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METAL VAPORIZER AND METHOD FOR VAPOR COATING

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Fig. 1

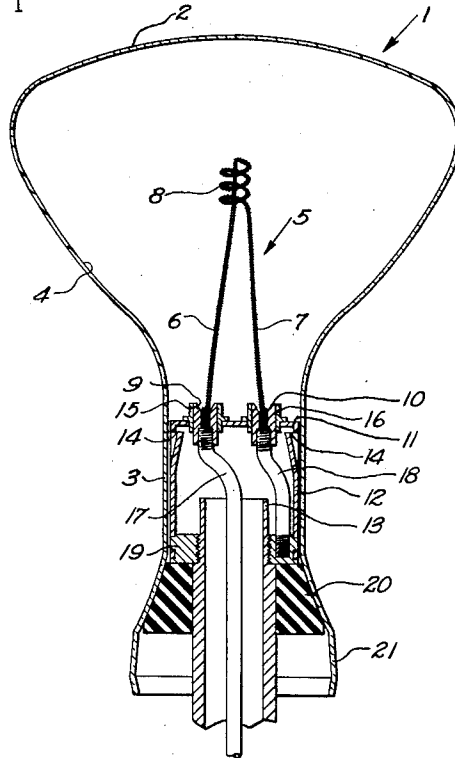
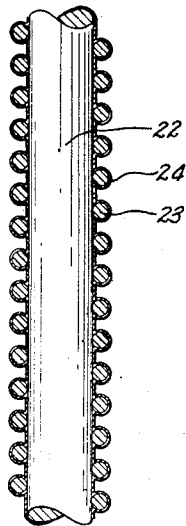


Fig. 2.



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METAL VAPORIZER AND METHOD FOR
VAPOR COATINGWalter J. Karash, Cleveland, and Alton G. Foote,
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5 Claims. (Cl. 117—97)

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The present invention relates to the manufacture of electric lamp bulbs having a reflecting surface.

Electric lamps provided with a reflecting metal film on a portion of the inner surface of the glass bulb to control the light emitted by the incandescent filament in the bulb are available commercially and are used extensively for spot-lighting and floodlighting purposes. The bulbs of certain of such lamps are of blown glass and have a clear flattened end for transmitting light from the lamp and a side wall portion of special contour to the inner surface of which a reflecting metal film is applied for directing light out through the clear end of the bulb.

The application of the reflecting metal film in the high speed production of such bulbs has presented problems heretofore and it is the principal object of the present invention to provide a process and metal vaporizer means whereby a uniform, highly reflective metal film may be applied by mass production methods to the inner surface of such bulbs. Still further objects and advantages of the invention will appear from the following detailed description of species thereof and from the appended claims.

In the drawing accompanying and forming part of this specification an embodiment of the invention is shown in which Fig. 1 is an elevational, partly sectional view of the vaporizer means of the present invention mounted in a lamp bulb; and Fig. 2 is a fragmentary, elevational view on an enlarged scale of the vaporizer means.

As shown in the drawing, the glass bulb 1 of the lamp comprises a flattened end portion 2, a neck portion 3 and an approximately paraboloidal side wall portion 4 between the end portion 2 and the neck portion 3. In the finished lamp, including the bulb 1, the paraboloidal portion 4 is covered with a reflecting metal film (not shown) which also extends a short distance into the neck 3 of the bulb. The usual incandescent tungsten filament is mounted in the finished lamp at the focus of the reflecting paraboloidal bulb portion 4 which directs light out through the clear end portion 2.

A highly effective method of applying reflecting metal films to glass surfaces comprises the steps of vaporizing the metal to be applied and condensing the metal vapor on the glass and this method is utilized in accordance with this invention to apply a reflecting metal film to the inner surface of the paraboloidal portion 4 and the adjoining portion of the bulb neck 3.

In coating lamp bulbs of the type shown in Fig.

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1 of the drawing by the above method, we have observed that the shape of the vaporizer has a great effect on the uniformity of the condensed metal film on the bulb surface because it controls the distribution of vaporized metal in the bulb. In accordance with this observation, we have provided a vaporizer peculiarly adapted for use in applying reflecting metal films to lamp bulbs of the type shown in Fig. 1.

As shown in the drawing, the vaporizer 5 comprises two legs 6 and 7 having free ends by which the vaporizer is supported in position in the bulb 1 and a coiled portion 8 uniting the legs 6 and 7 and around an end portion of leg 6. The vaporizer 5 is so proportioned with respect to the bulb 1 that the coiled portion 8 thereof is at the focus of the paraboloidal part 4 of the bulb 1 when properly mounted on the head of a machine for exhausting the bulb 1 and supplying electrical energy to the vaporizer 5.

The free ends of the legs 6 and 7 of the vaporizer slip into and frictionally engage hollow contact members 9 and 10, preferably of Phosphor bronze, each disposed in openings in the top 11 of a cover 12 for the exhaust port 13 of an exhaust system for the bulb 1. The cover 12 is provided with indented openings 14 through which port 13 communicates with the interior of the bulb 1. The contact members 9 and 10 are electrically insulated from the cover by glass bushings 15 and 16 and are electrically engaged by electrical conductors 17 and 18, one of which (17) extends within and is electrically insulated from the exhaust port 13 and the other of which (18) is without the exhaust port 13 and electrically connected therewith by the cover support 19 threaded onto the end of the exhaust port 13. The cover support 19 also serves as a stop for the cone-shaped flexible rubber gasket 20 mounted around the exhaust port and which is longitudinally compressed by a cam-compression system (not shown) to make a vacuum-tight seal with the cullet portion 21 of the bulb 1 and to support the bulb 1 on the head of a rotary vaporizing machine (not shown) including the exhaust port.

The bulb 1 and the vaporizer 5 are thus easily mounted on and removed from the head of the machine to expedite coating of a plurality of lamps on the machine.

The vaporizer 5 is proportional to the size of the bulb 1 to be coated and a vaporizer suitable for use in applying a reflecting coating to a bulb known commercially as the R-40 bulb is fully described below as a detailed illustration of the invention and by way of example.

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As shown clearly in Fig. 2, the vaporizer 5 comprises a core wire 22 having a finer wire 23 helically wound thereon and a coating 24 of the metal to be vaporized covering the exposed surface of the wires 22 and 23. Although tungsten may be used, molybdenum is the preferred metal for the wires when silver is the metal to be vaporized. In making a vaporizer for use in coating an R-40 bulb, a molybdenum wire 6 mils in diameter is helically wound on a 25 mil molybdenum wire at 78.8 turns per inch. The resulting coil-on-mandrel is then annealed to relieve strains in the wire. The annealed coil-on-mandrel is cut to a straight length of 213 mm. and jig-formed into proper shape by use of a hollow mandrel 1/4 inch in diameter and notched at the end to facilitate coiling of the coil-on-mandrel thereon. A 75 mm. length of the coil-on-mandrel is inserted in the hollow mandrel and bent at right angles to the notch. Three complete turns of the coil-on-mandrel are wound back on the outside of the hollow mandrel at 8 turns per inch and the remaining length of the coil-on-mandrel is bent parallel to the part of the coil-on-mandrel in the hollow mandrel. The hollow mandrel is then removed and the finer wire is pushed up the mandrel wire about 8 to 10 mm. on the free end of each leg to complete the vaporizer.

The shaped vaporizers are then fired in a reducing atmosphere, such as a wet hydrogen furnace, to an elevated temperature, about 1300° to 1700° C., for about 10 minutes and are then ready for silver plating. Plating is preferably accomplished by an electrolytic process and the proper amount of silver on the vaporizer for coating an R-40 bulb is 135 to 150 milligrams. After plating and drying the vaporizers, they are fired in boats in a hydrogen furnace for about 15 minutes at 850° C. and are ready for mounting on the vaporizing machine.

In coating the lamp bulbs 1, the latter are heated uniformly to the highest temperature the bulb will stand without deforming when evacuated of air. The heated bulbs 1 are exhausted of air by the machine and electric current is applied to the vaporizer 5 to raise its temperature above the vaporization temperature of the silver. After all the silver on the vaporizer 5 has been vaporized off and deposited on the bulb 1 in the form of a reflecting metal film, the bulb is removed from the machine and the silver deposited on the flattened end 2 is dissolved to leave the glass clear at this end. The bulb is then ready for use in making up a lamp.

The vaporizer 5 may be replated and used to coat other bulbs. In coating larger or smaller bulbs, the size of the vaporizer and the weight of metal to be vaporized may be changed in proportion to the change in the size of the bulb to be coated. For example, in coating an R-30 bulb, the length of the coil-on-mandrel to be shaped into the vaporizer is 185 mm. and the weight of metal plated on the vaporizer is 85 to 95 milligrams. The diameter of the wires making up the vaporizer is the same as in the vaporizer for the R-40 bulb. Other metals, such as copper, may be plated on the vaporizer for disposition on glass bulbs.

The overwound wire construction of the vaporizer 5 and the plating of the metal 24 to be vaporized are important features of the invention. The overwind 23 increases the ratio of surface area to cross-section of the wire. It also increases the weight of the metal 24 that can be

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used on the vaporizer by preventing the metal from running along the vaporizer and collecting in large globules that are hard to vaporize due to inability to concentrate sufficient heat into them. If the overwind is omitted, it requires too much wire to provide the necessary amount of coating metal, because the amount of current required to heat the longer wire length raises the wattage, and consequently the heat, so high as to result in breakage of the bulbs 1. Moreover, the application of the metal 24 by electroplating provides a very pure coating of the metal which is essential to the manufacture of satisfactory lamps. To provide the coating metal 24 in the form, for example, of another overwind of wire of such metal is unsatisfactory because of the unavailability of the wire in sufficiently pure form, and also because such a vaporizer can be used only once, whereas a vaporizer according to the invention can be used repeatedly by replating and heat treating it.

It is also to be noted that these advantages are attained in a vaporizer of the type wherein the metal to be vaporized (preferably silver) does not "wet" the metal (preferably molybdenum) of the vaporizer. This has the advantages that the base metal of the vaporizer is not used up and, also, the coating is not contaminated.

The vaporizer assembly including the vaporizer 5 and the cover 12 is disclosed and claimed in our copending application Serial No. 227,162, filed May 19, 1951, and assigned to the same assignee of this application.

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

1. A vaporizer for vaporizing metals in the interior of necked bulbs comprising an electrically conducting wire core of metal more refractory than that of the metal to be vaporized, a similar refractory metal wire wound on said core with its turns spaced apart, an electroplating of metal to be vaporized covering the composite wire body, the quantity of said vaporizable metal on said body being limited to an amount sufficient only to coat the interior of a single bulb, said vaporizer having a convoluted center portion to control the distribution of metal vaporized therefrom.

2. A vaporizer for vaporizing metals in the interior of necked bulbs comprising an electrically conducting wire core of metal more refractory than that of the metal to be vaporized, a similar refractory metal wire wound on said core with its turns spaced apart, an electroplating of metal to be vaporized covering the composite wire body, the quantity of said vaporizable metal on said body being limited to an amount sufficient only to coat the interior of a single bulb, said vaporizer having a convoluted center portion to control the distribution of metal vaporized therefrom, and two leg portions extending generally in the same direction from said center portion for engagement with electrically conducting supports for said vaporizer.

3. A vaporizer for vaporizing metals in the interior of necked bulbs comprising an electrically conducting wire core of metal more refractory than that of the metal to be vaporized, a similar refractory metal wire wound on said core with its turns spaced apart, an electroplating of metal to be vaporized covering the composite wire body, the quantity of said vaporizable metal on said body being limited to an amount sufficient only to coat the interior of a single bulb, said vaporizer having juxtaposed end portions constituting supporting legs and a convoluted center portion

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around and radially spaced from an end of one of said legs to control the distribution of metal vaporized therefrom.

4. The method of coating the interior of glass bulbs by vaporization which comprises preparing a vaporizer member by helically coiling a refractory metal overwind wire upon a refractory metal core wire, shaping the center portion of the resulting composite wire body into a convoluted form, electroplating said wire body with a vaporizable metal of lower vaporization temperature than that of the metal of said wire body and in a predetermined amount sufficient only to coat a single bulb, introducing the resulting vaporizer member into the interior of a bulb, passing an electric current through the vaporizer member to heat it to a temperature and for a time sufficient to vaporize substantially all the said vaporizable metal from the said composite wire body and to cause the said vaporizable metal to be deposited upon the interior surface of said bulb, and then removing said wire body from the coated bulb for re-use in coating another bulb.

5. The method of coating the interior of glass bulbs by vaporization which comprises preparing a vaporizer member by helically coiling a molybdenum overwind wire upon a molybdenum core wire, shaping the center portion of the resulting composite wire body into a convoluted form elec-

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troplating said wire body with silver in a predetermined amount sufficient to coat a single bulb, introducing the resulting vaporizer member into the interior of a bulb, passing an electric current through the vaporizer member to heat it to a temperature and for a time sufficient to vaporize substantially all the silver from the said composite wire body and to cause the silver to be deposited upon the interior surface of said bulb, and then removing said wire body from the coated bulb for re-use in coating another bulb.

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