March 21, 1939. C. BIRDSEYE ET AL 2,151,649

MAKING REFLECTING LAMPS

Filed Nov. 9, 1935

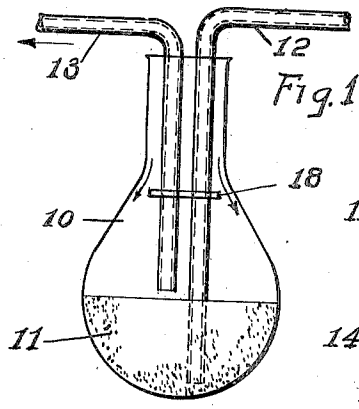


Fig. 1.

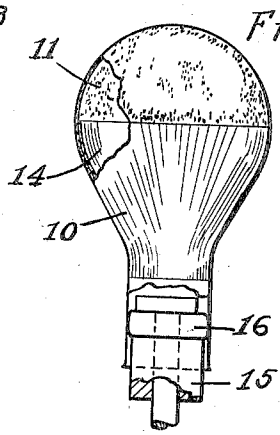


Fig. 2.

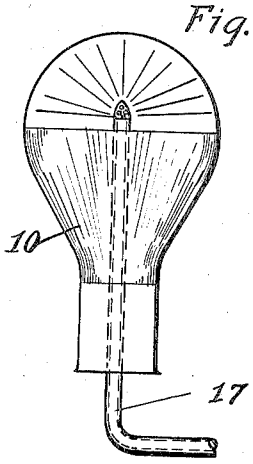


Fig. 3.

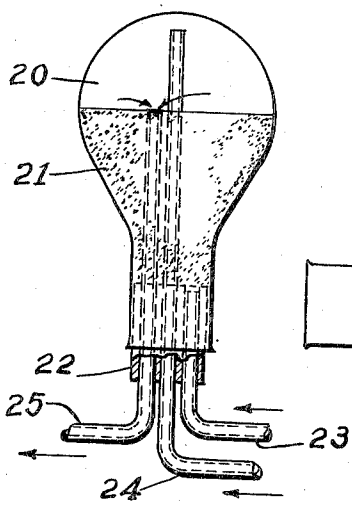


Fig. 4.

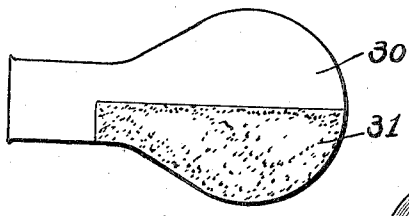


Fig. 5.

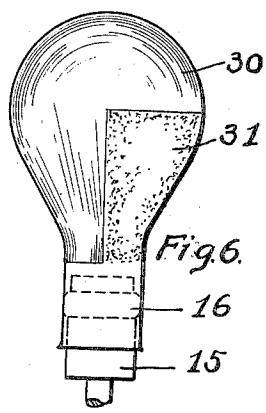


Fig. 6.

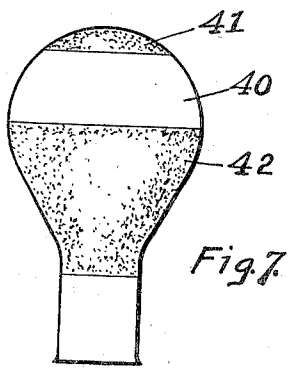


Fig. 7.

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MAKING REFLECTING LAMPS

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Application November 9, 1935, Serial No. 49,047

9 Claims. (Cl. 91—69.1)

This invention consists in improvements in the manufacture of electric lamps which have a reflecting medium applied to a predetermined portion of the bulb area. One important field of use of our invention is in the production of lamp bulbs silvered in accordance with the process of the copending application of Pincus Deren, Serial No. 42,227, filed September 26, 1935, and for purposes of illustration the invention will be described in that connection, although it will be understood that it is not limited in its scope to use in connection with a silvered coating or any other specific reflecting medium.

In the production of a lamp bulb having a part of the internal surface silvered, or in any other manner given reflecting properties for the purpose of directing the light so that a larger part is available in the useful field, the part of the bulb not acting as a reflector should be entirely clear of the reflecting medium so that the direct light, as well as the reflected light, may be transmitted efficiently through the clear parts of the bulb. Heretofore it has been the practice in applying a silvered reflecting surface to the inside of a bulb to form a silver deposit uniformly over practically the entire bulb surface, and then to remove the deposit by either mechanical or chemical means from areas where the silver is not required. It has been considered inexpedient to deposit silver only in selected areas because in forming a satisfactory silver coating it is desirable to maintain the silver depositing solution in motion in order to secure a smooth, fine coating of substantially uniform thickness.

With these problems in mind, the present invention contemplates the employment of a masking medium capable of restricting the silver deposit to selected, predetermined areas which may be defined by the masking medium. There are particular difficulties and definite requirements to be met in masking a part of the bulb area preparatory to a silvering operation and these must be well understood and appreciated if satisfactory results are to be attained. A consideration of these factors will make the particular value of the present invention more readily apparent.

The masking coating applied to a selected area of the inside surface of a specially cleaned and prepared bulb ready for silvering must adhere firmly to the glass of the bulb so that a silvering solution flowing or whirling thereover will not remove small flecks or particles from it. It must produce a sharp line of demarkation and once this boundary line is established it must not tend to creep in either direction. The finally deposited masking coat itself should not have an appreciable vapor pressure that will permit even a trace of the masking medium to condense upon the parts of the bulb to be subsequently silvered, since such traces, if present, would act as impurities upon the glass and produce a surface to which the silver coating will not adhere in a satisfactory manner. Since a melted masking material, or a solution of a masking material in organic solvent, will have an appreciable vapor pressure, we prefer to rinse or scavenge the bulb continuously with air during the application of such masking material. The masking medium also should be of such a character and applied in such a manner that it forms a continuous surface coating over the glass, substantially free from pinholes, that is, it must have relatively low surface tension and tend to wet the glass uniformly over its surface.

The present invention contemplates the employment of a masking medium which is very readily soluble in a suitable solvent or applicable in a melted state. It is essential that the medium be relatively solid or non-flowing after it has been applied. It must also be readily removable after the silvering operation has been completed without in any way injuring or darkening the silver coating and preferably without the use of expensive and dangerous organic solvents. The masking medium, moreover, must not be affected by the silvering solution itself during the silvering operation and since such solutions might contain a caustic alkali, saponifiable or acidic materials of themselves are not generally useful.

Beyond these considerations, from the practical standpoint of economical production, it is desirable that a very thin coating of masking medium should function in a satisfactory manner, not only so that a small amount may be used, but so that the time factor for cooling or drying will be short. From the same standpoint, the masking medium and the vehicle and the solution used to remove the coating must be carefully chosen so that even the least trace of this foreign material is completely removed from the bulb. Impurities of chemically active sulphur compounds should be avoided because of the darkening effect on the silver deposit.

With these considerations in mind we have found it possible to employ as a masking medium materials that may be dissolved in alcohol, or in hydrocarbons of high flash point or in a chlorinated solvent which is non-inflammable; but we prefer materials which not only can be applied to the bulb surface in the molten state and so

avoid the use of any solvent at this point of the operation, but which can be removed from the surface of the bulb following the silvering operation without the use of organic solvents, and by using a water solution of alkalies and emulsifying agents.

Not only are organic solvents expensive and often dangerous from a fire and health standpoint, but a considerable period of time is required to remove them from the masking coating before carrying out the silvering operation. Moreover, with materials that cannot be readily removed by alkaline water solutions, and where organic solvents must be employed, it is necessary to rinse out the bulb several times with the fresh solvent in order to remove the last traces of the masking material; and even then it is in most cases necessary to wash the bulb with a warm water solution of an alkali or emulsifying agent to be certain that every trace of both solvent and masking material is completely removed.

In cases where volatile solvents are used in the application of the masking material, as, for example, a benzol and alcohol solution of gum damar, or an alcohol solution of beeswax, or carbon tetrachloride solution of high melting point paraffin wax, or in all cases where we use a molten material—such, for example, as paraffin containing a small amount of beeswax or rosin, and in general whenever the material itself or the mixture used has an appreciable vapor pressure under the conditions of use, we prefer to remove such vapors continuously as long as the solution remains in the bulb by aspirating air into the bottom of the bulb, and in such a manner that the vapors are diluted and prevented from coming in contact with the walls of the bulb on those areas later to be covered with a silver coating.

In our preferred method for industrial applications of this invention, we use a base material, such as paraffin, and adjust certain of its properties by adding small amounts of other materials, such as gum damar. Paraffin itself has certain of the desired properties—it is cheap, inert chemically, free from troublesome impurities, is not markedly crystalline and so does not tend to develop cracks between crystals when cooled in thin layers, it melts at a convenient temperature, it can be readily removed with organic solvents and, if care is exercised, it can be removed by hot solutions of alkalies. However, it tends to be greasy and may not always adhere sufficiently well to the glass to withstand the vigorous agitation of the silvering solution.

We have found that paraffin—preferably of relatively high melting point, about 135° F.—that has been first melted and mixed with from 1% to 5% by weight of dewaxed gum damar will form a satisfactory masking material if applied in the following manner. The bulb surface must be scrupulously clean and ready for silvering, as described in the application above identified, and then the melted mixture is carefully allowed to enter the bulb, which is held rigidly in the desired position. If the temperature of the mix is too low, too thick a coating will result, even if the bulk of the molten mixture is withdrawn immediately. If too hot and immediately withdrawn, the coating will be too thin. Moreover, since the glass bulb is generally cooler than the melted mixture, some of the mixture on entering the cooler bulb tends to solidify at once, and under these conditions may trap a thin film of air between the solidified mixture and the surface of the bulb. Poor adhesion will always occur at these points, unless the temperature of the mix and the time that the full amount of melted mix is allowed to remain in the bulb is sufficient to remelt those parts of the mix which solidified prematurely. That is, if the temperature of the mix is between 160° F. and 190° F. for a 130° F.—melting point paraffin, when it enters the bulb, although some premature solidification will occur, the solidified compound will again melt after perhaps 60 seconds standing. As soon as the mix is uniformly melted the bulk of the material may be withdrawn from the bulb. The film left on the masked areas will rapidly cool and harden and will be of proper thickness and of adequate tackiness to adhere without flecking off during the silvering operation.

We have found that the temperature of application of the mix must be high enough to remelt all of any prematurely solidfied material formed when it first enters the cool bulb, and low enough so that a film of adequate thickness is left on the bulb surface.

The base material of the mix may be any other inert wax, easily removed preferably by hot alkalies, which does not markedly tend to crystallize, such as ceresine or carnauba wax for example.

Instead of the gum damar, of the example above, any other tacky resinous material may be used which will be readily miscible with the hot melted base material chosen and which will remain either molten and miscible or which on cooling may separate out as a minute dispersion of fine globules in the base material, provided even in this state it remains tacky, such as common rosin or copal or sandarac, for example.

These gums are generally of acidic nature and not only are they of use in the matter of rendering the base material more adhesive, but they appear to assist the hot alkaline solution in removing the masking film after the silvering operation. We have been able to remove thin layers of paraffin from bulbs masked in the manner by shaking vigorously for a period with a hot solution, say 10%, caustic soda. However, the time required and the amount of shaking is much reduced if the base material contains a few per cent of one of these acidic gums. This is probably because the caustic attacks the acidic components and produces a small amount of a resin soap which aids the hot caustic in forming a crude emulsion of the softened or even melted mix. Much soap is undesirable since it is difficult to remove the final traces by rinsing with water. This is also true of a caustic solution, and we have found it desirable, after removing by preliminary continuous rinsings most of the caustic to rinse with a very dilute nitric acid solution—½ of 1% for example. Final rinsing of the neutralized surface of the glass with water is rapidly accomplished.

The invention will be more fully understood and appreciated from the following description of several specific examples of ways in which it may be carried out in practice as illustrated in the accompanying drawing, in which—

Fig. 1 is a view in elevation of a bulb in position for the application of a masking coat.

Fig. 2 is a similar view of the same bulb inverted and positioned for the silvering operation.

Fig. 3 is a similar view of the bulb in position for the removal of the masking coating.

Fig. 4 is a view in elevation of a bulb in po-

sition for the application of a masking coat to another portion of its surface.

Fig. 5 is a view in elevation of a bulb in horizontal position having a masking coat applied to a longitudinal portion thereof.

Fig. 6 is a view similar to Fig. 2, showing the bulb of Fig. 5 in position for the silvering operation, and

Fig. 7 is a view in elevation of a bulb having a masking coat applied to separate areas.

In Figs. 1–3 are illustrated steps of applying a silver reflecting coating to a bulb in an area extending from its line of maximum diameter to a line in its neck. In applying the masking coat the bulb **10** is positioned neck up as shown in Fig. 1 and masking solution is admitted to the bulb through the tube **12** until it rises to the desired level, in the illustrated example, to the line of maximum bulb diameter. The solution in the present instance may be a compound of paraffin with 3% by weight of gum damar and is supplied in melted condition and at a temperature approximating 180° F. This temperature is sufficient to cause remelting of any of the compound which may be chilled and solidified by contact with the cool bulb so as to insure the presence in the bulb of a completely liquid body. As soon as the masking compound has reached the desired level it is at once drawn off through the tube **12**, leaving a thin film **11** of the compound firmly adhering to the inner surface of the glass bulb in the selected area.

In order to prevent any vapor of the masking compound from condensing upon the walls of the bulb **10**, it is desirable to provide a second tube **13** terminating just short of the desired level of the masking compound, and to suck air continuously through this tube from the interior of the bulb during the application of the masking coating. This tends to draw in sufficient air along the walls of the bulb, diluting any vapor which may be formed and carrying it out from the bulb. Preferably a baffle or deflecting disk **18** may surround the tubes **12** and **13** to deflect the incoming air toward the walls of the bulb. It will be seen that a scavenging condition is maintained within the bulb while it contains any masking compound which is likely to vaporize. Of course the scavenging operation may be carried out in any other suitable manner, the important thing being to maintain the surface of the bulb scrupulously clean from any trace of foreign material in the area to be subsequently silver coated.

Having applied the masking coat **11** to the bulb **10**, a predetermined amount of a cool alkaline silver depositing solution is admitted thereto and the bulb is stoppered and inverted as shown in Fig. 2. For this purpose it is convenient to utilize a combined stopper and support comprising a standard **15** and a compressible washer **16**. A combined rotary and longitudinal movement is now imparted to the bulb causing the silver depositing solution to slosh or whirl upwardly in the bulb and coat the unmasked area thereof. The manner of accomplishing this step may be varied as desired, although we prefer to use the procedure outlined, in that it is effective to form a uniform silver coating free from pin holes and tightly adherent to the glass of the bulb.

As indicated in Fig. 2 the silver coating **14** extends from the neck of the bulb up to the line of maximum bulb diameter where it is terminated by the edge of the masking coat **11**. The silver may or may not deposit to some extent upon the masking coat, but this is not important since the masking coat is now to be removed from the bulb together with any silver which may adhere to it.

The step of removing the masking coat is indicated in Fig. 3 wherein the bulb **10** is shown in inverted position upon a rinsing tube **17** having a spray nozzle at its upper end. For the removal of the masking coat we prefer to use a hot solution of 10% caustic soda. This is effective to entirely remove the masking coat and all traces of the masking compound from the bulb leaving only the silver coating in the definitely selected area determined by the prior application of the masking coating.

The reflecting lamp shown in Fig. 3 is intended particularly for direct lighting, its luminous field being limited by the silver coating and reinforced by the reflection of rays which would otherwise be lost in the upper part of the bulb.

In Fig. 4 we have illustrated one way of applying a masking coat to an inverted bulb up to its line of maximum diameter, in those cases where the reflecting coating is subsequently to be applied to the curved end of the bulb. In those instances the inverted bulb **20** is provided with a stopper **22**, through which enter three tubes **23**, **24**, and **25**. The masking solution or compound may be admitted through the tube **23** which terminates at or below the inner face of the stopper **22**. The tube **25** may be adjusted to act as an overflow and scavenging pipe and by its height to determine the exact level of the masking compound in the bulb. The tube **24** serves to admit air under low pressure and as will be apparent this will flow across the surface of the bulb tending to keep it free of vapor and then out through the tube **25**. The melted compound is allowed to stand in the bulb for a few seconds and then immediately drawn out through the tube **23** leaving a masking coat upon the selected area of the bulb as in the case above described.

It will be noted that the area covered by the masking coat may be modified by tipping the bulb while the coating is contained therein; for example, by tipping the bulb shown in Fig. 4 successively in four directions, the line of the masking coat may be curved in four lobes instead of terminating in a horizontal plane.

In Fig. 5 is suggested an application of a masking coat **31** to a bulb **30** which is shown in the horizontal position. It is obvious that the coating **31** may be applied by the general methods above disclosed, or in some cases it may be applied with a brush or swab.

In Fig. 6 is suggested the step of applying the silver coating to the portion of the bulb **30** which was left unmasked.

In Fig. 7 is shown a bulb **40** having a masking coat applied to separate selected areas. In this case the coating **41** in the end of the bulb may be applied in the manner suggested in Fig. 1 and then, as a supplementary step, the coating upon the zone **42** may be applied in the manner suggested in Fig. 4. In silvering the bulb thus prepared a peripheral reflecting zone corresponding to the clear band **40** may be formed in the bulb.

It will be apparent that we have illustrated only a few ways of applying a masking coating to selected areas of a lamp bulb and have referred only to a few compounds or solutions suitable for this purpose. It is contemplated however, that wide variation and modification may be made in accordance with the requirements of innumerable

special cases encountered in designing reflecting lamps for a great variety of uses.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. The process of making reflecting electric lamps, which includes the steps of applying to portions of a bulb a masking solution containing components having appreciable vapor pressure under the conditions employed, and withdrawing air from the bulb until the masking medium has solidified therein, thereby preventing condensation on the uncoated inner surface of the bulb.

2. The process of making reflecting electric lamps, which is characterized by the steps of admitting a masking solution to a predetermined level in a bulb, then withdrawing excess solution leaving a film thereof upon the walls of the bulb up to said level, and meantime scavenging the interior of the bulb to remove vapor of the solution therefrom and prevent condensation on the uncoated inner surface of the bulb.

3. The process of making reflecting electric lamps, characterized by the steps of admitting to and withdrawing from a bulb a hot liquid masking medium comprising an inert wax containing a small proportion of an acidic resin, thus forming a masking film upon portions of the bulb surface, then admitting a silver-depositing solution to the bulb and finally removing the masking film by a hot alkaline solution.

4. The process of making reflecting electric lamp bulbs, which includes the steps of forcing into the interior of a bulb a predetermined quantity of melted wax compound at a temperature substantially above its melting point, and immediately withdrawing the excess while removing vapor from the bulb.

5. The process of making reflecting electric lamp bulbs, which includes the steps of chemically cleaning the inner surface of the bulb, inserting two tubes into the neck of said bulb, forcing through one of said tubes into the interior of said bulb a predetermined quantity of melted wax compound at a temperature substantially above its melting point, and immediately withdrawing the excess by means of the other of said tubes, while removing air and vapor from the interior of said bulb, silvering the unwaxed inner surface of said bulb while violently agitating the same, and finally removing the wax film by a hot alkaline solution.

6. The process of masking a portion of the inner surface of an electric lamp bulb, which includes the steps of supporting said bulb neck down, closing the neck of the bulb, inserting a first tube in said bulb above a predetermined level, forcing into the interior of said bulb through a second tube a melted wax compound at a temperature substantially above its melting point and in quantity more than sufficient to bring the exposed surface thereof above said level, admitting air into said bulb through said first tube while withdrawing air, wax vapor, and excess melted wax by a third tube inserted in the neck of said bulb and reaching to said predetermined level, whereby an exact liquid level is maintained in said bulb, and whereby condensation of wax vapor on the inner walls of said bulb is minimized, and withdrawing the excess of said melted wax compound.

7. The process of producing a reflector upon the inner surface of an electric lamp bulb supported in any position, from its lowest point to any predetermined line, which includes the steps of inserting a tube through the neck of said bulb, placing the open end of said tube adjacent said lowest point of said bulb, forcing a melted wax compound through said tube, into said bulb up to a predetermined level in said bulb, and withdrawing all but a masking film of said melted wax compound through said tube, and then coating the unmasked area of the bulb with a reflecting medium.

8. The process of making reflecting electric lamps characterized by the steps of filling the bowl end of a bulb with a hot masking solution, withdrawing all but a masking film of the solution, filling the bulb from its neck end to approximately its line of maximum diameter, withdrawing all but a masking film of the solution as before, and finally applying a metallic reflecting coating to the bulb area bounded by the separate masked areas thus produced.

9. The process of making reflecting electric lamps, characterized by the steps of successively filling different portions of the bulb with a masking solution to cover separate areas spaced from each other upon the inner surface of the bulb and successively withdrawing all but a masking film of the solution, meanwhile scavenging the interior of the bulb to prevent condensation on its uncoated area, and then applying a reflecting coating to the area set off by said masked areas.

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