United States Patent [19]

Bonazoli et al.

[11] **3,735,185**

[45] **May 22, 1973**

[54] **LAMP ASSEMBLY**

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[73] Assignee: **Sylvania Electric Products Inc.**, Danvers, Mass.

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[21] Appl. No.: **121,519**

Related U.S. Application Data

[62] Division of Ser. No. 741,066, June 28, 1968, abandoned.

[52] **U.S. Cl.** **313/278,** 313/315

[51] **Int. Cl.** **H01j 1/92, H01j 19/48, H01k 1/24**

[58] **Field of Search** 313/278, 315

[56] **References Cited**

UNITED STATES PATENTS

3,211,950	10/1965	Cardwell, Jr.	313/278 X
3,602,761	8/1971	Kimball et al.	313/315 X

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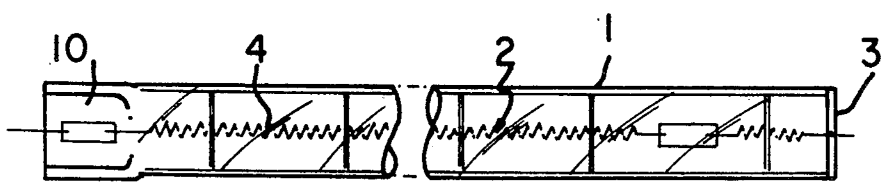
[57] **ABSTRACT**

A tubular tip-less lamp is manufactured by exhausting and filling the lamp through an open end of an extra long tubular envelope, the other end being sealed. The envelope is then press-sealed at a section thereof located a short distance from the open end and the extra length of the envelope is then removed.

3 Claims, 5 Drawing Figures



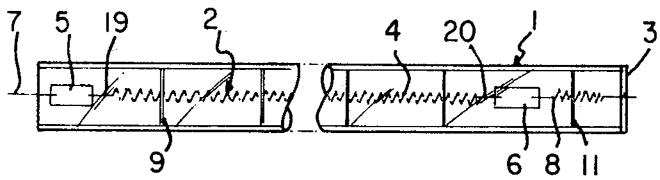


FIG. 1

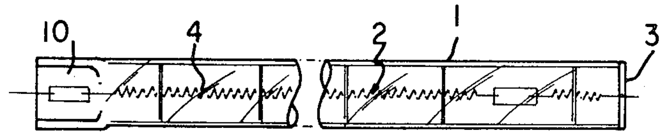


FIG. 2

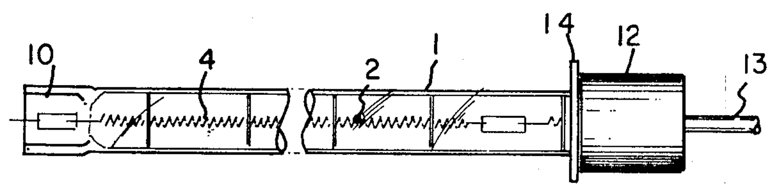


FIG. 3

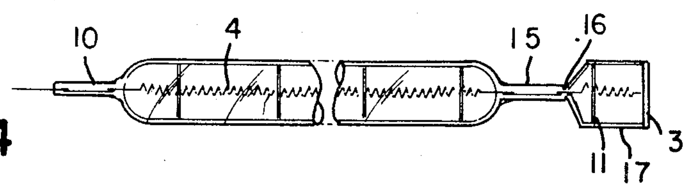


FIG. 4

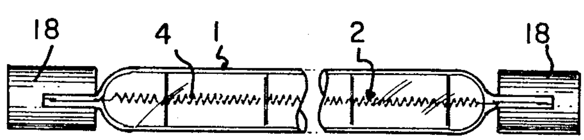


FIG. 5

LAMP ASSEMBLY

This is a division of Ser. No. 741,066, filed June 28, 1968. abandoned

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to incandescent lamps and particularly to those having tubular quartz envelopes. Such envelopes have a higher softening temperature than ordinary glass envelopes and must be heated to higher temperatures during sealing.

2. Description of the Prior Art

The exhausting, filling and sealing of lamps having tubular quartz envelopes has generally been effected by means of an exhaust tube attached to the envelope. In the case of a double-ended lamp, the exhaust tube was usually positioned at about the midpoint of the envelope. In single-ended lamps, the exhaust tube was generally opposite the sealed end.

The exhaust tube was generally of smaller diameter than the lamp envelope and simplified the manufacturing problems involved in obtaining a vacuum-tight seal around the exhaust tube during the exhausting, filling and sealing operations. The lamp was subjected to a vacuum to exhaust the air, moisture and other gases within the envelope and was then filled with a suitable atmosphere, usually an inert gas, such as nitrogen or argon, and a halogen, such as bromine or iodine. After filling, the lamp was sealed by tipping off the exhaust tube at a point close to the envelope,

Since the exhaust tube was usually smaller in diameter than the envelope, a smaller flame could be used to seal the exhaust tube than was required, say, to seal the end of the envelope. In addition, the smaller flame and the long length of the exhaust tube obviated the need of protecting the vacuum-tight seal from the heat of the flame. Such vacuum-tight seals usually comprised a rubber ring, which was compressed around the end of the exhaust tube, and could not withstand being heated to temperatures above about 80° to 100° C. without rapidly deteriorating.

Quartz lamps generally have a tungsten filament the ends of which are connected to molybdenum ribbons, such as is shown in U. S. Pat. No. 3,242,372 issued to Bonazoli et al. on Mar. 22, 1966. The molybdenum ribbons, which are connected to external lead-in wires, are embedded in press seals at the ends of the envelope and, by proper positioning of the ribbons during the press sealing operation, support the tungsten filament in its desired position. Since the ends of the envelope were open and uncovered during the press sealing operation, it was convenient to fixedly position the molybdenum ribbons by clamping the external lead-in wires to an external positioning device during the press sealing operation. Upon cooling of the press seals, the positioning device was removed and the press seals would adequately support the external lead-in wires and molybdenum ribbons and, thereby, the tungsten filament. The external positioning device substantially prevented any movement of the lead-in wires, molybdenum ribbons or filament during the press sealing operation. Since the exhaust tube provided for the subsequent exhausting, filling and final sealing of the envelope, there was no need to make provision therefor during the press sealing operation. Such provision would interfere with the usual positioning and press sealing steps.

However, it has become desirable to manufacture such lamps without the usual residual tip that protrudes from the surface of the envelope when the exhaust tube is tipped off. The tip is generally weaker than the smooth walls of the envelope and could be the cause of early failure in heavily loaded lamps, especially since it is usually located near the hottest part of the envelope. In addition, distortion of the light rays that passed through the tip was undesirable in certain optically stringent applications. Furthermore, particular uses of such lamps especially in the field of radiant heating where an array of lamps are partially encompassed by close fitting reflective fixtures, made it desirable to eliminate the exhaust tube tip.

SUMMARY OF THE INVENTION

This invention relates to a method of manufacturing a tip-less tungsten-halogen lamp that obviates the need of an exhaust tube for exhausting, filling and final sealing the lamp envelope. In our method a quartz envelope is exhausted and filled through an open end of the envelope. The lamp envelope is then press sealed at a section thereof located a short distance from the open end.

In the manufacture of a lamp according to this invention, a lamp envelope is initially prepared from light-transmitting high silica tubing such as quartz by, for example, severing a suitable length from commercially available tubing. The severed length must be longer than the final length of the finished lamp as will be explained later.

A filament assembly is then prepared by connecting, such as by welding, the legs of an elongated coiled filament to thin molybdenum ribbons. External lead-in wires are then similarly connected to the molybdenum ribbons, with said lead-in wires extending away from the filament. The external lead-in wires are sufficiently long to protrude beyond the press seals of the finished lamp and provide for eventual connection to a base and/or to an external power source. However, one of the lead-in wires, hereinafter called the second lead-in wire, is fabricated in such a manner as to position itself and the adjoining molybdenum ribbon substantially centrally within the envelope during the second press sealing operation. In addition, the end of the second lead-in wire is connected to the midpoint of a crossbar, said crossbar being substantially perpendicular to the second lead-in wire. The length of the crossbar is slightly shorter than the outside diameter of the lamp envelope, but greater than the inside diameter. Thus, when the filament assembly is inserted into the open ended envelope, the crossbar does not enter the envelope, but, upon complete insertion, rests against the edge of the envelope wall.

In order to make the first press seal, the external end of the first lead-in wire is clamped in a positioning device that positions said wire substantially axially in the envelope. The device also stretches the filament assembly slightly and, since the opposite end is prevented from moving in the direction of stretching by the crossbar resting against the edge of the envelope, the entire filament assembly is placed under tension. The first end of the envelope is then heated to the softening point by high temperature flames and immediately pressed between a pair of movable jaws to form the first press seal. Upon cooling, the positioning device is removed. Embedded within the press seal are the entire length of the first molybdenum ribbon and the adjoining sections of the lead-in wire and filament leg. As a result of the embedment, the filament assembly is maintained under tension.

The open end of the envelope is then placed in a head of a vacuum exhaust machine. A vacuum-rubber ring within the head encircles the envelope end and provides the vacuum seal necessary to exhaust and fill the envelope. Since the crossbar is shorter than the outside diameter of the envelope, it is not engaged by the rubber ring nor does it interfere with the vacuum seal.

The envelope can then be evacuated to a vacuum, say, about 10 microns, and filled with a suitable gas. Exhausting and filling can be alternatively repeated several times for maximum purification of the envelope atmosphere. In addition, heat may be applied to theenvelope and filament assembly during the exhaust cycle to aid in cleaning and outgassing the constituent parts of the lamp.

After the final exhaust cycle the lamp is filled by means of the vacuum machine head with the desired atmosphere, say, argon and iodine, in the case of a particular quartz-iodine lamp.

The envelope is then prepared for sealing by heating with high temperature flames the portion thereof that surrounds the second molybdenum ribbon. To distance between said ribbon and the open envelope end is enough to keep the flames from directly impinging on the exhaust head. Usually 1 or 2 inches or a distance greater than the length of the ribbon is adequate. However, we prefer to place a water-cooled metal plate between the exhaust head and the flames for increased protection of the rubber ring against overheating. Said plate has a hole through its center just large enough to accommodate the diameter of the envelope and is placed in position at the time of insertion of the envelope and into the exhaust head.

After the heated portion reaches its softening point, the press seal is made, as before, by a pair of movable jaws. Of course, the movement of the jaws is substantially orthogonal to the molybdenum ribbon so that said ribbon is embedded substantially parallel to, and within, said press seal. Again, as before, the entire ribbon and the adjoining portions of the lead-in wire and filament leg are embedded within the press seal.

The lamp is then removed from the exhaust head and the extra envelope length, that is, that section extending beyond the second press seal, is severed. A convenient method of severing the extra length is to apply a sharp blow thereto, which usually breaks it off at the end of the press seal. However, to insure a clean break we prefer to provide a thin, readily breakable line at the end of the press seal by posing suitable knife edges on the movable jaws. The extra length of lead-in wire, including the crossbar, is also then cut off to leave about the same length as extends at the other end of the lamp, say about one-eighth inch.

The procedure is satisfactory for lamps having a fill pressure of less than one atmosphere. For lamps filled to a pressure greater than one atmosphere, the first and of the lamp can be cooled below the boiling point of the fill gases during the filling cycle. Such a process is known to the art and is shown in U. S. Pat. No. 3,162,499, issued on Dec. 22, 1964, to Gustin entitled "Fabrication of Incandescent Lamps."

In order to provide accurate positioning of the second molybdenum ribbon and second lead-in wire, we prefer to fasten a positioning device, such as a spacer ring, to said lead-in wire at a point about halfway between said ribbon and the exhausting end of the envelope. The spacer ring, of course, is attached to said lead-in wire at the time of fabrication of the filament assembly, prior to insertion thereof into the lamp envelope. The spacer ring can be composed of a wire having a turn of small diameter wrapped around the lead-in wire, the wire then extending from this turn and forming an outer turn of larger diameter fitting against the inner wall of the quartz envelope. Such a spacer ring is shown in patent application Ser. No. 515,899, filed on Dec. 23, 1965 by Karn and assigned to the assignee of the instant invention. In order to position the second lead-in wire substantially axially within the envelope, the outer turn of the spacer ring is made concentric with the inner turn. The spacer ring also serves to substantially prevent radial movement of the lead-in wire and crossbar within the envelope; such movement could dislocate the crossbar within the envelope; such movement could dislocate the crossbar from bearing against the end of the envelope wall.

The spacer ring should be attached to the lead-in wire with a space between it and the molybdenum ribbon somewhat greater than the desired length of the lead-in wire in the finished lamp. Thus, the spacer is also discarded when the extra length of lead-in wire is removed.

The primary purpose of the crossbar is to maintain a slight tension on the filament assembly during the final press sealing and also in the finished lamp, in the absence of other means for maintaining tension. Without this tension, the filament could sag and distort during lamp operation and materially shorten its useful life. In addition, the tension aids in preventing close adjacent turns of the coiled filament from shorting to one another.

However, other tension maintaining elements may also be used in place of the crossbar. For example, a wire structure in the shape of a cone would also be satisfactory. The largest diameter of the cone would have to lie between the inner and outer diameters of the envelope. Thus it would engage the end of the envelope wall without protruding outside the periphery of the envelope. And the lead-in wire could be attached to the apex of the cone. Such an arrangement would also aid in the axial positioning of the lead-in wire.

However the tension maintaining element must not fill substantially the entire bore of the envelope tubing. Otherwise, the flow of gases around and through the element during the exhausting and filling steps would be materially impeded. Thus the cone mentioned above is made of wire, and not of solid sheet metal, to permit gas flow through it.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a plan view of an open-ended quartz envelope containing a filament assembly in accordance with one embodiment of this invention.

FIG. 2 shows the same envelope after one end thereof has been press sealed.

FIG. 3 shows a vacuum exhaust head in schematic form with the open end of the envelope inserted therein.

FIG. 4 is a side view of the envelope after the second press seal has been formed, with the extra envelope length still attached.

FIG. 5 shows the finished lamp with bases attached.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A 500 watt, 120 volt infrared heating lamp manufactured in accordance with this invention, was made from quartz tube **1** which had a length of 10¼ inches, an outside diameter of ⅜ inch and a wall thickness of 1.0 mm.

As shown in FIG. **1**, filament assembly **2** was inserted into tube **1**, both ends thereof being open, until crossbar **3** rested against one end of tube **1**. Filament assembly **2** comprised an elongated coiled tungsten filament **4** having legs **19** and **20** to each of which were attached molybdenum ribbons **5** and **6** respectively, which in turn were connected to external lead-in wires **7** and **8** respectively. Disposed along the length of filament **4** were tungsten spacers **9**, designed to maintain filament **4** substantially co-axial within tube **1**. A similar spacer **11** was fastened to leadin wire **8** about midway between ribbon **6** and crossbar **3**.

As positioned, ribbons **5** and **6** were ⅜ and 2 ¼ inches from their respective ends of tube **1**. Lead-in wires **7** and **8** protruded about one-fourth to one-half inch beyond the ends of tube **1**. Crossbar **3** comprised a 0.377 inch length of 25 mil nickel wire and was welded, at its midpoint, to lead-in wire **8** substantially orthogonally thereto and about one-fourth inch from the end thereof. Thus crossbar **3** had a length greater than the inside diameter of tube **1** and rested against the end wall thereof.

The end of lead-in wire **7** was clamped to a positioning device (not shown) which positioned lead-in wire **7** substantially axially within tube **1** and also stretched filament assembly **2** until ribbon **5** was only about one-fourth inch from its respective end of tube **1**. Said end of tube **1** was then heated to its softening point with high temperature flames and a pair of movable jaws (not shown) then squeezed the softened end to form press seal **10**, shown in FIG. **2**. Press seal **10** was about three-fourths inch long and it embedded all of molybdenum ribbon **5** and about one-fourth inch each of lead-in wire **7** and leg **19**.

After removal from said positioning device, the open end of tube **1** was inserted into vacuum exhaust head **12**, as shown in FIG. **3**. Exhaust head **12** comprised an externally grooved metal cylinder having one open end and exhaust-and-filling tube **13** at the other end. Concentrically disposed within, and closely fitting, the metal cylinder was a rubber ring (not shown) 22 mm. in diameter, 10 ½ mm. long and having an axial hole therethrough to provide a close fit around envelope **1**. Disposed at the open end of the metal cylinder was a matching metal cap having internal grooves designed to engage the grooves of the metal cylinder. A hole through the metal cap permitted insertion therethrough of envelope **1**. After the open end of envelope **1** was inserted into the bore of the rubber ring, the metal cap was screwed onto the metal cylinder to compress the rubber ring therebetween and provide the vacuum-tight seal for exhausting and filling.

Quartz tube **1** was then exhausted to about 10 microns and then filled with forming gas (a mixture of hydrogen and nitrogen). The filament assembly was heated during this process by passing electric current therethrough; physical contact between exhaust head **12** and crossbar **3** provided the necessary electrical path.

The exhausting and filling process was repeated and then after an additional exhaust, the lamp was filled with a mixture of nitrogen and methyl bromide to a pressure of one atmosphere.

The portion of tube **1** that surrounded ribbon **6**, disposed about two inches from exhaust head **12**, was then heated to its softening point by high temperature flames. Exhaust head **12** was protected from the heat by brass plate **14** disposed around tube **1** and adjacent exhaust head **12**. Plate **14** was 2 inches square by one-fourth inch thick and had internal passages permitting it to be water cooled. The pressure within the lamp was maintained at one atmosphere during heating by means of a venting apparatus within the exhaust system.

The softened portion of tube **1** was then squeezed between a pair of movable jaws, as before, to form press seal **15**, embedding therein all of ribbon **6** and adjacent portions of lead-in wire **8** and leg **20**. The jaws had knife edges thereon to form a thin breakable line **16** at the outer edge of press seal **15**, as shown in FIG. **4**.

After removal of the lamp from exhaust head **12**, crossbar **3** was cut off with wire cutters. Tube portion **17** was then sharply struck to sever it at line **16** from press seal **15**. The extra length of lead-in wire **8** was then cut off, to leave about one-eighth inch extending from press seal **15**. Bases **18** were then attached to lead-in wire **7** and **8** to complete the lamp as shown in FIG. **5**.

Various changes in the details which have been described herein may be made by those skilled in the art within the spirit and scope of the invention. It is our intention, however, only to be limited by the scope of the appended claims.

We claim:

1. An incandescent lamp assembly comprising a smooth surfaced quartz tube press sealed at one end and open at the other end; a coiled tungsten filament axially disposed within said tube; a first end of said filament connected to a first molybdenum ribbon; said ribbon being embedded within said press seal; a second end of said filament connected to a second molybdenum ribbon, said second ribbon disposed within said tube and spaced from said open end a distance greater than the length of said ribbon; a lead-in wire connected to said second ribbon; a first means positioning said lead-in wire axially within said tube; and a second means connected to said lead-in wire maintaining said filament in tension.

2. The lamp assembly of claim **1** wherein said second means comprises a crossbar bearing against said open end of sais tube.

3. The lamp assembly of claim **1** wherein said first means comprises a spacer ring bearing against the inner wall surface of said tube.

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