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**Electric lamp and method of manufacturing same.**

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Description

The invention relates to an electric lamp provided with:
- a translucent lamp vessel having an axis and an end portion,
- a light source in the lamp vessel,
- a lamp cap comprising a sheath portion and a base portion, in which an end portion of the lamp vessel is fixed by means of a thermoplastic synthetic resin in that the latter has adhered both to the lamp vessel and to the lamp cap, said lamp cap having an electric contact to which a current supply conductor to the light source is connected.

The invention further relates to the manufacture of such a lamp. Such a lamp is known from GB-A-1 380 720.

In the known lamp, the lamp cap is fixed to the lamp vessel by means of a synthetic resin, for example a thermoplastic synthetic resin of the kind of which in this known lamp the lamp cap consists, i.e. a polysulphone or a polyketone. A ring of this polymer is arranged to surround the end portion of the lamp vessel and is caused to melt. Subsequently, the lamp cap is provided and a butt joint is obtained between the lamp vessel and the lamp cap by cooling the assembly.

It has been found that with the use of a said synthetic resin lamps are obtained which do not satisfy the IEC standard. Especially the adhesion of the polymer to the lamp vessel is too poor for the requirements imposed on the torsional strength of the connection between the lamp vessel and the lamp cap.

The invention has for its object to provide an electric lamp of the kind mentioned in the opening paragraph which can readily be manufactured and of which the connection between the lamp vessel and the lamp cap has an improved torsional strength.

According to the invention, this object is achieved in an electric lamp of the kind mentioned in the opening paragraph in that polyetherimide is used as the thermoplastic synthetic resin.

In a favourable embodiment, the synthetic resin connects in radial directions, i.e. directions transverse to the axis of the lamp vessel, the end portion of the lamp vessel to the lamp cap. This embodiment is advantageous because in this case there is a comparatively large surface of application for the synthetic resin both to the lamp vessel and to the lamp cap. Moreover, size differences in these components are then more readily neutralized and the lamp cap can be more readily positioned correctly coaxially to the lamp vessel. The lamp vessel, the synthetic resin and the lamp cap are then arranged substantially coaxially.

The torsional strength of the connection between the lamp vessel and the lamp cap is even considerably larger if the end portion of the lamp vessel has a projection which extends transversely to the axis of the lamp vessel and projects into the synthetic resin. Such a projection neutralizes shearing forces in the interface between the lamp vessel and the synthetic resin. The uniformity of the forces in this interface is large if several, for example two or more, of such projections are distributed along the circumference of the end portion. Such projections are readily obtained during the operation in which the end portion of the lamp vessel is shaped. This operation is a normal step in the manufacture of conventional lamps of which the lamp vessel is fixed in the lamp cap by means of cement.

Such an effect on the torsional strength is obtained if the end portion of the lamp vessel is unround in a different manner, i.e. is non-circular in cross-sections transverse to the axis of the lamp vessel. The end portion may be, for example, oval in cross-sections or may have one or more depressions, for example transversal or axial grooves, in which the thermoplastic synthetic resin has adhered and which are filled with this synthetic resin. The projections mentioned in the preceding paragraph have a particular advantage, however, which will be mentioned hereinafter.

The adhesion of the synthetic resin to the material of the lamp cap, generally metal, for example copper alloys, such as copper-nickel, brass or tombak, stainless steel, aluminium, new silver or nickel-plated metals, is generally stronger than to glass of the lamp vessel. Nevertheless, the inner surface of the lamp cap where it is in contact with the synthetic resin can be profiled to enlarge the application of the synthetic resin thereto. A good possibility is to use for this purpose an inwardly depressed metal lamp cap. The depression(s) is (are) then at least tangentially enclosed in the synthetic resin.

In a particular embodiment of the lamp according to the invention, a current supply conductor to the light source is clamped between the synthetic resin and the sheath of the lamp cap. In lamp caps having a metal sheath, it has surprisingly been found that a good electrical contact between this sheath and this conductor is obtained. In fact it has been found that it is possible in this manner, for example with Swan-s lamp caps, i.e. Swan lamp caps having only one contact at the base portion and one contact at the sheath, and with Edison lamp caps to connect the contact at the sheath of the lamp cap to a current supply conductor without using a soldering or welding operation. This means a very considerable simplification and acceleration of the manufacturing process, the more so as a current conductor emerging from the lamp over
the edge of its cap can be situated at any point along the circumference of this edge. This is in contrast with a current conductor that can emerge from the base portion of the lamp cap only at one given area. Therefore, before this current conductor can be fixed, it has first to be ascertained where this conductor is situated. Another important advantage is that the relevant current supply conductor is now allowed to be so short that it does not emerge from the lamp cap. A loose wire outside the lamp cap, which may be touched in conventional lamps while it is alive, is not possible in this embodiment in which the current supply conductor remains inside the lamp cap. This embodiment renders welding or soldering of contacts entirely superfluous in lamps having two lamp caps each having a sheath contact, such as in a lamp having festoon caps.

Very satisfactory results are attained with at least substantially aromatic polyetherimides, such as polyetherimides marketed under the tradename Ultem by General Electric Plastics and having the structure of a repeating unit shown in Figure 6 of the drawings. The polyetherimides may have a filling of mineral powders, such as SiO₂, CaCO₃, MgO, ZnO, BaSO₄, Al₂O₃, but alternatively of fibres, such as glass fibres.

The lamp according to the invention can be one of several kinds, for example an incandescent lamp, in which the light source is a filament. The filament may be surrounded by an inner bulb which is arranged in the lamp vessel. The lamp may alternatively be a discharge lamp, for example a low-pressure discharge lamp, such as a low-pressure mercury discharge lamp. The light source is in this case an ionizable mercury-containing gas with electrodes that may be arranged in the lamp vessel. Inside the lamp vessel, the gas filling may be present in an inner bulb, such as in a low-pressure sodium discharge lamp. The lamp may alternatively be a high-pressure discharge lamp, such as a high-pressure sodium discharge lamp, which emits at least substantially white light. The light source is in this case a sodium-containing ionizable gas in a crystalline inner bulb provided with electrodes.

The lamp according to the invention can be very readily manufactured. It has proved to be favourable to arrange a preformed ring of polyetherimide around the hot end portion of the lamp vessel. It is favourable to carry out this step while this end portion is still hot, for example has a temperature of 400 - 450 °C due to the operation in which this portion is shaped. In an embodiment of the method, the ring is brought to an elevated temperature, for example 150 - 200 °C. The ring adheres, when it is provided, to the hot surface of the end portion. If desired, the ring around the end portion may then be shaped by means of a jig. The jig may have an elevated temperature, for example of 150 - 200 °C. Subsequently, the lamp cap is provided.

The lamp cap is heated for this purpose at a temperature of about 400 - 450 °C. The temperatures are not critical. At temperatures at the level of 400 °C, the synthetic material rapidly softens and adheres. At temperatures at the level of 200 °C, the ring retains its shape and does not adhere to objects with which it is in contact. On adhesion to objects of about 400 °C, a connection is obtained which becomes stronger upon cooling.

When a current supply conductor is bent around the ring provided on the end portion, an electrical connection is obtained with the lamp cap during the step of providing the lamp cap if this lamp cap has a metal sheath. The said steps of connecting the cap and making an electrical contact require only a few, for example 3 to 4 seconds, while, when using a conventional cement, times of up to 25 seconds are required for curing the cement only. As a result, in conventional lamps, the step of mounting the lamp cap is one of the slowest assembling steps, so that the lamp according to the invention and its manufacture mean a material improvement.

In the case of a lamp in which the synthetic resin connects the end portion of the lamp vessel to the lamp cap, in directions transverse to the axis of the lamp vessel the ring of synthetic resin has in a favourable embodiment a conical shape, for example with an apic angle of 2 x 5°. This shape facilitates the step of providing the ring around the end portion of the lamp vessel. In many cases, the lamp vessel is moreover conical at the free end of its end portion, because glass mouldings cannot be made with sharp shapes.

One or more projections at the end portion of the lamp vessel are particularly favourable means for enlarging the grip of the synthetic resin on the lamp vessel. The ring of synthetic resin can then have at its inner surface one or more grooves, which are caused to engage these projections. A ring having a smaller wall thickness can be used whilst maintaining its enlarged grip if this ring has at its wide end one or more recesses with which the ring laterally engages a projection. These embodiments continue to render it possible to provide the ring around the end portion in a simple manner, by slipping this ring onto it whilst they nevertheless require only a small quantity of synthetic resin. Similar recesses at the narrow end of the ring or grooves in the outer surface of the ring may be present to receive inward depressions in the lamp cap.

EP-A-0 186 827 discloses a lamp of pressed glass whose lamp cap is connected via a skirt of synthetic resin to the bottom of the lamp vessel. The sleeve then replaces a metal collar and a glass body through
which in conventional lamps of pressed glass the bottom of the lamp vessel is connected to the lamp cap. The skirt of synthetic resin has a wide collar portion with longitudinal slots and internal nose-shaped projections, which under elastic deformation of the collar portion are caused to engage cavities in the bottom of the lamp vessel. As a result, a mechanical coupling is obtained between the lamp vessel and the skirt. At its outer surface the skirt has parts of screw-thread onto which the Edison lamp cap is screwed, while it further has in its outer surface recesses in which the lamp cap is depressed in order to lock the screw connection between the skirt and the lamp cap against displacement. The skirt is consequently secured mechanically both to the lamp vessel and to the lamp cap. The skirt is more than a means for coupling the lamp vessel to the lamp cap. It is an insulator body between the lamp vessel and the lamp cap and a body which causes the length of the lamp to be considerably greater than in the case of a direct connection of the lamp cap to the lamp vessel. To the synthetic resin that can be used for the sleeve belong polyetherimides.

An embodiment of the lamp and the method according to the invention will be described more fully with reference to the drawings.

In the drawings:

- Figure 1 shows an embodiment of the lamp in side elevation with the lamp cap in longitudinal sectional view,
- Figure 2 shows a ring of thermoplastic synthetic resin,
- Figure 3 shows a first step for mounting the lamp cap,
- Figure 4 shows a second step for this mounting,
- Figure 5 shows a third step for this mounting,
- Figure 6 shows the unit of which the synthetic resin used in Figure 1 is composed.

The lamp of Figure 1 has a translucent glass lamp vessel 1 having an axis 2 and an end portion 3. A filament 4 serving as the light source is arranged in the lamp vessel 1. In the lamp cap 5, which has a sheath portion 6 and base portion 7, the end portion 3 of the lamp vessel 1 is fixed by means of a thermoplastic synthetic resin 8 in that the latter has adhered both to the lamp vessel and to the lamp cap.

The lamp cap 5 has an electrical contact at the sheath 6 to which a current supply conductor 11 to the light source 4 is connected. A base contact 9 at the base portion 7 is connected to a second current supply conductor 12 to the light source 4. As thermoplastic synthetic resin use is made of polyetherimide containing 30% by weight of glass fibre.

The synthetic resin 8 connects the end portion 3 of the lamp vessel 1 in directions transverse to the axis 2 of the lamp vessel 1 to this lamp vessel. The synthetic resin 8 and the lamp cap 5 consequently surround the end portion 3 and the synthetic resin 8, respectively, substantially coaxially.

The end portion 3 has a non-circular cross-section transverse to the axis 2 of the lamp vessel 1 in which the end portion 3 is in contact with the synthetic resin. In Figure 1, this non-circularity is due to a projection 10 which extends transversely to the axis 2 and projects into the synthetic resin 8 (Figure 5).

Although this is not visible in Figure 1, the end portion 3 has diametrically opposite to the projection 10 a second similar projection (14 in Figure 3). The projections 10, 14 are consequently distributed regularly along the circumference.

The current supply conductor 11 is in electrical contact with the lamp cap 5 on the inner side of this lamp cap due to the fact that this conductor 11 is clamped between the synthetic resin 8 and the sheath portion 6 of the lamp cap 5.

Figure 2 shows a conical ring 8 of the thermoplastic synthetic resin, whose wide end is provided with two diametrically opposed recesses 13.

In Figure 3, the lamp vessel 1 is rotated through 180° with respect to Figure 1 and is held in position by a holder 20. The end portion 3 has a temperature of 400 to 450 °C due to a shaping and cleaning process, at the end of which the lamp vessel 1 was sealed in a vacuum-tight manner by closing the exhaust tube 15. A thermoplastic ring 8 heated at about 150 - 200 °C is situated in a holder 21 accommodating heating elements 22. The holders 20, 21 are moved towards each other and the ring 8 is pressed on the end portion 3, the ring melting at its inner surface and adhering to the end portion 3. The recesses 13 in the ring 8 then engage the projections 10, 14. The ring consequently has a profile cooperating with the non-circular cross-section of said end portion 3. Similar recesses could be present at the narrow end of the ring 8 in order to cooperate with depressions that can be present in the lamp cap 5.

A shaper 23 in figure 4, which internally is oversized with respect to the interior of the lamp cap 5, is moved to the holder 20 to shape the thermoplastic ring 8.

After the current supply conductor 11 has been shortened and bent and the current supply conductor 12 has been aligned substantially coaxially, a holder 24 (Figure 5) with a lamp cap 5 shown diagrammatically, which is heated by means of, for example, a flame to a temperature of about 400 to 450 °C, is
pressed on the ring 8, this ring melting at its outer surface and adhering to the sheath portion 6 of the lamp cap 5. After the holder 24 has been removed, the connection of the base contact 9 with the current supply conductor 12 can be made and the lamp may be cooled by means of an air jet.

Alternatively, the current supply conductor may be shortened before the ring 8 is applied in Figure 3. Lamps of the kind shown in Figure 1, which, however, are not provided with projections 10, 14, and which are manufactured whilst using a ring 8 of polyetherimide without recesses 13, were compared with similar lamps in which a similar ring was used, made of the thermoplastic polyethersulphone known from the aforementioned GB-A-1 380 720.

A number of lamps were stored according to IEC 432 (1982) for 1500 hours at 210°C. The torsional strength of the connection of the lamp caps was measured and compared to lamps that had been stored at room temperature for 1 hour after their manufacture. The results are indicated in Table 1.

<table>
<thead>
<tr>
<th>Torsional strength (Nm) after</th>
<th>1 hr 25°C</th>
<th>1500 hr 210°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyetherimide n = 10</td>
<td>&gt;6</td>
<td>1.15</td>
</tr>
<tr>
<td>Polyethersulphone n = 10</td>
<td>&gt;6</td>
<td>1.15</td>
</tr>
</tbody>
</table>

It appears from this table that both synthetic resins yield the same initial adhesion amply surpassing the standard. After the heat treatment, the adhesion provided by the polyetherimide according to the invention is larger than that of the known synthetic resin. The lowest measured value moreover lies amply above the standard, whereas the lowest value of the known synthetic resin lies below the standard.

Claims

1. An electric lamp provided with:
   - a translucent lamp vessel (1) having an axis (2) and an end portion (3),
   - a light source (4) in the lamp vessel (1),
   - a lamp cap (5) having a sheath portion (6) and a base portion (7) in which said end portion (3) of the lamp vessel (1) is fixed by means of a thermoplastic synthetic resin (8) in that the latter has adhered both to the lamp vessel (1) and to the lamp cap (5), said lamp cap (5) having an electrical contact to which a current supply conductor (11) to the light source (4) is connected, characterized in that polyetherimide is used as the said thermoplastic synthetic resin.

2. An electric lamp as claimed in Claim 1, characterized in that the synthetic resin (8) connects the end portion of the lamp vessel to the lamp cap in directions transverse to the axis (2) of the lamp vessel (1).

3. An electric lamp as claimed in Claim 2, characterized in that the end portion of the lamp vessel where it is in contact with the synthetic resin has a non-circular cross-section transverse to the axis of the lamp vessel.
4. An electric lamp as claimed in Claim 3, characterized in that the end portion (3) of the lamp vessel (1) has a projection (10) which extends transversely to the axis (2) of the lamp vessel and projects into the synthetic resin (8).

5. An electric lamp as claimed in Claim 4, characterized in that the lamp vessel has several of such projections (10,14) distributed along the circumference of the end portion (3).

6. An electric lamp as claimed in Claim 2, 3, 4 or 5, characterized in that said current supply conductor (11) to the light source is electrically connected to the sheath portion (6) of the lamp vessel and that this conductor (11) is clamped between the synthetic resin (8) and the sheath portion (6) of the lamp cap.

7. A method of manufacturing an electric lamp as claimed in Claim 1, characterized in that a polyetherimide ring (8) is arranged to surround an end portion of the lamp vessel (1) having a temperature of about 400 - 450 °C, and in that a lamp cap (5) having a temperature of about 400 - 450 °C is arranged to surround the polyetherimide.

8. A method as claimed in Claim 7, characterized in that the ring is applied at a temperature of about 150 - 200 °C.

9. A method as claimed in Claim 7 or 8, characterized in that the polyetherimide ring is conical.

10. A method as claimed in claim 9, characterized in that the lamp vessel has an end portion which has non-circular cross-sections where it is brought into contact with the ring, and in that said ring is having a profile cooperating therewith.

11. A method as claimed in Claim 10, characterized in that the end portion (3) has at least one projection (10,14) extending transversely to the axis of the lamp vessel, and in that said ring has at least one recess (13) for this projection.

Patentansprüche

1. Elektrische Lampe mit:
   - einem lichtdurchlässigen Lampenkolben (1) mit einer Achse (2) und einem Endteil (3),
   - einer Lichtquelle (4) im Lampenkolben (1),
   - einem Lampensockel (5) mit einem Hüllenteil (6) und einem Basisteil (7), in dem der Endteil (3) des Lampenkolbens (1) mittels eines thermoplastischen Kunstharzes (8) festgesetzt ist, daß dieser Kunstharz sowohl am Lampenkolben (1) als auch am Lampensockel (5) haftet, wobei der Lampensockel (5) einen elektrische Kontakt aufweist, an den ein Stromversorgungsleiter (11) angeschlossen ist, dadurch gekennzeichnet, daß Polyätherimid als der erwähnte thermoplastische Kunstharz verwendet wird.

2. Elektrische Lampe nach Anspruch 1, dadurch gekennzeichnet, daß der Kunstharz (8) in Richtungen quer zur Achse (2) des Lampenkolbens (1) den Endteil des Lampenkolbens mit dem Lampensockel verbindet.

3. Elektrische Lampe nach Anspruch 2, dadurch gekennzeichnet, daß der Endteil des Lampenkolbens, an der Stelle, an der er mit dem Kunstharz in Kontakt steht, einen nichtkreisförmigen Querschnitt quer zur Achse des Lampenkolbens aufweist.

4. Elektrische Lampe nach Anspruch 3, dadurch gekennzeichnet, daß der Endteil (3) des Lampenkolbens (1) einen Vorsprung (10) aufweist, der sich quer zur Achse (2) des Lampenkolbens erstreckt und in den Kunstharz (8) hineinragt.
5. Elektrische Lampe nach Anspruch 4, dadurch gekennzeichnet, daß der Lampenkolben mehrere derartiger Vorsprünge (10, 14) in einer Verteilung auf dem Umfang des Endteils (3) besitzt.


7. Herstellungsverfahren einer elektrischen Lampe nach Anspruch 1, dadurch gekennzeichnet, daß ein Polyätherimidring (8) zum Umgeben eines Endteils des Lampenkolbens (1) mit einer Temperatur von etwa 400 ... 450 °C angeordnet wird, und daß ein Lampensockel (5) mit einer Temperatur von etwa 400 ... 450 °C zum Umgeben des Polyätherimids angeordnet wird.

8. Verfahren nach Anspruch 7, dadurch gekennzeichnet, daß der Ring bei einer Temperatur von etwa 150 ... 200 °C angebracht wird.

9. Verfahren nach Anspruch 7 oder 8, dadurch gekennzeichnet, daß der Polyätherimidring konisch ist.

10. Verfahren nach Anspruch 9, dadurch gekennzeichnet, daß der Lampenkolben einen Endteil aufweist, der nicht kreisförmige Querschnitte an den Stellen aufweist, an denen er mit dem Ring in Kontakt gebracht wird, und daß der Ring ein damit zusammenarbeitendes Profil besitzt.

11. Verfahren nach Anspruch 10, dadurch gekennzeichnet, daß der Endteil (3) wenigstens einen Vorsprung (10, 14) aufweist, der sich quer zur Achse des Lampenkolbens erstreckt, und daß der Ring wenigstens eine Ausnehmung (13) für diesen Vorsprung aufweist.

**Revendications**

1. Lampe électrique munie - d'un récipient en verre transparent (1) présentant un axe (2) et une partie terminale (3), - d'une source lumineuse (4) disposée dans le récipient en verre (1), - d'un culot (5) comportant une partie d'enveloppe (6) et une partie de base (7), dans lequel est fixé ladite partie terminale (3) du récipient en vertu (1) au moyen d'une résine synthétique thermoplastique (8) du fait que cette dernière a adhéré au récipient en vertu (1) aussi bien qu'au culot (5), ledit culot (5) présentant un contact électrique auquel est relié un conducteur d'alimentation de courant (11) s'étendant vers la source lumineuse (4), caractérisée en ce que le film de polyéther est utilisé comme ladite résine synthétique thermoplastique.

2. Lampe électrique selon la revendication 1, caractérisée en ce que la résine synthétique (8) relie la partie terminale du récipient en verre au culot dans des directions transversales à l'axe (2) du récipient en vertu (1).

3. Lampe électrique selon la revendication 2, caractérisée en ce que la partie terminale du récipient en verre présente, à l'endroit où il est en contact avec la résine synthétique, une coupe droite non circulaire transversale à l'axe du récipient en verre.

4. Lampe électrique selon la revendication 3, caractérisée en ce que la partie terminale (3) du récipient en vertu (1) présente une saillie (10) qui s'étend transversalement à l'axe (2) du récipient en vertu et qui pénètre dans la résine synthétique (8).

5. Lampe électrique selon la revendication 4, caractérisée en ce que le récipient en vertu présente plusieurs de telles saillies (10, 14) réparties sur la circonférence de la partie terminale (3).
6. Lampe électrique selon l'une des revendications 2, 3, 4 ou 5, caractérisée en ce que ledit conducteur d'alimentation de courant (1) s'étendant vers la source lumineuse est relié électriquement à la partie d'enveloppe (6) du récipient en verte et en ce que ledit conducteur (11) est enserré entre la résine synthétique (8) et la partie d'enveloppe (6) du culot.

7. Procédé pour la fabrication d'une lampe électrique selon la revendication 1, caractérisé en ce qu'un anneau en imide de polyéther (8) est disposé de manière à entourer une partie terminale du récipient en verte (1) présentant une température qui est approximativement comprise entre 400 et 450 °C et en ce qu'un culot (5) présentant une température comprise approximativement entre 400 et 450 °C est disposé de manière à entourer l'imide de polyéther.

8. Procédé selon la revendication 7, caractérisé en ce que l'anneau est formé à une température comprise approximativement entre 150 et 200 °C.

9. Procédé selon la revendication 7 ou 8, caractérisé en ce que l'anneau en imide de polyéther est conique.

10. Procédé selon la revendication 9, caractérisé en ce que le récipient en verte présente une partie terminale ayant des coupes transversales non circulaires à l'endroit où il est mis en contact avec l'anneau et en ce que ledit anneau présente un profil coopérant avec lesdites coupes.

11. Procédé selon la revendication 10, caractérisé en ce que la partie terminale (3) présente au moins une saillie (10, 14) qui s'étend transversalement à l'axe du récipient et en ce que l'anneau présente au moins un évidement (13) conçu pour cette saillie.