

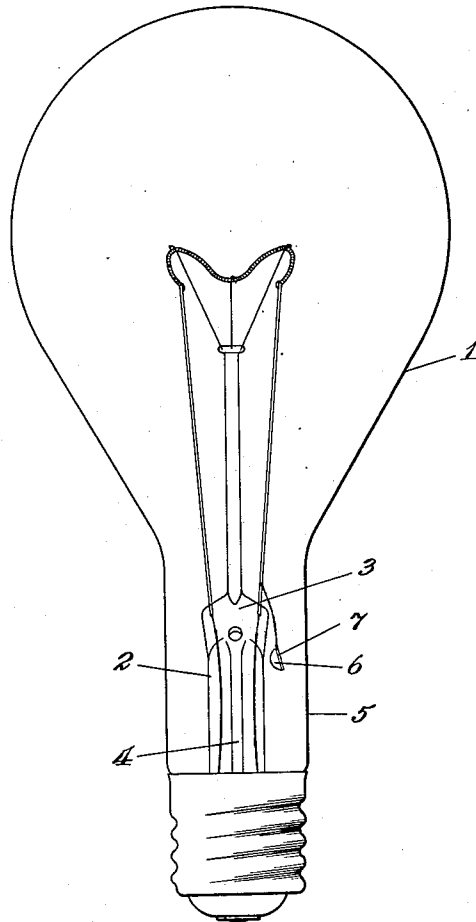
Nov. 9, 1937.

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2,098,907

INCANDESCENT ELECTRIC LAMP AND METHOD OF MANUFACTURE THEREOF

Filed March 31, 1936



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2,098,907

INCANDESCENT ELECTRIC LAMP AND
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Application March 31, 1936, Serial No. 71,834

9 Claims. (Cl. 176—2)

This invention relates to electric lamps and more particularly to methods and means for maintaining the luminous efficiency of lamps employing filaments of tungsten and the like.

5 There is disclosed in application Serial No. 41,555, filed September 21st, 1935, a method of maintaining the luminous efficiency of a tungsten filament lamp by applying to the interior of the lamp bulb a quantity of potassium nitrate which
10 acts to prevent evaporated tungsten from forming a light obstructing coating on the interior of the bulb. There is also disclosed in said application a method of carrying out this idea on the usual automatic high production lamp making
15 machines such for example as the Sealex machine, by employing a reversible water-vapor getter in conjunction with the nitrate coating.

I have found that the effectiveness of the nitrate or similar anti-discoloration material may
20 be maintained by employing a specially prepared form of phosphorus pentoxide within the lamp. I have also found that in certain lamps the phosphorus pentoxide alone, when applied as described herein, is capable of materially reducing
25 the discoloration usually caused by the tungsten deposited on the inner surface of the bulb.

Notwithstanding that it has been known for a long time that phosphorus pentoxide has the property of taking up deleterious gases and also
30 water vapor, this substance has not been used generally in the manufacture of incandescent filament lamps. I have found that one of the reasons why phosphorus pentoxide is not capable of use in its ordinary form is that it is extremely
35 difficult to introduce it into a lamp bulb in a sufficiently dry state because of its affinity for water vapor. This characteristic of phosphorus pentoxide is a decided limitation to its use in connection with anti-discoloration materials such
40 for example as potassium nitrate or other materials which tend to give off water vapor during the normal life of the lamp. Accordingly it is one of the principal objects of this invention to provide a method of introducing phosphorus
45 pentoxide in a dry condition into a lamp.

A feature of the invention relates to an electric lamp of the incandescent tungsten filament type having a quantity of potassium nitrate and a quantity of dry phosphorus pentoxide within the
50 lamp bulb to maintain the luminous efficiency of the lamp.

Another feature relates to the method of introducing barium oxide into a lamp bulb.

Another feature relates to the use of phosphorus pentoxide, barium oxide and the like in

conjunction with potassium nitrate or other water releasing substance, whereby the lamp may be manufactured on standard high production lamp making machinery and in such a manner
5 as to form a continuously active agent for the removal of released water during the entire life of the lamp.

A further feature relates to the improved processing of tungsten filament lamps whereby the luminous output of such lamps may be maintained at a high value during the life of the
10 lamp.

Other features and advantages not specifically enumerated will be apparent after a consideration of the following detailed descriptions and
15 the appended claims.

While the invention will be described herein as applied to one known form of incandescent lamp, it will be understood that this is done
20 merely for explanatory purposes and not by way of limitation. In the drawing, the numeral 1 represents any well-known form of lamp bulb having sealed therein the usual reentrant stem
2 terminating in the press 3. An exhaust tubulation 4 is provided by means of which the lamp
25 may be evacuated and filled with the desired gas or mixture of gases. Supported on the press 3 in any well-known manner is a filament 5 preferably of tungsten or similar refractory metal. Supported at any convenient place within the
30 lamp envelope, but preferably within the neck portion 5, is a container 6 in the form of a metal cup having a foraminous cover 7 whereby the contents of the cup may be retained in place. Containers of this nature are very well-known
35 in the lamp making art and it is understood that the present invention is not limited to any particular manner of holding the material to be ignited. In accordance with this invention, the container 6 is filled with a quantity of red phosphorus which as is well-known is very stable and
40 is capable of being exposed to ordinary atmospheric conditions for a considerable period of time without any appreciable chemical change and especially without danger of collecting water
45 or water vapor.

Prior to sealing-in the stem and lamp mount into the envelope, there is applied to the interior wall of the envelope a quantity of a material which has the property of coating with the
50 tungsten vaporized from the filament 5 to prevent the latter forming an opaque or otherwise light obstructing deposit. For this purpose, I have found potassium nitrate to be very well suited and preferably the potassium nitrate is
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applied in the form of a thin transparent coating as set forth in said application Serial No. 41,555. The assembled lamp is then subjected to the usual exhaust procedure such as is usually employed in automatic lamp making machines and if the lamp is to be of the gas-filled type, a predetermined quantity of an appropriate inert gas such as nitrogen is introduced into the envelope. Prior to the completion of the exhaust schedule (in the case of vacuum lamps) and prior to the final flushing with the inert gas (in the case of gas-filled lamps), there is introduced into the lamp an appropriate quantity of dry oxygen. As is well-known when lamps are made by the usual lamp-making machines such for example on the Seallex machine, the lamp is advanced gradually to a number of successive positions where it is subjected to different temperature conditions for baking, evacuation, etc., and in the case of gas-filled lamps, there are a number of positions where the envelope is flushed with an inert gas such as nitrogen. In accordance with the present invention the dry oxygen is introduced preferably at a position corresponding to about one-third or one-half of the complete exhaust schedule (in the case of vacuum lamps) and to about one-third to one-half of the total number of flushings with the inert gas. Care must be taken however that both the flushing gas and the oxygen are entirely dry when they are introduced into the lamp. Preferably just sufficient dry oxygen is introduced so that complete combustion of the phosphorus in the container 6 is effected when the phosphorus is heated to a sufficiently high temperature. Any well-known manner of heating the phosphorus to combustion temperature, may be employed. Thus when the phosphorus is situated in a metal container as described, the latter may be heated by induction from a suitable source of high frequency alternating or pulsating current. If however the phosphorus is applied to the filament 5 the latter may be raised momentarily to the ignition temperature of the phosphorus by passing a current through the filament. In this latter case, the current through the filament should be chosen of such a magnitude that complete ignition of the phosphorus is effected without appreciably oxidizing the filament itself. During this stage of the process the red phosphorus is converted into dry phosphorus pentoxide. The lamp may then be subjected to the remainder of the normal exhaust or flushing schedule and if there is any excess of oxygen, it is removed in the completion of the exhaust schedule. After the lamp has been subjected to the complete schedule, the tubulation 4 may be tipped off in the usual manner and a suitable contact base applied to the lamp.

I have found that by following the above-described procedure, it is possible to produce a lamp containing phosphorus pentoxide in a completely dry state and accordingly should the potassium nitrate release any water vapor during the normal life of the lamp, it is immediately taken up by the dry phosphorus pentoxide. On the other hand, if the phosphorus pentoxide were originally introduced in the normal way, it would take up sufficient water vapor during the preliminary exhaust schedule to prevent it subsequently taking up the water vapor released by the potassium nitrate coating. As pointed out in said application Serial No. 41,555, it is very difficult to exhaust lamps containing a coating of potassium nitrate on standard high production

lamp making machines during the relatively short time allowed for exhaust on such machines. By introducing the phosphorus in a dry state in the manner above described, I have found that nitrate-coated lamps may be satisfactorily exhausted on such machines and the phosphorus remains as a continuously active agent in conjunction with the anti-discoloration coating to maintain the luminous output and efficiency of the lamp.

As an alternative method of introducing the phosphorus pentoxide in a dry state, the red phosphorus may be evaporated from the filament or from the container 6 after the lamp has been evacuated or in the presence of an inert gaseous atmosphere and the evaporated phosphorus is allowed to deposit on the inner wall of the lamp bulb, preferably at a point where it will not interfere with the light from the filament. On being so deposited the phosphorus is transformed into yellow phosphorus which is very active and will readily combine with the dry oxygen that is later introduced during the exhaust schedule as described above to form dry phosphorus pentoxide. When the dry phosphorus pentoxide has been thus formed the lamp is subjected to the rest of the normal exhaust or gas flushing procedure.

I have found that instead of employing dry phosphorus pentoxide similar results are obtained by using barium oxide. Here again, it is extremely difficult to introduce the barium oxide originally into the lamp without at the same time having the barium oxide take up appreciable amounts of water vapor. Accordingly the barium oxide is formed after the lamp has been subjected to approximately one-third to one-half of the usual standard exhaust schedule. Thus when the mount is assembled into the envelope there is also assembled within the envelope a pellet of barium preferably enclosed within a relatively thin protective metal coating such for example as copper. When the lamp has been subjected to about one-third to one-half of the usual standard exhaust schedule or to the standard gas flushing schedule the barium is flashed by being subjected to a high temperature produced for example by a high frequency alternating electro-magnetic field. The flashed barium then deposits on the inner wall of the lamp and preferably the original copper-clad barium pellet is so mounted that when it is flashed the barium deposits on the neck of the lamp or at some other inconspicuous portion thereof. The barium deposit is then subjected to the action of a supply of dry oxygen in sufficient quantity to oxidize all of the deposited barium. In order to expedite the oxidizing process the temperature of the lamp may be raised to a few hundred or more degrees centigrade. The exhaust or flushing procedure is then continued in the normal manner and any excess oxygen remaining in the lamp is readily removed prior to the completion of the exhaust or flushing operations.

Instead of first flashing the barium and then introducing the dry oxygen, the barium may be flashed from the pellet in the presence of the dry oxygen. This procedure is however not quite as advantageous as the above described procedure because the barium reacts very rapidly with the oxygen and the resultant barium oxide is extremely nonvolatile so that the resulting mass of material is very compact and localized, whereas with the above described procedure the barium oxide is distributed over a comparatively

large area in a thin film or sheet and is more effective in combining with any water vapor that may be released by the nitrate or other anti-discoloration coating that is employed. In this connection, it should be noted that the barium oxide is of very great advantage where potassium nitrate is used as the anti-discoloration material because the chemical compound that results from the chemical reaction between water and barium oxide is barium hydroxide and the vapor pressure of any water resulting from the decomposition of barium hydroxide does not become appreciable until temperatures of the order of 600° K. are attained.

While the process described above involves the use of dry phosphorus pentoxide in conjunction with potassium nitrate I have found that in certain cases, for example in multiple filament lamps of 300 watts or less, the dry phosphorus pentoxide alone, when applied to the bulb surface as described above, has the property of very materially reducing the tendency to discoloration caused by the deposited tungsten. This is probably due to oxidation of the evaporated tungsten, thus forming a coating on the bulb which absorbs much less light than the ordinary tungsten deposit. This improvement is especially noticeable when the lamp is burned base down.

While specific embodiments and methods of processing tungsten filament lamps have been disclosed herein, it will be understood that various changes and modifications may be made therein without departing from the spirit and scope of the invention.

What I claim is:

1. The method of making an incandescent electric lamp whereby its luminous output is maintained during life, which includes the steps of, applying to the interior surface of a lamp bulb a thin transparent coating consisting of a water bearing anti-discoloration material, fixing to a lamp mount a getter consisting of a material which in its oxide form has a high affinity for water vapor, sealing said lamp bulb to the stem bearing said mount, subjecting the lamp to an exhaust schedule comprising successive flushings and exhaustions, then oxidizing the material, continuing the schedule, and then sealing-off the lamp.

2. The method of making an incandescent electric lamp whereby its luminous efficiency may be maintained during life which includes the steps

of applying a thin transparent coating consisting of water-bearing potassium nitrate to the interior surface of a lamp bulb, fixing a getter consisting of red phosphorus to a lamp mount, sealing to said bulb a stem bearing said mount, subjecting the lamp to an exhaust schedule, admitting dry oxygen to the lamp, flashing the phosphorus in the presence of the oxygen to convert the phosphorus to phosphorus pentoxide, removing the excess oxygen and then sealing off the lamp.

3. The method according to claim 2 in which the phosphorus is flashed to form yellow phosphorus before the dry oxygen is admitted to form the phosphorus pentoxide.

4. The method of making an incandescent lamp whereby its efficiency may be maintained during life which consists of, applying a thin transparent coating consisting of potassium nitrate to the interior surface of a lamp bulb, fixing a getter consisting of metallic barium to a lamp mount, sealing to said bulb a lamp stem bearing said mount, subjecting the lamp to an exhaust schedule, oxidizing the barium, and then sealing off the lamp.

5. The method according to claim 4 in which the barium is flashed before being oxidized.

6. An electric incandescent lamp comprising a tungsten filament, a sealed bulb with a bowl portion and a neck portion, a thin transparent coating on the interior surface of said bowl portion consisting of a water bearing material which reacts with the evaporated tungsten to prevent discoloration of the lamp, and a quantity of dry phosphorus pentoxide in the neck portion of said bulb to absorb the water evaporated from the discoloration preventing material.

7. A lamp as in claim 6, in which the water-bearing material on the interior surface of the bowl portion of the bulb is potassium nitrate.

8. An electric incandescent lamp comprising a tungsten filament, a sealed bulb with a bowl portion and a neck portion, a thin transparent coating on the interior surface of said bowl portion consisting of water-bearing potassium nitrate, and a quantity of a water vapor getter in the neck portion of said bulb, said getter consisting of a dry alkali-metal oxide to absorb water evaporated from the nitrate.

9. A lamp as in claim 8, in which the alkali-metal oxide is barium oxide.

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