(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 093 383**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **83104091.0**

(22) Date of filing: **26.04.83**

(51) Int. Cl.³: **H 01 J 9/40**
H 01 J 5/02

(30) Priority: **03.05.82 US 374038**

(43) Date of publication of application:
09.11.83 Bulletin 83/45

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

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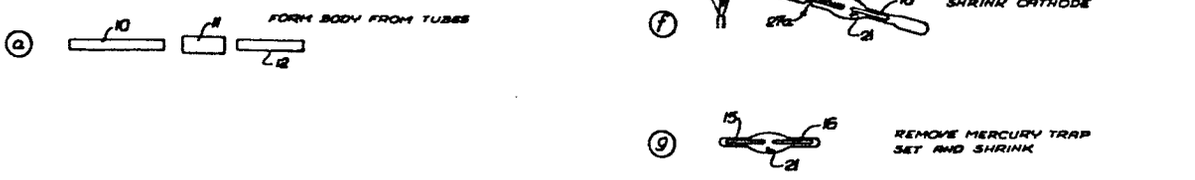
(54) Gas lamp and method of manufacture.

(57) A new and improved gas-filled lamp and method of manufacturing such a lamp, wherein the usual tip-off region on the glass envelope of the lamp is eliminated. In manufacture of the lamp, the lamp envelope (10, 11, 12) is provided with a coaxial mercury trap (25) at the end of the envelope opposite the gas pumping end (26), the electrodes (15, 16) are inserted, air is pumped out, fill gas is pumped in, the envelope is shrunk down onto the electrode (16) at the pumping end, mercury (21) is tipped into the envelope bulb, and the mercury is held against the remote, colder region of the envelope while shrinking down on the second electrode (15).

Fig. 2



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GAS LAMP AND METHOD OF MANUFACTURE

BACKGROUND OF THE INVENTION

This invention relates generally to improvements in gas-filled lamps and methods of manufacturing such lamps and, more particularly, to a new and improved gas-filled lamp devoid of a weakened tip-off region, and an improved process for manufacturing such lamps in an efficient, economical and reliable manner.

It is common practice in the manufacture of gas-filled lamps, such as conventional mercury short-arc lamps, to pump out air, pump in fill gas, and admit mercury via a conduit in the form of a hollow stem communicating with the bulb portion of the glass envelope defining the outer shell of the lamp. When the pumping process and introduction of mercury has been completed, the then useless pumping stem is sealed, leaving a small exhaust pip in the surface of the glass bulb, this exhaust pip being referred to in the art as a tip-off.

Unfortunately, the existence of such a tip-off region may severely limit the operating pressures which can be safely provided inside the lamp envelope, since the tip-off region represents a weakened area in the glass bulb which can rupture and explode in the presence

of excessively high internal gas pressures within the lamp. As a result, samples of such lamps must be explosion tested to mitigate the possibility of potentially extensive and costly damage to the environments in which the lamps are used in the event of such explosions.

Hence, those concerned with the development and use of such gas-filled lamps, and the manufacture of such lamps, have long recognized the need for improved lamps devoid of tip-off regions, capable of reliably handling higher lamp internal gas pressures, as well as improved, relatively simple, reliable, efficient and cost effective methods for manufacturing such lamps. The present invention clearly fulfills these needs.

SUMMARY OF THE INVENTION

Briefly, and in general terms, the present invention provides a new and improved gas-filled lamp devoid of the usual weakened tip-off region on the glass envelope of the lamp, and further provides a new and improved method of manufacturing such lamps wherein the glass envelope is provided with a coaxial mercury trap at one end of the glass envelope and all pumping of gas is accomplished at the opposite, coaxial end of the envelope where the electrode enters the glass.

In a presently preferred embodiment, by way of example and not necessarily by way of limitation, the new and improved gas-filled lamp is manufactured by providing a glass envelope with a coaxial mercury trap at one end of the envelope adjacent an electrode and opposite the pumping end of the envelope. A pair of coaxial cathode and anode electrodes are inserted through the open pumping end of the envelope, air is pumped out of the

envelope and a suitable fill gas is pumped into the envelope. The envelope is then shrunk down onto the electrode at the pumping end, mercury is tipped from the mercury trap into the bulb portion of the envelope, and the mercury is held against the remote colder region of the envelope bulb while simultaneously shrinking down the envelope into sealing engagement with the second electrode. After the process is complete, each of the sealed ends of the lamp may be covered by a suitable electrode cap or the like which serves to further cover and/or reinforce the sealed ends.

The new and improved gas-filled lamp and method for lamp manufacture of the present invention provides a safer, substantially explosion-proof lamp capable of successfully withstanding higher internal gas pressures than lamps of the prior art, and the manufacturing process simplifies the manufacturing procedures in an efficient, economical and reliable manner.

The above and other objects and advantages of the invention will become apparent from the following more detailed description, when taken in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIGs. 1a-1i are simplified model diagrams, illustrating the prior art techniques for producing a conventional gas-filled lamp which possesses a tip-off region in the glass bulb; and

FIGs. 2a-2g schematically illustrate a presently preferred embodiment of the process of the present

invention for fabricating a new and improved gas-filled lamp devoid of any tip-off region.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As previously indicated, the present invention relates to a new and improved gas-filled lamp, such as a mercury short-arc lamp, and a method of manufacturing such a lamp, wherein the usual lamp tip-off region can be eliminated. In the typical systems of the prior art, a glass stem is normally used to evacuate the lamp envelope and to introduce mercury to the inside of the lamp in conventional manufacturing procedures. The stem is then sealed or tipped-off, leaving a weakened area subject to rupture and explosion from high internal gas pressure within the lamp. In accordance with the present invention, evacuation is accomplished at one end of the lamp envelope and introduction of mercury is accomplished at the opposite end of the envelope, adjacent the lamp electrodes, rather than forming a separate stem on the envelope bulb for that purpose. When the envelope ends are sealed, they may then be covered by electrode caps or the like which further serve to cover and/or reinforce the terminal ends of the lamp.

Referring now more particularly to FIGs. 1a-1i of the drawings, a prior art technique for forming a conventional gas-filled lamp with associated tip-off region on the glass bulb is described, in order to facilitate a better understanding of the present invention which will be subsequently contrasted with the prior art process.

As illustrated in FIG. 1a, the process begins by drawing glass tubing from stock and cutting to length

to provide a pair of smaller end tubes 10, 12 and a larger midsection 11 which ultimately will define the bulb region of the lamp envelope. The tubing is then placed in a lathe and attached together to form the lamp body or envelope. Once the envelope has been formed, a hole is blown in the bulb to attach a hollow pumping stem 13, as illustrated in FIG. 1b. This is done by heating a small area on the bulb and holding the pressure inside the bulb until the hole opens. The pumping stem 13, which is normally a two-inch length of quartz tubing, is then fused to the bulb directly over the previously formed hole. The entire length of the body is then fire-polished to remove any quartz dust produced during forming of the body and attaching of the pumping stem 13. Once this has been accomplished, a small area on the body arm 10 is heated to seal one end 14 and prepare the envelope for electrode loading.

As best observed in FIG. 1c, a pair of coaxial electrodes 15, 16 are loaded into the envelope through the open end 17 which is then, in turn, sealed off in the same manner as the end 14. Once the electrodes have been loaded in the aforedescribed manner, the lamp envelope is attached to a suitable pump 18 to evacuate the lamp. Subsequently, the lamp is baked out to drive out moisture and impurities. The lamp may also be purged with nitrogen.

As shown in FIG. 1e, after the required pumping time and cooling down of the lamp, the lamp is removed from the pump 18 by heating the pumping stem 13 with a torch to close off the pumping stem and leave approximately 1-1/2" of stem remaining attached to the lamp bulb. Both electrodes 15, 16 are then set into place coaxially at opposite ends of the glass envelope and the

envelope is then shrunk onto the ribbon of each electrode to seal the lamp. The setting of the electrodes is typically accomplished by hand, using a fixed bench torch and spinning the lamp in the flame. The shrinking process is accomplished in a glass lathe using a hand torch. Once the lamp is shrunk onto the electrodes 15, 16, it is ready to pump and fill.

As best illustrated in FIG. 1f, the pump and fill operation begins by breaking open the pumping stem 13 and attaching a mercury trap 19 which is typically a section of 2 mm x 4 mm tubing with a small bubble blown in the center of the tubing. This bubble is adapted to contain the mercury during the pump and fill operation. It is not desirable to insert the mercury directly into the glass envelope at any earlier stage of the process because the mercury might vaporize and cause the envelope to explode, or provide offsetting pressure during the shrinking process.

As shown in FIG. 1f, one end of the mercury trap is sealed onto the pumping stem 13 which has been broken open again so that the trap can be attached to the stem by heating with a torch. After the mercury trap 19 is sealed onto the stem 13, it is loaded with the proper quantity of mercury 21 and the open end of the trap is attached to the pump 18. The lamp envelope is then evacuated to an appropriate pressure, after which the lamp is again baked out using a hand torch.

After sufficient cooling and pumping time, the lamp is backfilled with a predetermined amount of inert gas such as argon or xenon. Once this has been accomplished, the end of the mercury trap 22, adjacent the

pump 18 is heated with a torch to seal off the end 22 and remove the lamp from the pump.

As best illustrated in FIG. 1h, the mercury trap 19 is then heated with a torch, while tipping the trap and the lamp, to run the mercury into the lamp envelope. As shown in FIG. 1i, the mercury trap is then removed or tipped-off, leaving a small bump or exhaust pip 23 on the lamp bulb. The tip-off region represents a weakened area in the glass envelope. At this point, the sealed lamp is ready for any external operations, such as the installation of electrode end caps.

Referring now more particularly to FIGs. 2a-2g of the drawings, the new and improved gas-filled lamp and method of manufacturing such a lamp will become apparent.

As shown in FIG. 2a, three pieces of tubing 10, 11 and 12 are again used to form the lamp body or envelope by placing the tubing in a lathe and attaching all the pieces together, using a hand torch.

FIG. 2b illustrates the formation of a coaxial mercury trap 25 at one end of the lamp envelope, after the entire length of the lamp body has first been fire-polished. The mercury pocket 25 is typically provided by measuring approximately 4-1/2" from the lamp bulb on the side in which the trap is to be provided, applying heat to the glass (usually quartz) and allowing the glass to collapse to about half of its original internal diameter. The glass is then stretched until there is a passage of approximately 1 mm internal diameter. After this latter step, the glass is again heated approximately 1/4" further away from the bulb along the axis of the

lamp envelope, to seal off the open end adjacent the mercury trap 25.

As shown in FIG. 2c, a predetermined quantity of mercury 21 is injected into the lamp envelope and tapped down into the mercury pocket 25. The electrodes 15, 16 are next loaded into the envelope, the coaxial cathode 15 first (closest to the mercury trap) followed by the coaxial anode electrode 16.

At this point, the lamp is ready to attach to the pump 18 so that it can be evacuated, baked out, cooled under vacuum and then backfilled with a predetermined amount of inert gas, such as argon or xenon. The lamp is then removed from the pump 18 by heating the envelope end 26 near the pump 18 and letting the glass collapse to seal off the end.

The electrode setting and shrinking operations are best observed in FIG. 2e which shows the lamp removed from the pump and sealed off. The anode is set into place carefully by hand-positioning, and the glass envelope is shrunk down onto the ribbon of the anode electrode 16 by heating with a torch. During this anode setting and shrinking process, the anode end of the lamp is elevated relative to the cathode end to keep the cathode electrode 15 and the mercury 21 out of the envelope bulb.

Once the anode has been set and shrunk, the lamp is removed from the glass lathe and the cathode is set into place by collapsing portions of the glass envelope onto the corners of the cathode ribbon at location 27a, 27b, (FIG. 2f) leaving enough of a clearance passage for the mercury 21 to run down the end of the lamp into the bulb.

As best observed in FIG. 2f, the mercury 21 is run down into the lamp bulb, by heating the mercury pocket 25 with a torch while tipping the lamp so that the anode end is lower than the cathode end. Once this has been accomplished, the final set on the cathode electrode 15 is performed by shrinking down the glass envelope into sealing engagement with the ribbon of the cathode electrode, using a torch. The mercury 21 is held against the portion of the lamp bulb remote from the cathode electrode 15, i.e., adjacent the anode electrode 16, which is the coolest region of the lamp bulb during the cathode shrinking process, and thus mitigates the possible excess vaporization of the mercury which might otherwise pose the threat of explosion.

As best observed in FIG. 2g, once the cathode electrode 15 has been sealed in place, the mercury trap 25 is removed and, using a torch, the cathode end of the envelope is sealed, thus readying the lamp for any external operations, such as the installation of electrode end caps (not shown).

The gas-filled lamp and method of manufacture of the present invention satisfies a long existing need for a new and improved lamp wherein the usual lamp tip-off region and its associated problems are eliminated and, further, for a simplified, efficient, reliable and cost effective method for manufacturing such lamps.

It will be apparent from the foregoing that, while particular forms of the invention have been illustrated and described, various modifications can be made without departing from the spirit and scope of the invention. Accordingly, it is not intended that the invention be limited except as by the appended claims.

CLAIMS

1. A method of manufacturing a gas-filled lamp, comprising the steps of: forming a lamp envelope of glass with a mercury trap; loading mercury into said trap; loading electrodes into said envelope; pumping said lamp envelope; setting said electrodes in position and shrinking said envelope into sealing engagement with said electrodes; and removing said mercury trap characterized in that said mercury trap is formed at one end of said envelope and in that said envelope is pumped from an open end opposite the end in communication with said mercury trap.

2. A method of manufacturing a gas-filled lamp as claimed in Claim 1, further characterized in that said envelope is first shrunk into sealing engagement with the electrode at the pumping side of said envelope; mercury is run from said trap into the envelope region between said electrodes; and the other side of said envelope is thereafter shrunk into sealing engagement with the other of said electrodes.

3. A method of manufacturing a gas-filled lamp, including the step of forming a lamp envelope of glass, including a pair of coaxial ends on opposite sides of a bulb; and characterized by the steps of forming a closed coaxial mercury trap at one of said ends; loading mercury into said mercury trap; inserting a pair of coaxial electrodes through the open end of said envelope opposite said one end communicating with said trap; pumping out air through said open end; pumping in a fill gas through said open end; removing the pump and sealing said open end; shrinking the envelope end on the side opposite said trap into sealing engagement with one of said electrodes; setting the remaining electrode located on the same side as said trap; running the mercury from said trap into said bulb; holding said mercury against the colder region of said bulb while shrinking the end of said

envelope into sealing engagement with said remaining electrode; and sealing the envelope end adjacent said trap and removing said mercury trap.

4. An intermediate process in the manufacture of a gas-filled lamp, including the steps of: forming a lamp envelope having a pair of coaxial ends on opposite sides of a bulb; and forming a closed, coaxial mercury trap at one of said ends opposite the end through which pumping of gas is accomplished.

5. A gas-filled lamp product manufactured by any of the methods as claimed in Claims 1-4.

6. A gas-filled lamp, comprising: a sealed envelope containing a plurality of electrodes and characterized in that said envelope is devoid of any tip-off or weakened areas vulnerable to high internal gas pressures within said envelope.

7. A lamp as claimed in Claim 6, wherein said envelope is further characterized by a pair of coaxial ends located on opposite sides of a bulb.

8. A lamp as claimed in Claim 7, further characterized in that said electrodes are coaxially positioned on opposite sides of said bulb, and said ends are in sealing engagement with said electrodes.

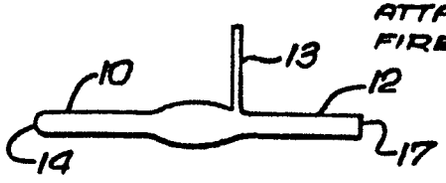
9. An intermediate product in the manufacture of a new and improved gas-filled lamp, comprising: a glass envelope having a pair of ends; a pair of spaced-apart coaxial electrodes positioned within said envelope; and characterized by a coaxial mercury trap at the end of said envelope opposite that used for pumping gas.

10. An intermediate product as claimed in Claim 9, wherein said ends of said envelope are located on opposite sides of a glass bulb and no pumping stems or mercury traps directly contact any portion of said bulb.

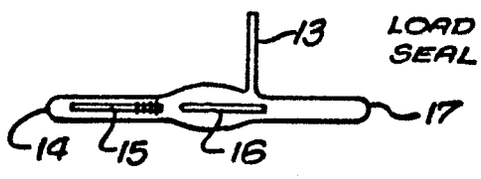
FIG. 1
PRIOR ART

(a) 

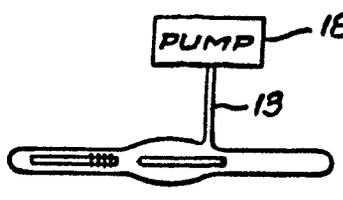
FORM BODY FROM TUBES

(b) 

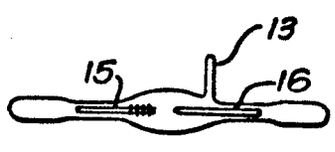
ATTACH PUMPING STEM
FIRE POLISH

(c) 

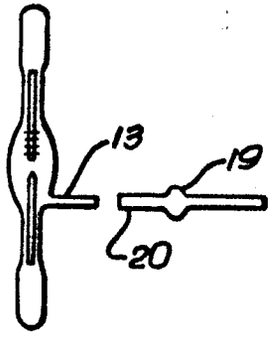
LOAD ELECTRODES
SEAL BODY

(d) 

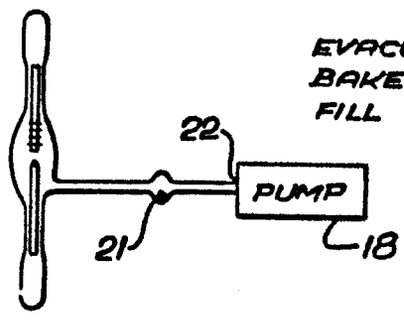
EVACUATE
BAKE

(e) 

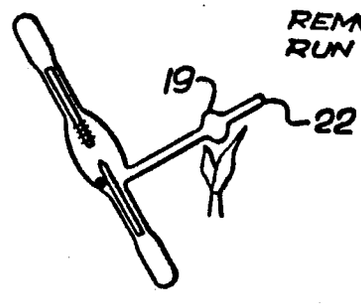
SEAL PUMPING STEM
SET ELECTRODES & SHRINK

(f) 

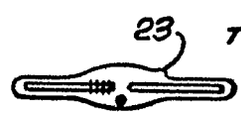
BREAK OPEN STEM
ATTACH MERCURY TRAP
LOAD WITH MERCURY

(g) 

EVACUATE
BAKE
FILL

(h) 

REMOVE FROM PUMP(SERL)
RUN MERCURY INTO LAMP

(i) 

REMOVE MERCURY TRAP
TIPP OF TO CORRECT DIMENSION

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Fig. 2