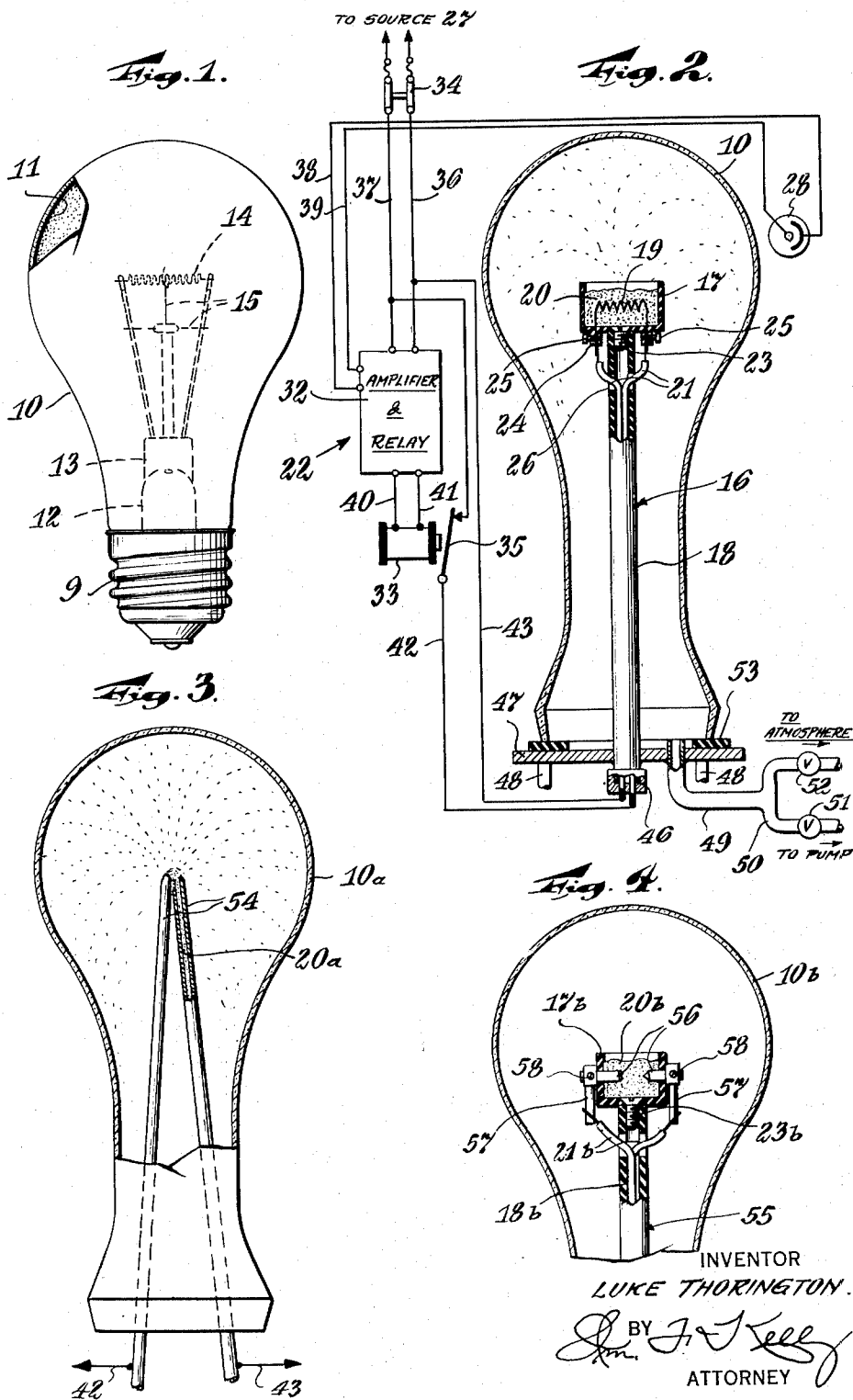


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LAMPS WITH A DIFFUSING COATING
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APPARATUS FOR COATING INCANDESCENT LAMPS WITH A DIFFUSING COATING

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This invention relates to the process of coating vitreous materials and, more especially, to the process of coating an incandescent lamp bulb with a diffusing medium.

In the use of incandescent lamps, especially those of high intensity, it is desirable under various conditions to diffuse the light rays emanating therefrom. Heretofore the diffusing medium employed to produce uniform surface brightness have been a separate diffusing surface associated with the bulb of an incandescent lamp, inside frosting or etching the bulb, a superficial coating of a preparation, such as an enamel or the like, to the bulb of the lamp, and inside coating of the bulb with fine particles of silicon dioxide.

The last-named method is the most recent and apparently capable of the best results. The silica used must be of high quality and desirably has a final coating particle size corresponding in diameter with the wavelength of visible light, i. e., approximately 5000 A. U. or 0.5 micron. A number of methods for coating the bulb of an incandescent lamp with fine particles of silicon dioxide have been used, such as liquid flush coating, electrostatic coating, and coating by burning any of a number of organic silicon compounds to remove the organic components and deposit silicon dioxide smoke on the bulbs.

Of the organic silicon compounds employed, ethyl silicate appears to give best overall results; although the burning tip requires continual cleaning to avoid clogging. In addition, the attendant hazard of an explosion lessens the inherent value of this coating method.

Further, in all of the above mentioned coating methods, lack of proper control of the uniformity of resultant particle size of coating on the bulb is a serious defect. The coating equipment used in each case is complicated and expensive. Such equipment in each respective case is not readily combined in a production line with the sealing and exhaust operations on one automatic machine.

Hence, it has been found advantageous, according to my invention, to employ the method of coating the bulb with a diffusing medium by subliming a less pure grade of amorphous silica onto the bulb to be coated. The method consists of heating the silica or silicon dioxide within the bulb before sealing a mount thereon to convert the silica from a solid to a vapor and condense the silica vapor on the bulb as by cooling until the desired surface brightness or coating density is obtained.

One method of subliming the silica onto the

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bulb comprises mounting a small tungsten filament within a small open-ended refractory container, packing the silica powder around the filament, and heating the silica.

A second method for purifying and at the same time subliming the silica onto the bulb comprises the use of two carbon electrodes having axial holes packed with silica powder, and heating the silica by an electric arc between said electrodes.

A third method for subliming the silica onto the bulb comprises mounting two small diameter carbon electrodes projecting into a small open-ended refractory container in which the silica powder is packed and heating the silica by an electric arc between said electrodes.

In its general aspect, the present invention has as its objective the elimination of the disadvantages and defects of the prior art coating of incandescent lamp bulbs with a diffusing medium.

Another object of the present invention is the coating of an incandescent lamp bulb with a diffusing medium by equipment of the utmost simplicity.

Further, an object of the present invention is the use of a less pure grade of silica in the coating of an incandescent lamp bulb with a diffusing medium.

A still further object of the present invention is the coating of an incandescent lamp bulb with a diffusing medium by equipment having close automatic control.

Another object of the present invention is the coating of an incandescent lamp bulb with a diffusing medium of extremely uniform particle size.

A further and general object of the present invention is the coating of an incandescent lamp bulb by subliming a diffusing medium onto the bulb.

A still further and specific object of the present invention is the use of apparatus for coating a bulb with a diffusing medium, comprising silica packed about a tungsten filament within a refractory open-ended container.

An additional object of the present invention is the use of apparatus for coating a bulb with a diffusing medium, comprising silica packed within the axial holes of two carbon electrodes.

A still further object of the present invention is the use of apparatus for coating a bulb with a diffusing medium, comprising a refractory open-ended container and packed silica between two small carbon electrodes within said container.

Other objects of the invention will appear to

those skilled in the art to which it appertains as the description thereof proceeds, both by direct recitation thereof 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 an incandescent lamp with a part broken away to show the diffusing medium on the inner surface of the envelope;

Fig. 2 is a sectional view of a lamp envelope, showing a refractory container having silica packed about a filament therein;

Fig. 3 is a sectional view of a lamp envelope, showing two carbon electrodes having silica packed in axial holes therein;

Fig. 4 is a sectional view of a lamp envelope, showing a refractory container having silica packed about two carbon electrodes therein.

In Fig. 1, the reference numeral 10 designates the bulbous vitreous envelope of an incandescent electric lamp. The inside surface of said envelope is coated, as hereinafter explained, with a layer of silica 11 of controlled density, as the diffusing medium. Suitably sealed to the neck of envelope 10 is a filament mount 12, comprising a suitable stem 13, filament 14, and filament support wires 15. Attached to the lower extremity of the neck of said envelope is a base 9.

In Fig. 2, wherein the apparatus for coating the envelope 10 with the diffusing medium by a preferred method is shown, envelope 10 is juxtaposed suitably axially about the coating apparatus 16. Said apparatus 16 comprises a refractory ceramic open-ended container 17, hollow mounting rod 18, heating filament 19, silica 20, filament lead-in conductors 21, suitably insulated from each other, and coating density control apparatus 22. Said container 17 has a threaded stud 23 of refractory metal axially joined by a suitable threaded connection to the outer surface of the bottom of container 17. Also projecting from said bottom and joined thereto, also by threaded connections, are hollow refractory pipe-like nipples 24 with appropriate set screws 25 threaded through the side wall of each for securing the legs of filament 19 in any desired position.

The rod 18 is handily threaded on its upper end to receive stud 23, thereby securing container 17 in place. Two holes 26 through the side wall of rod 18 rear its upper threaded end permit passage of leading-in conductors 21 from the legs of filament 19, where said conductors are secured, as by welding, through said side wall and down rod 18 to apparatus 22 and the line voltage supply 27. Silica 20 is packed about the filament 19 to a convenient depth within container 17. Such silica need not be of such high quality as is normally used in the art.

Automatic close control of the coating density of the diffusing medium is achieved by apparatus 22 which comprises a photocell or similar light sensitive element 28, an amplifier and relay circuit 32 for energizing an electromagnet 33, switch 34, and normally closed contact 35.

The source of power 27 connects through switch 34 and lines 36 and 37 to the amplifier and relay circuit 32, said circuit being, in turn, connected through lines 38 and 39 and 40 and 41, respectively, to photocell 28 and magnet 33. The source 27 also connects to lead-in conductors 21 through lines 42 and 43, the former through contact 35.

The electromagnet 33 is suitably disposed in close proximity to spring loaded (not shown)

magnetic contact 35, so that said contact may be opened by the magnet when it is energized.

It will be understood that silica vapor would always surround the heating filament 19 by the time said filament reaches operating temperature, thus protecting the filament from oxidation during operation. Therefore, the use of a protective atmosphere during coating operation may be optional. When a protective atmosphere is employed, hollow mounting rod 18 is suitably vacuum-sealed at its lower end, as by brazing, to metallic cap 46. Appropriate holes are drilled through the bottom of cap 46 to permit passage of the insulated lead-in conductors 21 there-through. A suitable enamel painted over the holes and conductors at the point of emergence of said conductors from the cap 46 completes the seal.

In turn, the rod 18 is coaxially and hermetically joined as by brazing along the side walls of a suitable hole in a flat metallic mounting plate 47 having legs or other supporting means 48. Attached to plate 47 in a vacuum-tight joint, through an appropriate hole therethrough, is an exhaust pipe 49. This pipe 49 connects through a T connection 50 to a valve 51 and a suitable pump (not shown) on one side of connection 50 and to valve 52 and the atmosphere on the other side of connection 50. To complete the protective system, the open-end of envelope 10 is supported on a washer-like rubber gasket 53 located axially on the upper surface of plate 47.

In Fig. 3, an apparatus for coating the envelope 10a with the diffusing medium by an alternative method of the invention is shown. In this modification, envelope 10a suitably axially situated over two axially hollow carbon electrodes or tubes 54, handily disposed with respect to each other for the generation of an electric arc discharge when an appropriate voltage from source 27 is applied through control apparatus 22 (Fig. 2) between the electrodes 54. Into the axial cavity of each electrode 54 is packed silica 20a.

Fig. 4 shows an apparatus for coating the envelope 10b with the diffusing medium by another method of my invention. Envelope 10b is axially arranged about coating apparatus 55. Such apparatus 55 comprises an open-ended refractory ceramic container 17b suitably secured by threaded stud 23b to the threaded end of hollow mounting rod 18b, two small solid carbon electrodes 56 each with a refractory metal connector 57, silica 20b, lead-in conductors 21b and the control apparatus 22 as shown in Fig. 2. The electrodes 56 project interiorly through suitable holes in the side wall of container 17b and are covered to a suitable depth with finely divided silica 20b, within container 17b. The outer extremity of each electrode is secured in a suitable hole in one end of connector 57 by a set screw 58. In turn, the other end of said connectors is joined as by welding to the lead-in conductors 21b.

According to my invention, the envelope 10, to be coated with a diffusing medium by the preferred embodiment of coating apparatus as shown in Fig. 2, is axially aligned over a coating apparatus 16. By closing switch 34, line voltage, suitably 110 volts A. C., from source 27 heats filament 19 of the coating apparatus 16 above 1750° C. Vaporized silica 20 from container 17 condenses uniformly on the cooler surrounding envelope 10 to produce the desired coating density, as measured by the diffuse light intensity from filament 19. When the desired light intensity is received through the coating by photocell 28, it actuates

amplifier and relay circuit 32 to energize electromagnet 33. In turn, magnet 33 moves normally closed contact 35, thereby opening supply line 42 and shutting off power to the filament 19.

If a protective atmosphere is employed during the coating process, envelope 10 is axially aligned with respect to coating apparatus 16 and the open end of the envelope is supported on rubber gasket 53. Valve 52 to the atmosphere is closed and valve 51 to the pumping means is opened. When the desired degree of vacuum is obtained, envelope 10 is coated with the diffusing medium upon closure of switch 34, as explained above, in the protective vacuum.

To remove the coated envelope 10, the pumping means is shut off through valve 51 and air at room pressures admitted through valve 52, thereby breaking the seal between the open end of coated envelope 10 and gasket 53 and allowing removal of said coated envelope 10.

It will be understood that the protective atmosphere used in coating the envelope may also be an inert gas, such as nitrogen, argon, or the like.

According to my invention, envelope 10a may also be coated with a diffusing medium by an alternative embodiment of the coating apparatus shown in Fig. 3. Said envelope is centered longitudinally over the two axially hollow carbon electrodes 54 which are packed with silica 20a. Line voltage applied through switch 34 and coating density control apparatus 22 (Fig. 2) initiates an instantaneous arc discharge between electrodes 54. At temperatures well above 1750° C. the silica 20a in the axial cavities of electrodes 54 sublimates onto the inner surface of envelope 10a. When a sufficient coating density is achieved, the resultant intensity of light causes the electromagnet 33 to open contact 35 and extinguish the arc between the electrodes 54.

Further, according to my invention, the envelope 10b may be coated with sublimed silica 11b, as a diffusing medium by the coating apparatus of Fig. 4. After centrally locating the envelope 10b, about the coating apparatus 55, and applying line voltage to the density control apparatus 22 and across the two small solid carbon electrodes 56, an arc discharge is initiated therebetween. The arc discharge continues to sublime the silica 20b onto the inner surface of envelope 10b at temperatures in excess of 1750° C. until the desired coating density is obtained and the arc is terminated by the energization of magnet 33 and the opening of contact 35 in the same manner as previously explained relative to Figs. 2 and 3.

It will be seen from the foregoing, that my invention achieves the coating of a diffusing medium on the envelope of an incandescent lamp with coating equipment of the utmost simplicity. By subliming the silica powder 20 onto the envelope 10, according to my invention, I am able to employ less pure silica than used in conventional methods and to purify the silica 20 by the sublimation itself. Through the use of coating density control apparatus 22, I am able to closely control the coating density of the sublimed silica on the envelope 10 and, at the same time, obtain extremely uniform particle size.

Specifically, the preferred method of my invention for subliming silica onto the envelope 10 consists of heating above 1750° C., silica 20 packed about a tungsten heating filament 19 within an open-ended refractory ceramic container 17 by applying line voltage to said fila-

ment 19. An alternative method of my invention comprises heating above 1750° C. the silica 20a packed in the axial holes of two carbon electrodes 54 by an electric arc between said electrodes and subliming said silica onto the envelope 10a. A further alternative method of my invention sublimes the finely divided silica 20b onto the envelope 10b by vaporizing said silica from a refractory open-ended container 17b by an electric arc between two small solid carbon electrodes 56 within said container 17b and condensing said silica on the envelope 10b.

Although preferred 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. Apparatus for coating the inner surface of an envelope for an incandescent lamp with sublimed finely divided silica as a diffusing medium, comprising means disposable within said envelope for containing silica, and heating means for raising the temperature of said container above 1750° C., and a coating density control apparatus in electrical parallel with said heating means and having photoelectric means for automatically shutting off said heating means when the desired coating density is obtained.

2. Apparatus for coating the inner surface of an envelope for an incandescent lamp with sublimed finely divided silica as a diffusing medium, comprising: means disposable within said envelope and having an open-ended refractory container for silica and a heater filament in said container for raising the temperature of said container above 1750° C., and a coating density control apparatus adjacent said envelope in electrical parallel with said filament and having photoelectric means for automatically shutting off said filament when the desired coating density is obtained.

3. Apparatus for coating the inner surface of an envelope for an incandescent lamp with sublimed finely divided silica as a diffusing medium, comprising: means disposable within said envelope and having a refractory open-ended container for silica and a heater filament in said container for raising the temperature of said container above 1750° C. and a protective atmosphere also within said envelope; and a coating density control apparatus having photoelectric means adjacent said envelope, in electrical parallel with said filament and which automatically shut off said filament when the desired coating density is obtained; and a protective atmosphere also within said envelope.

4. Apparatus for coating the inner surface of an envelope for an incandescent lamp with sublimed finely divided silica as a diffusing medium comprising: means disposable within said envelope and having two carbon electrodes provided with axial holes for silica and an electric discharge arc between said electrodes for raising the temperature of said electrodes above 1750° C.; and a coating density control apparatus adjacent said envelope, in electrical parallel with said electrodes and having photoelectric means which automatically shut off said arc when the desired coating density is obtained.

5. Apparatus for coating the inner surface of an envelope for an incandescent lamp with a sublimed finely divided silica as a diffusing medium comprising: means disposable within said envelope and having a refractory open-ended container for silica, two carbon electrodes in said

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container and an electric arc discharge between said electrodes for raising the temperature of said container above 1750° C.; and a coating density control apparatus adjacent said envelope, in electrical parallel with said electrodes and having photoelectric means which automatically shut off said arc when the desired coating density is obtained.

6. Apparatus for coating the inner surface of an envelope for an incandescent lamp bulb with sublimed finely divided silica as a diffusing medium comprising: means disposable within said envelope and having an open-ended refractory container for silica, a heater filament in said container for raising the temperature of said container above 1750° C. and a protective atmosphere also within said envelope; and a coating density control apparatus adjacent said envelope and having a light-sensitive element and an amplifier and relay circuit in electrical parallel with said filament for energizing an electromagnet and automatically opening a normally closed contact in one side of a filament voltage line when the desired coating density is obtained.

7. Apparatus for coating the inner surface of an envelope for an incandescent lamp with sublimed finely divided silica as a diffusing medium comprising: means disposable within said envelope and having two carbon electrodes provided with axial holes for silica and an electric discharge arc between said electrodes for raising the temperature of said electrodes above 1750° C. and a coating density control apparatus adjacent said envelope and having a light-sensitive element and an amplifier and relay circuit in electrical parallel with said electrodes for energizing an electromagnet and automatically opening a normally closed contact in one side of a filament voltage line when the desired coating density is obtained.

8. Apparatus for coating the inner surface of an envelope for an incandescent lamp with sublimed finely divided silica as a diffusing medium comprising: means disposable within said en-

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velope and having within an open-ended refractory container for silica, two carbon electrodes in said container and an electric arc discharge between said electrodes for raising the temperature of said container above 1750° C.; and a coating density control apparatus adjacent said envelope and having a light-sensitive element and an amplifier and relay circuit in electrical parallel with said electrodes for energizing an electromagnet and automatically opening a normally closed contact in one side of a filament voltage line when the desired coating density is obtained.

9. Apparatus for coating the interior surface of an envelope for an incandescent lamp with sublimed finely divided silica as a diffusing medium, comprising an open ended refractory container for silica within said envelope and having a heater filament therein for raising the temperature of said container above 1750° C., said heater filament having input leads and a normally closed contact in one of said leads, a protective atmosphere also within said envelope, and a coating density control apparatus adjacent said envelope and having a light sensitive element in contiguous relationship with the portion of said envelope to be coated and an amplifier and relay circuit in electrical parallel with said filament leads for energizing an electrode magnet in operable proximity to said contact for automatically opening said contact when the desired coating density is obtained.

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