of these conditions are desirable. A mottled coating detracts considerably from the appearance of the finished product. Coating solution which runs down the outside walls of the glass tube and dries thereon is a source of trouble during the baking process, while such coating as dries on the neck of the bulb renders the sealing process more difficult. On the other hand, when the angle is much greater than 35°, there is a tendency for air to be drawn in over the top of the glass tube, resulting in clear spots appearing in the coating at that end.

Not only is this angle critical but it also has been found that there is a definite and vital relationship between the diameter of the plug 2 and the inside diameter of the main body of the elongated glass tube which is to be coated. Thus, for example, when what is known in the art as a T8 tube is to be coated, i. e., a tube, the main body of which has a one inch outside diameter, and a wall thickness which may vary anywhere from .020 to .050 inch, it has been found that unless a plug of substantially $\frac{3}{8}$ inch diameter is used, there is a definite and sharp difference in the efficiency of the coating apparatus. When tubes of different diameters are used, plugs of correspondingly different diameters should be used in order that substantially the same ratio between the bulb diameter and the plug diameter may be maintained.

Another factor, which must be considered, in order to insure that the flow of luminescent material solution from the ejector plug to the walls of the tube is in the form of a continuous unitary hollow cone, is the pressure under which this

solution is placed. We have found that, just as the angle of deflection and the relationship between the diameter of the bottom of the deflector plug and the internal diameter of the elongated glass tube is important, so too, the pressure under which the solution is placed is important. If the solution is under excessive pressure, it will not flow on to the walls of the tube but strike the walls with such a force that the impact causes the coating adjacent the top to assume a mottled appearance when dry. On the other hand the pressure must be great enough to insure the flow of the main body thereof down the walls of the tube rather than have a considerable portion of the solution merely dropping down perpendicularly from the deflector plug. Therefore, we have found that a pressure, substantially in the range of from 8 to 12 pounds, is desirable for the attainment of best results with a tube of the type mentioned above.

Figure 2 also shows a recess in the bottom of the plug. This serves to distribute, on the periphery of the plug, the solution which tends to accumulate thereabout during the continued use of the coating apparatus. This is an added feature of our invention in that it prevents any of this accumulation from dropping off and falling on the walls of the tube either before or after the main discharge of coating solution is released. Failure to provide this control results in drops of solution falling on the walls of the tube before the main flow of coating solution is released, or on the coating immediately after it has been applied. In either case, the uniformity of the coating is marred.

The apparatus of this invention may be utilized with a machine of the type shown in co-pending application Serial No. 409,496 filed September 4, 1941, entitled "Apparatus for coating fluorescent lamps," or any similar means.

What we claim is:

1. Apparatus for applying a coating of luminescent material solution to the walls of an elongated glass tube, said apparatus comprising: an elongated bonnet having a channel extending longitudinally therethrough; means through which said luminescent material solution may be introduced into the upper extremity of said channel; an elongated valve shaft concentric with said bonnet and extending longitudinally through said channel and moveable in a vertical reciprocating manner therein to open and close said valve, said shaft being flared out at its lower extremity to an angle of substantially between 30° to 35° above horizontal at that portion thereof which is flush with the lower end of said bonnet when said valve is closed; and means for centering said glass tube with respect to said bonnet.
2. The combination of claim 1 and an elongated guide concentric with said shaft and fitted thereabout, said guide being located longitudinally thereon between the source through which the luminescent material solution enters said channel and the flared extremity of said shaft, said guide having a plurality of elongated channels running longitudinally therethrough.

3. The combination of claim 1 and an elongated guide concentric with said shaft and fitted thereabout, said guide being located longitudinally thereon substantially half-way between the source through which the luminescent material solution enters said channel and the flared extremity of said shaft, said guide having a plurality of elongated channels running longitudinally therethrough.

4. Apparatus for applying a coating of luminescent material solution to the walls of an elongated glass tube comprising an elongated bonnet and a solution deflector plug centered with said bonnet and extending along the longitudinal axis thereof, in which the ratio between the diameter of the end of said deflector plug and the outside diameter of said tube is substantially $\frac{5}{8}$ to 1 when the wall thickness of said tube is substantially between .020 and .050 inch.

5. The combination of claim 1 in which the ratio between the diameter of the flared extremity of said shaft and the outside diameter of said tube is substantially $\frac{5}{8}$ to 1 when the wall thickness of said tube is substantially between .020 and .050 inch.

6. Apparatus for applying a coating of luminescent material solution under pressure to the walls of an elongated glass tube comprising an elongated bonnet; means for holding said tube at one end of said bonnet; a solution deflector plug centered with said bonnet and extending along the

longitudinal axis thereof, in which the angle of deflection of said plug is substantially between 30° to 35° , the ratio between the diameter of the end of the deflector plug and the outside diameter of the tube is substantially $\frac{5}{8}$ to 1 when the wall thickness of said tube is substantially between .020 and .050 inch, and the pressure under which the solution is placed within said bonnet is substantially between 8 to 12 pounds.

7. Apparatus for applying a coating of luminescent material solution to the walls of an elongated glass tube, comprising an elongated bonnet with a valve seat therein; and a solution valving plug mounted in said bonnet; said valving plug having its lower end flared to form a peripheral valve flange for engagement with said valve seat; and having its lower end face recessed upwardly from the bottom of said flange throughout the periphery of said plug.

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