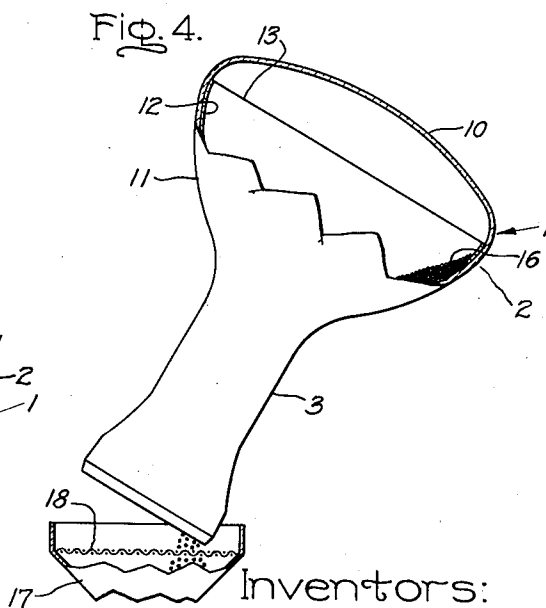
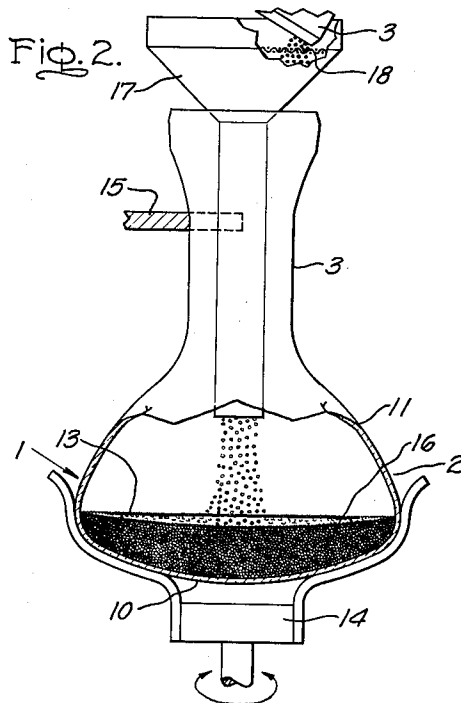
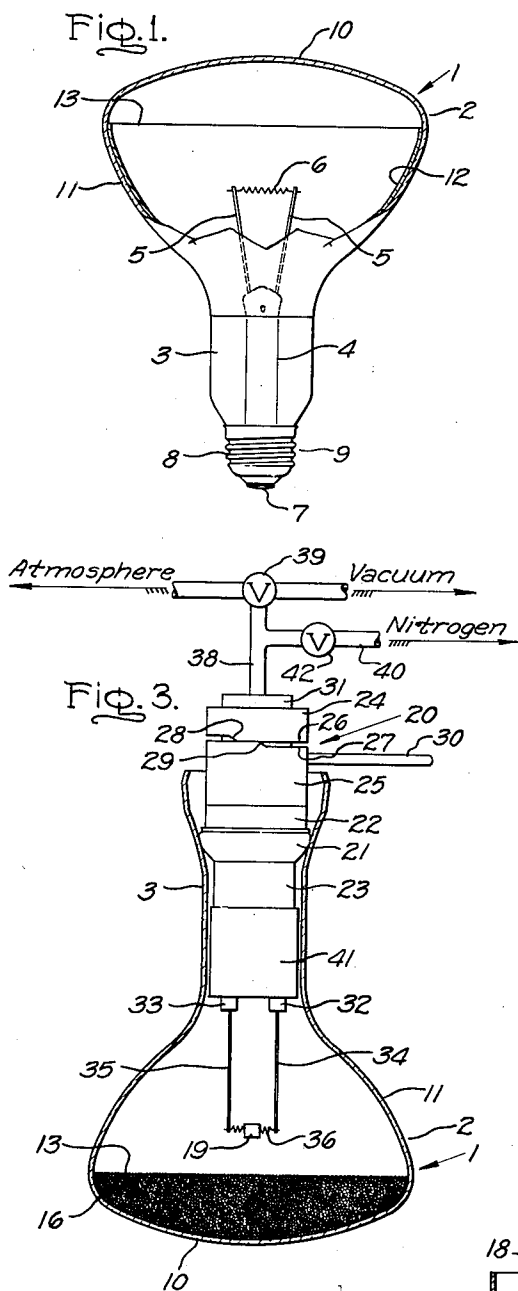


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METHOD OF INTERNALLY COATING LAMP
BULBS WITH REFLECTIVE MATERIAL
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2,733,166

METHOD OF INTERNALLY COATING LAMP BULBS WITH REFLECTIVE MATERIAL

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This invention relates to a process of applying reflective coatings to a selected portion of the inner surfaces of hollow articles, such as lamp bulbs and the like.

Certain types of radiant energy devices, such as heat, spot, flood and sun lamps, employ a glass bulb of the single neck end type having an internal reflective coating on the sidewall portion only of the bulb, the bowl or face end of the bulb being left clear to allow the radiant energy to freely pass therethrough. The most common practice of producing such reflector-coated lamp bulbs is to first coat substantially the entire inner surface of the bulb with the reflective coating material, either by deposition thereof from a solution or by thermal vaporization of the metallic coating material onto the interior wall of the bulb while the latter is in an evacuated condition, and to then remove the metallic coating from the bowl end portion of the bulb, up to a given cut-off line thereon, by a chemical dissolving operation wherein a measured quantity of solvent or acid dissolving solution is introduced in the bulb while positioned neck end up and subsequently withdrawn from the bulb after a short time interval sufficient to effect the dissolving of the reflector coating. A more simplified manufacturing procedure, however, has been proposed in which the bowl end portion of the bulb to be left clear is masked off by a granular masking material, such as fine glass beads, and the coating material then heated and vaporized within the bulb, while the latter is in an evacuated condition, to thereby flash the coating material onto the exposed or unmasked portion of the inner surface of the bulb. The glass beads are subsequently removed from the bulb, as by a pouring operation. The heating and vaporization of the coating material within the bulb is generally effected by an electric heating element, such as a coiled tungsten or molybdenum filament, on which the coating material is either supported or plated so as to be in heat-receiving relation thereto.

With such a glass bead masking type coating process, however, difficulty is encountered in the formation of an electro-static charge between the glass beads and the glass bulb, which causes the glass beads to bounce around in the bulb and become attracted in large groups and to cling to the unmasked sidewall portion of the bulb to which the reflective coating material is to be applied. After the flashing of the coating material onto the exposed or unmasked portion of the bulb wall, these attached groupings of glass beads then drop off the bulb wall and leave pinholes in the reflective coating. Such pinholes are, of course, highly undesirable and render the reflective coating unsatisfactory.

It is an object of our invention, therefore, to provide a novel process of applying a reflective coating to a selected portion only of a glass lamp bulb or similar article, which utilizes glass bead masking material for masking off the portion of the bulb to be left clear and which is effective to produce a reflective coating entirely free of pinholes.

Another object of our invention is to provide a process

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of applying a reflective coating to a selected portion only of a glass lamp bulb or similar article which utilizes glass bead masking material for masking off the portion of the bulb to be left clear and which is characterized by the absence of any electrostatic charge between the glass beads and the bulb and resultant attraction and clinging of the glass beads to the unmasked portion of the inner wall of the bulb to be coated.

Briefly stated, in accordance with one aspect of the invention, the glass beads which are utilized to mask off the portion of the inner wall of the glass bulb or other article to be coated are thoroughly preheated to an elevated temperature of at least approximately 140° C. but below their softening point prior to their introduction into the article to be coated, and are maintained at such elevated temperature during the flashing of the coating material onto the unmasked portion of the bulb wall.

Further objects and advantages of the invention will appear from the following detailed description of a species thereof and from the accompanying drawing.

In the drawing,

Fig. 1 is an elevation, partly in axial section, of an electric incandescent lamp employing a bulb provided with an internal reflective coating produced by the method of our invention.

Fig. 2 is a side elevation, partly in section, showing the first step in the method of our invention wherein a predetermined quantity of preheated glass bead masking material is introduced into the bulb and the latter agitated by rotatively oscillating it about its axis to distribute the masking material over the face end of the bulb which is to be kept clear of reflective coating.

Fig. 3 is a view illustrating the second step in the method of our invention wherein the bulb is evacuated and a reflecting coating flashed onto the unmasked portion of the inner wall of the bulb, and

Fig. 4 is a view illustrating the third step in the method of our invention wherein the glass bead masking material is removed from the bulb.

Referring to the drawings, the invention is therein illustrated as applied to the manufacture of reflecting type glass envelopes or bulbs such as are commonly employed for radiant energy devices such as electric incandescent lamps, infra-red lamps, sun lamps and the like. Fig. 1 illustrates an electric lamp provided with such a reflecting type glass envelope or bulb 1. The said bulb 1 comprises a bowl portion 2 and a neck portion 3 having a reentrant stem portion 4 through which are sealed a pair of leading-in wires 5 which are connected at their inner ends, interiorly of the bulb, to an electric energy translation element 6 such as a coiled tungsten filament. At their outer ends, the leading-in wires 5 are connected to the end or eyelet contact 7 and the side or shell contact 8, respectively, of a conventional type lamp base 9 suitably secured to the neck 3 of the bulb, as by conventional basing cement. The bowl 2 of the bulb is composed of a slightly curved or dish-shaped end face portion 10 and a flaring side wall or reflector portion 11 the inner surface of which is provided with a reflecting coating 12 which may be composed of aluminum, silver, or other reflective metallic material. The end face portion 10 of the bulb is left clear, or is frosted, colored or otherwise suitably treated, to permit passage therethrough of the radiations emitted by the filament or other electric energy translation element 6. As shown, the reflective coating 12 extends from the neck 3 of the bulb up to the region of maximum diameter thereof, at the junction between the end face and side wall portions 10 and 11 of the bulb, where it preferably terminates in a straight, even cut-off line 13.

In producing the reflecting coating 12 on the bulb by the method of our invention, an open neck glass bulb 1 as formed by the bulb-molding machine (i. e. prior to the

sealing into the bulb of the lamp mount comprising the glass stem 4, leading-in wires 5 and filament 6) is preferably, although not necessarily, initially preheated to a temperature of the order of 450° C. to 500° C. and supported in upright neck-up position, as shown in Fig. 2, in a suitable holder 14 which is adapted to be rotated or oscillated by suitable means (not shown) so as to rotate or oscillate the bulb about its axis, a supplementary support 15 holding the bulb neck in upright position but unrestrained against rotation. A measured quantity 16 of granular masking material in the form of fine glass beads, thoroughly preheated to an elevated temperature of at least approximately 140° C. but below their softening point, is then poured into the bulb as shown in Fig. 2 and distributed therein, preferably while being poured, by oscillating the bulb holder 14 so as to cause the masking material 16 to be evenly distributed or leveled over the bottom or end face portion 10 of the bulb by centrifugal force, to a predetermined even cut-off line as indicated at 13. Instead of rotatively oscillating the bulb 1 to level the glass beads therein, the bulb may be agitated in any other suitable manner which is effective for such purpose, as by tapping or vibrating the bulb.

The glass beads 16 may be of any suitable commercial grade having a more or less uniform size within the range of from approximately .008 to .020 inch in diameter and preferably .011 to .013 inch in diameter. For a given size of glass bead within the above specified range, however, the variation in the particle size of the glass beads is preferably maintained within approximately 0.003 inch in diameter. The glass bead masking material 16 may be introduced into the bulb 1 through a funnel 17 inserted in the bulb and having a screen 18 thereacross for screening out any foreign matter in the glass beads being introduced into the bulb. The preheating of the glass beads 16 in accordance with the invention to a temperature of at least 140° C. but below their softening point eliminates the electrostatic charge which otherwise would be present between the beads and the glass bulb and which would cause the glass beads to jump around in the bulb and be attracted in large groups to the unmasked sidewall portion 11 of the bulb to be coated and to cling thereto where they would then produce pinholes, as pointed out above, in the reflector coating 12 to be subsequently applied to the inner surface of the bulb sidewall 11. For the purposes of the invention, the glass bead masking material 16 should be thoroughly heated, as by means of an electric oven for instance, so that each glass bead is heated throughout to the said minimum operating temperature of at least approximately 140° C.

With the heated glass bead masking material 16 distributed in proper masking position over the bottom or end face portion 10 of the bulb 1 as described above, the bulb is then evacuated while held in upright neck-up position and a metallic coating 12 of aluminum, silver or other reflective metal then applied to the unmasked sidewall portion 11 of the evacuated bulb by heating and vaporizing a small quantity 19 of the coating material disposed within the bulb. For such purpose, the bulb 1 may be placed over and held in upright neck-up position on a combination bulb exhausting and coating head 20 as shown in Fig. 3. The said bulb exhaust head 20 may be of the general type disclosed in co-pending application Serial No. 276,494, Reynolds et al., filed March 14, 1952, and assigned to the assignee of the present invention, and comprises a compression rubber chuck consisting of an expansible rubber ring 21 which is compressed between upper and lower clamp rings 22 and 23, respectively, to thereby expand it against the inside wall of the bulb neck 3 so as to form a vacuum-tight seal therewith and thus close off the interior of the bulb from the atmosphere. The upper clamp ring 22 is lowered relative to the lower clamp ring 23, to thereby compress the rubber ring 21, by means of upper and lower cam rings 24 and 25, respectively, having abutting faces 26 and 27 formed with in-

clined cam surfaces 28 and 29, respectively, which act to lower the lower cam ring 25 upon rotation thereof relative to the upper cam ring 24. The lower cam ring 25 is provided with an operating lever 30 which projects laterally outward therefrom and which serves to impart rotational movement to the lower cam ring 25 in one direction to compress the rubber ring 21 and in the other direction to release the compression of the said rubber ring. The compression rubber ring 21, clamp rings 22, 23 and cam rings 24, 25 are all mounted on a central tube 31 which extends through the said rings and provides an exhaust passageway extending through the exhaust head 20 and leading to the lower end thereof and into the bulb 1 when mounted thereon. The upper cam ring 24 and the lower clamp ring 23 are fixedly fastened in place on the said tube 31.

At its lower end, the exhaust head 20 is provided with a pair of sleeve-type electric socket contacts 32 and 33 which receive the two ends of a pair of current supply or support wires 34 and 35 across which is connected an electric vaporizer element 36 comprising a coiled filament of suitable refractory metal wire, such as tungsten or molybdenum, on or in which is supported a short piece or strip 19 of aluminum, silver or other metal to be flashed onto the bulb. A desirable material for such purpose is crimped aluminum ribbon. Instead of employing a strip or ribbon 19 of the coating material on the vaporizer element 36, the said coating material may be plated on the vaporizer element, as disclosed in U. S. Patent 2,660,540, Karash et al., dated November 24, 1953. Suitable electrical connections (not shown) to the socket contacts 32 and 33 are provided on the exhaust head 20 for connecting the filament 36 to a suitable source of electric power. At its upper end, the exhaust tube 31 of the exhaust head is adapted to be connected, through a connecting tube 38 and valve means 39, either to a suitable source of vacuum or vented to the atmosphere. The said exhaust tube 31 is also adapted to be connected to a source of nitrogen supply through a valved nitrogen supply line 40. At its lower end, the exhaust head 20 is additionally provided with a cylindrical shield 41 for masking off the neck portion 3 of the bulb to a region adjacent or just short of its junction with the side wall portion 11 of the bulb, as shown.

The operation of the exhaust head 20 to flash the coating material 37 onto the inner surface of the bulb 1 is as follows: With the exhaust head 20 closed off from the nitrogen supply line 40 by the valve 42 therein, the exhaust head is then connected to the vacuum line, by the operation of the control valve 39, to initiate the evacuation of the bulb. When the bulb attains the degree of vacuum required for satisfactory operation of the reflector flashing process, as determined by a suitable vacuum gauge (not shown) connected to the exhaust tube 31 of the exhaust head 20, the electrical circuit to the vaporizer element or filament 36 is closed to energize and heat the filament which then vaporizes the strip of reflector coating material 37, causing it to condense and deposit on the unmasked sidewall portion 11 of the inner surface of the bulb so as to form a reflecting coating 12 thereon. Upon completion of the reflector coating flashing operation, the filament 36 is dennergized and the bulb then flushed with nitrogen from the nitrogen supply line 40, by operation of the control valve 42, to cool the filament without oxidizing it, so that it will be at a sufficiently low temperature so as not to oxidize upon subsequent exposure to the atmosphere following the removal of the bulb from the exhaust head 20. When the filament 36 is thus sufficiently cooled, the bulb 1 is then vented to the atmosphere by the operation of the valve 39, after which the compression rubber chuck 21 is opened by the operation of the lever 30 to release the bulb 1 which is then removed from the exhaust head.

Following the flashing of the reflector coating 12 onto the bulb, the glass bead masking material 16 is then re-

moved from the bulb. This may be accomplished simply by pouring the said material out of the bulb, as shown in Fig. 4. Because the reflector coating 12, as formed by a flashing operation such as described above, is in a dry state practically as soon as it is deposited on the bulb wall, the glass bead masking material 16 can therefore be poured out of the bulb, directly over the freshly applied reflector coating thereon, without any harmful scratching or marring of the coating. If at the time it is removed from the bulb, the glass bead masking material 16 is at a temperature above the previously mentioned minimum operating temperature of at least 140° C., then in such case it may be poured from the coated bulb 1 directly into another bulb to be processed, through a funnel 18 inserted therein.

Inasmuch as the bulbs 1 to be processed are preferably initially preheated to an elevated temperature of at least 450° C. or thereabouts, very little cooling of the glass bead masking material 16 in the bulb then occurs between the time the material is first introduced into the bulb and subsequently removed therefrom upon completion of the bulb coating operation. As a result, where the glass bead masking material 16 is initially preheated, at the start of operation, to a temperature of around 200° C. or above in accordance with the preferred practice of the method of our invention, wherein the bulb 1 is also preheated to a temperature of at least 450° C., then the said material will remain at a temperature above the previously mentioned minimum operating temperature of at least 140° C. for a prolonged period of time (four or more hours), thus enabling the continued reuse of the glass bead masking material 16 for coating successive bulbs without the necessity of reheating the same.

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

1. The method of producing a reflective coating on a selected portion of the inner surface of a hollow glass article having a single open neck end, which method comprises introducing into the article a predetermined quantity of granular masking material comprising fine glass beads heated to a temperature of at least approximately 140° C. but below the softening temperature thereof, agitating the article to distribute the said glass beads so as to form an even masking-off line around the article, exhausting said article to produce a vacuum therein, heating a quantity of a vaporizable metallic coating material within the said article, while the said beads are maintained in their said heated condition, to thereby flash the said coating material onto the exposed portion of the inner surface of the article unmasked by the said

glass beads, and thereafter removing the glass beads from the said article.

2. The method substantially as set forth in claim 1 wherein the said glass beads have an approximately uniform particle size within the range of from approximately .008 inch to .020 inch in diameter.

3. The method of producing a reflective coating on a selected portion of the inner surface of a hollow glass article having a single open neck end, which method comprises heating the glass article to a temperature appreciably above 140° C. but below the softening temperature thereof, introducing into the article a predetermined quantity of granular masking material comprising fine glass beads heated to a temperature of at least approximately 140° C. but below the softening temperature thereof, agitating the article to distribute the said glass beads so as to form an even masking-off line around the article, exhausting said article to produce a vacuum therein, heating a quantity of a vaporizable metallic coating material within the said article, while the said glass beads are maintained in their said heated condition, to thereby flash the said coating material onto the exposed portion of the inner surface of the article unmasked by the said glass beads, and thereafter removing the glass beads from the article.

4. The method of producing a reflective internal coating on the sidewall portion only of a glass lamp bulb having a single open neck end, which method comprises heating a bulb to an elevated temperature of several hundred degrees C. but below the softening temperature thereof, introducing into the bulb a predetermined quantity of fine glass beads heated to a temperature of at least approximately 140° C. but below the softening temperature thereof, said glass beads having a uniform particle size within the range of from approximately .011 inch to .013 inch in diameter, agitating the bulb to distribute the said glass beads so as to mask off the bowl end portion of the bulb and form an even masking-off line therearound, exhausting the bulb to produce a vacuum therein, heating a quantity of a vaporizable metallic coating material within the said bulb, while the said glass beads are still in their said heated condition, to thereby flash the said coating material onto the exposed sidewall portion of the inner surface of the bulb, and thereafter removing the glass beads from the bulb.

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