July 12, 1938. O. H. BIGGS 2,123,706

METHOD OF MANUFACTURE OF REFLECTOR BULBS

Original Filed July 20, 1932

Fig. 1.

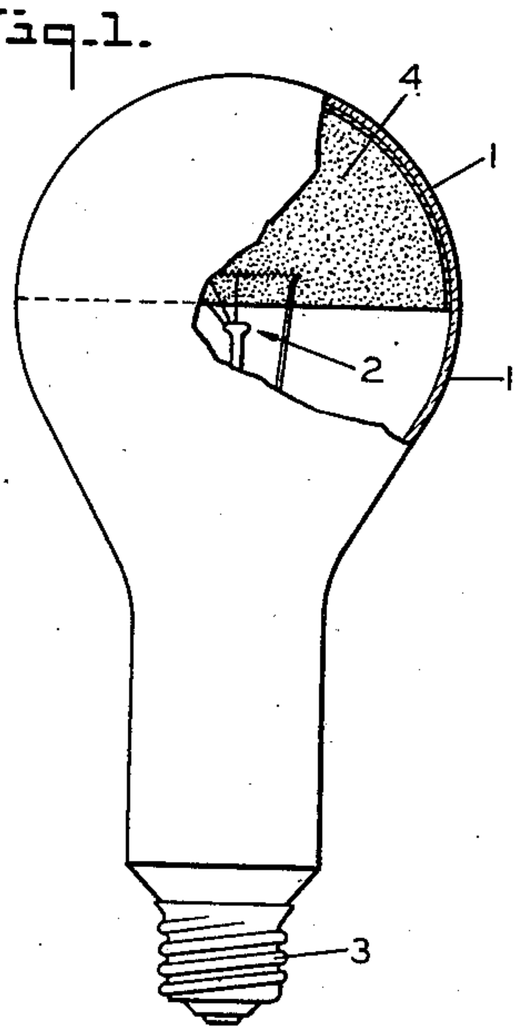

Fig. 2.

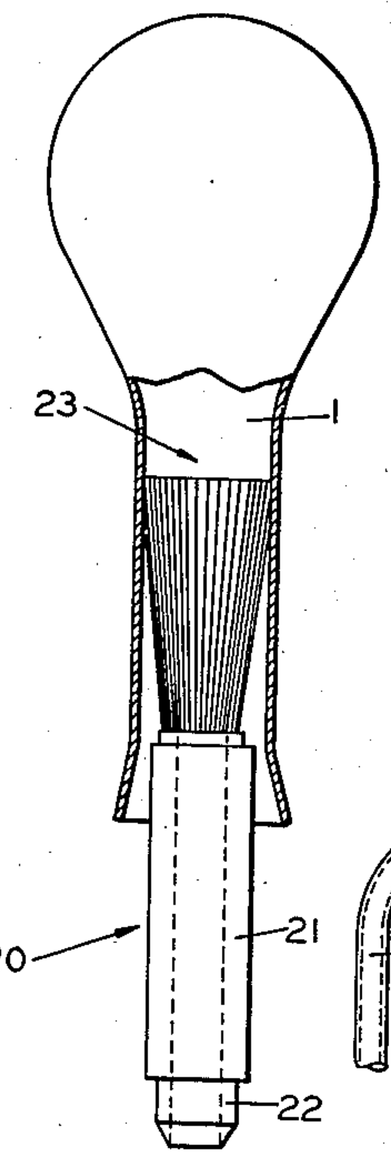

Fig. 3.

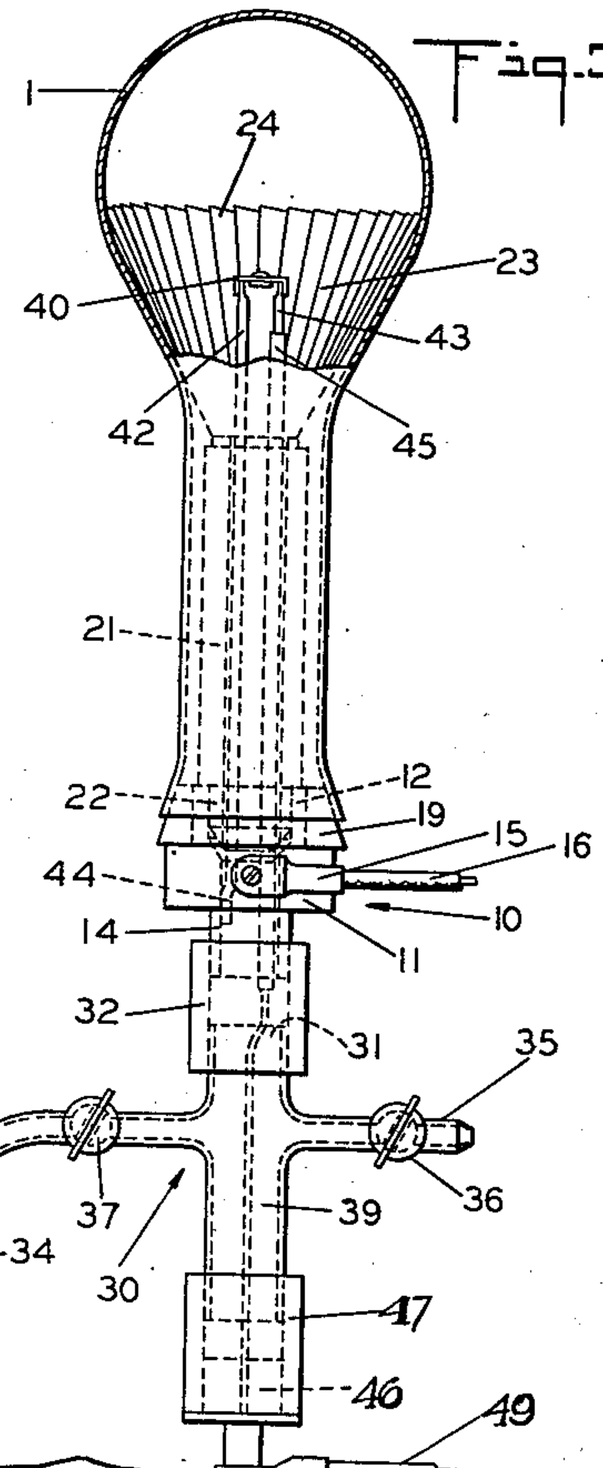

Fig. 4.

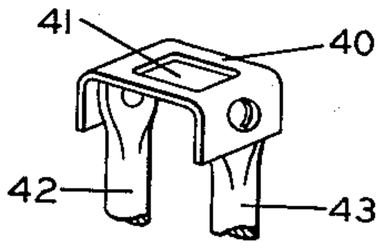

Fig. 5.

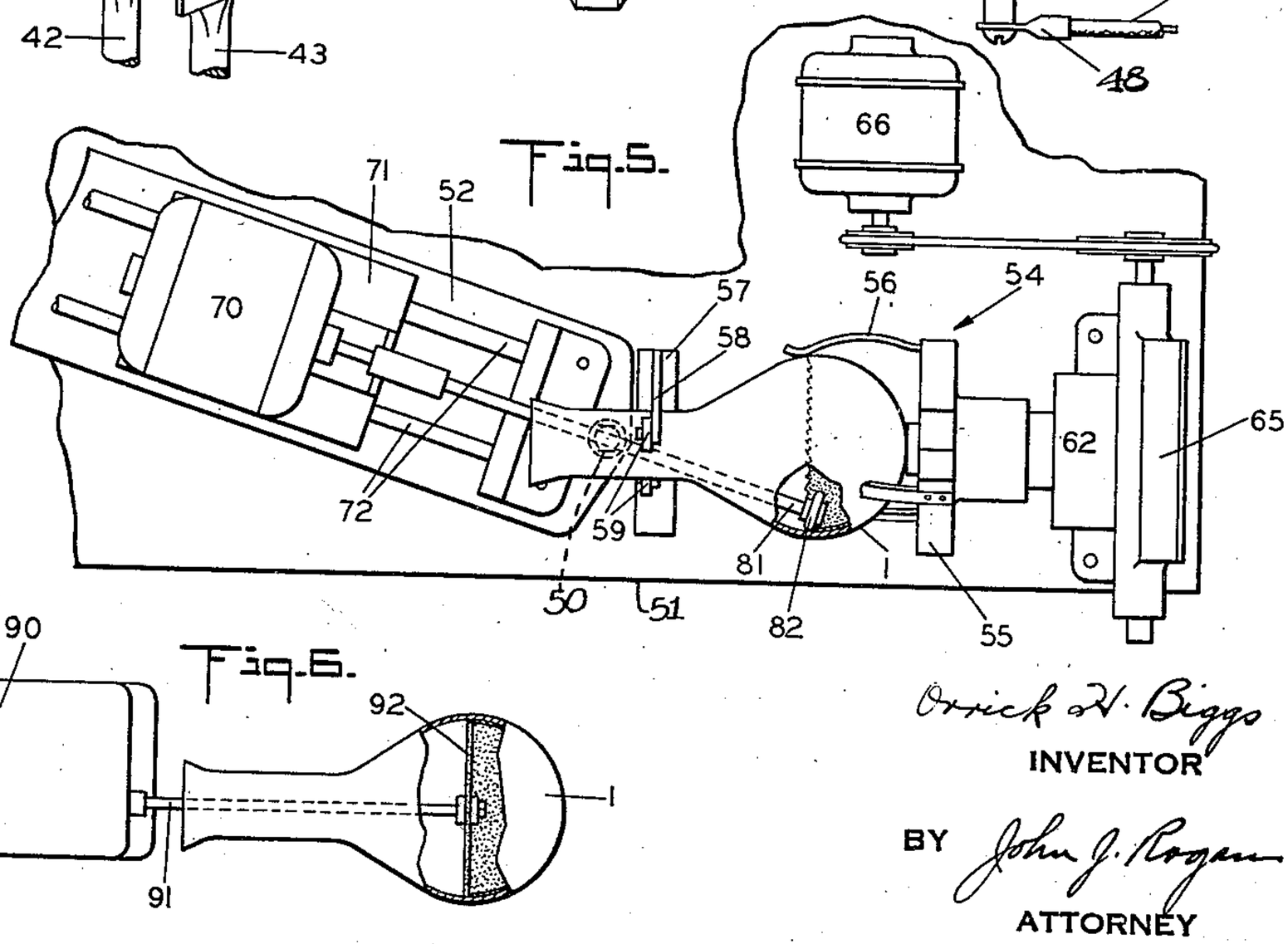

Fig. 6.

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METHOD OF MANUFACTURE OF REFLECTOR BULBS

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8 Claims. (Cl. 91—70)

This invention relates to evacuated or gas-filled vessels, and with particularity to a method of providing such vessels with light-reflecting internal coatings.

In certain of the arts, for example in the incandescent lamp art, it is desirable to provide the lamp with an integral reflector, and for this purpose it has been proposed to cover the outside surface of the lamp with a coating of silver, or even to provide the lamp with a tight-fitting cap. These latter expedients, however, have certain disadvantages which will become apparent from the follcwing descriptions. I have found that a reflecting layer of a specially chosen material covering the inside surface of the lamp bulb is in many respects superior to the prior art reflectors. It is one of the objects of the present invention to provide a vessel, for example the glass bulb of an incandescent lamp, with a firmly adherent and smooth internal coating having a high specular reflection characteristic, which coating is substantially free from contamination during the life of the lamp.

Another object is to provide a method of interiorly coating a vessel with a light-reflecting material confined to a pre-determined localized area on the inner surface of the vessel.

Another object of the invention relates to a method of providing the interior wall of a vessel such as a bulb, with a smooth light reflecting coating of aluminum.

Another object is to provide a method of making bulbs with inside coatings of the kind referred to, in a satisfactory and inexpensive manner, to provide methods and means for evaporating metal, as for example aluminum, within a vessel in order to coat its inside or a well defined part thereof, with a firmly adherent and light reflecting layer of the metal, and to provide operating conditions for this process which permit its practice in the most satisfactory manner.

In certain types of lamps for example, those having a relatively long and restricted neck portion and a spherical or bulb portion, ordinary coating methods are inapplicable to restrict the coating to a section only of the bulb, particularly if the coating is to be deposited by an evaporation process. Accordingly a principal feature of the invention relates to the novel method of coating such lamps with a localized light reflecting coating of a vaporized metal such as aluminum.

Still another object is to provide a stencil or shield which may be conveniently inserted into, and removed from, a vessel having a comparatively narrow neck.

These and other objects and advantages of the present invention will be apparent from the following descriptions of specific embodiments of my new method, and of the article of manufacture obtained therewith, with reference to the drawing in which:

Fig. 1 is a side elevational view, partly in section, of an incandescent lamp made according to my invention;

Fig. 2 is a side elevational view of a lamp bulb, with the neck of the bulb in section, showing how the shield used according to my invention is introduced into the bulb;

Fig. 3 shows a device for treating a bulb according to my invention, with the upper portion of the bulb sectioned, in order to reveal the shield and ribbon filament in operative position;

Fig. 4 is a detail view of the ribbon filament;

Fig. 5 is a plan view of a device for finishing a coated bulb, with a bulb in position; and

Fig. 6 is a plan view of an alternative device for finishing bulbs.

Referring to Fig. 1, numeral 1 denotes the glass bulb, 2 the filament, and 3 the base of an incandescent lamp of any desirable shape, design, color, or other characteristics. The inside of the glass bulb 1 is covered with a firmly adherent thin and smooth coating 4 of light reflecting material, as for example silver or aluminum. Lamps of this type are especially suitable for use in lamp fixtures providing indirect illumination, and, accordingly, Fig. 1 shows the reflecting layer as approximately covering the semi-spherical portion opposite the stem of a spherical lamp. It is, however, understood that any portion of any configuration, of the inside of a lamp of any desired shape or of any vessel generally, may be coated according to my invention.

It is apparent that lamps of this type have the important advantage that the reflecting layer is perfectly protected against any mechanical injury, or against vapors etc., to which exterior coatings are exposed. Further, the rough surface of exterior coverings heretofore employed, becomes easily covered with dust, soot, etc., which being difficult to remove without injuring the reflector, not only spoils the appearance of the lamp, but also renders the installation less efficient due to the presence of an energy absorbing black body near the path of the reflected light. Still another important advantage of the inside coating is the fact that it remains exceptionally cool during operation of the lamp, even cooler than an uncoated lamp of similar rating. This is due to the circumstance that the radiant energy

passes through the glass walls once in the case of an ordinary bulb and twice in the case of an external reflector, whereas my new lamp reflects the rays without permitting them to penetrate the glass at the reflector, so that it remains cool to the extent for example, that a lighted and exposed, inside coated 300 watt lamp may be handled with unprotected hands.

Although the internal coating may consist of any material which adheres firmly to the glass walls and provides a specular reflecting surface, my preferred method of coating bulbs consists substantially in evaporating a substance and condensing the vapors upon the inside walls of the vessel. Silver or any white metal that is capable of high specular reflection is suitable, but aluminum is preferable because it does not discolor to any objectionable degree during certain manufacturing operations, as heating and baking, whereas silver, for example, tarnishes quite easily, probably due to the copper contents of commercial silver, which is the only silver practical for purposes of this kind. I have also found that the color, and therefore the light reflecting characteristics of aluminum, are preferable to those of other metals.

My new process of internally coating bulbs, or vessels generally, of the above described nature, is preferably carried out with the aid of a device shown in Figs. 2, 3, 4. This device is supported by a casting 10 having a body 11 and two extensions 12 and 14, which may be suitably mounted upon a working table by means of an insulated clamp or similar conventional means not herein shown. The body 11 of casting 10 has terminal 15 of an electric lead 16 screwed thereto, and the upper extension 12 is provided with a conical rubber washer 19. A shield structure 20 comprises a sleeve 21 having an extension 22 at its lower end and a substantially conical collapsible shield 23 fastened to its upper end. The shield consists of leaves 24 which may be made of any suitable material, as for example thin sheet metal. The leaves overlap to make the shield tight, and at its apex the shield cone is so fastened to sleeve 21 that the leaves can be contracted, as shown in Fig. 2, permitting the bulb to be slipped over it. The shield being completely inserted, its leaves spread apart so that the approximately circular upper edge of the shield rests against the inside of the bulb wall. The lower extension 22 of shield sleeve 21 fits into extension 12 of casting 10, forming a joint as shown in Fig. 3.

The lower extension 14 of casting 10 is connected to port 31 of an exhaust pump manifold by means of a tube or hose 32. Conduit 34 with cock 37 leads to an exhaust pump, and open conduit 35 with cock 36 connects the manifold with the atmosphere.

A ribbon filament 40, preferably made of tungsten, with a bowl shaped recess 41, is screwed to leads 42 and 43. Lead 42 is fastened to casting 10 at 44 and therefore in electrical connection with conductor 16. Lead 43 has an insulating covering 45, for example of glass, and extends downwardly through casting 10 and tube 32 into extension 39 of the pump fixture, and is fastened to seal 46, which is tightly joined to 30 by means of a rubber tube 47. Terminal 48 of conductor 49 is screwed to seal 46 and therefore in electrical connection with the second lead of the ribbon filament.

With the aid of this device my new method is carried out in the following manner. A lamp bulb or other vessel is first carefully cleaned and dried in order to remove any dust or dirt which might mechanically impair the coating, and also in order to eliminate any harmful substances, as alkalies, which are especially harmful to aluminum films. The metal to be evaporated, as for instance aluminum, is placed on the filament in the form of pellets or small shavings, and the bulb is then slipped over the shield structure, as above described, and pressed against the rubber washer where a vacuum tight joint is established during the following evacuation process. Fig. 3 shows the bulb in this position. The pumps are then started and the bulb exhausted below the glow point, that is, to a vacuum of approximately 10 to 30 microns. During the exhaust period the bulb is heated, for example by means of an open flame, in order to drive out any occluded gases. During this step of the process the temperature of the bulb is approximately 300 degrees Centigrade. When the bulb has cooled slightly, the metal is quickly evaporated by heating the tungsten filament. The filament is heated by applying a sufficiently strong EMF across the leads 16 and 49. I have found that the reflecting film on the inside of the bulb is of superior quality if the evaporating process takes place fairly quickly, for example in approximately five seconds. The hot filament radiates considerable energy, and if maintained at a high temperature for a longer time, other parts of the enclosure might be also heated and release contaminating gases. The metal vapors condense quickly upon the surface of the bulb where it is not protected by the shield, but air should not be admitted until the filament has cooled down, in order to prevent oxidation.

Although the edge of the coating is comparatively well defined, especially if the shield is carefully made and inserted, it is often desirable to remove excess metal in order to straighten the zigzag line which may have been left by the irregular edge of the shield. This finishing step is preferably performed with the aid of a small high speed buffing wheel inserted in the bulb by means of an arrangement shown in Fig. 5. In this figure, 51 is a working table with a motor support 52, fulcrumed at 50, and bulb supporting means mounted thereon. The bulb supporting means comprises a lamp holder 54 with a base 55 and resilient arms 56, and a bulb guide 57 with arms 58 having rollers 59 rotatably mounted upon the ends thereof. Base 55 is mounted on a driving gear journalled at 62 and rotated with suitable speed by any means adapted for this purpose, as for example a worm gear within housing 65 driven by motor 66. The motor 70 has a base 71 sliding upon rails 72 and rotating with support 52 around fulcrum 50. The motor 70 has a shaft 81 with a buffer wheel mounted thereon. As indicated in Fig. 5, the bulb can be easily and quickly fastened in the rotating holder, the shaft 81 can be inserted in the bulb, and the edge of the coating straightened by means of the buffer wheel, which may be conveniently positioned and directed, as will be apparent from Fig. 5 and the above description, without further detailed explanation.

This method of finishing a bulb is quite satisfactory in the case of comparatively thin metal coatings, whereas for thicker films I found that an alternative method is preferable, the arrangement for this method being schematically shown in Fig. 6. In this figure, 92 is a felt disc impregnated with an abrasive, of about the diameter

of the largest section of the bulb, and mounted on a spindle 91 which can be rotated at high speed, preferably about 3500 R. P. M., by means of any suitable drive. Fig. 6 indicates for this purpose a gear box 90 with driving shaft 95. The spindle 91 is long enough to permit insertion of the soft felt disc, which, upon being rotated at high speed, flattens out into a rather hard and stiff structure. The periphery of the disc approximately coincides with the coating edge to be cleaned, and is therefore in constant contact therewith, so that the entire available abrasive surface is always active, which assures speedy and certain action.

It should be understood that the present disclosure is for the purpose of illustration only, and that this invention includes all modifications and equivalents which fall within the scope of the appended claims.

This application is a division of application Serial No. 623,504 filed July 20, 1932.

The following other applications based on said application Serial No. 623,504 have been filed; divisional application Serial No. 182,735, filed December 31, 1937; continuation-in-part Serial No. 114,562, filed December 7, 1936 and continuation-in-part Serial No. 172,397, filed November 2, 1937 and continuation-in-part application Serial No. 183,063, filed Jan. 3, 1938.

I claim:

1. The method of partly coating the inside of a vessel having a bowl portion at one end and a restricted neck at the other end, with a reflecting coating confined to the bowl portion which comprises inserting a shield through the neck portion, expanding the shield to cover all but the bowl portion to be coated, subsequently evaporating a metal within the vessel, condensing the metal vapors to form a coating, collapsing the shield and withdrawing the shield through the neck portion.

2. The method of providing only the bowl portion of a lamp bulb with an interior reflecting coating, which comprises inserting a shield through the neck of the bulb, expanding the shield to cover the part of the bowl which is to be kept uncoated, evaporating a metal within said bulb, subsequently collapsing the shield and withdrawing it through the neck.

3. The method of providing a bowl portion of a constricted neck lamp bulb with a metal coating, which comprises inserting a shield through the neck of the bulb, expanding said shield to cover the portion of the bulb which is to be uncoated, evaporating metal while the shield is within said vessel, condensing the metal vapor upon the unprotected bowl portion and upon the shield, collapsing the shield, withdrawing it through the bulb neck, and removing excess metal along the contours of the coating mechanically.

4. The method as in claim 3, in which the excess metal along the contours of the coating is removed by buffing.

5. The method of providing a lamp bulb having a bowl portion and a neck portion with a metal coating over a part of its surface, the diameter of the cut-off between the coated and uncoated portions being greater than the diameter of the neck of the bulb, which comprises inserting a shield through the neck, expanding the shield to protect the area which is not to be coated, subsequently evaporating a metal within said vessel, condensing the metal on the unprotected portion and on the shield, collapsing said shield, and removing said shield.

6. The method of claim 3, in which the aluminum is evaporated within five seconds.

7. The method of providing a bowl portion of a constricted neck bulb with a metal coating, which comprises inserting a shield through the neck of the bulb, expanding said shield to cover the portion of the bulb which is to be uncoated, evaporating metal while the shield is within said vessel, condensing the metal vapor upon the unprotected bowl portion and upon the shield, collapsing the shield, withdrawing it through the bulb neck, and then removing excess metal along the contours of the coating.

8. The method of coating a part of a bulb with an interior specular reflecting coating which comprises the steps in the order given, of cleaning the bulb surface free of alkalis, evacuating the bulb to a pressure below the glow point, baking the bulb at a temperature of the order of 300° C., inserting an expansible shield within the bulb and then expanding the shield into contact with the bulb surface, evaporating aluminum from a place inside the bulb, condensing the aluminum on the bulb surface except where it is shielded by said shield, and collapsing and removing the shield after the condensation of the aluminum on the bulb surface.

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