April 29, 1969 M. L. STONE ETAL 3,441,774

HALOGEN CYCLE INCANDESCENT LAMP WITH PLANAR FILAMENT

Filed Dec. 12, 1966

Fig. 1.

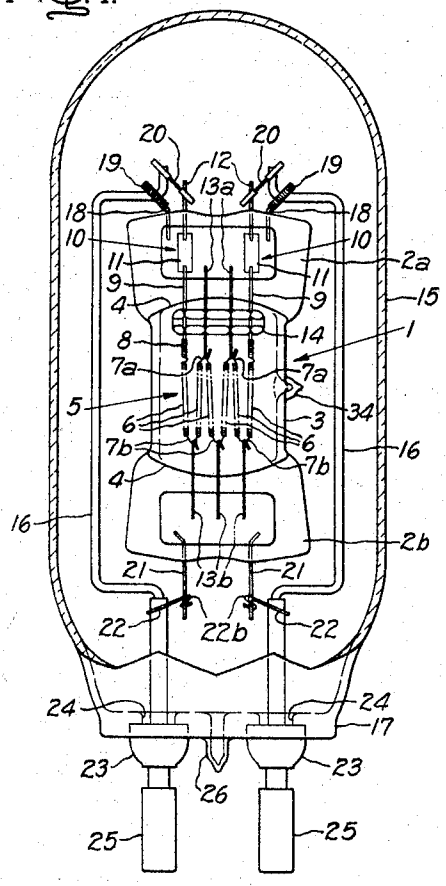


Fig. 2.

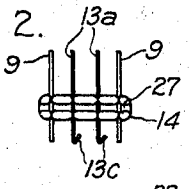


Fig. 3.

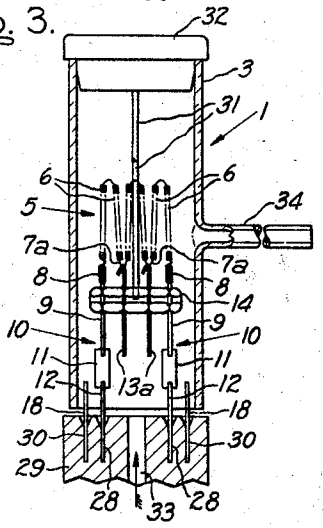


Fig. 4.

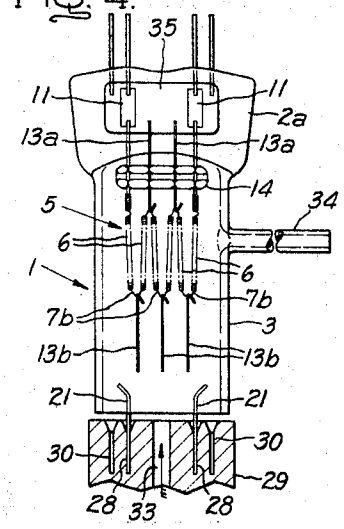
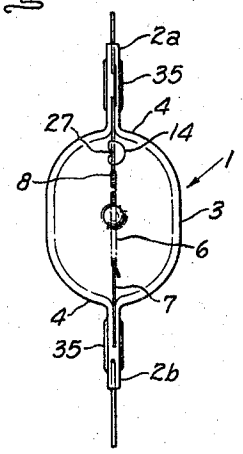


Fig. 5.



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HALOGEN-CYCLE INCANDESCENT LAMP WITH PLANAR FILAMENT

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U.S. Cl. 313—174 8 Claims

ABSTRACT OF THE DISCLOSURE

An incandescent halogen-cycle lamp embodying a planar type filament and unique supporting structure, wherein the compact lamp envelope has pinch seals at opposite ends and located in a plane which also generally contains the coiled segments of the planar filament which segments are supported from the pinch seals. The halogen lamp may be mounted inside an outer bulb or envelope through supplementary support wires embedded in respective pinch seals and connected to rigid lead-in and support members in the outer envelope.

BACKGROUND OF THE INVENTION

This invention relates generally to electric incandescent lamps comprising a sealed envelope containing an incandescible filament. More particularly, the invention relates to lamps of the halogen cycle type comprising a tungsten filament and a gaseous atmosphere comprising a halogen which functions as a regenerative getter by reacting with tungsten particles vaporized from the filament to form a tungsten-halogen compound which returns to the vicinity of the filament where it is dissociated and the tungsten is deposited back upon the filament.

It is a requirement of halogen cycle lamps that the envelope be of compact size and shape such that the entire interior surface of the envelope be at a minimum wall temperature sufficient to effect the reaction between the tungsten and the halogen, and that the envelope interior be devoid of substantial pockets wherein halogen compound might condense with eventual removal of halogen from effective relationship with the filament and the hot bulb walls.

In most cases the filament has heretofore been in the form of a simple helical coil or coiled-coil extending axially of a cylindrical bulb or envelope, as for example, in Patent 2,883,571 to Fridrich et al. Lamps of this form have generally been provided with special bases at their ends, as in Patent 3,001,096 to Mosby, and used in new lighting applications or in systems where new equipment can be used. Therefore, an object of this invention is to provide an incandescent halogen-cycle lamp with physical and optical characteristics which will extend the applications of such lamps, with their inherent advantages, to fields heretofore served by conventional incandescent lamps.

For certain high intensity lighting applications such as motion picture, television and photographic studios, theatre stages, display and architectural lighting, there has been a need for an improved lamp having a planar-type filament, that is, one which comprises a plurality of coiled segments arranged in generaly parallel side-by-side relationship in or closely adjacent to a single plane and having the desirable features of the heretofore single coil halogen-cycle incandescent lamp, namely, longer life, greater total light output over life, higher stability of output and color, and a compact size.

Accordingly, it is an object of this invention to provide a halogen-cycle lamp in a compact envelope only slightly

larger than the planar type filament and having the above-stated features which are inherent in an incandescent halogen-cycle lamp.

It is also an object to provide such a lamp having a support structure of comparatively simple form with a minimum of internal components for comparatively simple assembly and to eliminate the possibility of adversely effecting the halogen regenerative cycle.

It is a still further object to provide for mounting of such a halogen-cycle lamp in an outer bulb or envelope with considerably greater ease and economy than the mounting of a conventional planar filament in such outer bulb or envelope.

SUMMARY OF THE INVENTION

In accordance with one aspect of the invention, the above objectives are achieved by providing a halogen lamp construction wherein the envelope is provided with flattened pinch seals at the longitudinal ends thereof, and the planar filament is arranged to be substantially in a common plane which also includes the said pinch seals, with a pair of lead-in conductors extending through one of the pinch seals into the envelope and electricaly connected at their inner ends to the respective outermost segments at opposite sides of the filament. The filament is supported from the pinch seals, preferably by support wires each having one end engaging bight portions which connect the ends of adjacent internal filament segments, and with the other ends of said support wires extending into and embedded in proximate pinch seals.

In accordance with another aspect of the invention, provision is made for mounting the halogen lamp as a light source in an outer bulb or envelope, and more particularly by supporting it therein from its pinch seals.

BRIEF DESCRIPTION OF THE DRAWING

Further features and advantages of the invention will appear from the following detailed description of species thereof and from the drawing wherein:

FIG. 1 is a front elevation of a halogen-cycle incandescent lamp embodying the invention and which is shown mounted in an outer bulb or envelope;

FIG. 2 is an elevation of a sub-assembly of a bead or bridge with lead-in and support wires in a preferred form of support structure for one end of the filament, the upper end as viewed in FIG. 1;

FIG. 3 is a front elevation, partly in section, illustrating a preferred assembly of the halogen lamp bulb or envelope with the filament, the supporting sub-assembly of FIG. 2, and additional lead wire and lamp support wire members prior to the first pinch sealing;

FIG. 4 is a front elevation of the lamp envelope after the first pinch seal and inverted from its position in FIG. 3, and with additional filament support wires and lamp support wires, prior to the second pinch sealing; and

FIG. 5 is a side elevation of a finished halogen lamp, taken at right angles to FIGS. 1–3 and illustrating the approximately coplanar relationship of the planar-type filament, the pinch seals, and the elongated bead or bridge member.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 of the drawing, the incandescent halogen-cycle lamp **1** illustrated therein comprises a generally tubular bulb or envelope **3**, which is preferably composed of essentially fused silica such as quartz or the material known as Vycor or as 96% silica glass, and having upper and lower compressed portions or pinch seals **2***a*, **2***b* at its ends which hermetically seal the envelope from the atmosphere. During formation of the pinch

seals 2*a*, 2*b*, the ends of the cylindrical bulb 3 are rounded off in directions normal to the plane of the seals, as shown at 4 in FIG. 5. The envelope 3 contains a filling of inert gas such as argon plus a small amount of a halogen such as iodine or bromine or compounds thereof.

Filament 5, preferably of tungsten wire, comprises helically coiled segments 6 which are in a generally parallel side-by-side relation in or adjacent to a common plane. The common plane defined by the coil segments 6 closely coincides with the plane containing the pinch seals 2*a*, 2*b* at each end of the envelope (see FIG. 5). The diameter of the envelope 3 is correlated with the size of the filament to maintain a short distance between the filament and the envelope walls to insure proper performance of the halogen regenerative cycle. The coil segments 6 are electrically connected in series by upper and lower intermediate bight portions 7*a*, 7*b*, preferably loop portions between adjacent segments 6.

The filament segments 6 are preferably of an even number with the current supply or lead-in conductors located at one end of the envelope. The inner portions 9 of lead-in conductors 10 are mechanically attached, normally by tack-welding to coiled filament leg portions 8 at the ends of the outermost segments 6 of filament 5, thereby providing a means of supplying electrical energy to the inside of the envelope through intermediate foliated portions 11 which are attached to respective outer lead portions 12 to which external electrical power may be applied.

In further accordance with the invention, upper and lower filament supports 13*a*, 13*b* (as viewed in FIG. 1) are each attached at one end to respective intermediate bight portions 7*a*, 7*b* at the upper and lower ends of the filament, and the other end is embedded in the proximate pinch seal 2*a* or 2*b*.

To add stability and to insure a proper positioning of the filament supports 13*a* and the inner portions 9 of lead-in conductors 10, an elongated bead or bridge 14 of vitreous material, preferably quartz or high silica content glass, is preferably used within which portions of upper filament supports 13*a* and inner portions 9 of lead-in wires 10 are embedded and fixedly held in parallel relationship. A bridge member such as bead 14 may be used to tie together the filament supports at either end of the filament or at both ends. The arrangement as shown in FIG. 1 is preferred in this specific embodiment since the elongated bead 14 aids in the alignment and support of the filament in a preferred method of assembly as described hereinafter.

The lamp 1 is useful as a light source by itself, in which case a suitable base or terminal structure might be attached at one end to the pinch seal 2*a* and the auxiliary supports 18 and 21 omitted. However, the lamp 1 may advantageously be mounted within an outer bulb or jacket 15 as illustrated herein. Rigid lead-in and support conductors 16 are supported from the lower end or base portion 17 of outer glass bulb 15 and extend longitudinally along the opposite sides of the inner envelope 3. These conductors 16 are also approximately in the plane containing the pinch seals 2*a*, 2*b*. The lamp 1 is mechanically attached to said supporting conductors 16 by means of upper supplementary support wires 18 which each have one end embedded in the upper pinch seal 2*a* and the other end attached, preferably by a weld, to the proximate supporting conductor 16. The welded joint is preferably strengthened by providing a wire overwind 19 on the wire 18. The electrical connection is preferably made by fuse element 20 which connects each of the supporting conductors 16 to the outer portions 12 of respective lead-in conductors 10 whereby electrical energy can be conducted to the filament 5 in envelope 3.

In such gas-filled compact incandescent lamps as described above, it is desirable to provide the fuses 20 to open the circuit to the filament if it burns out or breaks, to thereby prevent arcing which could result in an explosion of the lamp. Since the fuses 20 are generally composed of a thin, fragile or flexible wire, the supplementary support wires 18 provide the mechanical support for the lamp envelope 3.

In a preferred construction shown in FIG. 1, alignment of the lower end of envelope 3 within outer bulb 15 is maintained by lower supplementary support wires 21 in conjunction with wire retainer members 22 which each have one end rigidly affixed to a conductor 16, and a looped or coiled end 22*b* loosely encircling a wire 21. The retainer wires 22 thereby restrict horizontal motions of lower supplementary supports 21 but permit them to slide within the loops 22*b* upon longitudinal expansion of the rigid lead-in and support conductors 16 which have a greater coefficient of expansion than the quartz envelope 3 and which are heated when the lamp is in operation.

The lower ends of conductors 16 extend through respective openings 24 in the glass base 17 and terminate in posts 25 io which are attached metal skirts or ferrules 23 which have thin edges which are hermetically sealed and embedded in the thickness of the base 17 around the said openings 24, all as fully disclosed in Patent 2,098,080 to D. K. Wright.

The outer bulb 15 is preferably evacuated and filled with an inert gas through a glass exhaust tube which is then sealed or tipped off as shown at 26. The sealing of the lamp 1 in the outer bulb 15 not only provides a convenient final lamp form useful in conventional fixtures, but it also eliminates seal temperature limitations of the lamp 1 by preventing oxidation of the outer leads 12 and foils 11 which are usually made of molybdenum. The inert fill gas in bulb 15 may be nitrogen, but in some cases a gas of higher heat conductivity is needed to avoid overheating of the lamp 1 with attendant blackening. In such cases the fill gas may consist of helium which may be introduced at a pressure of about 600 torr, or approximately atmospheric.

A preferred method of manufacture of the lamp will now be described.

Referring to FIG. 2, the sub-assembly of "upper" filament support and lead wires is made by supporting a quartz rod 14 along its length while heating it to a softened condition, laying transversely across its exposed longitudinal upper side the support and lead wire members 13*a* and 9 which are held in parallel relationship, and then pressing and embedding portions of said wire members into the softened rod 14 with a tool which has a knife-like edge which forms a longitudinal groove or depression 27 in the bead 14 so that the head assumes a thick generally C-shaped in cross-section, as best seen in FIG. 5. The parallel alignment of the upper filament supports 13*a* and inner portions 9 of the lead-in conductors 10 assure proper alignment of the filament segments 6.

After completion of the assembly shown in FIG. 2, the remaining portions of the lead-in conductors 10 are added (FIG. 3) by tack-welding the foil portions 11 and outer lead portions 12 to the inner lead portions 9. Then the coiled leg portions 8 of the filament 5 are slipped over the free ends of inner lead portions 9 and preferably firmly attached by tack-welding. The bight portions 7*a* of the filament are brought into engagement with hook-shaped ends 13*c* (FIG. 2) of the filament supports 13*a*. This assembly is then placed in an upright position by inserting the outer lead portions 12 in the bores 28 in holder 29 (FIG. 3). At the same time, the upper supplementary supporting wires 18 are placed in additional bores 30 in the holder 29. The filament assembly is held in upright position by auxiliary means 31 which may consist of a parallel pair of wires which straddle the filament 5 and bead 14 and which are attached to stopper 32 which is fitted in the upper end of the tubular envelope 3. The lower end of the envelope is then heated to plasticity while inert gas flows through opening 33 in support 29 and through exhaust tube 34 to prevent the metal components from oxi-

dizing when the envelope is heated. After the lower end of the envelope **3** becomes plastic, a pair of conventional type pinch jaws are closed to form a pinch seal **2***a* (FIG. 4) which is in a plane coincident with the plane defined by the filament segments **6**. The seal **2***a* may be formed with a thickened pad portion **35** within which the foils **11** are enclosed.

The envelope **3** is then inverted over holder **29** (FIG. 4) in which lower supplementary support wires **21** are held. The lower filament support wires **13***b* are hung by their hooked ends from the lower bight portions **7***b* from which they depend in parallel relationship. This avoids the necessity for an additional bead to insure alignment, and thereby reduces the number of components within the lamp. The parallel alignment of lower support wires **13***b* is assured by the precise alignment of the upper supports **13***a* which is made possible by the preferred procedure of embedding them in bead **14**.

The portion of the envelope **3** adjacent to the lower support wires **13***b* is then heated to plasticity and lower pinch seal **2***b* is formed. This second pinch seal **2***b* is located in the same plane as the first pinch seal **2***a*, as are the filament segments **6** as shown best in FIG. 5. The envelope **3** is then evacuated and filled through exhaust tube **34** with an inert gas and a halogen, after which the exhaust tube **34** is tipped off (FIG. 1) to hermetically seal the envelope **3** and form a completed lamp or light source **1** (FIG. 5).

However, the lamp unit **1** is preferably used as the light source in an outer bulb which may, by way of example, take the so-called bipost "mount" structure, comprising the support and lead-in conductors **16**, posts **25**, ferrules **23** and glass base **17**, is made before sealing the outer bulb **15** to said base **17**. This is done by first threading the lower supplementary support wires **21** through the coiled ends **22***b* of retainers **22** which have been attached to support conductors **16**. The upper supplementary supports **18** with overwind **19** are then tack-welded to the conductors **16**. The fuses **20** are then tack-welded at each end between the conducting rods **16** and the outer lead wire portions **12** which have been shortened by clipping off the ends thereof. The outer bulb **15** is then fused at its lower end to the glass base member **17**.

The outer bulb **15** is flushed and filled with a gas such as nitrogen through an exhaust tube **26** which is then tipped off to hermetically seal the outer bulb and prevent oxidation of the metal parts therein during operation of the lamp.

While a preferred construction and method of assembly have been shown and described, it will be evident to those skilled in the art that various modifications, omissions and additions may be made within the spirit and scope of the invention as defined in the appended claims.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. An electric incandescent halogen-cycle lamp comprising a compact envelope of essentially fused silica having flattened upper and lower pinch seals at the longitudinal ends thereof and containing an inert gas filling and a halogen functioning as a regenerative getter, a planar type filament comprising a plurality of coiled tungsten wire segments arranged in side-by-side relation longitudinally of the envelope and closely adjacent a common plane which also includes said pinch seals, proximate upper and lower ends of adjacent said segments being serially connected by bight portions, a pair of lead-in conductors extending through the upper said pinch seal into the envelope and electrically connected at their inner ends to respective outermost segments at opposite sides of said filament, at least one upper support wire engaging a bight portion connecting adjacent upper ends of internal segments of the filament and extending into the said upper pinch seal, and at least one lower support wire engaging a bight portion connecting adjacent lower ends of internal segments of the filament and extending into the said lower pinch seal.

2. A lamp as in claim **1** including an elongated bead of vitreous material extending transversely of the envelope adjacent the said upper pinch seal and in said common plane with portions of said lead-in conductors and upper support wire embedded therein.

3. A lamp as in claim **1** including supplementary lamp supporting wires having end portions thereof embedded in respective pinch seals and extending externally thereof, an outer bulb enclosing said lamp, rigid lead-in and support conductors having portions sealed in the lower end of said outer bulb and extending longitudinally into the bulb along opposite sides of said lamp and substantially in the said common plane which includes said pinch seals and said filament, the said supplementary lamp supporting wires which extend from the upper pinch seal being secured to upper end portions of respective adjacent said rigid lead-in and support conductors, means electrically connecting the said lamp lead-in conductors to respective adjacent said rigid lead-in and support conductors, and means physically connecting the supplementary lamp supporting wires which extend from the lower pinch seal with adjacent portions of respective said rigid lead-in and support conductors.

4. A lamp as set forth in claim **3** wherein a fuse is incorporated in at least one of the said means electrically connecting the lamp lead-in conductors to respective adjacent said rigid lead-in and support conductors.

5. A lamp as set forth in claim **3** wherein the means physically connecting the supplementary lamp supporting wires which extend from the lower pinch seal with adjacent portions of respective said rigid lead-in and support conductors includes means which confine lateral motion of said lamp supporting wires but permit longitudinal sliding motion thereof.

6. An electric incandescent halogen-cycle lamp comprising a compact envelope of essentially fused silica having flattened upper and lower pinch seals at the longitudinal ends thereof and containing an inert gas filling and a halogen functioning as a regenerative getter, a planar type filament comprising a plurality of coiled tungsten wire segments arranged in side-by-side relation longitudinally of the envelope and closely adjacent a common plane which also includes said pinch seals, proximate upper and lower ends of adjacent said segments being serially connected by bight portions, a pair of lead-in conductors extending through the upper said pinch seal into the envelope and electrically connected at their inner ends to the respective outermost segments at opposite sides of said filament, upper support wires engaging the bight portions of adjacent upper ends of internal segments of the filament, an elongated bead of vitreous material extending transversely of the envelope adjacent the said upper pinch seal and in said common plane with portions of said lead-in conductors and upper support wires embedded therein, and lower support wires engaging the bight portions of adjacent lower ends of segments of the filament and extending into the lower pinch seal.

7. A lamp as in claim **6** including supplementary lamp supporting wires having end portions thereof embedded in respective pinch seals and extending externally thereof, an outer bulb enclosing said lamp, rigid lead-in and support conductors having portions sealed in the lower end of said outer bulb and extending longitudinally into the bulb along opposite sides of said lamp and substantially in the said common plane which includes said pinch seals and said filament, the said supplementary lamp supporting wires which extend from the upper pinch seal being secured to upper end portions of respective adjacent said rigid lead-in and support conductors, means electrically

connecting the said lamp lead-in conductors to respective adjacent said rigid lead-in and support conductors, and means physically connecting the supplementary lamp supporting wires which extend from the lower pinch seal with adjacent portions of respective said rigid lead-in and support conductors.

8. A lamp as set forth in claim **7** wherein a fuse is incorporated in at least one of the said means electrically connecting the lamp lead-in conductors to respective adjacent said rigid lead-in and support conductors.

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U.S. Cl. X.R.

313—273, 274, 316