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3,522,470

QUARTZ-HALOGEN PROJECTION LAMP

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FIG. 1

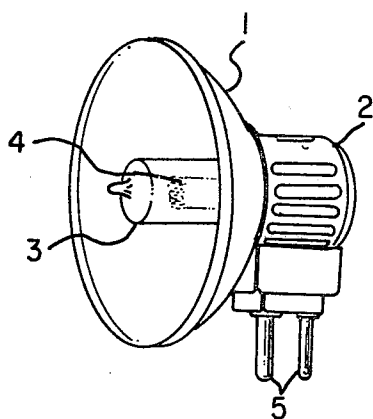
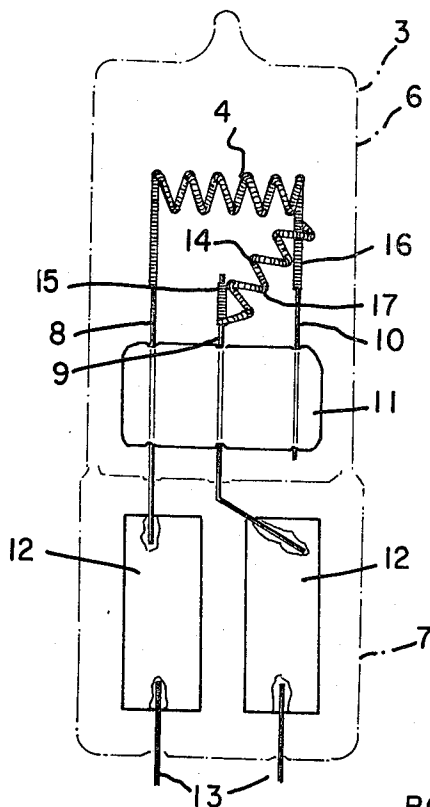


FIG. 2



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QUARTZ-HALOGEN PROJECTION LAMP

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10 Claims

ABSTRACT OF THE DISCLOSURE

An ellipsoidal reflector and a lamp are fixedly attached to a base, with the lamp filament positioned at the focus of the reflector. A ballast coil within the lamp envelope is in series with the filament to reduce the voltage across the filament. The filament and ballast coil are compactly mounted on a 3-wire quartz bridge and each has a coiled leg connected to, and encircling, a common support wire.

BACKGROUND OF THE INVENTION

This invention relates to incandescent lamps and more particularly to projection lamps having a ballast coil in series with a tungsten filament.

DESCRIPTION OF THE PRIOR ART

Projection lamps of the type used in slide projectors and moving picture projectors commonly have a reflector associated therewith, to direct the light from the lamp in a desired direction. Such a reflector could be disposed either within or without the lamp envelope. Pat. No. 2,979,634 issued Apr. 11, 1961 to Peek et al. shows one type of projection lamp having an internal reflector. Such lamps were commonly made of either soft or hard glass and were usually satisfactory for the projection apparatus in which they were used.

In some cases, such as where vibration resulted from cooling fans used in the projector, a ballast coil was connected in series with the lamp filament to improve the life of the lamps and limit the current at burnout, as is shown in Pat. No. 3,222,567, issued Dec. 7, 1965, to Smith.

Recently it has become desirable to reduce the size and increase the brightness of such lamps in order to make a more compact, efficient projector. Since the filament normally operated at high temperatures, above 2200° C., and wattages above 100 watts, the glass envelope had to be adequately spaced therefrom in order to maintain a safe temperature margin below its softening point. This prevented a substantial reduction in the size of the envelope. In addition, although the brightness of the lamp could be increased by elevating the filament operating temperature, lamp life would be correspondingly reduced, because of the rapid increase in the evaporation rate of the filament and its subsequent burnout.

When glass of high silica content, such as quartz, became commercially available as a lamp envelope material, it permitted a substantial reduction in the size thereof, since the softening point of quartz is hundreds of degrees C. higher than that of commercial soft or hard glass. Also, the use of a halogen fill permitted an increase in the filament operating temperature, without substantial reduction in life, because of the regenerative effect of the halogen on the tungsten filament.

However, in order to take full advantage of the highest possible operating temperatures and make the lamp as compact as possible, it became necessary to improve the filament support and make it capable of withstanding

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higher operating temperatures and a halogen atmosphere. Welded connections, as generally used in prior art lamps, were unsatisfactory under these more stringent operating conditions; they could separate or else the embrittled wire adjacent to the weld could break. In addition, some materials used in support wires, such as nickel, corroded in a halogen atmosphere.

The ballast coil, also, would have to be so connected to the support wires as to permit maximum miniaturization of the lamp without interfering with light output. It also would have to be securely connected for satisfactory operations throughout lamp life.

Ballast coils are generally used in lamps which are operated at line voltage, that is, about 120 volts. Their purpose is to reduce the voltage applied to the filament, say, from 120 volts to 80 volts, in order to permit the use of a shorter length of filament wire. To illustrate, a 100 watt filament operated at 80 volts could use a wire length about two-thirds that of a 150 watt filament operated at 120 volts. Shorter filament wire is preferable since the mounting span is shorter, and therefore, the filament is less susceptible to sagging and more resistant to the effects of vibration.

SUMMARY

According to this invention, a filament mounting quartz bridge, including three support wires, is disposed within an envelope made of high silica glass, such as quartz. Two of the support wires also serve as lead-in wires and the third connects and supports one leg each of a tungsten filament and a tungsten ballast coil. The legs of the filament and ballast coil comprise circular turns having a bore, that is, an inside diameter, which provides a close fitting encirclement on the third support wire. Connection therebetween is established by inserting the support wire into and through the bore of one leg of the ballast coil and then into the bore of one leg of the filament. The opposite leg of the ballast coil is similarly connected to one of the lead-in wires and the other leg of the filament to the other lead-in wire. If desired, the connections may be further secured by hot crimping the encircling turns on the lead-in wire, that is, simultaneously applying heat and a compressive force thereon. The amount of heat applied is, preferably, less than that necessary to melt or weld the tungsten.

In manufacturing the filament and ballast coil, lengths of tungsten wire can be primary-coiled to a predetermined diameter, pitch and length. Coiled-coils are then formed by secondary-coiling the central portion of the primary coiled lengths to a predetermined diameter and pitch. The legs, which then extend from each end of the coiled-coils, comprise straight segments of primary coiling. To properly fit the ballast coil on the mounting bridge, the legs may then be appropriately bent prior to attachment thereto. For example, one leg of the ballast coil can be bent to an angle which corresponds to the angle formed by a support wire and the mounted ballast coil.

The corresponding support wire is then inserted into and through that leg and beyond the bend in order to also permit connection of a filament leg.

However, the coiled turns on the legs of the filament and ballast coil need not be a part of the primary coiling, but can be separately coiled or spaced from the body, that is, the coiled-coil portion, by a short length of substantially uncoiled wire.

It is necessary only that there be a close fitting relationship between the inside diameter of the coiled turns and the support wire in order to provide a secure connection.

The mounting bridge also includes a rod or bead made of high silica glass, such as quartz, which is connected to,

and supported by, the two lead-in wires. The latter then extend into, and are supported by, a press seal at one end of the envelope where they are connected to molybdenum ribbons which, in turn, are connected to external connecting wires. In turn, the third support wire is partially embedded in, and supported by, the quartz bead.

In operation, electric current flows in series through the ballast coil and the filament, since one leg of each adjoins and is in electrical connection with the other on the third support wire. The ballast coil generally has a more open pitch than the filament and operates at a lower temperature. Also, the ballast coil generally has lower resistance than the filament in order to consume less power.

To achieve maximum miniaturization of the lamp, the ballast coil is preferably disposed between the filament and the quartz bead and is substantially co-planar with both. Also, the filament and quartz bead are preferably parallel with each other, and the ballast coil is angularly disposed in relation to both. Since the ballast coil operates at a lower wattage than the filament, and thus radiates less heat, it can be positioned closer than the latter to the quartz bead, subject to the limitation that the maximum temperature attained by the quartz bead is below its softening point.

When used in a projector, the lamp is mounted so that its filament is at or about the focus of a curved reflector, preferably ellipsoidal with the lamp axis co-axial with the reflector. The reflected light can then be accurately directed toward a condenser lens or the film to be projected.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a lamp, according to this invention, attached to a reflector.

FIG. 2 is an expanded view of the lamp showing the details of the mount support.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIG. 1, ellipsoidal reflector 1 is centrally attached to base 2 by means of, for example, a high temperature adhesive. Reflector 1 is conveniently made of glass and the reflective coating thereon can be metallic, but is preferably dichroic. A dichroic coating efficiently reflects the light radiation falling on its surface but permits a substantial amount of the heat radiation to pass therethrough, which advantageously minimizes the heat directed towards the film to be projected. Base 2 is preferably perforated or slotted to increase heat dissipation.

Lamp 3 is fastened to base 2 through an opening at the center of reflector 1, so that lamp 3 and reflector 1 are substantially co-axial and filament 4 is at about the focus of reflector 1. The opening in reflector 1 is slightly greater than the diameter of lamp 3 but not large enough to materially diminish the quantity of reflected light. Pins 5, protruding from base 2 and internally connected to the lamp lead-in wires, are designed for insertion into a suitable electrical socket.

Lamp 3 comprises, as shown in FIG. 2, a tubular quartz envelope 6 having press seal 7 at the lower end thereof. Disposed within envelope 6 is a mounting bridge comprising two support and lead-in wires 8 and 9, a third support wire 10 and quartz rod 11. Lead-in wires 8 and 9 extend into, and are supported by, press seal 7, where they connect to molybdenum ribbons 12 which, in turn, are connected to externally extending lead-in wires 13. Lead-in wires 8 and 9 also extend into the interior of envelope 6, are fastened to quartz rod 11, thereby supporting the latter, and extend further into envelope 6. To provide proper positioning for filament 4 and ballast coil 14, one wire, shown in the figure to be wire 8, is longer than the other. Quartz rod 11 is positioned in the lower portion of envelope 6, orthogonal to the axis thereof, and

is the supporting member for support wire 10. Support wire 10, one end of which is fastened to quartz rod 11, extends into envelope 6 about the same distance as wire 8, so that when filament 4 is connected to the ends of wires 8 and 10, filament 4 is substantially parallel to quartz rod 11. Wires 8, 9 and 10 extend upwardly from quartz rod 11 substantially parallel, with wire 9 shorter than the other two and located about midway between them. Thus, ballast coil 14, when connected to the ends of wires 9 and 10, is positioned angularly within the lamp.

Ballast coil 14 is made of 274 mm. of tungsten wire having a weight of 19.85 mg./200 mm., which is equivalent to a diameter of about 3.2 mils. It is primary-coiled on a 14 mil mandrel at 174 turns per inch and then partially secondary-coiled on a 25.8 mil mandrel at 24 turns per inch to form a U-shape, with legs 15 and 16 being about 7 mm. long and body 17 about 3½ mm. long. Legs 15 and 16 are then stretched somewhat and bent back toward body 17 so that they are roughly aligned with the axis thereof, but at an angle. The resultant shape is that necessary to permit ballast coil 14 to be mounted on wires 9 and 10 by inserting the latter through the bent portions of legs 15 and 16 respectively. After legs 15 and 16 have been bent to the proper shape they are trimmed in length, so that only about 2 mm. of each leg will engage wires 9 and 10 respectively. Wires 9 and 10 are made of 13 mil tungsten wire and provide a close fit with legs 15 and 16 on insertion therein. To mount ballast coil 14, wire 10 is inserted into the bore of leg 16, out through the space between the primary turns caused by the bend and protrudes about 2 mm. beyond, to provide for the subsequent connection to filament 4. Conversely, wire 9 is inserted into the bore of leg 15 at the space between the primary turns caused by the bend and out through the end of leg 15 for a short distance only.

Filament 4 is made of 519 mm. of tungsten wire having a weight of 19.78 mg./200 mm. It is primary-coiled on a 14 mil mandrel at 210 turns per inch and then partially secondary-coiled on a 40 mil mandrel at 39 turns per inch to form a U-shape, the legs being about 2 mm. long and the body about 3½ mm. long. Filament 4 is mounted by first inserting the end of wire 8 completely into the straight portion of one filament leg and then the protruding portion of wire 10 into the other. The distance between wires 8 and 10 is preset to correspond to the distance between the filament legs, thereby permitting a facile connection therebetween. To assure a more positive connection, the legs of ballast coil 14 and filament 4 were hot crimped on their respective support wires.

The completed filament mount was thus quite compact, occupying an area of only 9 mm. (the length of rod 11) by 11 mm. (measured between the extremities of rod 11 and filament 4). Lamp 3 was completed by positioning the filament mount in envelope 6, press sealing, exhausting, filling with nitrogen and bromine to a pressure of 3 atmospheres and tipping off. The finished lamp was 1⅝ inch in diameter by 1¼ inches long.

At the assembly of the lamp and reflector, the position of lamp 3 in reflector 1 was adjusted for maximum efficiency of reflected light prior to fastening in base 2.

At 120 volts operation, the lamp consumed 150 watts of power, with filament 4 operating at 84 volts and the ballast coil at 36 volts. The operating temperatures of the filament and the ballast coil were 3350° and 3050° K., respectively.

We claim:

1. An incandescent lamp comprising:
 - a tubular high-silica-glass envelope having a press seal at one end thereof;
 - a tungsten filament, having coiled legs, disposed substantially orthogonal to the axis of said envelope;
 - a high-silica-glass rod, substantially parallel to said filament, disposed between said filament and said press seal;

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a first support wire extending through said rod and into the bore of one leg of said filament, said first support wires being electrically connected to a first externally-extending lead-in wire;

a second support wire extending from said rod into the bore of the other leg of said filament, said second support wire not being electrically connected in the circuit;

a third support wire extending through said rod into a first coiled leg of a ballast coil, said third support wire being electrically connected to a second externally extending lead-in wire, the resistance of said ballast coil being less than that of said filament; and a second coiled leg of said ballast coil encirclingly connected to said second support wire, adjacent said other leg of said filament.

2. The lamp of claim 1 wherein said first leg of said ballast coil extends toward said filament and said second leg of said ballast coil extends toward said rod.

3. The lamp of claim 2 wherein said third support wire extends into and through the bore of said first coiled leg of said ballast coil and into the bore of said other leg of said filament.

4. The lamp of claim 3 wherein said ballast coil is angularly disposed between said filament and said rod.

5. An incandescent lamp comprising:

a tubular high-silica-glass envelope;

a high-silica-glass rod orthogonally disposed within said envelope;

a tungsten filament, having a coiled leg, disposed within said envelope;

a ballast coil, having a coiled leg, in series with said filament and disposed between said rod and said filament; and

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a support wire extending through said rod, into and through the bore of said ballast coil leg and into the bore of said filament leg.

6. The lamp of claim 5 wherein said filament is substantially parallel to said rod.

7. The lamp of claim 6 wherein said filament and said ballast coil each has a second coiled leg, said second coiled legs being connected to, and encircling, separate lead-in wires, said lead-in wires extending through said rod.

8. The lamp of claim 7 wherein said coiled legs are hot crimped on said support wire and said lead-in wires.

9. The lamp of claim 8 and a curved dichroic reflector wherein said lamp is coaxially disposed within said reflector.

10. The lamp of claim 8 wherein said reflector is ellipsoidal and said filament is disposed at about the focus of said reflector.

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