

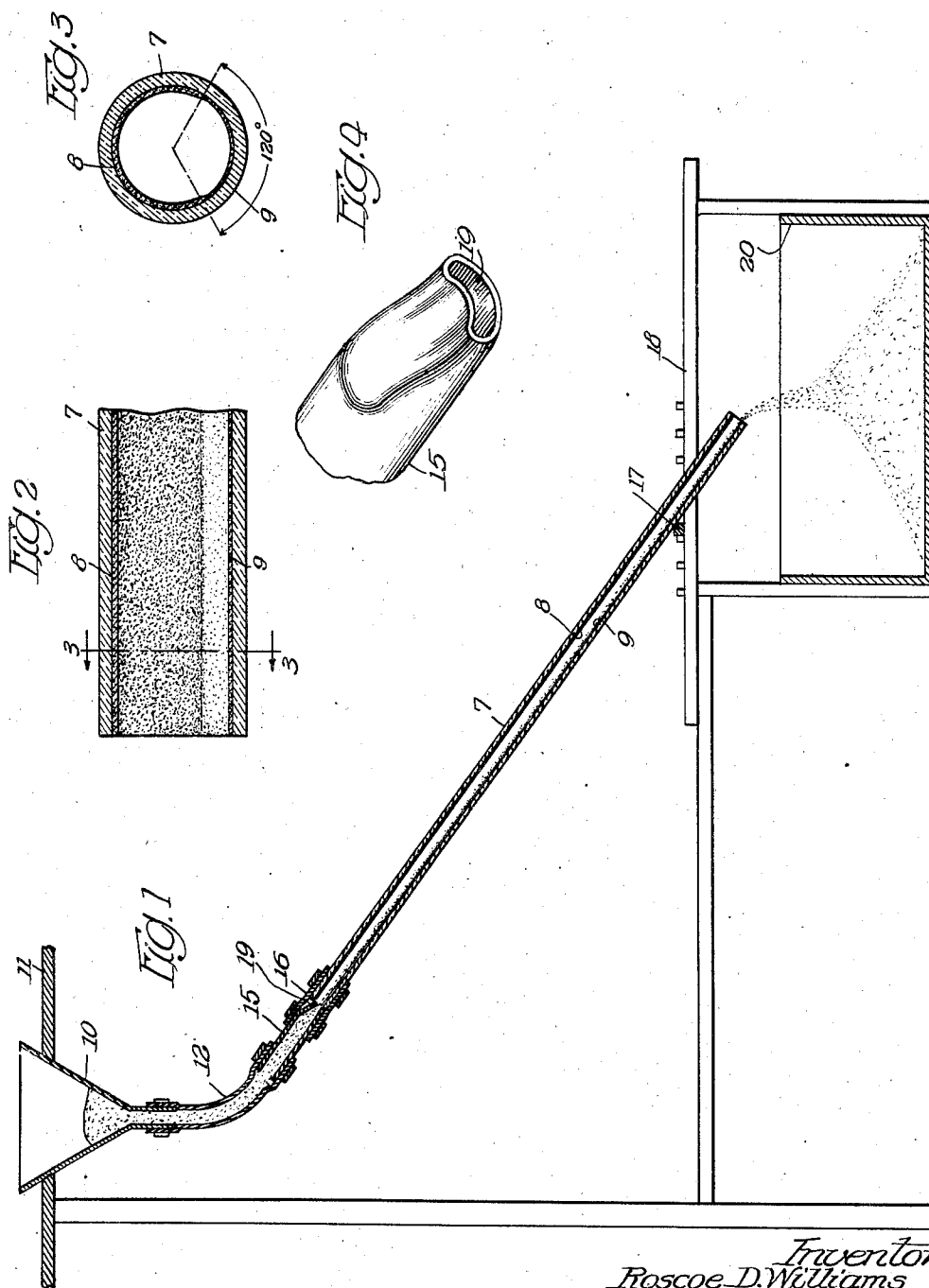
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MANUFACTURE OF FLUORESCENT TUBING

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MANUFACTURE OF FLUORESCENT TUBING

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4 Claims. (Cl. 117-19)

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The invention relates to tubes for fluorescent lighting and the fabrication thereof.

The crystals in the coating of fluorescent material on the inner periphery of the glass tube for fluorescent lighting change the wave length of the light, part of which is ultra-violet, created by the electrical discharge through the inert gas and mercury vapor to wave lengths of light which are perceptible by human vision, and produce highly efficient lighting, as a whole, but the fluorescent material, which has a degree of opaqueness, to a degree restricts the visible light discharged from the tube.

One object of the invention is to provide a tube for fluorescent lighting by which the light-discharge is increased in a controlled direction. This object is attained primarily by relatively varying the thickness of the fluorescent coating in longitudinally extending sections or zones on the inner periphery of the tube so that one section will have a fluorescent coating of lesser thickness than the remaining section having a fluorescent coating of standard or greater thickness. With these sections having coatings of different thickness, the section of reduced thickness will function to discharge light at a higher rate than the other section and the section of thicker coating will function as a reflector for the light transmitted through the section having the coating of reduced thickness. In this manner, the discharge of light at the higher rate is directionally controlled by the section with the coating of reduced thickness, without the use of a reflector. By rotation of the tube on its axis and in the lamp-fixture, the direction of the light through the section having the reduced thickness of coating may be varied as desired. Some of the light which passes directly through the coating of lesser thickness may, in a degree, be untransformed while the ultra-violet light is absorbed by the glass. While the greater amount of light is transformed in the tube, the untransformed light which passes directly through the coating of lesser thickness may be discharged with a distinctive color of its own. This distinctive color added to the major portion of the translated and reflected light from the section having the thicker coating changes and improves the color value of the total light emitted when white fluorescent tubes are used.

Another object of the invention is to provide an improved method of producing fluorescent light tubing with sections of fluorescent coating of different thickness. In practice it has been found that this result may be efficiently and practically

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accomplished by a controlled flow of an abrasive, such as suitable silica, over a longitudinally extending section or zone of the glass tube after its entire periphery has been coated with the standard or greater thickness of fluorescent material or the thickness desired in the section of greater thickness. This method lends itself to the reduction of the thickness of the coating in one section to the desired thinness for the control of light from the tube.

Other objects will appear from the detailed description of the invention.

The invention consists in the several novel features which are hereinafter set forth and more particularly defined by claims at the conclusion hereof.

In the drawings:

Fig. 1 is a sectional view illustrating the method for reducing the thickness of the fluorescent coating in a section of the previously coated tube.

Fig. 2 is a transverse section of a tube with fluorescent coating of different thickness on different sections of the tube.

Fig. 3 is a section taken on line 3-3 of Fig. 2.

Fig. 4 is a view illustrating the tube with the discharge for controlling the flow of abrasive through the tube.

The improved fluorescent tubing is illustrated in Figs. 2 and 3 and comprises a transparent glass tube 7 of usual wall thickness and length for use in the fabrication of tubular fluorescent lamps which are provided with the usual end caps and electrical contacts and are adapted to retain a suitable inert gas, as usual in the art. A coating 8 of fluorescent chemical containing powder having crystals of fluorescent minerals or chemicals and of the predetermined or standard thickness now used in fluorescent lamps, extends around a section or zone, for example approximately 240° of the inner periphery, and from end to end of the tube. The remaining section of approximately 120° of the inner periphery and extending from end to end of the tubing has a coating of lesser thickness than the portion 8. This interior peripheral coating 8 of the tube may also be made greater than standard thickness to achieve a directional output of a greater portion of the total light emitted from the tube. The section 9 of the coating is of the same fluorescent chemical with like powder and has a lesser thickness than the portion 8, or the thickness of the fluorescent chemical at 9 may be practically nil. These coating sections are formed by coating the entire inner periphery of the tubing with the

same fluorescent chemical and powder of the thickness in the section 8 of the coating and then removing a portion thereof from the inner face of the coating to form the section 9 of lesser thickness. The fluorescent coating 8 can be of standard or ordinary thickness so that the wave length of most of the light from the incandescent gas, a large part of which is ultra-violet, will be changed by the crystals of the powder in the fluorescent coating, the electrical discharge, the inert gas and mercury vapor, when the lamp is energized, to visible wave lengths of visible light, or of greater than standard thickness so that more of the last mentioned light is changed to visible light. This coating, where it is of greater or standard thickness, as in section 8, reduces the transparency throughout the area of the section to which it is applied. The area of the section 9 of the coating of reduced thickness is provided to permit visible light to escape more freely from the tube than it does through the area having the thicker coating. As a result, the fluorescent material 8 of greater thickness functions not only to transform the ultra-violet light into visible light, but also to reflect the visible light in the direction of section 9, and this visible light can be directionally controlled by the axial direction and the area of the coating of reduced thickness. The direction of this light passing through the section having the coating of lesser thickness can be readily varied by rotation of the tube on its axis. Some of the light that falls on the portion of the tube having the coating of lesser thickness may not be transformed. Most of this untransformed light is ultra-violet and is absorbed by the glass but part of it is visible. The proportion of this visible and directionally controlled light may be controlled by the thickness of the coating 9. This visible light directly from the incandescent gas which escapes through the coating 9 has a distinctive color of its own. This distinctive color, added to the translated light in the tube, changes the color value to some extent of the light emitted from the tube with coating of lesser thickness and the color of the light when white fluorescent tubes are used is improved. Tubing coated as aforesaid with fluorescent material of different thickness makes it possible to directionally control a large portion of the light emitted, results in an increase in light efficiency without the use of a reflector, and improves the color value of the emitted light.

The fluorescent material is of a loose and flocculent nature composed largely of minute crystals of fluorescent material. This fluorescent material transforms the ultra-violet light to visible and hence useful light, but it possesses a degree of opaqueness. The present practice in the art is to make the coating of optimum and uniform thickness so that the most lumens per watt of visible light are emitted by the tube when energized. An increase of the present standard thickness will cause more of the ultra-violet light in the interior of the tube to be transformed to visible light, but less to be transmitted through the coating and glass. If the coating around the entire inner periphery of the tube is thinner than the standard, less light would be transformed, but more would be transmitted. According to the present invention, the coating can be of increased thickness for the transformation of more of the ultra-violet light and an increase of its reflecting power because a sufficient amount of the coating is removed from the arcuate section 9 for the emission and escape of the transformed and

reflected light in a controlled and useful direction to produce a further increase of light emitted in that direction.

In fabricating the tubing, the entire inner periphery is first coated with fluorescent chemical containing the fluorescent powder of substantially uniform and the maximum thickness desired in any portion of the tubing or that corresponding to the coating in the section 8. The thickness of the coating in the section 9 is then reduced by abrasion to the thinness desired for the increased flow of light through the latter section. In carrying out the method of producing this tubing the apparatus illustrated in Fig. 1 may be advantageously used. The tube 7 of glass is suspended at such an angle as to cause an abrasive to flow by gravity longitudinally over the coating on the lower portion and through the entire length of the tube. A hopper 10 for the abrasive is stationarily supported in an elevated table 11. The lower end of the hopper is connected by a section of flexible tubing 12 to a flow control tube 13. The upper end of the tube 7 is connected to the discharge end of the control tube by a flexible hose section 16. The lower end of the suspended tube is supported by a bar 17 which may be adjusted in steps over a support 18 to vary the angle of inclination of the tube 7 and correspondingly vary the velocity of the abrasive through the tube 7. The control tube 16 is provided with a discharge orifice 19 which is shaped to direct the abrasive to the lower arc of, and to limit the rate of flow through, the glass tube 7. The silica flows by gravity from hopper 10 to pipe section 12, control tube 13 and the orifice 19 to the bottom portion of the glass tube 7 and slides downwardly by gravity over the fluorescent coating on the lower portion of the tube 7. The orifice 19 and gravity confine the abrasive to the section of the tubing 7 desired, and the orifice limits the flow into the tube. The abrasive in flowing over the coating on the inner periphery of the glass tube 7 reduces the thickness of the coating 9 of the section. The velocity and volume of the abrasive flowing through the tube 7 may be readily controlled to reduce the thickness of the coating to the desired degree. The abrasive used must flow freely through the orifice 19 and over the fluorescent coating on the tube and must not leave any residue which will have a consequential detrimental reaction when the tube is fabricated into a lamp. For instance, the presence of iron in the abrasive is likely to have such a detrimental effect. An example of an abrasive which can be used in carrying out the invention consists of silica sand composed largely of silicon dioxide, which is substantially free from iron and other contamination. The silica for this purpose must be composed of the following:

	Per cent
20 mesh -----	.5
30 mesh -----	32.2
40 mesh -----	62.8
50 mesh -----	4.0
70 mesh -----	0.5

This mixture has been found to give the desired result in reducing the thickness of the coating. The shape and size of the discharge orifice 19 may be changed according to the area of the arcuate section of the tube from which the coating is to be removed, and according to the relative amount of fluorescent material to be removed from portion 9 and also depending on the size of the tube to be processed.

In practice, for example, a charge of approxi-

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mately 4 ounces of silica is placed in the hopper 10 with an orifice which will pass the charge in approximately 15 seconds, will usually produce the desired reduction in the thickness of the coating for a standard length of 20 millimeter tubing. In practice it may be desirable to flow the silica over approximately $\frac{1}{2}$ of the area of the section 9 through the tube and then reverse the tube and flow silica through the other end of the tube positioned for the removal of the other half portion of said section. After the abrasive has been passed through the tubing a puff of warm air is forced through it to remove any loose fluorescent material from the tube. This flow of silica will result in the thickness of the coating being graduated between the sections so that there will be no sharp line of demarcation between them.

The abrasive material is discharged from the tube into a bin 20 and is protected from outside contamination. The abrasive material may be repeatedly used until it becomes charged with the fluorescent material to the extent that its abrasive and flow characteristics are changed. The fluorescent material can be washed and reclaimed from the silica if desired, and the cleaned and dried silica reused.

The method of removing the fluorescent coating may be advantageously used to remove substantially all of the fluorescent coating from a narrow section of the tubing, if that should be desired for specific uses.

The invention exemplifies a method of producing tubing coated with fluorescent material whereby the reduction in thickness of the coating may be accurately controlled and quickly and economically effected. The invention also exemplifies tubing for fluorescent lighting which is provided with zones of fluorescent coating of the same material in sections of different thickness for increasing the visible light emitted from the tubing for directional control.

The invention is not understood as restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. That improvement in making fluorescent lighting tubing which comprises: delivering into tubing, which is uniformly coated on its inner periphery with fluorescent material of a predetermined thickness, abrasive material so it will flow over an arcuate portion of the periphery of and longitudinally through the tubing until the coat-

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ing in said arcuate zone is reduced in thickness, for increased light projection therethrough of the light transformed and reflected by the coating of predetermined thickness.

2. That improvement in making fluorescent lighting tubing which comprises: delivering into tubing, which is uniformly coated on its inner periphery with fluorescent material of a predetermined thickness, abrasive material so it will flow by gravity over an arcuate portion of the periphery and longitudinally through the tubing until the thickness of the coating in said arcuate zone is reduced in thickness, for increased light projection therethrough of light transformed and reflected by the portion having the coating of predetermined thickness.

3. That improvement in making fluorescent lighting tubing which comprises: delivering into tubing, which is uniformly coated on its inner periphery with fluorescent material of a predetermined thickness, abrasive material so it will flow at a controlled rate over an arcuate portion of the periphery and longitudinally through the tubing until the coating in said arcuate zone is reduced in thickness, for increased light projection therethrough of light transformed and reflected by the portion having the coating of predetermined thickness.

4. That improvement in making fluorescent lighting tubing which comprises: delivering into tubing, which is uniformly coated on its inner periphery with fluorescent material of a predetermined thickness, abrasive material so it will flow by gravity and at a controlled rate over an arcuate portion of the periphery and longitudinally through the tubing until the coating in said arcuate zone is reduced in thickness, for increased light projection therethrough of light transformed and reflected by the portion having the coating of predetermined thickness.

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