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(54) **Tubular incandescent lamp**

Röhrenförmige Glühlampe

Lampe tubulaire à incandescence

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EP-A- 0 397 422
GB-A- 2 080 022

FR-A- 2 608 838
US-A- 4 916 353

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Description

Field of the Invention

This invention relates to tubular incandescent lamps and, more particularly, to a self-supporting, self-centering filament in a double-ended lamp capsule.

Background of the Invention

Tubular incandescent halogen lamps include a helical filament axially mounted within a quartz lamp envelope. Filament supports attached to the filament support and center the filament within the lamp envelope. The ends of the lamp envelope are hermetically sealed, typically by press sealing. Molybdenum foils electrically connect the filament through the seals to external electrical leads. The interior of the lamp envelope is typically filled with an inert gas and one or more halogen compounds. Such lamps are known from GB-A 2 080 022 wherein the envelope is a straight structureless tube. Several ring-like support members are arranged along the tube in order to center the filament. Another example is US-A 4 916 353 wherein the support members mount the filament in a single-ended lamp capsule. Still another example is EP-A 397 422, wherein the support member is described to have the shape of a ring with a loop on each side.

FR-A 2 608 838 describes a tubular incandescent lamp having a filament with an incandescent active central segment, two inactive end segments and skip turns connecting the central segment with the end segments. The end segments are directly fused into the press seal ends of the tube.

It is important to center the filament within the lamp envelope to prevent undesired interactions between the filament and the walls of the lamp envelope. In addition, it is well known that for proper lamp performance, the spacing between coils of the filament must be precisely controlled. This is important because a slight change in filament length significantly changes the operating temperature of the filament. Any change in filament temperature will have a dramatic effect on lamp performance and life.

In one particular lamp type, filament location is even more critical. This type of lamp is known as an infrared conserving lamp, which has a wavelength selective filter coating applied to a surface of the lamp envelope. A central region of the lamp envelope adjacent to the filament typically has a geometrically shaped section, such as an ellipsoid. The selective filter coating transmits visible radiation and reflects infrared radiation back to the filament. The reflected infrared radiation can significantly reduce the electrical power consumption of the lamp. In order to gain maximum benefit from the reflected infrared radiation, the filament must be very precisely centered on the axis of the lamp envelope. Also, in order for the filament to perform at its design temperature, the fil-

ament length must be precisely controlled.

An important component of the tubular incandescent lamp capsule described above is the filament support used to support and center each end of the filament and to conduct electrical energy to the filament. Filament supports for tubular incandescent lamps are disclosed in U.S. Patent No. 4,942,331 issued July 17, 1990 to Bergman et al; U.S. Patent No. 4,510,416 issued April 9, 1985 to Meade et al and U. S. Patent No. 4,959,585 issued September 25, 1990 to Hoegler et al. Filament supports are also disclosed in pending application Serial No. 07/815,004 filed December 27, 1991 (US-A-5 250 873) and in pending application Serial No. 07/815,089 filed December 27, 1991 (US-A-5 254 902). Factors involved in the design of filament supports include the requirement for easy insertion in a tubular lamp envelope, which may vary in inside diameter from lamp to lamp, the requirement for accurate centering of the filament over the life of the lamp and the requirement to maintain the filament at a predetermined length throughout the life of the lamp.

It is a general object of the present invention to provide improved tubular incandescent lamp capsules.

Summary of the Invention

According to the invention as claimed, there is provided a lamp capsule comprising a light-transmissive lamp envelope including seals at opposite ends thereof, transition sections located on either side of a central section, and parent tubing sections located between the transition sections and the seals and having a central axis. The lamp capsule additionally comprises a coiled coil filament within the envelope having two inactive end segments, an active central segment, and skip turns interconnecting the end segments and the central segment. An inner surface of the lamp envelope contacts the end segments for retaining the filament within the lamp envelope such that the filament is centered within the lamp envelope.

In a preferred embodiment of the present invention as claimed, the lamp capsule further comprises foil conductors which pass through the seals and connect opposite ends of the filament to external leads. The lamp envelope further includes a central section having an infrared reflective coating thereon. The filament central segment is located within the envelope central section. The filament skip turns are located within the envelope transition sections. An inner surface of each parent tubing section contacts respective filament end segments for retaining the filament within the lamp envelope.

Brief Description of the Drawings

For a better understanding of the present invention, together with other and further objects, advantages and capabilities thereof, reference is made to the accompanying drawings which are incorporated herein by refer-

ence and in which:

FIG. 1 shows a tubular incandescent lamp capsule in accordance with the prior art;

FIG. 2 shows a filament suitable for use in the present invention; and

FIG. 3 shows a tubular incandescent lamp capsule of the present invention incorporating the filament of FIG. 2.

Description of the Prior Art

A tubular incandescent lamp capsule in accordance with the prior art is shown in FIG. 1. A helically coiled filament 10 is mounted within a tubular lamp envelope 12. The filament 10 is supported at each end by filament supports 14 and 16. The filament supports 14 and 16 center the filament 10 on a central axis 20 of lamp envelope 12. Filament support 14 is electrically connected to an external lead 22 by a molybdenum foil conductor 24 which passes through a seal 26. Filament support 16 is electrically connected to an external lead 30 by a molybdenum foil conductor 32 which passes through a seal 34. Seals 26 and 34 hermetically seal the lamp envelope 12. An infrared reflective coating 36 is applied to the outside surface of the lamp envelope 12. Helical portions of filament supports 14 and 16 engage the inner surface of lamp envelope 12 and center filament 10 on axis 20. The filament supports 14 and 16 may be made from molybdenum and the filament 10 is made from tungsten. The filament supports 14 and 16 are welded to the filament 10.

Detailed Description of the Invention

A filament suitable for use in the present invention is shown in FIG. 2. A filament 50 has a "coiled coil" configuration (described below) with three coaxial segments: a center segment 52 and two end segments 54 and 56. The filament 50 has a central axis 58 along which the three segments are coaxially located. The center segment 52 is attached to end segments 54 and 56 through skip turns 60 and 62, respectively. Inlead portions 64 and 66 are located at opposite ends of the filament 50 and are connected to the end segments 54 and 56, respectively.

The "coiled coil" configuration of the filament 50, as will be appreciated by those skilled in the art, is so called because the filament preferably includes a single length of electrically conductive wire, such as tungsten, which is first wound in a helix about a first molybdenum mandrel. The resulting tungsten wire helix and molybdenum mandrel structure is then helically coiled about a pin, or second mandrel. The pin is preferably made of steel, but other materials are suitable. The pin is thereafter retracted from the structure leaving the first molybdenum mandrel in place with the tungsten wire wound helically therearound. The remaining structure is then chemically

treated, preferably with an acid, to selectively remove (dissolve) portions of the first molybdenum mandrel. Portions of the filament are masked with an acid resistant coating such as wax, during the procedure, for protecting sections of the mandrel from the acid so that such protected sections of the mandrel remain in place after the process. This process yields a tungsten wire in the form of a double helically wound structure known as a "coiled coil" filament. Such a coiled coil configuration exhibits excellent self-centering and self-supporting characteristics.

During operation in an incandescent lamp, portions of the filament which surround remaining sections of the mandrel are electrically inactive. In other words, only the filament portions which surround removed sections of the mandrel are electrically active and will reach incandescence. In a preferred embodiment of the present invention, only the center segment of the filament is electrically active and reaches incandescence during operation. The end segments of the filament surround remaining sections of the mandrel and are electrically inactive during operation.

The skip turns 60 and 62 are formed by a short length of the filament, preferably within the range of 1mm to 3mm in length, having a reduced number of secondary turns per cm (or per inch (TPI)) in relation to the secondary TPI of the other filament segments, thus, producing a gap between the segments. The skip turns readily define the three filament segments and aid in the mandrel section removal process. In addition, the skip turns provide accurate axial filament segment positioning within a double-ended envelope by providing axial spacing between the end segments 54 and 56 and the center segment 52. In doing so, the skip turns 60 and 62 provide separation between the electrically active and inactive filament segments during operation.

The filament wire of the present invention has a typical diameter of 50.8 μm (0.002 inch), suitable for a typical lamp current of 0.5 amps. The primary turns of the filament have a typical diameter of 330.2 μm (0.013 inch) and the secondary turns of the filament have a typical diameter of 1,499 μm (0.059 inch).

The end segments 54 and 56, may have the same or different number of secondary turns per cm (or per inch) as the center segment of the filament.

A double-ended, tubular incandescent lamp capsule incorporating the filament 50 is shown in Fig. 3. The filament 50 is mechanically supported within a double-ended tubular lamp envelope 80, typically quartz. The envelope 80 and the filament 50 share a common central axis 82. The coiled coil configuration of the filament 50 offers structural stability for accurate self centering and self support.

The lamp envelope 80 includes the following sections: a central section 84, preferably two transition sections 86 and 88, connected to opposite ends of the central section 84, two filament support sections 90 and 92, connected to transition sections 86 and 88, respectively,

and two press seal sections 94 and 96, located at opposite ends of the lamp envelope.

The central section 84 is preferably ellipsoidal in shape and includes an infrared reflective coating on the outer surface. Techniques for application of infrared reflective coatings are known in the art. The central section 84 is geometrically shaped to optically optimize reflected infrared light rays onto the electrically active center segment 52 of the filament 50, for energy conservation.

The transition sections 86 and 88, which surround the filament skip turns 60 and 62, have a constant diameter and have an inside diameter slightly larger than the outside diameter of the skip turns such that a positive clearance exists between the filament 50 and envelope 80 in the transition sections 86 and 88. This clearance is provided to prevent any deleterious interaction between the active portion of the filament 50 (center segment 52) and the lamp envelope 80 during lamp operation. Within the transition sections 86 and 88, the filament 50 transitions from active to inactive through the skip turns 60 and 62 due to the presence of the retained mandrels (not shown) in the end segments 54 and 56.

The filament support sections 90 and 92 mechanically retain the filament end segments 54 and 56, respectively, serving to accurately position the filament 50 centrally within the central section 84. The inside surfaces 97 and 98 of the filament support sections 90 and 92 contact the filament end segments 54 and 56, respectively. Because the end segments 54 and 56 are electrically inactive, no harmful interaction between the filament 50 and quartz lamp envelope occurs.

A "tacking" process, which shrinks the filament support sections 90 and 92 around the end segments 54 and 56, respectively, is used to create an intimate locking fit, thereby securing the filament 50 in a fixed position relative to the lamp envelope 80 during the lamp making process. During such process the filament 50 is placed within the lamp envelope 80. Then, the filament 50 is axially positioned as desired and stretched using a calibrated measurement system and other process-specific hardware. When the desired filament location and stretch are established, the exterior of the filament support sections 90 and 92 of the lamp envelope 80 are locally heated with a torch. The filament support sections 90 and 92 then collapse around the end segments 54 and 56, respectively, and secure the filament 50 in position after cooling. Mechanical pressure may be applied to the filament support sections 90 and 92 to aid in collapsing such sections. The tacking process is described in more detail in U.S. patent application serial no. 07/814,739, filed December 27, 1991 (US-A-5 209 689), entitled METHODS FOR MOUNTING FILAMENTS IN TUBULAR INCANDESCENT LAMP CAPSULES.

The filament inlead portions 64 and 66 are connected to external leads 100 and 102 by molybdenum foil conductors 104 and 106, respectively. The foil conduc-

tors 104 and 106 pass through the press seal sections 94 and 96, respectively, at opposite ends of the lamp envelope 80. The press seal sections 94 and 96 provide a hermetic seal between the quartz lamp envelope 80 and the foil conductors 104 and 106. Electrical power is supplied to the filament 50 through the external leads 100 and 102.

While there have been shown and described what are at present considered the preferred embodiments of the present invention as claimed, it will be obvious to those skilled in the art that various changes and modifications may be made herein without departing from the scope of the invention as defined by the appended claims thereto.

Claims

1. A tubular incandescent lamp comprising:

a light-transmissive double-ended lamp envelope (80) including seals (94, 96) at opposite ends thereof and a central section (84), and having a central axis (82);

a coiled coil filament (50) within the lamp envelope, the filament (50) including two inactive end segments (54, 56) which provide for self-supporting of the filament, an active central segment (52), which is located within the central section (84) of the envelope, and skip turns (60, 62) interconnecting the end segments (54, 56) and the central segment (52),

wherein the end segments, the central segment and the skip turns have their common central axis shared with the envelope;

and means for coupling electrical energy through the seals to the filament;

characterized in that filament support sections (90, 92) of the envelope are located adjacent the seals (94, 96), having an inner surface contacting the filament end segments for retaining the filament within the lamp envelope such that the filament is substantially centered within the lamp envelope;

the lamp envelope includes transition sections (86, 88) located on either end of the central section (84), within which the filament skip turns (60, 62) are located; the transition sections being adjacent to the filament support sections (90, 92);

the transition sections having a substantially constant diameter and having an inside diameter slightly larger than the outside diameter of the skip turns such that a positive clearance exists between the filament and envelope in the transition sections.

2. A tubular incandescent lamp as defined in claim 1 wherein the central section (84) has an infrared reflective coating thereon.

3. A tubular incandescent lamp as defined in claim 1 wherein the coupling means includes foil conductors (104, 106) which pass through the seals (94, 96) and connect opposite ends (64, 66) of the filament to external leads (100, 102).

4. A tubular incandescent lamp as defined in claim 3 wherein the central segment (52) is the only electrically active segment of the filament.

5. A tubular incandescent lamp as defined in claim 1 wherein the end segments are coiled around a mandrel.

6. A tubular incandescent lamp as defined in claim 5 wherein the filament comprises a single length of wire.

7. A tubular incandescent lamp as defined in claim 5 wherein the filament further comprises two inlead portions attached to the end segments.

8. A tubular incandescent lamp as defined in claim 1 wherein the coiled coil configuration includes primary and secondary turns and wherein the skip turns include less secondary turns per cm (per inch) than the end segments and central segment.

9. A tubular incandescent lamp as defined in claim 1 wherein the filament support sections (90, 92) secure the filament end segments (54, 56) by an intimate locking fit.

Patentansprüche

1. Röhrenförmige Glühlampe, die folgendes umfaßt:

einen lichtdurchlässigen zweiseitig verschlossenen Lampenkolben (80) mit Dichtungen (94, 96) an seinen entgegengesetzten Enden und einem zentralen Abschnitt (84), und mit einer Mittelachse (82);

einen doppelt gewendelten Glühfaden (50) innerhalb des Lampenkolbens, wobei der Glühfaden (50) zwei inaktive Endsegmente (54, 56), die für die Selbststützung des Glühfadens sorgen, ein aktives zentrales Segment (52), das sich im zentralen Abschnitt (84) des Kolbens befindet, und Übergangswindungen (60, 62), die die Endsegmente (54, 56) und das zentrale Segment (52) miteinander verbinden, enthält, wobei die Endsegmente, das zentrale Segment und die Übergangswindungen ihre gemeinsa-

me Mittelachse mit dem Kolben teilen; und Mittel zum Koppeln elektrischer Energie durch die Dichtungen zu dem Glühfaden;

dadurch gekennzeichnet, daß sich Glühfadenstützabschnitte (90, 92) des Kolbens neben den Dichtungen (94, 96) befinden, eine Innenfläche aufweisen, die die Glühfadenendsegmente berührt, um den Glühfaden derart im Lampenkolben zu halten, daß der Glühfaden innerhalb des Lampenkolbens im wesentlichen zentriert ist;

daß der Lampenkolben an beiden Enden des zentralen Abschnitts (84) befindliche Übergangsabschnitte (86, 88) enthält, innerhalb derer sich die Glühfadenübergangswindungen (60, 62) befinden; wobei die Übergangsabschnitte sich neben den Glühfadenstützabschnitten (90, 92) befinden; wobei die Übergangsabschnitte einen im wesentlichen konstanten Durchmesser haben und einen Innendurchmesser aufweisen, der geringfügig größer ist als der Außendurchmesser der Übergangswindungen, so daß in den Übergangsabschnitten zwischen dem Glühfaden und dem Kolben ein Sicherheitsabstand besteht.

2. Röhrenförmige Glühlampe nach Anspruch 1, bei der auf dem zentralen Abschnitt (84) eine Infrarotstrahlung reflektierende Beschichtung aufgebracht ist.

3. Röhrenförmige Glühlampe nach Anspruch 1, bei der das Kupplungsmittel Folienleiter (104, 106) enthält, die durch die Dichtungen (94, 96) hindurchgehen und entgegengesetzte Enden (64, 66) des Glühfadens mit externen Leitungen (100, 102) verbinden.

4. Röhrenförmige Glühlampe nach Anspruch 3, bei der das zentrale Segment (52) das einzige elektrisch aktive Segment des Glühfadens ist.

5. Röhrenförmige Glühlampe nach Anspruch 1, bei der die Endsegmente um einen Dorn herum gewickelt sind.

6. Röhrenförmige Glühlampe nach Anspruch 5, bei der der Glühfaden aus einem einzigen Stück Draht besteht.

7. Röhrenförmige Glühlampe nach Anspruch 5, bei der der Glühfaden weiterhin zwei an den Endsegmenten befestigte Einleitungsteile umfaßt.

8. Röhrenförmige Glühlampe nach Anspruch 1, bei der die doppelt gewendelte Konfiguration Primär-

und Sekundärwindungen enthält und bei der die Übergangswindungen weniger Sekundärwindungen pro cm (pro Zoll) als die Endsegmente und das zentrale Segment enthalten.

9. Röhrenförmige Glühlampe nach Anspruch 1, bei der die Glühfadenstützabschnitte (90, 92) die Glühfadenendsegmente (54, 56) durch eine enge Arretierung sichern.

Revendications

1. Lampe à incandescence tubulaire comportant :

une enveloppe (80) de lampe à double extrémité transmettrice de la lumière comportant des joints (94,96) à ses extrémités opposées et une partie (84) centrale, et ayant un axe (82) central ;

un filament bispiralé (50) à l'intérieur de l'enveloppe de lampe, le filament (50) comportant deux segments (54,56) d'extrémité inactifs qui assure un support autonome du filament, un segment (52) actif central, qui se trouve à l'intérieur de la partie (84) centrale de l'enveloppe, et des spires (60,62) de saut reliant les segments (54,56) d'extrémité et le segment (52) central,

dans lequel les segments d'extrémité, le segment central et les spires de saut ont leur axe central commun partagé avec l'enveloppe; et des moyens destinés à coupler de l'énergie électrique par les joints aux filaments;

caractérisée en ce que les parties (90,92) de support de filament de l'enveloppe sont situées adjacentes aux joints (94,96), en ayant une surface intérieure en contact avec les segments d'extrémité de filament pour maintenir le filament dans l'enveloppe de lampe de sorte que le filament est sensiblement centré à l'intérieur de l'enveloppe de lampe.;

l'enveloppe de lampe comporte des parties (86,88) de transition situées à une extrémité ou l'autre de la partie (84) centrale, à l'intérieur de laquelle les spires (60,62) de saut de filament se trouvent; les parties de transition étant adjacentes aux parties (90,92) de support de filament;

les parties de transition ayant un diamètre sensiblement constant et ayant un diamètre intérieur légèrement plus grand que le diamètre extérieur des spires de saut, de sorte que un jeu positif existe entre le filament et l'enveloppe dans les parties de transition.

2. Lampe à incandescence tubulaire suivant la revendication 1, dans laquelle la partie (84) centrale est recouverte d'un revêtement réfléchissant l'infrarouge.

3. Lampe à incandescence tubulaire suivant la revendication 1, dans laquelle les moyens de couplage comportent des conducteurs (104,106) à feuille qui passent dans les joints (94,96) et relient des extrémités (64,66) opposées du filament à des conducteurs (100,102) extérieurs.

4. Lampe à incandescence tubulaire suivant la revendication 3, dans laquelle le segment (52) central est le seul segment actif électriquement du filament.

5. Lampe à incandescence tubulaire suivant la revendication 1, dans laquelle les segments d'extrémité sont bobinés autour d'un mandrin.

6. Lampe à incandescence tubulaire suivant la revendication 5, dans laquelle le filament comporte une seule longueur de fil.

7. Lampe à incandescence tubulaire suivant la revendication 5, dans laquelle le filament comporte en outre deux parties d'entrée fixées aux segments d'extrémité.

8. Lampe à incandescence tubulaire suivant la revendication 1, dans laquelle la configuration de bobine bispiralée comporte des spires primaires et secondaires et dans laquelle les spires de saut comportent moins de spires secondaires par centimètre (par pouce) que les segments d'extrémité et le segment central.

9. Lampe à incandescence tubulaire suivant la revendication 1, dans laquelle les parties (90,92) de support de filament fixent les segments (54,56) d'extrémité de filament par un ajustage verrouillé intime.

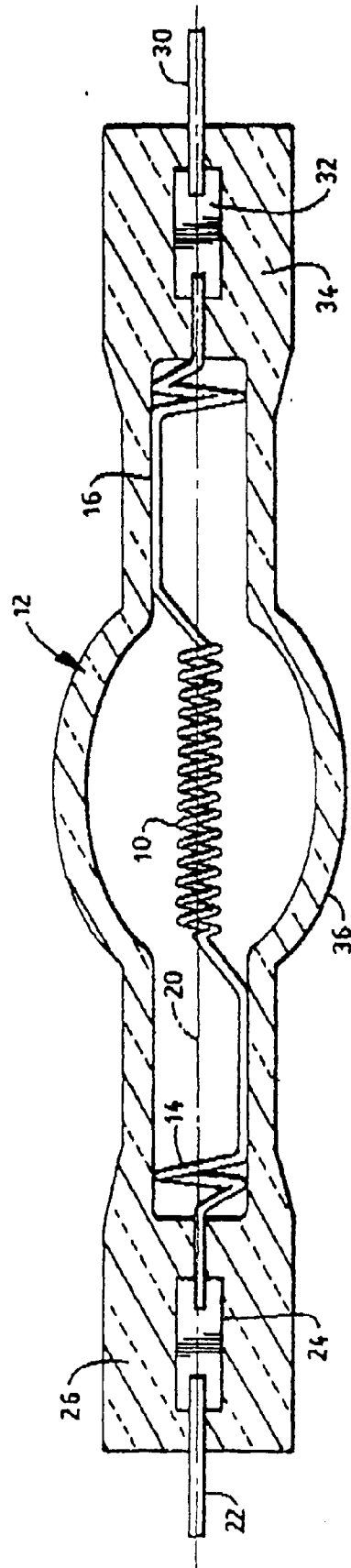


FIG. 1
PRIOR ART

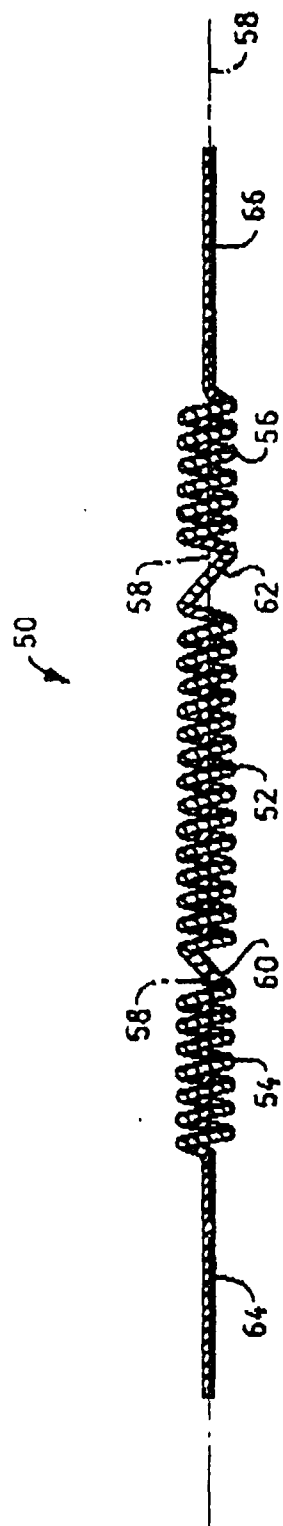


FIG. 2

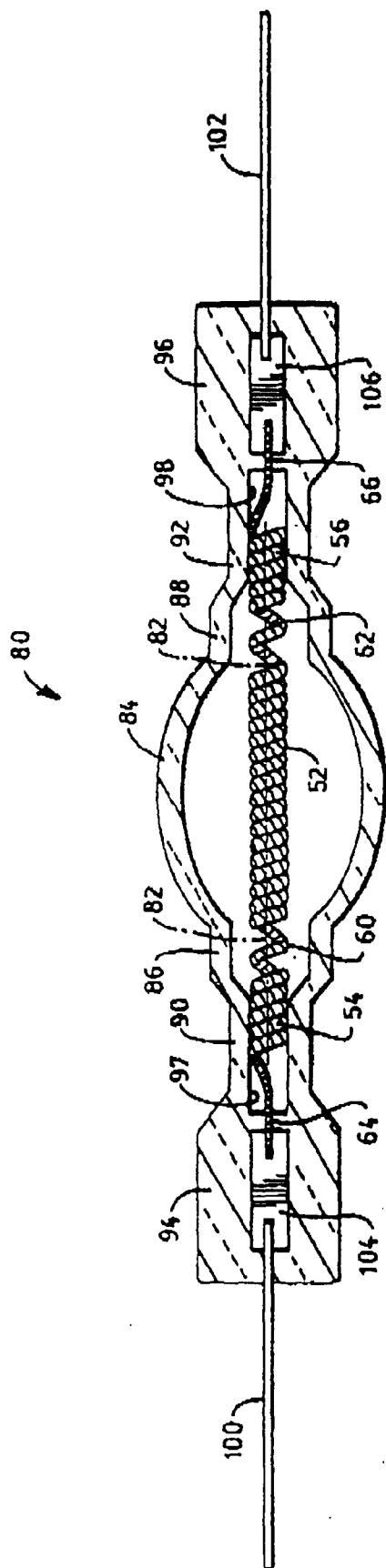


FIG. 3