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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:	WO 93/13544
H01K 1/24	A1	(43) International Publication Date:	8 July 1993 (08.07.93)

(21) International Application Number: PCT/US92/10289

(22) International Filing Date: 30 November 1992 (30.11.92)

(30) Priority data:
815,089 27 December 1991 (27.12.91) US

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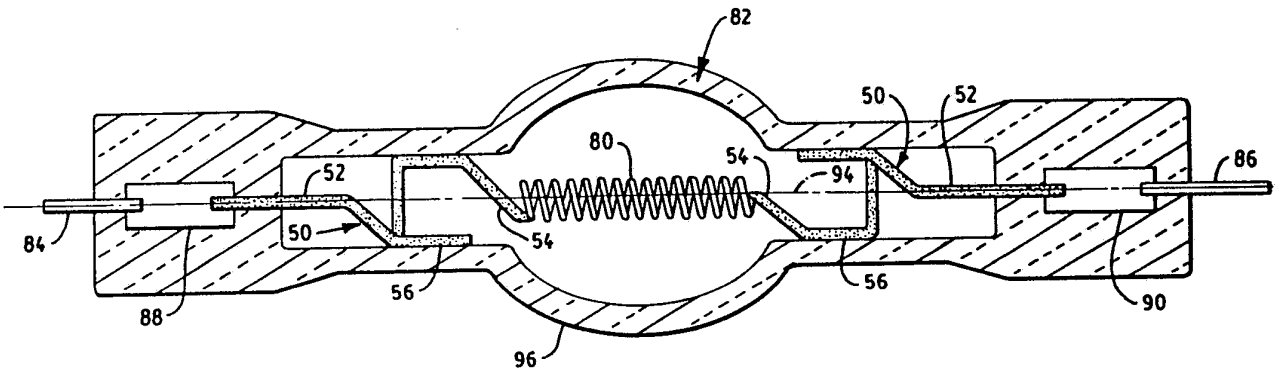
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(81) Designated States: CA, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: FILAMENT SUPPORT FOR TUBULAR LAMP CAPSULE



(57) Abstract

Filament supports (50) for supporting and centering a filament (80) in a double-ended lamp envelope (82) include an inlead portion (52) defining a central axis (94), a filament attachment portion (54) and a centering portion (56) interconnecting the inlead portion (52) and the filament attachment portion (54). The centering portion (56) contacts an inner surface of the lamp envelope (82) at a plurality of discrete, circumferentially spaced-apart contact regions that are substantially equally spaced from the central axis (94). The filament supports (50) are attached to opposite ends of the filament (80) for accurately centering the filament (80) within the lamp envelope (82). The filament supports (50) are particularly useful in a tubular incandescent lamp capsule having an infrared reflective coating (96) on its outer surface.

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FILAMENT SUPPORT FOR TUBULAR LAMP CAPSULE

Field of the Invention

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

Background of the Invention

Tubular incandescent halogen lamp capsules 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.

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 the outside surface of the lamp envelope. A central region of the lamp envelope adjacent to the filament typically has a geometrically shaped section such as ellipsoidal. 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 filament 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. 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.

It is another object of the present invention to provide improved filament supports for tubular incandescent lamp capsules.

It is a further object of the present invention to provide filament supports for accurate and stable centering of a filament within a tubular incandescent lamp capsule.

It is yet another object of the present invention to provide filament supports for tubular incandescent lamp capsules which are easy to manufacture and which are low in cost.

Summary of the Invention

According to the present invention, these and other objects and advantages are achieved in a

filament support for supporting and centering a filament in a double-ended lamp envelope. The filament support comprises an inlead portion defining a central axis, a filament attachment portion and a centering portion interconnecting the inlead portion and the filament attachment portion. The centering portion includes means for contacting an inner surface of the lamp envelope at a plurality of discrete, circumferentially spaced-apart contact regions that are substantially equally spaced from the central axis.

In a first embodiment of the invention, the centering portion includes first, second and third axial segments defining first, second and third contact regions, a first lateral segment interconnecting the first and second axial segments, and a second lateral segment interconnecting the second and third axial segments.

In a second embodiment, the centering portion includes first, second and third interconnected lateral segments defining a first generally U-shaped section, fourth, fifth and sixth interconnected lateral segments defining a second generally U-shaped section, and an axial segment interconnecting the first and second U-shaped sections.

In a third embodiment, the centering portion includes first and second lateral segments which are interconnected by an axial segment to define a generally U-shaped section, and third and fourth

lateral segments which are axially spaced apart and which are interconnected by the U-shaped section.

In a fourth embodiment, the centering portion includes first and second lateral segments which are interconnected by an axial segment to define a generally U-shaped section, and first and second radial segments which are axially spaced-apart and which are interconnected by the U-shaped section.

According to another aspect of the invention, there is provided a lamp capsule comprising a light-transmissive lamp envelope having seals at opposite ends thereof and having a central axis, a filament within the lamp envelope, first and second filament supports connected to opposite ends of the filament for supporting and centering the filament on the central axis of the lamp envelope, and means for coupling electrical energy through the seals to the first and second filament supports. The first and second filament supports are configured as one of the embodiments described above.

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 reference and in which:

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

FIGS. 2A-2C show front, side and top views,

respectively, of a first embodiment of the filament support;

FIG. 3 shows a tubular incandescent lamp capsule incorporating the first embodiment of the filament support;

FIGS. 4A-4C show front, side and top views, respectively, of a second embodiment of the filament support;

FIG. 5 shows a tubular incandescent lamp capsule incorporating the second embodiment of the filament support;

FIGS. 6A-6C show front, side and top views, respectively, of a third embodiment of the filament support;

FIG. 7 shows a tubular incandescent lamp capsule incorporating the third embodiment of the filament support;

FIGS. 8A-8C show front, side and top views, respectively, of a fourth embodiment of the filament support; and

FIG. 9 shows a tubular incandescent lamp capsule incorporating the fourth embodiment of the filament support.

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.

Detailed Description of the Invention

A filament support in accordance with a first embodiment of the invention is shown in FIGS. 2A-2C. A filament support 50 includes an inlead portion 52, a filament attachment portion 54 and a centering portion 56. The filament support 50 has a central axis 58. The filament attachment portion 54 extends through the central axis 58 at an angle, as best shown in FIG. 2B. The centering portion 56 interconnects inlead portion 52 and filament attachment portion 54, and provides support and accurate centering of the filament.

The centering portion 56 includes a first axial segment 60, a second axial segment 62 and a third axial segment 64. As used herein, "axial segment"

refers to a segment of the filament support that is generally parallel to axis 58. The axial segments 60 and 62 are interconnected by a lateral segment 66, and the axial segments 62 and 64 are interconnected by a lateral segment 68. As used herein, "lateral segment" refers to a segment of the filament support that is generally perpendicular to axis 58. The filament attachment portion 54 is connected to axial segment 64, and the inlead portion 52 is connected to axial segment 60 by an angled segment 70. As shown in FIG. 2C, the lateral segments 66 and 68 are oriented at an angle of about 60° with respect to each other.

The axial segments 60, 62 and 64 define regions A, B and C respectively, for contact with the inside surface of a cylindrical lamp envelope. The contact regions A, B and C are equally spaced from central axis 58 and are equally spaced from each other to define an equilateral triangle.

The filament support 50 is preferably fabricated from a single length of electrically conductive, refractory wire, such as molybdenum, but other materials, such as tungsten, may also be suitable. The wire must have sufficient strength to support the filament and must have a diameter that is sufficient to carry the lamp current. A molybdenum wire diameter of about 0.013 inch, for example, is suitable for lamp currents of one amp or less. The wire is formed into the required shape by a four-slide wire forming machine. In a preferred

embodiment, the filament support 50 has an overall length of 0.5 inch, and the centering portion 56 is dimensioned to fit with minimum clearance in a lamp envelope having an inside diameter of 0.116 inch.

A double-ended tubular incandescent lamp capsule incorporating filament supports 50 is shown in FIG. 3. A helically coiled filament 80 is supported within a double-ended tubular lamp envelope 82, typically quartz, by filament supports 50. The filament attachment portions 54 are attached to filament 80 by one of several methods, as known in the art, such as crimping or welding. In the resulting subassembly, the two filament supports and the filament all share a common axis. The inlead portions 52 are connected to external leads 84 and 86 by molybdenum foil conductors 88 and 90, respectively, which pass through seals at opposite ends of lamp envelope 82. The centering portions 56 of filament supports 50 contact the inner cylindrical walls of the lamp envelope 82 at contact regions A, B and C (FIG. 2C) to accurately center filament 80 on a central axis 94 of lamp envelope 82. The lamp envelope 82 has an infrared reflective coating 96 on its outer surface. Techniques for fabrication and sealing of lamp envelopes and for application of infrared reflective coating 96 are known in the art.

A filament support in accordance with a second embodiment of the present invention is shown in FIGS. 4A-4C. A filament support 110 includes an

inlead portion 112, a filament attachment portion 114 and a centering portion 116. The inlead portion 112 defines a central axis 118. The inlead portion 112 and the filament attachment portion 114 correspond to the inlead portion 52 and the filament attachment portion 54, respectively, shown in FIGS. 2A-2C and described above. The centering portion 116 interconnects inlead portion 112 and filament attachment portion 114, and provides support and accurate centering of the filament.

The centering portion 116 includes lateral segments 120, 122 and 124, which are interconnected to define a first, generally U-shaped section 126. The segments 120, 122 and 124 are approximately equal in length. The segments 120 and 124 are generally perpendicular to segment 122 and are generally parallel to each other. The centering portion 116 also includes lateral segments 130, 132 and 134, which are interconnected to define a second, generally U-shaped section 136. The segments 130 and 134 are generally perpendicular to segment 132 and are parallel to each other. The U-shaped sections 126 and 136 are axially spaced apart, lie in planes generally perpendicular to axis 118 and are interconnected by an axial segment 140. Inlead portion 112 is connected to segment 130 by a segment 142. Filament attachment portion 114 is connected to segment 120.

As best shown in FIG. 4C, each of the U-shaped sections 126 and 136 defines contact points A, B, C

and D for contact with an inner cylindrical surface of the lamp envelope. The contact points A, B, C and D define a rectangle. The filament support 110 can be fabricated in accordance with the techniques described above in connection with filament support 50.

A double-ended tubular incandescent lamp capsule incorporating filament supports 110 is shown in FIG. 5. The lamp capsule of FIG. 5 is the same as the lamp capsule shown in FIG. 3, except that filament supports 110 are utilized to support and center filament 80. Like elements have the same reference numerals in FIGS. 3 and 5. The inlead portions 112 of filament supports 110 are connected to molybdenum foils 88 and 90, respectively. The filament attachment portions 114 of filament supports 110 are connected to opposite ends of filament 80. The centering portions 116 of filament supports 110 contact the inner cylindrical surfaces of lamp envelope 82 at points A, B, C and D (FIG. 4C) to provide accurate centering and location of filament 80.

A filament support in accordance with a third embodiment of the present invention is shown in FIGS. 6A-6C. A filament support 150 includes inlead portion 152, filament attachment portion 154 and centering portion 156. The inlead portion 152 defines a central axis 158. The inlead portion 152 and the filament attachment portion 154 correspond to the inlead portion 52 and the filament attachment

portion 54, respectively. The centering portion 156 interconnects inlead portion 152 and filament attachment portion 154 and provides support and accurate centering of the filament in the lamp envelope.

The centering portion 156 includes lateral segments 160 and 162 which are interconnected by an axial segment 163 to define a generally U-shaped section 164. The centering portion 156 further includes axially spaced-apart lateral segments 166 and 168 which are interconnected by U-shaped section 164. As best shown in FIG. 6C, segments 166 and 168 are oriented at an angle of about 60° with respect to segments 160 and 162. Inlead portion 152 is interconnected to segment 168, and filament attachment portion 154 is interconnected to segment 166.

Segments 160, 162, 166 and 168 define contact points A, B and C, as shown in FIG. 6C, at which the centering portion 156 contacts the inner cylindrical surface of the lamp envelope. Contact points A, B and C are equally spaced from axis 158 and define an equilateral triangle. The filament support 150 can be fabricated in accordance with the techniques described above in connection with filament support 50.

A double-ended tubular incandescent lamp capsule incorporating filament supports 150 is shown in FIG. 7. The lamp capsule of FIG. 7 is the same as the lamp capsule of FIG. 3, except for the use of

filament supports 150 to support and center filament 80. Like elements in FIGS. 3 and 7 have the same reference numerals. The inlead portions 152 are attached to molybdenum foils 88 and 90, respectively. The filament attachment portions 154 are connected to opposite ends of filament 80. The centering portions 156 contact the cylindrical inner walls of lamp envelope 82 at contact points A, B and C (FIG. 6C) to provide accurate centering and location of filament 80.

A filament support in accordance with a fourth embodiment of the present invention is shown in FIGS. 8A-8C. A filament support 210 includes an inlead portion 212, a filament attachment portion 214 and a centering portion 216. The centering portion 216 interconnects inlead portion 212 and filament attachment portion 214 and provides support and accurate centering of the filament. The inlead portion 212 defines an axis 218 of the filament support 210. The inlead portion 212 and the filament attachment portion 214 correspond to the inlead portion 52 and the filament attachment portion 54, respectively, of filament support 50 described above.

The centering portion 216 includes axially spaced-apart lateral segments 220 and 222, which are interconnected by an axial segment 224 to define a U-shaped section 226. The centering portion 216 also includes radial segments 230 and 232 which are axially spaced-apart, as best shown in FIG. 8B. The

U-shaped section 226 is connected to radial segment 230 by a lateral segment 234 and is connected to radial segment 232 by a lateral segment 236. The lateral segments 220, 222, 234 and 236 lie in a plane and are perpendicular to radial segments 230 and 232. The inlead portion 212 is connected to radial segment 232, and filament attachment portion 214 is connected to radial segment 230.

The radial segments 230 and 232 and the lateral segments 220, 222, 234 and 236 define contact points A, B and C, as shown in FIG. 8C, at which the centering portion 216 contacts an inner cylindrical surface of the lamp envelope. Contact points A, B and C are equally spaced from axis 218 and form an equilateral triangle.

A double-ended tubular incandescent lamp capsule incorporating filament supports 210 is shown in FIG. 9. The lamp capsule shown in FIG. 9 is the same as the lamp capsule shown in FIG. 3, except that filament supports 210 are used to support and center filament 80. Like elements in FIGS. 3 and 9 have the same reference numerals. Inlead portions 212 of filament supports 210 are connected to molybdenum foils 88 and 90, respectively. Filament attachment portions 214 of filament support 210 are connected to opposite ends of filament 80. The centering portions 216 contact the cylindrical inner walls of lamp envelope 82 at points A, B and C (FIG. 8C) and provide accurate centering and location of filament 80 on the central axis 94 of lamp envelope 82.

As indicated above, it is important for proper operation of tubular incandescent lamp capsules that the filament be accurately centered within the lamp envelope and have a desired spacing between turns of the filament coils. These parameters are particularly important in the infrared conserving lamp which has an infrared reflective coating on its outer surface. The filament supports shown and described above are dimensioned to fit the inside diameter of the lamp envelope relatively closely. However, due to the large variation of the inside diameter of the lamp envelope from lamp to lamp, the filament support must be sized a few thousandths of an inch smaller than the nominal inside diameter of the lamp envelope. It will be recognized that the lack of an intimate fit between the filament supports and the lamp envelope can result in variations in position of the filament relative to the lamp envelope. The lack of intimate fit between the filament supports and the lamp envelope is preferably overcome by a process known as "tacking". The tacking process shrinks the lamp envelope around the filament supports, thereby creating an intimate locking fit and securing the filament in a fixed position relative to the lamp envelope.

The tacking process is performed during the lamp making process. First the lamp envelope is mounted in a holding fixture. Then a filament assembly, including a helical filament with a filament support

attached to each end, is positioned within the lamp envelope. The ends of the filament assembly are secured in separately movable holding fixtures which can be moved both radially and axially. Next, the axial and radial positions of the filament are determined using a calibrated measurement system such as a vision system. When the actual filament position differs from the desired filament position, the filament position is corrected by moving the holding fixtures. When the correct filament location and stretch are established, the exterior of the lamp envelope is locally heated with a torch in a region adjacent to the filament support. The heating causes the lamp envelope to soften and collapse around the filament support. During the heating operation and for a short cooling time thereafter, the interior of the lamp envelope is flushed with an inert gas or a reducing gas to prevent oxidation of the interior metal parts. Preferably, the interior of the lamp envelope is flushed with argon or nitrogen, sometimes blended with small quantities of hydrogen. If necessary, the internal pressure of the lamp envelope can be reduced to facilitate the collapse of the lamp envelope around the filament support.
Alternatively, mechanical pressure can be applied to the heated area of the lamp envelope to facilitate collapse of the lamp envelope around the filament support. Preferably, mechanical pressure is applied by counter-opposed metal jaws. In any case, the

lamp envelope in the heated region collapses around the filament support and secures it in position after cooling. The relative positions of the filament and the lamp envelope are maintained by the holding fixtures until the lamp envelope has cooled.

The tacking process can be performed sequentially at each end of the lamp envelope, or both ends can be tacked simultaneously. In still another variation, only one end of the lamp envelope is tacked. In this version, one end of the lamp is sealed, such as by press sealing or vacuum sealing. Then, the opposite end of the lamp is adjusted and tacked as described above. In this variation, the sealing operation provides sufficient anchoring of the filament support to eliminate the need for tacking at that end.

When the glass or quartz lamp envelope is collapsed around the filament support, it is not necessary for the glass or quartz to be adhered to the filament support. Mechanical entrapment is generally sufficient to maintain filament position. Filament supports described above, including filament supports 50, 110, 150 and 210, are designed to contact the inner surface of the lamp envelope at a plurality of discrete, circumferentially spaced-apart contact regions. This configuration of the filament supports facilitates positioning of the filament by tacking. When the lamp envelope is heated and collapses around the filament support,

the lamp envelope contacts the filament support at the contact points or regions shown in FIGS. 2C, 4C, 6C and 8C. In addition, the lamp envelope material can deform into the spacers between contact points, thereby securely holding the filament supports after cooling. By contrast, prior art helical filament supports do not have sufficient spaces between contact points to permit deformation of the lamp envelope. As a result, prior art helical filament supports are less securely held after the tacking process. Further details regarding the tacking process are provided in application Serial No. (Docket No. 91-1-894 entitled Methods for Mounting filaments in Tubular Incandescent Lamp Capsules), filed concurrently herewith, which is hereby incorporated by reference.

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

CLAIMS

What is claimed is:

1. A filament support for supporting and centering a filament in a double-ended lamp envelope, comprising:

an inlead portion defining a central axis of said filament support;

a filament attachment portion; and

a centering portion interconnecting the inlead portion and the filament attachment portion, said centering portion including means for contacting an inner surface of the lamp envelope at a plurality of discrete, circumferentially spaced-apart contact regions that are substantially equally spaced from said central axis.

2. A filament support as defined in claim 1 wherein said centering portion includes first, second and third axial segments defining first, second and third contact regions, a first lateral segment interconnecting said first and second axial segments, and a second lateral segment interconnecting said second and third axial segments.

3. A filament support as defined in claim 2 wherein said first and second lateral segments are about equal in length and are oriented at about 60° with respect to each other.

4. A filament support as defined in claim 1 wherein said centering portion includes first, second and third interconnected lateral segments defining a first generally U-shaped section, fourth, fifth and sixth interconnected lateral segments defining a second generally U-shaped section, and an axial segment interconnecting said first and second U-shaped sections.

5. A filament support as defined in claim 4 wherein said first and second U-shaped sections comprise approximately equal length segments that are interconnected at about right angles.

6. A filament support as defined in claim 1 wherein said centering portion includes first and second lateral segments which are interconnected by an axial segment to define a generally U-shaped section, and third and fourth lateral segments which are axially spaced apart and which are interconnected by said U-shaped section.

7. A filament support as defined in claim 6 wherein said first, second, third and fourth lateral segments are approximately equal in length and wherein said first and second lateral segments are oriented at about 60° with respect to said third and fourth lateral segments.

8. A filament support as defined in claim 1 wherein said centering portion includes first and second lateral segments which are interconnected by an axial segment to define a generally U-shaped section, and first and second radial segments which are axially spaced apart and which are interconnected by said U-shaped section.

9. A filament support as defined in claim 8 wherein said first and second lateral segments are approximately perpendicular to said first and second radial segments.

10. A filament support as defined in claim 1 wherein said inlead portion, said filament attachment portion and said centering portion comprise a single length of refractory wire.

11. A filament support as defined in claim 1 wherein centering portion contacts a cylindrical inner surface of said lamp envelope at three contact regions that are substantially equally spaced around the circumference of said inner surface.

12. A lamp capsule comprising:

a light-transmissive lamp envelope having seals at opposite ends thereof and having a central axis;

a filament within said lamp envelope;

first and second filament supports connected to opposite ends of said filament for supporting and

centering said filament on the central axis of said lamp envelope; and

means for coupling electrical energy through said seals to said first and second filament supports, said first and second filament supports each comprising an inlead portion attached to said coupling means, a filament attachment portion attached to said filament and a centering portion interconnecting the inlead portion and the filament attachment portion, said centering portion including means for contacting an inner surface of said lamp envelope at a plurality of discrete, circumferentially spaced-apart contact regions.

13. A lamp capsule as defined in claim 12 wherein said centering portion includes first, second and third axial segments defining first, second and third contact regions, a first lateral segment interconnecting said first and second axial segments, and a second lateral segment interconnecting said second and third axial segments.

14. A lamp capsule as defined in claim 12 wherein said centering portion includes first, second and third interconnected lateral segments defining a first generally U-shaped section, fourth, fifth and sixth interconnected lateral segments defining a second generally U-shaped section, and an axial segment interconnecting said first and second U-shaped sections.

15. A lamp capsule as defined in claim 12 wherein said centering portion includes first and second lateral segments which are interconnected by an axial segment to define a generally U-shaped section, and third and fourth lateral segments which are axially spaced apart and which are interconnected by said U-shaped section.

16. A lamp capsule as defined in claim 12 wherein said centering portion includes first and second lateral segments which are interconnected by an axial segment to define a generally U-shaped section, and first and second radial segments which are axially spaced apart and which are interconnected by said U-shaped section.

17. A lamp capsule as defined in claim 12 wherein said centering portion contacts a cylindrical inner surface of said lamp envelope at three contact regions that are substantially equally spaced around the circumference of said inner surface.

18. A lamp capsule as defined in claim 12 wherein said filament comprises a helical coil.

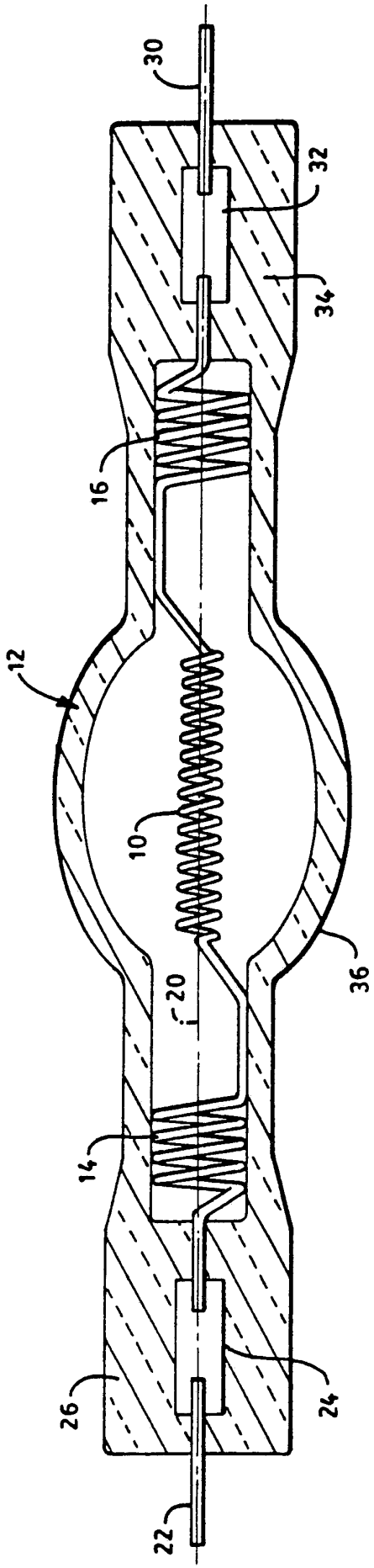


FIG. 1
PRIOR ART

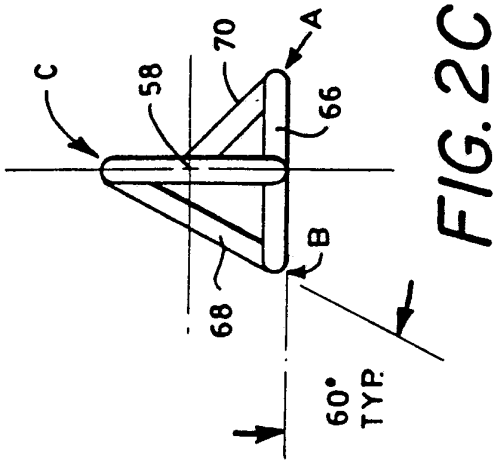


FIG. 2C

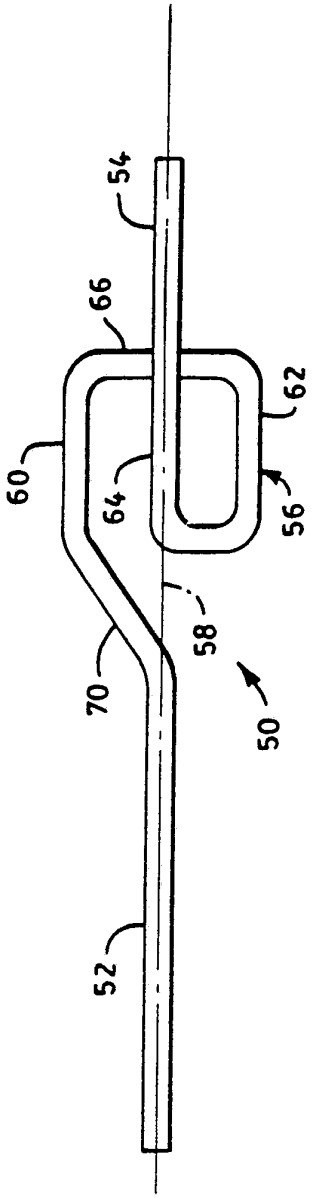


FIG. 2A

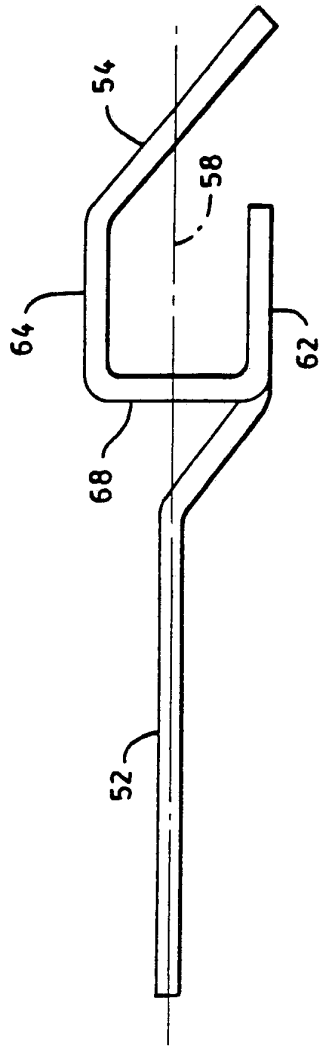


FIG. 2B

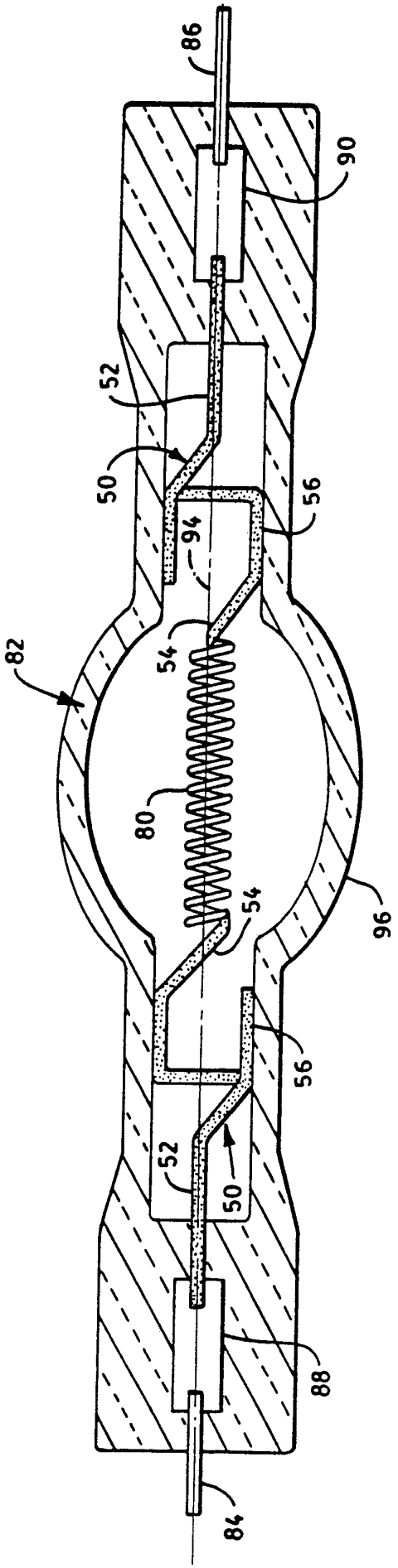


FIG. 3

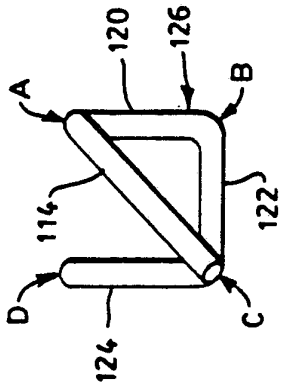


FIG. 4C

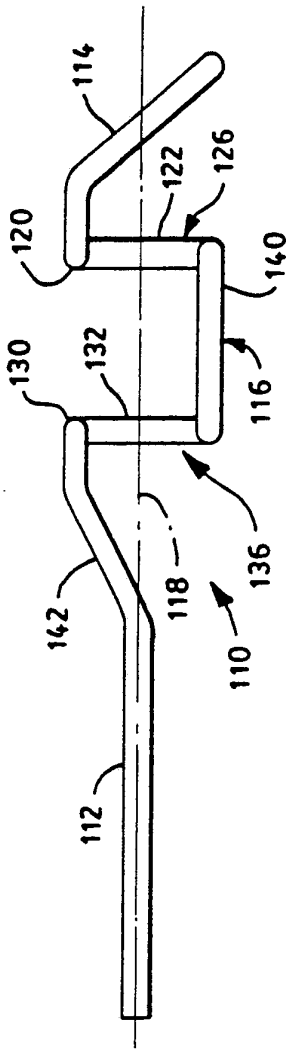


FIG. 4A

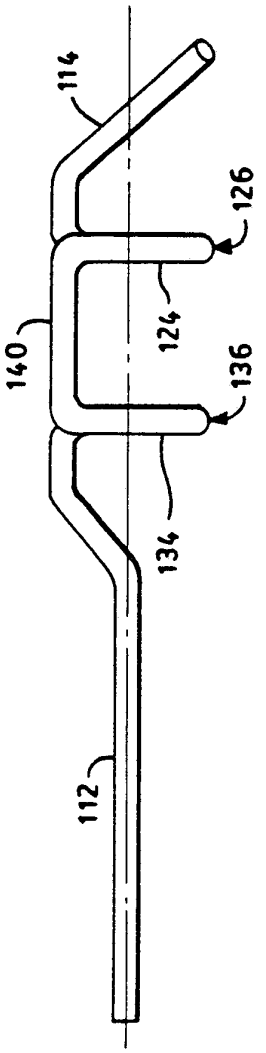


FIG. 4B

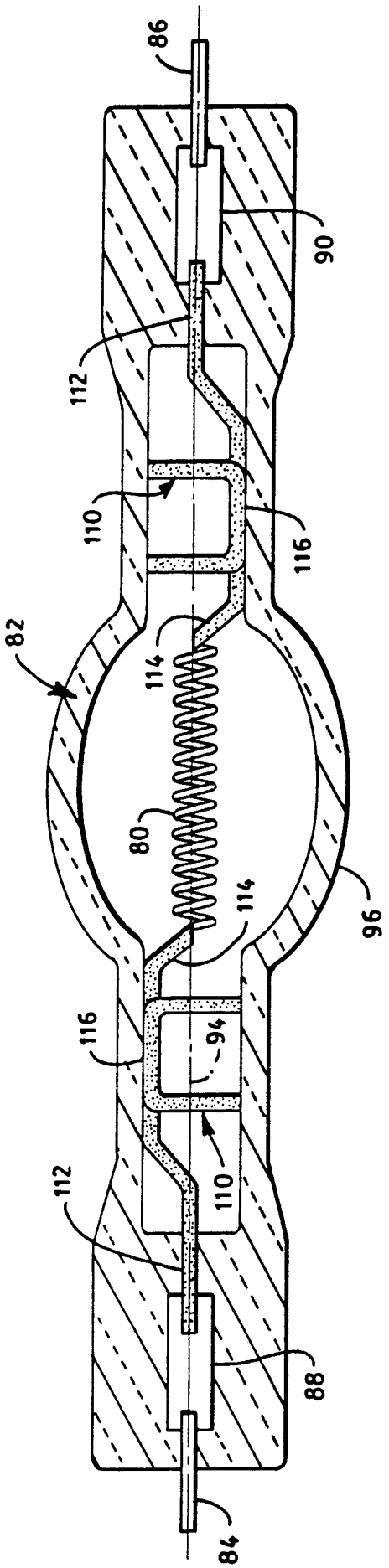


FIG. 5

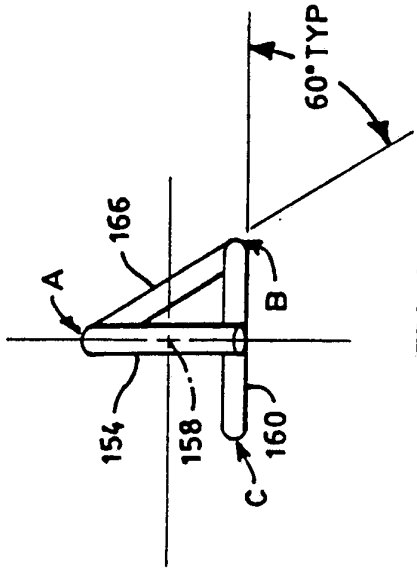


FIG. 6C

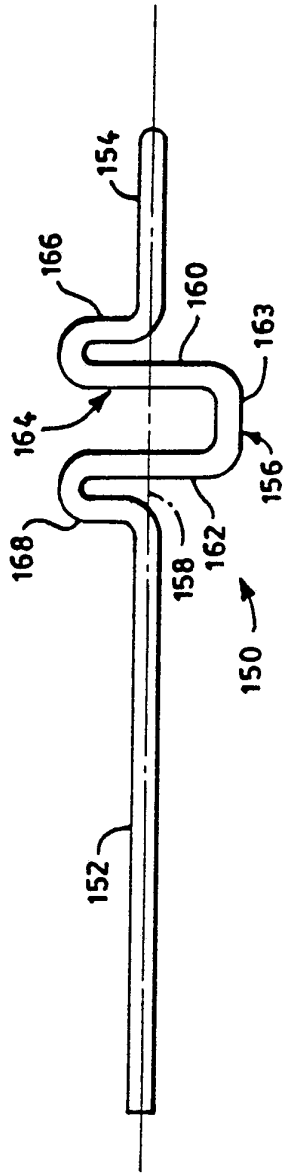


FIG. 6A

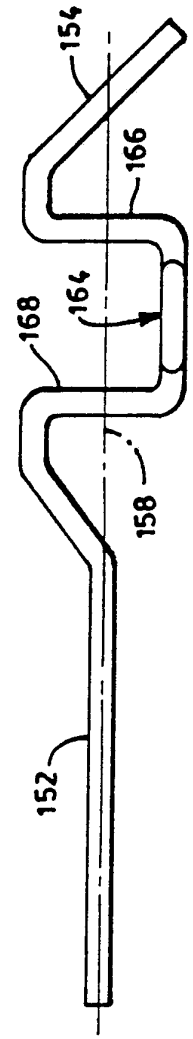


FIG. 6B

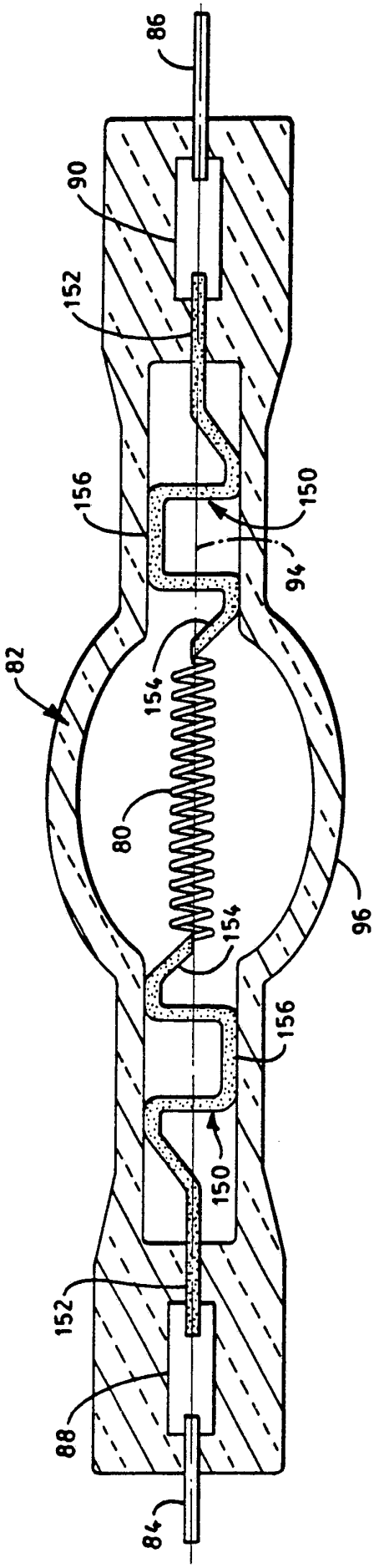


FIG. 7

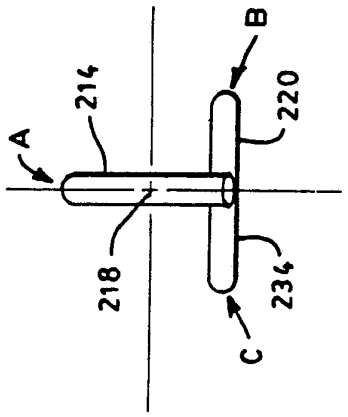


FIG. 8C

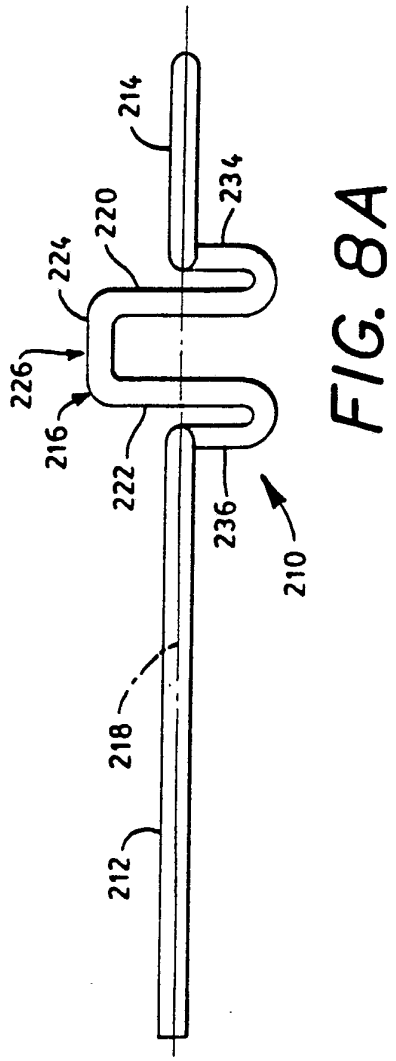


FIG. 8A

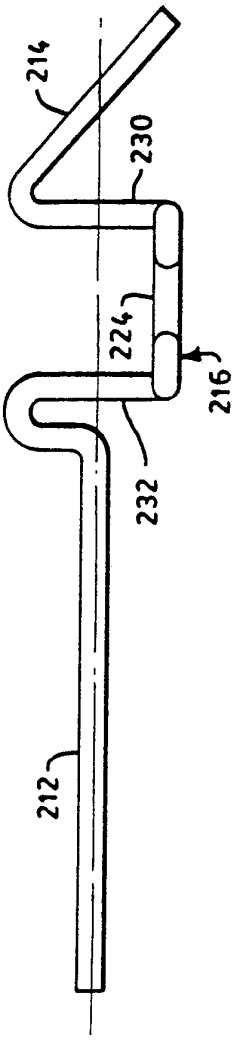


FIG. 8B

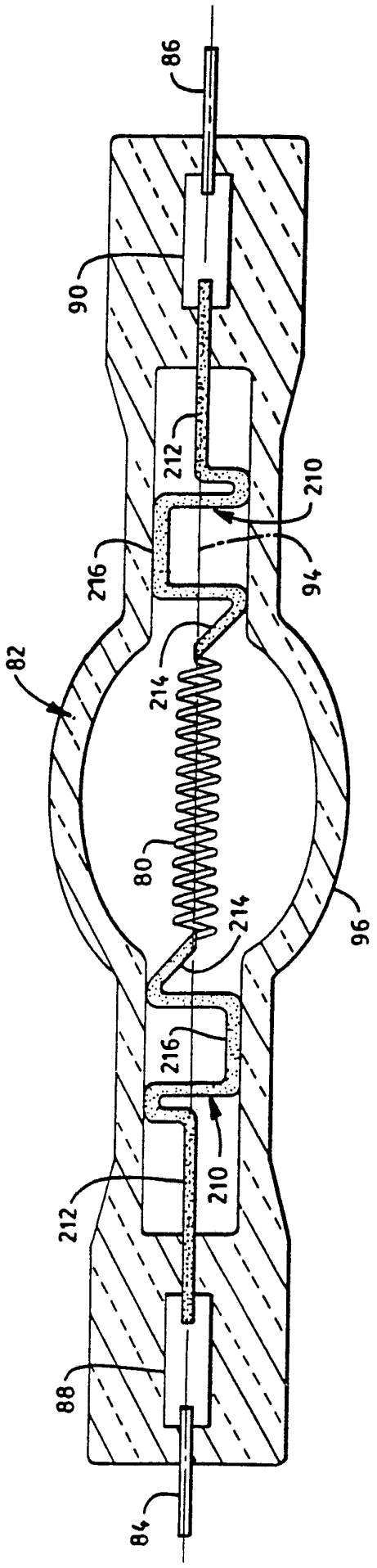


FIG. 9

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 92/10289

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 H01K1/24

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	H01K ; H01J

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
A	EP,A,0 397 422 (GENERAL ELECTRIC COMPANY) 14 November 1990 cited in the application see figures 1-4	1,12
A	DE,A,1 589 246 (N.V. PHILIPS' GLOEILAMPENFABRIEKEN) 26 March 1970 see figures	1,12
A	DE,A,2 314 452 (FRITZ) 3 October 1974 see figure 2	1,12

° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
11 FEBRUARY 1993	02 MAR 1993
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	MARTIN Y VICENTE M.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

US 9210289
SA 67473

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 11/02/93

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DE-A-1589246	26-03-70	CH-A- 468715	
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		GB-A- 1110928	
		NL-A- 6704735	09-10-67
DE-A-2314452	03-10-74	None	