

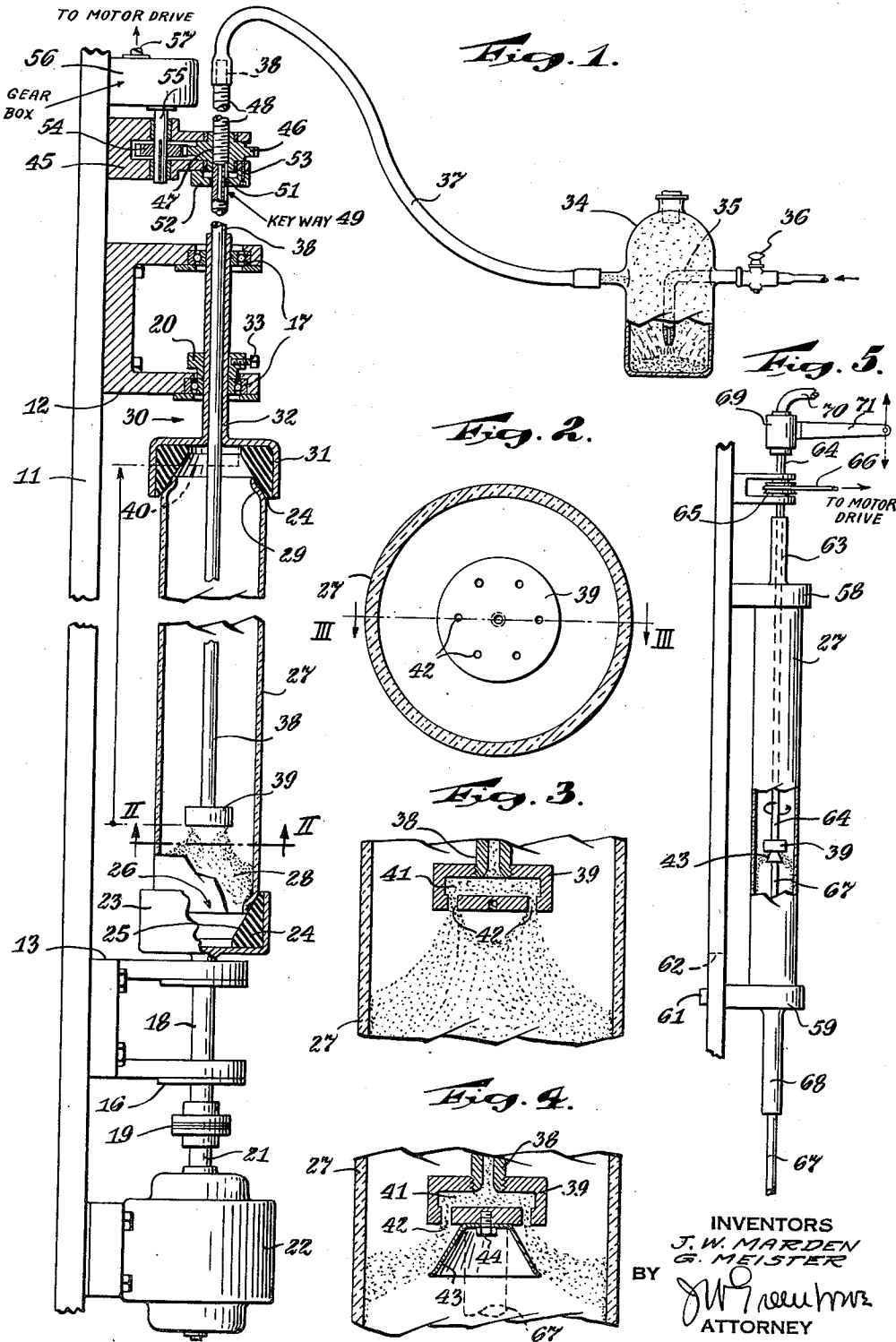
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METHOD AND APPARATUS FOR COATING ENVELOPES FOR ELECTRIC LAMPS

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METHOD AND APPARATUS FOR COATING
ENVELOPES FOR ELECTRIC LAMPS

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This invention relates to a method for applying powdered material to the inner walls of tubes, especially for providing fluorescent electric lamps with an inner coating of fluorescent material, and relates more particularly to the provision of a method which eliminates the use of a binder or of any adhesive material in performing the coating operation.

A conventional method of coating such tubes with fluorescent material has been to apply the fluorescent material suspended in a volatile binder by filling the tube to the height to which the coating is to extend in the completed tube, then to drain off the excess of binder and fluorescent material from the tube above that required for an adequate coating, and finally baking the tube to fire off the binder and carbon residue.

The exercise of this method is attended by numerous disadvantages and inconveniences, among which are to be noted the waste of material attendant the step of draining the tube after application of the binder and material. Also difficulty is encountered in trying to get a uniform coating by this method and since apparently all of the residue is not removed by the firing, or some other phenomenon takes place, the efficiency of the resultant coating when excited by ultra-violet is impaired, giving the lamp an undesirable color and an unpleasantly dull effect.

Another disadvantage of the foregoing method is the expense, delay and inconvenience of using baking ovens to perform the baking operation forming heretofore an essential step of the foregoing method.

In the effort to avoid these disadvantages, other workers in this field have sought to form coatings of fluorescent materials upon the inner walls of a fluorescent lamp by first coating the walls with an adhesive and then dusting the fluorescent powder into the tube, but this method is subject to the same above noted disadvantages.

It is accordingly an object of the present invention to provide a method and apparatus for applying powdered or fluorescent material in direct adhesion with the inner walls of an envelope, such as the tube of a fluorescent lamp, by introducing dry powdered material into the envelope while the latter is rotated, so that the material is caused to be affixed to the inner walls of the tube by exclusively mechanical operation.

Another object of the invention is to provide for creating the desired moment of centrifugal

force by causing relative rotation between the envelope and a device projecting therein through which the powdered material is introduced distributively to the interior of the envelope.

Another object of the invention is to provide controllable means whereby the aforesaid relative rotation is increased to a considerably higher speed after introduction of the powdered material, thereby securing an optimum affixing effect.

A still further object of the present invention is the provision of a method and apparatus for coating an envelope for a fluorescent lamp wherein a uniform coating is applied which firmly adheres to the walls of the envelope without a binder of any kind, thereby eliminating the necessity of removing the latter and at the same time increasing the fluorescent efficiency of the coating during operation of the completed lamp.

Other objects and features of the invention will appear as progress is made with the description of the illustrative embodiment of the invention shown in the drawing, wherein:

Fig. 1 is a vertical axial section of an apparatus in the construction of which the present invention has been embodied;

Fig. 2 is a fragmentary detail view in horizontal, on a larger scale, taken on the line II—II of Fig. 1;

Fig. 3 is a fragmentary detail view in vertical section, taken on the line III—III of Fig. 2, showing also the flow of powdered material from the nozzle of the device by which it is introduced distributively to the interior of the envelope;

Fig. 4 is a fragmentary detail view similar to Fig. 3, showing a modification of the distributing nozzle, and

Fig. 5 is a view on a smaller scale, similar to Fig. 1, illustrating a modified form of apparatus by which the method of the present invention is carried into effect.

Referring now in detail to the drawing, 11 is a supporting frame, provided with brackets 12 and 13 having anti-friction bearings 16 and 17, the first-named bearing, 16, being constructed and arranged to receive a shaft 18 coupled resiliently at 19 to the armature shaft 21 of an electric motor 22, the shaft 18 terminating at its other end in a cup-shaped chuck member 23 fitted with a gasket 24 of resilient material bevelled suitably, as at 25, to engage and center one end 26 of the envelope 27 of an electrical device to be coated, in this instance a cylindrical glass tube for use in a fluorescent lamp, and

which is to be provided with a coating of fluorescent material 28 in a dry powdered state.

The tube 27 can be rotated by the motor 22 at various speeds, regulated by conventional or otherwise suitable devices (not shown) and at the upper end 29 of the tube provision is made of a like cup-shaped chuck member 31 carried by a hollow shaft 32 mounted in the bearings 17, the latter being of well-known ball-bearing type in the instance illustrated, as clearly indicated in Fig. 1, so that further description is deemed unnecessary, except to note that the lower bearing 17 of the set has its rotating part 20 formed as a bushing provided with a set-screw 33 by which the hollow shaft 32 can be engaged at various positions of adjustment lengthwise of the shaft. This facilitates the introduction of tubes of different lengths between the chucks 23 and 31, and also permits the upper chuck to be moved slidingly out of the way of the upper end 29 of the tube where the latter is to be inserted or removed. Suitable clearance between the chuck and lower surface of the bearing 17 is provided, as at 30, to permit such axial movement of the hollow shaft, and rotation of the latter is caused by firm engagement of the chuck with the tube.

In pursuance of the invention, introduction of the powdered fluorescent material 28 distributively to the interior of the tube may be accomplished by any suitable means, and for this purpose we have devised the construction illustrated in Figs. 1 to 3, the material being derived from a suitable source, such as a supply container 34 which is in communication with a suitable source (not shown) of gas under pressure entering the container through a nozzle 35 provided with a regulating valve 36, so that the gas pressure may be controlled at will. Such pressures may vary through a desirably wide range, say from 2 or 3 pounds to about 40-50 pounds, and in some instances, when the powder is inserted in puffs, use has been made of a gas pressure of over 1000 pounds per square inch.

From the container 34 a flexible hose 37 leads to a suitable discharge tube 38 which passes through the hollow sleeve 32 into the interior of the envelope 27 and may be reciprocated axially therein to effect distributive introduction of the powdered fluorescent material to the interior. In Fig. 1 and Fig. 3, a nozzle or distributing head 39 is shown to facilitate the initial spreading of the material toward the inner walls of the tube 27 and this nozzle has substantially the general structure of a bath spray, being formed with a central chamber 41 and peripheral openings 42.

If found desirable, a spreader cone as 43 may be bolted at 44 to the distributing head 39, in order to enhance the initial distribution effect laterally as shown in Fig. 4.

While lengthwise movement of the tube 38, carrying the head 39 may be effected manually, if found desirable, it is preferred to make provision of means for effecting such distribution movement lengthwise with a regular gradual action for the accomplishment of which we have provided a mechanism coordinated with the rest of the apparatus, as shown at the upper part of Fig. 1.

A bracket 45 mounted on the frame provides bearings for a pinion 46 having a threaded bore 47 through which extends an exteriorly threaded part 48 of the hollow distribution shaft 38, the latter having a lengthwise exterior keyway 49 entered by a key 51 formed on a cap 52 secured by a screw 53 to the under surface of bracket 45.

When the pinion 46 is rotated, the threaded portion 48 of the hollow shaft 38 is thereby caused to move upwardly, and the distributor head 39 traverses the entire length of the tube 27 from the full-line position at the bottom of Fig. 1 to the dotted-line position 40 at the top of the chuck 31.

This movement is effected regularly by means of a driving pinion 54 and meshing with the pinion 46. The pinion 54 is keyed upon a countershaft 55 running from reducing gearing in a gear box 56, the input shaft 57 of which is driven by suitable connections (not shown) with the motor 22 or with another suitable moving part of the apparatus.

Recourse of the direction of rotation of the countershaft 55 will result in running the head 39 from the upper position 40 to the full-line position.

During the time that the head occupies the upper position, it is above the plane of the upper end 29 of the tube 27, and if the set-screw 33 be loosened, the chuck 31 can be raised to clear the upper end 29 of the tube 27, and the tube can be tilted laterally, and lifted out from chuck 23, when the apparatus will be ready to receive a fresh tube to be coated.

Having thus described adequately the structure of the apparatus, we will now disclose our novel method of affixing the dry powdered fluorescent material in the form of discrete particles, free from binder or other adhesive, to the inner walls of the tube, to effect a firm and permanent coating for the intended purpose, but it is to be noted in passing that the apparatus as shown in Fig. 1 provides a novel and unusually effective means for coating the interior of hollow articles of the general class illustrated, regardless of the novel provisions for creating a moment of centrifugal force to secure the improved adherence of the powdered material to the clean walls of the tube.

In further pursuance of the last-named object of the invention, our method comprises the step of causing relative rotation as between the tube 27 and the distributor head 39 as the latter traverses the length of the tube in the performance of its distributive action, and the apparatus of Fig. 1 is characterized by the rotation of the tube, while in Fig. 5, to be described later, the relative rotation is accomplished by rotating the distributor relatively to a stationary tube.

In the operation of the structure of Fig. 1, the motor 22 is run at a relatively low speed while the distributor head is traversing the length of the tube 27 from its lower full-line position to its upper dotted position with the air pressure supplying the force to apply the powder in a cloud to the envelope wall; and when the distributor head comes to rest in the upper position 40, the motor is speeded up until it is running at a speed sufficient to disperse the dry powder uniformly over the envelope wall by centrifugal force. Moreover, there is sufficient leakage around the gaskets 24 and the shaft 38 to prevent building up of the air pressure within the tube 27.

At the lower speed, the powdered material is acted upon by centrifugal force to seek the inner walls of the tube and be evenly distributed thereover, while the higher speed develops a much greater moment of centrifugal force, and causes the already distributed particles to affix themselves in a smooth firm coating upon the inner walls.

In the modification of Fig. 5, the tube 27 is

held between abutments 58 and 59, at least one of which 59 is movable lengthwise of the axis of the tube by a bolt 61 and slot 62 to permit introduction and withdrawal of the tube, and the upper abutment carries an extended bearing 63 through which runs a hollow shaft 64 carrying at its lower end the distributor head 39 which is shown as of the form already described with reference to Fig. 4.

The shaft 64 is movable lengthwise of the tube 27 by suitable raising means such as an arm 71 connected to a lifting mechanism to effect distribution traverse of the length of the tube 27 and even distribution of the dry powdered material to the clean inner wall of the tube. For the purpose of rotating the shaft 64, it may be run by means of a pulley 65 driven by a belt 66 from a suitable source of power (not shown). To prevent eccentric or whipping movement of the distributor head 39, it may be connected to a shaft 67 which latter threadedly engages the distributor head 39 and may hold the spreader cone 43 in place, as shown by the dotted lines in Fig. 4. Since this shaft 67 slidably engages a bearing 68 of the abutment 59, it follows longitudinal and rotary movement of the hollow shaft 64.

The powdered material is introduced to the hollow shaft 64 through a suitable hollow universal joint 69 connected to a flexible hose or conduit 70 running from a reservoir, such as the container 34 illustrated and described with reference to Fig. 1.

From the foregoing disclosure it will be apparent to those skilled in the art that we have avoided the disadvantages and inconveniences attendant upon the application of fluorescent material to the inner walls of tubes when accomplished with the use of a binder or other adhesive material, and requiring a baking operation, by our provision of a novel method according to which the fluorescent material in a dry, powder form without binders or adhesives is caused by centrifugal force to affix itself firmly to the clean inner walls of the tube, forming an even coating of optimum lighting capacity and free from discoloration or dimness; also that we have provided apparatus by means of which the foregoing method can be carried into effect rapidly and in an economical manner, and which is available to carry out coating operations in other fields than the fabrication of fluorescent electric lamps.

We claim:

1. The method of applying dry powdered material free from a binding component to the inner walls of an envelope for an electric lamp, comprising introducing the dry powdered material distributively to the interior of the envelope, and concurrently subjecting the material to centrifugal force whereby it is caused to be affixed to the inner walls of the envelope in an exclusively mechanical operation free from adhesive.

2. The method of applying fluorescent material in a powdered state free from a binding component to the clean inner walls of the tube of a fluorescent lamp comprising introducing the fluorescent material distributively to the interior of the tube, and concurrently rotating the tube thereby subjecting the powdered material to the action of centrifugal force and causing it to be affixed to the inner walls of the tube in an exclusively mechanical operation free from adhesive.

3. The method of applying fluorescent material in a dry powdered state free from a binder to the inner walls of the tube of a fluorescent lamp

comprising introducing the fluorescent material distributively to the interior of the tube and concurrently causing a rotary movement of the powdered particles to impart thereto a moment of centrifugal force adequate to cause the dry powdered material to be affixed to the inner walls of the tube without an adhesive.

4. The method of applying fluorescent material in a dry powdered state free from a binder to the inner walls of the tube of a fluorescent tube comprising introducing the material distributively to the interior of the tube to subject the fluorescent material to the action of centrifugal force, and rotating the tube at a higher speed after cessation of the distributive action whereby said fluorescent material is affixed firmly to said inner walls by a mechanical operation free from adhesive.

5. Apparatus for applying a coating of powdered material to the inner walls of an envelope comprising a pair of rotatable chucks for embracing the opposite ends of said envelope, means movable axially within said envelope to introduce said material under pressure distributively to the interior of the envelope, and means to rotate one of said chucks to cause rotation of said envelope and creation of a moment of centrifugal force adequate to affix said material firmly to said inner walls.

6. Apparatus for applying a coating of powdered material to the inner walls of an envelope of the class described, comprising a pair of chucks for embracing the ends of said envelope, distributor means including a head for introducing said material under pressure distributively to the interior of said envelope while moving axially thereof, and means to rotate said device and its head while so moving axially, whereby said material is subjected to the action of centrifugal force adequate to affix the material firmly to said inner walls.

7. Apparatus for applying a coating of powdered material to the inner walls of an envelope, comprising a pair of rotatable chucks for embracing the opposite ends of said envelope, means movable axially within said envelope to introduce said material under pressure distributively to the interior of the envelope, and means operable to rotate one of said chucks to cause rotation of said envelope and creation of a moment of centrifugal force adequate to affix said material firmly to said inner walls, and means to effect regular movement of said distributing device axially of said envelope while the latter is so rotated.

8. Apparatus for applying a coating of powdered material to the inner walls of an envelope, comprising a pair of rotatable chucks for embracing the opposite ends of said envelope, means movable axially within said envelope to introduce said material under pressure distributively to the interior of the envelope, and means to rotate one of said chucks to cause rotation of said envelope and creation of a moment of centrifugal force adequate to affix said material firmly to said inner walls in the absence of a binder, said rotating means being operable to cause rotation of said chuck at a given speed during said distributive action and to rotate the chuck at a higher speed after cessation of the distributive action.

9. Apparatus for applying a coating of powdered material to the inner walls of an envelope, comprising a pair of rotatable chucks for embracing the opposite ends of said envelope, means movable axially within said envelope to introduce said material under pressure distributively

to the interior of the envelope, and means to rotate one of said chucks to cause rotation of said envelope and creation of a moment of centrifugal force adequate to affix said material firmly to said inner walls without the necessity of a binder, said distributing device including a hollow shaft entering said envelope through one of said chucks and having a threaded exterior beyond the last-named chuck, means to prevent rotation of said hollow shaft, and an interiorly threaded pinion mounted to rotate in engagement with said hollow shaft and operable to cause lengthwise movement of the shaft within said envelope.

10. Apparatus for applying a coating of powdered material to the inner walls of an envelope, comprising a pair of rotatable chucks for embracing the opposite ends of said envelope, means movable axially within said envelope to introduce said material under pressure distributively to the interior of the envelope, and means to rotate one of said chucks to cause rotation of said envelope and creation of a moment of centrifugal force adequate to affix said material firmly to said inner walls in the absence of a binder, said distributing device including a hollow shaft entering said envelope through one of said chucks and having a threaded exterior beyond the last-named chuck, means to prevent rotation of said hollow shaft, an interiorly threaded pinion mounted to rotate in engagement with said hollow shaft and operable to cause lengthwise movement of the shaft within said envelope, and means to blow into said envelope through said hollow shaft dry powdered material from a suitable supply thereof.

11. Apparatus for applying a coating of dry powdered material to the inner walls of an envelope, comprising a pair of rotatable chucks for

embracing the opposite ends of said envelope, means movable axially within said envelope to introduce said material under pressure distributively to the interior of the envelope, and means to rotate one of said chucks to cause rotation of said envelope and creation of a moment of centrifugal force adequate to affix said material firmly to said inner walls in the absence of a binder, said chucks being cup-shaped and each provided with a bevelled gasket of resilient material whereby the ends of said tube are centered and protected against breakage, and one of said chucks being movable axially at will to clear the end of said tube contiguous thereto, thus freeing the tube for removal and replacement.

12. Apparatus for applying a coating of dry powdered material to the inner walls of an envelope, comprising a pair of rotatable chucks for embracing the opposite ends of said envelope, means movable axially within said envelope to introduce said material under pressure distributively to the interior of the envelope, and means to rotate one of said chucks to cause rotation of said envelope and creation of a moment of centrifugal force adequate to affix said material firmly to said inner walls in the absence of a binder, said chucks being cup-shaped and each provided with a bevelled gasket of resilient material whereby the ends of said tube are centered and protected against breakage, and one of said chucks being movable axially at will to clear the end of said tube contiguous thereto thus freeing the tube for removal and replacement, and means to hold said last-named chuck in its adjusted holding position.

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