Aug. 25, 1959 M. E. PATTERSON ET AL 2,901,375

FLUORESCENT LAMP COATING PROCESS

Filed Aug. 7, 1957

Fig. 2.

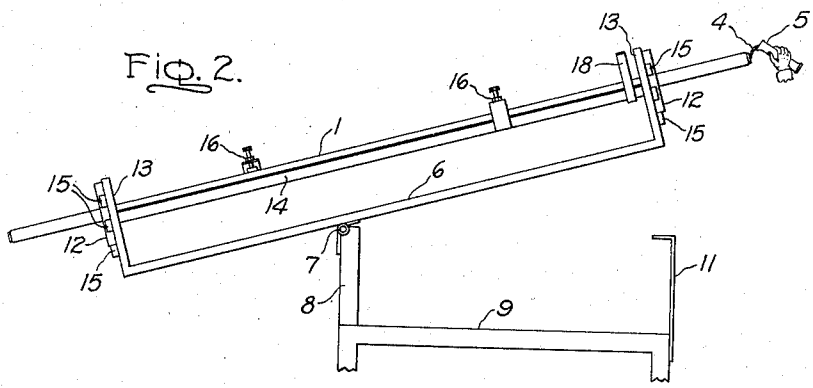


Fig. 3.

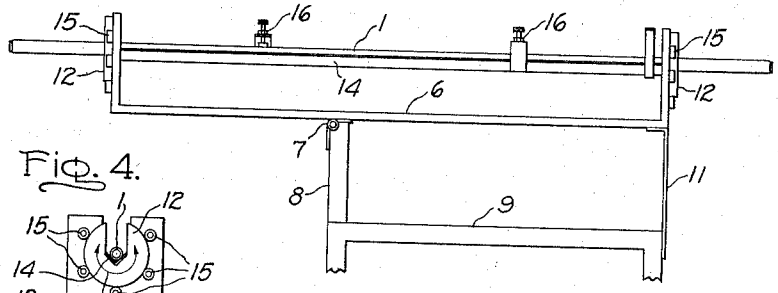


Fig. 5.

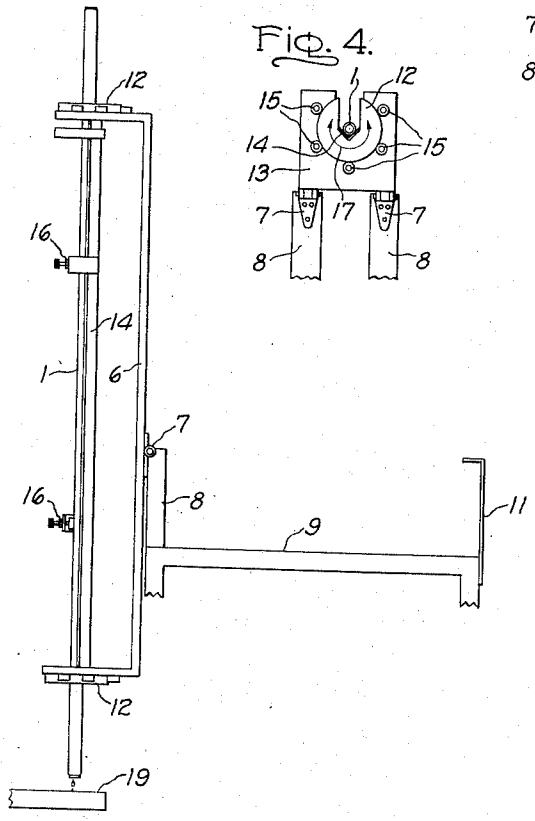
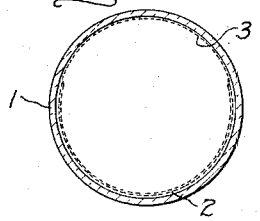


Fig. 4.

Fig. 1.



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FLUORESCENT LAMP COATING PROCESS

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6 Claims. (Cl. 117—37)

This invention relates to the manufacture of reflector fluorescent lamps of the elongated tubular kind wherein part of the envelope is coated internally with a reflective coating in a longitudinally extending band. The entire envelope is coated internally with a luminescent material or phosphor but the light output is concentrated by the reflector in the non-reflectively coated or window portion. The invention is particularly concerned with a method for applying the reflective band in such lamps.

In the first manufacture of reflector fluorescent lamps, the practice has been to coat the entire internal surface of the envelope with the reflective material and thereafter remove the reflective coating from the area intended as the window. Such removal was effected by scraping or brushing after the coating suspension or paint had dried. This produces dust which is difficult to remove entirely and reduces the quality of the product. If a brushing technique is used, the edges tend to be wavy or scalloped. The method is both laborious and wasteful of the reflective material, consisting generally of titania or titanium dioxide, inasmuch as the material brushed or scraped off is wasted along with vehicle for the suspension used in applying it.

The object of the invention is to provide a new and improved method for applying a coating or paint to a selected interior area or arc extending in a longitudinal band through a tubular envelope.

A more specific object of the invention is to provide a method for applying directly to the interior of a tubular fluorescent lamp envelope a reflective band of even thickness and having regular straight edges without further processing in the nature of scraping or brushing.

In accordance with the invention, the desired reflective band is applied to the interior of a tubular envelope by forming a longitudinally extending pool of coating suspension or reflective paint in the envelope, supporting the envelope horizontally, thereafter rocking the envelope about its longitudinal axis to cause the pool to extend over the desired arc or section. The envelope is then tilted or lifted up, while the coated portion is maintained lowermost, into a vertical position and allowed to dry. Preferably the reflective powder is applied as a suspension in a vehicle whose constituents have graded evaporation rates whereby to assure a gradual thickening of the coating as it dries rather than a sudden setting or solidifying.

For further objects and advantages and for a detailed description of an example of the process embodying the invention, attention is now directed to the following description and accompanying drawing. The features of the invention believed to be novel will be more particularly pointed out in the appended claims.

In the drawing:

Fig. 1 is a cross section of a fluorescent lamp showing the disposition of the internal reflector and phosphor coating.

Figs. 2 to 5 illustrate successive steps in accordance with the method of the invention for applying a reflective band to the interior of a fluorescent lamp envelope.

The type of lamp which is made in accordance with the process is illustrated in section in Fig. 1. The cylindrical glass envelope 1 is coated internally throughout its lower portion, somewhat in excess of a half-section, with a light-reflective coating 2 of a suitable finely ground material such as titanium dioxide. The entire interior of the envelope, including the reflectively coated lower portion, is further coated with a luminescent material or phosphor 3. The phosphor may be any of those commonly used for fluorescent lamps, for instance an alkaline earth halophosphate. The ultraviolet 2537 A. radiation produced by the mercury vapor discharge through the envelope causes visible light to be produced throughout the entire phosphor coating. However, that light produced by the phosphor overlying the reflective titania coating is reflected back into the envelope until it escapes through the non-reflectively coated upper portion or window. It will readily be appreciated that there is a substantial difference in brightness or contrast between the window and the reflector portions of the lamp. This accentuates the need for straight and regular edges to the window area if an attractive product is to be produced.

In accordance with the invention, the first step in the application of the reflective coating 2 is to deposit a longitudinally extending pool of coating material along the bottom of the lamp envelope in the volume required to effectively coat the desired circumferential width or band without appreciable excess. One way in which this can be accomplished is by supporting the envelope 1 on a slight incline as illustrated in Fig. 2 and slowly pouring a measured quantity of coating suspension 4 from a graduated beaker 5 into the upper end of the envelope. For example 80 to 90 cubic centimeters of coating suspension may be used to coat and 8 foot envelope, 1½ inches in diameter. The coating suspension runs down the lamp envelope in a relatively narrow stream towards the lower end. Preferably just before the stream reaches the lower end, pouring is stopped and the envelope is quickly lowered into a horizontal position as shown in Fig. 3.

For convenience, the lamp may be supported in a suitable jig, such as illustrated in the drawing, comprising a longitudinally extending frame 6 pivotally mounted by hinges 7 on uprights 8 extending from a table 9. When the frame is lowered, vertical bracket 11 supports the end and maintains the frame horizontal. A pair of slotted discs 12 on the outside of transverse slotted frame members 13 are joined together by a horizontally extending angle iron member 14 and are supported by rollers 15 allowing them to be rotated by hand. The lamp envelope 1 is supported in the frame with its ends extending through the slots in discs 12 and frame members 13, and is secured by clamps 16 on horizontal member 14. If necessary, several clamps 16 spaced along the length of the lamp envelope may be used to overcome and correct any bowing of the lamp envelope.

It is necessary to use care in the performance of the steps so far described in order to achieve the desired results. However, with some practice, sufficient skill can readily be developed in pouring the suspension and timing its cut-off and the lowering of the lamp envelope to assure a substantially uniform longitudinally extending pool of coating suspension along the bottom of the envelope.

The envelope is next rocked or rolled back and forth as indicated by curved arrow 17 in Fig. 4. This spreads the pool circumferentially in the interior of the envelope. The angle through which the lamp is rolled is of course less than 360° since a band only is desired and is governed by the circumferential extent or width of the

reflective band desired, for instance 200° of circumference. Preferably, the envelope is rocked back and forth several times in order to allow the coating suspension to flow back and re-wet a previously coated area as this has been found to assure a more even coating. In so doing, care must be exercised to assure that the envelope is rolled to the same limits on successive occasions; otherwise a series of longitudinally extending lines will be observed along the edges of the reflective band corresponding to the various limits of rolling. These lines will be due to the thickening of the reflector coating up to the line where wetting occurred on successive rolls. The jig may be provided with stop bars **18** on horizontal member **14** to assure constant angles of rolling.

The envelope is thereafter lifted into a vertical position while maintaining the coated portion lowermost as it is tilted up, as indicated in Fig. 5. This is important because the coating is still wet and if the envelope were allowed to turn around placing the coated portion uppermost while it is tilted, the coating material would run or spill over the edges. A pan **19** located below the lowermost end of the envelope, catches any slight drip due to excess of coating suspension. A gentle stream of heated air may be blown through the envelope to hasten drying of the suspension.

It is desirable to avoid both streaks and drapes in the reflector coating. The term "streaks" is used to describe the especially heavy lines due to excessive flow of coating into the center of the bulb while in the horizontal position. The term "drapes" is used to describe those defects resulting from excessively fast drying, especially along the edges of the coating pool in the horizontal position of the envelope. The term "drapes" is also used to describe defects such as ripples resulting from excessively fast setting of the coating while the lamp is drying as it is held vertically. To avoid these defects, we have found it desirable to provide a suspension of the titanium dioxide or reflective powder in a vehicle comprising constituents of graded evaporation rates which assure a gradual thickening during drying rather than a rapid setting and drying off. An organic vehicle may be used comprising a binder such as nitrocellulose in butyl acetate. A preferred binder, which will be hereinafter referred to simply as binder solution, consists of approximately 0.8% nitrocellulose in butyl acetate. To achieve the desired graded evaporation rates, there may be added to the binder solution other suitable solvents such as additional butyl acetate, and amyl acetate, butyl lactate, and Cellosolve solvent (monoethyl ether of ethylene glycol). The following is an example of a flow-coating suspension which we have found suitable for the practice of the invention.

Composition of flow-coating suspension

	Wt. Grams	Wt. Percent
TiO_2	790	19.6
Binder solution	2,183	54.3
Butyl acetate	275	6.8
Wetting agent	8	0.2
Amyl acetate	519	12.9
Cellosolve solvent	155	3.8
Butyl lactate	98	2.4
	4,028	100.0

The Cellosolve solvent (monoethyl ether of ethylene glycol) is desirable particularly in order to absorb any water or humidity which may be present in the bulb, and the wetting agent, which may consist of the material known commercially as Span #20, assists such action. Span #20 is described in the publication, "Surface Active Agents" of Atlas Powder Company, Wilmington, Del., copyright 1950, and consists of sorbitan monolaurate.

It will be appreciated that the application of the reflective band to a lamp envelope in accordance with the invention has numerous advantages over the process of coating the entire envelope and then removing the coating in order to form the window, as has been practiced heretofore. It reduces the amount of labor involved inasmuch as a coated bulb having the proper window opening is provided in a single operation. A substantial saving in reflective material and coating suspension is realized through elimination of the waste involved in the removal of the reflective coating from the window area.

In the manufacture of fluorescent lamps, it is desirable to apply the manufacturer's name or trademark and indications of the type and rating of the lamp to the glass envelope before any application of reflective coating or phosphor. If, after the application of these indicia, the entire envelope is coated with reflective material, it is then necessary to orient the envelope before removing the reflective coating so that the indicia will appear in the window or non-reflectively coated portion. Otherwise, of course, the indicia will hardly be visible if located in the reflectively coated portion of the envelope. This is a tedious and time-consuming operation. However, by coating the envelopes in accordance with the present method, the operator can orient the envelope at the time of coating so that the indicia appears in the window or non-reflectively coated portion, with resultant savings in labor.

The method of the invention also eliminates the saw-toothed or scalloped edge resulting from the use of a brush in removing the coating from the window area, as practiced heretofore. It also reduces or substantially eliminates phosphor suspension contamination caused heretofore by the dust produced in the brushing operation.

While a certain specific example of a process embodying the invention has been described in detail, the same is intended as an illustrative example and not in order to limit the invention thereto except as specified in the appended claims.

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

1. The method of forming a longitudinally extending reflective band along a portion of the interior of an elongated tubular envelope which comprises the steps of depositing a longitudinally extending pool of coating suspension along the bottom of the envelope, supporting the envelope horizontally and rocking it on its longitudinal axis through a prescribed angle less than 360° in order to spread the pool circumferentially therein into a longitudinally extending band.

2. The method of forming a longitudinally extending reflective band along a portion of the interior of an elongated tubular envelope which comprises the steps of depositing a longitudinally extending pool of coating suspension along the bottom of the envelope, supporting the envelope horizontally and rocking the envelope on its longitudinal axis through a prescribed angle less than 360° in order to spread the pool circumferentially therein into a longitudinally extending band, and then tilting the envelope up while maintaining the coated portion lowermost in order to allow the suspension to dry without spilling over the edges of the coated portion.

3. The method of forming a longitudinally extending reflective band along a portion of the interior of an elongated tubular envelope which comprises the steps of supporting the envelope on an incline, pouring a measured quantity of coating suspension into its upper end, allowing the suspension to flow in a relatively narrow stream through the envelope then lowering the envelope to a horizontal position to provide a longitudinally extending pool of coating suspension along the bottom thereof, and rocking the envelope on its longitudinal axis through a prescribed angle less than 360° in order to spread the pool circumferentially therein into a longitudinally extending band.

4. The method defined in claim 3 followed by the additional step of lifting the envelope up into a vertical position while maintaining the coated portion lowermost as it

is tilted up in order to allow the suspension to dry without spilling over the edges of the coated portion.

5. The method of forming a longitudinally extending reflective band along a portion of the interior of an elongated tubular lamp envelope which comprises the steps of forming a suspension of finely ground reflective material in a vehicle solution whose constituents have graded evaporation rates, depositing a longitudinally extending pool of coating suspension along the bottom of the envelope, supporting the envelope horizontally and rocking it on its longitudinal axis through a prescribed angle less than 360° in order to spread the pool circumferentially therein into a longitudinally extending band.

6. The method of forming a longitudinally extending reflective band along a portion of the interior of an elongated tubular lamp envelope which comprises the steps of forming a suspension of finely ground titania in a vehicle containing a binder in a solution of organic solvents having graded evaporation rates, depositing a longitudinally extending pool of coating suspension along the bottom of the envelope supporting the envelope horizontally and rocking it on its longitudinal axis through a prescribed angle less than 360° in order to spread the pool circumferentially in said envelope into a longitudinally extending band, and then tilting the envelope up while maintaining the coated portion lowermost in order to allow the suspension to dry slowly without spilling over the edges of the coated portion.

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