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(54) **Improved arc tube for high pressure metal vapor discharge lamp, lamp including same, and method**

Bogenkolben für Hochdruckmetalldampfentladungslampen, Lampe mit einem solchen Kolben und Verfahren zur Herstellung

Enveloppe à arc pour lampe à décharge à vapeur métallique à haute pression, lampe avec une telle enveloppe et méthode de fabrication

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EP 0 341 749 B1

Description

The present invention relates to arc tubes, and more particularly to arc tubes used in high pressure metal vapour discharge lamps.

The arc tube for a high pressure sodium (HPS) lamp typically comprises a translucent polycrystalline alumina (PCA) or yttria tubular envelope sealed at either end with a ceramic button fabricated from a similar material. Passing through this button is a feedthrough member (also referred to herein as "inlead") comprising niobium. The feedthrough member may be in the form of a tube or a wire. The feedthrough member may further comprise other metal additives such as, for example, zirconium. The feedthrough member performs the function of electrical inlead and electrode support. The end structure of the arc tube is hermetically sealed by means of a frit material. Frit materials typically comprise oxides of calcium and alumina. Frit materials may further include oxides of barium, magnesium, boron, strontium, beryllium, and/or yttrium.

Buttons for arc tubes typically are constructed in one of three conventional designs: the monolithic design, the hat design, or the disk design. Examples of these three conventional designs are described and illustrated in US-A-4,713,580.

The frit material used to form seals in the arc tube of a high pressure metal vapour discharge lamp must have a composition which does not react with the components of the fill gas. Additionally, the thermal expansion properties of the frit material should be within certain tolerances of those of the materials used to form the envelope seal button, and feedthrough member so that the seal formed will not crack upon thermal cycling. For practical reasons during sealing, it is desirable to minimize the melting point of the frit sealing material.

High pressure metal vapour discharge lamps of the high pressure sodium type operate at seal temperatures of about 700°C. Although such a lamp has very high luminous efficiency, the colour of the light output is not satisfactory for many applications. Thus, there is a need to improve the colour of such HPS lamps.

Because of the low colour rendering index (CRI) and colour temperature of HPS lamps, much research effort has been directed to improving the colour of the lamp light output. One technique for improving colour has been to increase the sodium pressure of the lamp which has the effect of increasing the overall CRI. Examples of this technology for lamps with a CR1 of about 60 are described by Bhalla (J. Illuminating Engineering Society, Vol. 8, pp 202-206 (1979)). These lamps only increase the correlated colour temperature of sodium lamps from about 2100 K to about 2250 K. This small improvement in colour temperature has not been of sufficient magnitude to compensate for other disadvantages associated with this technique. Thus, the resulting lamp has not been well received in the market.

Another approach has been to raise the sodium

pressure still further, which raises the colour temperature to about 2700 K, but the drop in efficacy for such a lamp is precipitous. To increase sodium pressure, the seal temperature must be increased. Sealing frit materials developed for this purpose are described in US-A-4,501,799. These frit materials have melting temperatures in excess of 1600°C. Such temperatures are much greater than those of conventional sealing frit materials which have melting temperatures of about 1250°C. Further, the rare earth elements included in these frit materials cause these frit materials to be more costly than standard frit materials which include alkaline earth oxide components.

US-A-4,409,517 describes achieving improved colour in discharge lamps employing ceramic arc tubes which include metal halide fills. To avoid the reaction of the halide components of the fill with the niobium feedthrough, the document teaches of applying a halide resistant coating to that portion of one of the upper inleads which is in contact with the lamp fill. The coating protects the inlead from reaction with the halide vapours.

Another technique for improving the colour of high pressure sodium discharge lamps is to include additional radiating elements in the fill. This technique was originally described in US-A-3,521,108. These lamps typically operate with seal temperatures about 1000°C. Such lamps often experience premature failure.

One of the reasons for failure of high pressure metal vapour discharge lamps of the high pressure sodium type is believed to be caused by reaction between the frit material and the sodium component of the lamp fill. Complete elimination of sealing frit material from the arc tube assembly of such type of lamp is disclosed as a solution to this problem in US-A-4,545,799. This patent describes assembling an arc tube envelope made from unsintered, compressed ceramic powder, an insert made from unsintered, compressed ceramic powder, and inlead, and sintering the assembly in a single step without inter-position of any frit whatsoever. Such a process requires both the electrodes be inserted through the feedthrough and welded thereto and the fill be added through the hollow inlead after the sintering operation. Neither of these fabrication constraints is desirable.

It is also known from US-A-4150317 to provide an arc tube for a high pressure metal vapour discharge lamp, the arc tube comprising a tubular ceramic envelope, a chemical fill within the envelope, a seal button at each end of the envelope, the seal button having an aperture therethrough for receiving a feedthrough member, the feedthrough member having an electrode projecting therefrom passing through the seal button aperture and being oriented such that the electrode projects into the tubular ceramic envelope, the feedthrough member being sealed into the seal button by means of a fritless seal between the seal button and the feedthrough member, and sealing frit material sealing

the seal buttons into the ends of the tubular ceramic envelope.

Viewed from one aspect the present invention is characterised in that the seal buttons comprise a ceramic material and have been shrunk onto said feedthrough member during firing to form the said fritless seals.

It has been found that the performance of preferred arc tubes, used in high pressure metal vapour discharge lamps, is improved by creating an interruption, or break in the continuity of, the seal interface between the feedthrough member and the frit material around the total circumference of at least a portion of the feedthrough member. This interruption of the feed-through member/frit interface inhibits, and advantageously prevents, formation of a continuous path through which fill gas contained in the arc tube can escape from the arc tube.

Viewed from a further aspect the present invention provides a method for fabricating an arc tube for a high pressure metal vapour discharge lamp, the method comprising the steps of; forming fritless seals between seal buttons and feed-through members for each end of an arc tube envelope, permanently affixing an electrode to the feedthrough member of each fritless seal button/feedthrough member assembly, sealing a first fritless seal button/feedthrough member assembly having the electrode attached thereto to one end of the arc tube envelope using frit material, depositing a chemical fill into the arc tube envelope sealed at one end, and sealing a second fritless seal button/feedthrough member assembly having the electrode attached thereto to the other end of the arc tube envelope using frit material characterised in that the seal buttons comprise a ceramic material, and in that said fritless seals are formed by shrinking the ceramic seal button onto the feedthrough member during firing of the ceramic seal button.

Preferred embodiments of the present invention will now be described by way of example only and with reference to the accompanying drawings, in which:

Figures 1 and 2 illustrate preferred embodiments of the end structures of arc tubes of the present invention.

Figure 3 illustrates an example of the structure of a high pressure metal vapour discharge lamp.

In accordance with the present invention, it has been found that the performance of arc tubes used in high pressure metal vapour discharge lamps is improved by eliminating a feedthrough member/frit material seal interface around the portion of the feedthrough member periphery which passes through the seal button aperture. The feedthrough member/frit material seal interface of a conventional ceramic arc tube typically extends from the point at which the feedthrough member projects into the arc tube to the point where the feedthrough member projects from the seal button to the exterior of the arc tube. Elimination of such continuous feedthrough member/frit material interface in high pressure metal vapour lamps, particularly those which operate with cold spot temperatures of at least 900°C, inhibits, and advantageously prevents, formation of a contin-

uous path from the interior to the exterior of the arc tube through which fill gas contained in the arc tube can escape.

The present invention is directed to employing a brazeless, fritless hermetic seal between the ceramic seal button and feedthrough member of a ceramic arc tube assembly.

With reference to Figure 1, there is shown, in cross-section, the end structure of one embodiment of the present invention. The seal button for the arc tube represented in Figure 1 is of a monolithic design. In Figure 1, a disk shaped seal button 1 is joined to the feedthrough member 2 by means of a fritless seal. An electrode 3 is attached to the feedthrough member 2 and projects into the interior of the arc tube 5. The seal button/feedthrough assembly is sealed to the arc tube envelope 6 by fused frit material 7.

Figure 2 illustrates, in cross-section, the end structure of an alternative embodiment of the present invention. The seal button for the arc tube represented in Figure 2 is of a hat design. In Figure 2, a hat shaped seal button 1 is joined to the feedthrough member 2 by means of a fritless seal. An electrode 3 is attached to the feedthrough member 2 and projects into the interior of the arc tube 5. The seal button/feedthrough assembly is sealed to the arc tube envelope 6 by fused frit material 7.

In accordance with the method of the present invention, fritless seals are formed between the ceramic seal buttons and feedthrough members for each end of the arc tube envelope, an electrode is attached to the feedthrough member of each fritless ceramic seal button/feedthrough member assembly. One fritless ceramic seal button/feedthrough member assembly having the electrode attached thereto is sealed to the arc tube envelope using frit by known techniques. The fill material is then added to the arc tube, and the other fritless ceramic seal button/feedthrough member assembly having the electrode attached thereto is sealed to the arc tube envelope using frit material by known techniques.

The present invention represents a simplified fabrication procedure over that described in US-A-4,545,799.

The present invention advantageously facilitates easy attachment of the electrode to the feed-through member. The electrode can be attached to the feedthrough member following the fritless sealing of the feedthrough member to the seal button without having to insert and weld the electrode to feedthrough member by operating through the axial hole passing there-through.

Additionally, the present invention permits the fill to be added to the arc tube after sealing one end of the arc tube and prior to sealing the second end of the arc tube envelope.

The following represents an example of a preferred method for forming a fritless seal between the seal but-

ton and feedthrough member. Such a preferred method for preparing fritless ceramic seal button/feedthrough member assemblies includes forming a cylindrical ceramic piece to the required green dimensions, calcining the ceramic to oxidize the binder and provide minimal strength, and then high firing to near maximum density. The green ceramic can be pressed to size or machined from a blank after isostatical pressing. The diameter of the hole into which the feedthrough member is placed is chosen to provide a predetermined interference to the free shrinkage of the ceramic. Determination of such interference is routine to one having ordinary skill in the art. The interference must be sufficiently large that the ceramic deforms and conforms to the metal but not so large as to excessively distort the shape of the end cap. The surface of the feedthrough member is most preferably free of grooves or unevenness to which the ceramic is unable to conform.

While the foregoing is representative of a preferred method for forming a fritless seal between the seal button and feedthrough member, alternative methods for forming such type of seal are known in the art and may be used instead.

EXAMPLE 1

The ceramic seal buttons used to seal each end of the arc tube were joined to feedthrough members by means of a fritless seal as shown in FIGURE 1. The feedthrough members having 3.96mm (0.156") OD comprising niobium and 1 weight percent zirconium, and had been roughly polished to remove major imperfections from the surfaces thereof. The ceramic seal buttons were isostatically pressed in the form of cigars, machined to size, and then calcined at 1350°C to burn out the 1.5% polyvinyl alcohol and 0.5% carbowax additives which had been added to the ceramic powder as binders. The seal buttons were shrunk onto the feedthrough members by firing for 15 minutes at 1830-1840°C in purified argon. The final dimensions of the buttons were 8.64mm (0.34") OD and 3.81 mm (0.15") thickness. The interference of the feedthrough member with free shrinkage of the button hole was chosen to be 4%, 7%, or 10% of the green hole diameter (i.e., the hole diameter would have closed by an additional 0.20mm, 0.36mm or 0.51mm (0.008", 0.014" or 0.020" respectively) if the inlead had not been present). The fired composition (designated type D) of the seal buttons comprise alumina, 1.7% yttria, and 0.05% magnesia, added originally as nitrates prior to spray drying, so as to produce a significant amount of liquid phase during sintering of the button.

Fritless seal button/feedthrough assemblies were sealed to both ends of four 8.89mm (0.350") OD arc tubes with PF frit in the standard manner. (As used herein "PF frit" refers to a sealing frit material comprising, prior to sealing, 45.6% Al_2O_3 , 39.0% CaO , 8.6% BaO , 5.2% MgO , and 1.6% B_2O_3 .) The arc tube fill was 150

mg Tl, 30 mg Cd, and 20kPa (150 torr) of argon. The arc tubes were placed inside evacuated quartz tubes and heated in a tube furnace so that the seals were maintained at 945-955°C. No leakage of fill was observed during the 1375 hours at temperature. Four controls were run the same way, but having the buttons joined to the inlead with PF frit, began to leak fill at an average of 120 hours and lost all their fill well before 1000 hours.

EXAMPLE 2

Hat type seal buttons, as shown in FIGURE 2, comprising a disk portion 8 and sleeve portion 9 (also referred to herein as sleeve) were joined to polished Nb/1% Zr inleads of 2.16mm (0.085") or 3.12mm (0.123") OD or Nb wire of 1.02mm (0.040") diameter. The seal buttons were first calcined at 1250°C for 5 hours in air and then shrunk onto the inleads by firing for 20 minutes at 1860°C in purified argon. All of the seal buttons had 1.27mm (0.05") sleeves and button thickness of either 1.52mm (0.06") or 4.32mm (0.17"). The interference on the inlead ranged from 1% to 10%. The seal buttons were made not only with type D formulation but also with a high alumina composition (designated type A) containing less than 0.1% oxides as sintering aids and grain growth inhibitors. The fired seal button contained 0.05% magnesia and 0.02% yttria. Allowance was made for the different shrinkage of composition types D and A.

The fritless seal button/feedthrough member assemblies having electrodes attached to the feedthrough members were sealed to each end of eight 8.89mm (0.350") OD arc tubes with PF frit and a fill of 150 mg Tl, 30 mg Cd, and 2.67 kPa (20 torr) of argon. The completed arc tubes were heated as in Example 1, except that the seal temperature was 1020°C. Four tubes went 2290 hours and four were held 3220 hours without any sign of leakage. A control tube at this same temperature began to leak its fill at 40 hours.

EXAMPLE 3

Six lamps were made with fritless joined seal buttons as shown in FIGURE 2. The seal buttons used in this set of experiments were fabricated from the aforementioned type D composition. The dimensions of the seal buttons after firing were 13.0mm (0.51") OD by 5.33mm (0.21") thick. Three pairs of buttons had 3% interference and three had 6% interference on the Nb/1% Zr feedthrough member. The three pairs of seal buttons with 3% interference were treated as one group, and the three pairs of seal buttons with 6% interference were treated as a second group. The feedthrough members which were used with two of the pairs of seal buttons in each group were polished to remove surface roughness. The feedthrough members used with the other pair of seal buttons of each group were used as manufactured. Each arc tube had a fill of 0.48 mg Na, 11.0 mg Hg, 15.4 mg Cd, 82.0 mg Tl, and a starting pressure

of 4kPa (30 torr) Xe. The PCA arc tubes, of 10.3mm (0.405") ID, 12.3mm (0.485") OD, and 56.9mm (2.24") cavity length, were sealed to the fritless seal button/feedthrough member assemblies using PF frit and a standard frit sealing procedure. The lamps were run at 250 W and the end of the arc tubes were insulated so that temperatures were in the 950-1000°C range.

None of the six lamps showed any signs of leakage of fill after 4400 hours of operation with two on/off cycles per day. In contrast, lamps otherwise made the same way but with a fritted seal between the seal button and feedthrough member invariably began to leak by 1000 hours.

EXAMPLE 4

Seven lamps were fabricated following a procedure similar to that described in Example 3, but using different interferences or materials for the buttons and only 0.3 mg of Na in the fill. Two lamps were made with D type material and 1% interference, two lamps with D material and 11% interference, and three lamps with A type material and 2% interference. The 11% interference caused a bulge in the button, which was then ground flat for sealing to the arc tube. These lamps have lasted 1500 hours without any leakage of fill from arc tube to the outer jacket.

EXAMPLE 5

A lamp was made using hat seal buttons fabricated from the aforementioned type D composition. These seal buttons were joined to 2.16mm (0.085") feedthrough members. Seal buttons having a length of 2.79mm (0.11") were used. These seal button sleeves stopped short of the weld between feedthrough member and the tungsten rod supporting the electrode. This lamp lasted over 1000 hours without leakage, whereas a control lamp with fritted seal button/feedthrough member seal lost sufficient fill by 500 hours to plate the jacket of the lamp with an opaque metallic film.

When seal buttons are used with longer sleeves, the sleeve has a tendency to develop radial cracks which lead to early failures. Short sleeves, such as were used in Example 2 present no problems. Care must be taken when the sleeve is longer as in this example. Resistance to cracking was shown by many experiments to be a function of sleeve diameter, feedthrough member diameter, sleeve length, and feedthrough member straightness. Ideally the sleeve should have a thick aspect ratio and small interference on the feedthrough member.

Other geometries which also employ direct (or fritless) bonding of a seal button to the feedthrough member and fritting of this assembly to the arc tube would be considered within the teaching of the present invention. An example of this is the fritless sealing of a disk shaped seal button to a feedthrough member, which fritless as-

sembly is sealed with frit material directly into a straight arc tube.

The ceramic seal button used in the present invention is preferably composed of material resistant to reaction with the feedthrough member, in particular, reduction of any of its components, so that fill does not have a pathway along the feedthrough member surface to the exterior.

The arc tube of the present invention can be used in high pressure metal vapour discharge lamps of the high pressure sodium type, or of the high pressure mixed metal vapour type. The details of the construction of these various types of lamps are well known to the artisan having ordinary skill in the lighting art.

FIG. 3 illustrates an example of a high pressure metal vapour discharge lamp of the high pressure sodium type to which the invention is applicable. The lamp 51 comprises an arc tube 59 supported within an evacuated outer vitreous glass envelope 52, for example, borosilicate glass, having means for electrically coupling the lamp with a power source (not shown), such as a lamp base 53 with a terminal 54. Electrical conductors 62,63 are sealed within and pass through the outer envelope to provide electrical connections from the interior to the exterior of the glass envelope. The arc tube 59 containing a fill comprising sodium, mercury, and a rare gas is supported within the outer envelope 52 by support means 58 such as a metallic frame in a well known manner. The rare gas acts as a starting gas and the mercury acts as a buffer gas to raise the gas pressure and operating voltage of the lamp to a practical level. Heat conserving means 55,56, may be wrapped about the arc tube 59 at each end thereof in the vicinity of the electrodes (not shown), in order to reduce the heat differential thereat from the center of the arc tube.

Each end of the arc tube includes a fritless seal between the seal button and the feedthrough member according to the present invention.

The seal between the fritless seal button/feedthrough member assembly having an electrode attached to the feedthrough member is formed from seal means comprising fused seal material, such as melted (or fused) glass ceramic frit.

The sealing frit material can be any of the sealing frit materials typically used in the fabrication of arc tubes for high pressure sodium vapour discharge lamps, such as, for example, an alkaline-earth based seal material including Al_2O_3 , CaO and BaO with replacements or additions of SrO , Y_2O_3 , La_2O_3 , MgO , and/or B_2O_3 .

A high pressure metal vapour discharge lamp in accordance with an embodiment of the present invention may be of a saturated or unsaturated vapour type. The amounts of sodium and mercury required to dose either saturated or unsaturated type high pressure sodium lamps are known to those skilled in the art.

Most high pressure metal vapour discharge lamps can operate in any position. The burning position has no significant effect on light outputs. A high pressure so-

dium discharge lamp may further include diffuse coatings on the inside of the outer bulb to increase source luminous size or reduce source luminance. The outer envelope may further include getters, 60,61.

Claims

1. An arc tube (5;59) for a high pressure metal vapour discharge lamp, said arc tube comprising a tubular ceramic envelope (6), a chemical fill within said envelope, a seal button (1) at each end of said envelope, said seal button having an aperture there-through for receiving a feedthrough member (2), said feedthrough member having an electrode (3) projecting therefrom passing through said seal button aperture and being oriented such that the electrode projects into said tubular ceramic envelope, said feedthrough member being sealed into said seal button by means of a fritless seal between said seal button and said feedthrough member, and sealing frit material (7) sealing said seal buttons into the ends of said tubular ceramic envelope, characterised in that said seal buttons (1) comprise a ceramic material and have been shrunk onto said feedthrough member during firing to form the said fritless seals.
2. An arc tube as claimed in claim 1 characterised in that said seal buttons (1) comprise substantially alumina with additions of yttria and magnesia.
3. An arc tube as claimed in claim 2 characterised in that said seal buttons (1) comprise 0.05% magnesia and 0.02% yttria.
4. An arc tube as claimed in claim 2 characterised in that said seal buttons (1) comprise 0.05% magnesia and 1.7% yttria.
5. An arc tube as claimed in any preceding claim characterised in that said fill comprises sodium, mercury, and a starting gas.
6. An arc tube as claimed in claim 5 characterised in that said fill further comprises an elemental radiating species.
7. An arc tube as claimed in any preceding claim characterised in that said fill comprises mercury, metal halide additives, and a starting gas.
8. An arc tube as claimed in any preceding claim characterised in that said frit material comprises, prior to sealing, Al_2O_3 , CaO, and BaO.
9. An arc tube as claimed in claim 8 characterised in that said frit material (7) comprises, prior to sealing,

47.0% Al_2O_3 , 37.0% CaO, and 16.0% BaO.

10. An arc tube as claimed in any preceding claim characterised in that said frit material (7) comprises, prior to sealing, Al_2O_3 , CaO, BaO, MgO, and B_2O_3 .
11. An arc tube as claimed in claim 10 characterised in that said frit material (7) comprises, prior to sealing, 45.6% Al_2O_3 , 39.0% CaO, 8.6% BaO, 5.2% MgO, and 1.6% B_2O_3 .
12. A high pressure metal vapour discharge lamp characterised in that said lamp comprises an arc tube (5;59) as claimed in any preceding claim.
13. A method for fabricating an arc tube (5;59) for a high pressure metal vapour discharge lamp (51), said method comprising the steps of; forming fritless seals between seal buttons (1) and feedthrough members (2) for each end of an arc tube envelope (6), permanently affixing an electrode (3) to the feedthrough member of each fritless seal button/feedthrough member assembly, sealing a first fritless seal button/feedthrough member assembly having the electrode attached thereto to one end of the arc tube envelope using frit material (7), depositing a chemical fill into the arc tube envelope sealed at one end, and sealing a second fritless seal button/feedthrough member assembly having the electrode attached thereto to the other end of the arc tube envelope using frit material, characterised in that said seal buttons (1) comprise a ceramic material, and in that said fritless seals are formed by shrinking the ceramic seal button onto the feedthrough member during firing of the ceramic seal button.

Patentansprüche

1. Entladungsröhre (5; 59) für eine Hochdruckmetall-dampfentladungslampe mit einer rohrförmigen keramischen Hülle (6), einer chemischen Füllung innerhalb der Hülle, einem Verschlussstopfen (1) an jedem Ende der Hülle, wobei der Verschlussstopfen eine durchgehende Öffnung zur Aufnahme eines Durchführungselements (2) aufweist, das eine von ihm vorstehende Elektrode (3) besitzt, die sich durch die Öffnung des Verschlussstopfens hindurcherstreckt und derart ausgerichtet ist, daß sie sich in die rohrförmige keramische Hülle hineinerstreckt, und wobei das Durchführungselement in den Verschlussstopfen mittels einer frittenlosen Dichtung zwischen dem Verschlussstopfen und dem Durchführungselement eingesiegelt ist und wobei die dichtende Fritte (7) die Verschlussstopfen in die Enden der rohrförmigen keramischen Hülle einsiegelt, dadurch **gekennzeichnet**, daß die Verschlussstop-

fen (1) aus einem keramischen Material bestehen und während des Brennens auf das Durchführungselement aufgeschumpft worden sind, um die frittenlosen Abdichtungen zu bilden.

2. Entladungsröhre nach Anspruch 1, dadurch **gekennzeichnet**, daß die Verschlußstopfen (1) im wesentlichen aus Aluminiumoxid mit Zugaben von Yttriumoxid und Magnesiumoxid bestehen.
3. Entladungsröhre nach Anspruch 2, dadurch **gekennzeichnet**, daß die Verschlußstopfen (1) 0,05 % Magnesiumoxid und 0,02 % Yttriumoxid aufweisen.
4. Entladungsröhre nach Anspruch 2, dadurch **gekennzeichnet**, daß die Verschlußstopfen (1) 0,05 % Magnesiumoxid und 1,7 % Yttriumoxid aufweisen.
5. Entladungslampe nach irgendeinem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß die Füllung Natrium, Quecksilber und ein Startgas aufweist.
6. Entladungsröhre nach Anspruch 5, dadurch **gekennzeichnet**, daß die Füllung außerdem einen elementaren strahlenden Stoff aufweist.
7. Entladungsröhre nach irgendeinem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß die Füllung Quecksilber, Metallhalogenidadditive und ein Startgas aufweist.
8. Entladungsröhre nach irgendeinem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß das Frittenmaterial vor dem Verschließen Al_2O_3 , CaO und BaO aufweist.
9. Entladungsröhre nach Anspruch 8, dadurch **gekennzeichnet**, daß das Frittenmaterial (7) vor dem Verschließen 47,0 % Al_2O_3 , 37,0 % CaO und 16 % BaO aufweist.
10. Entladungsröhre nach irgendeinem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß das Frittenmaterial (7) vor dem Verschließen Al_2O_3 , CaO, BaO, MgO und B_2O_3 aufweist.
11. Entladungsröhre nach Anspruch 10, dadurch **gekennzeichnet**, daß das Frittenmaterial (7) vor dem Verschließen 45,6 % Al_2O_3 , 39,0 % CaO, 8,6 % BaO, 5,2 % MgO und 1,6 % B_2O_3 aufweist.
12. Hochdruckmetalldampfentladungslampe, dadurch **gekennzeichnet**, daß die Lampe eine Entladungsröhre (5; 59) besitzt, wie sie in irgendeinem der vorhergehenden Ansprüche beansprucht ist.

13. Verfahren zur Herstellung einer Entladungsröhre (5; 59) für eine Hochdruckmetalldampfentladungslampe (51), das aus folgenden Schritten besteht:

5 Herstellen einer frittenlosen Abdichtung zwischen Verschlußstopfen (1) und Durchführungselementen (2) für jedes Ende einer rohrförmigen Entladungshülle (6), dauerhaftes Anbringen einer Elektrode (3) an dem Durchführungselement jeder frittenlosen Verschlußstopfen/Durchführungselement-Baugruppe, Einsiegeln einer ersten frittenlosen Verschlußstopfen/Durchführungselement-Baugruppe mit an ihr angebrachter Elektrode an einem Ende der rohrförmigen Entladungsröhre unter Verwendung von Frittenmaterial (7), Deponieren einer chemischen Füllung in der an einem Ende verschlossenen, rohrförmigen Entladungshülle, sowie Einsiegeln einer zweiten frittenlosen Verschlußstopfen/Durchführungselement-Baugruppe mit an ihr angebrachter Elektrode in das andere Ende der rohrförmigen Entladungsröhre unter Verwendung von Frittenmaterial, dadurch **gekennzeichnet**, daß die Verschlußstopfen (1) aus keramischem Material bestehen und daß die frittenlosen Abdichtungen durch Aufschumpfen der keramischen Verschlußstopfen auf die Durchführungselemente während des Brennens der keramischen Verschlußstopfen hergestellt werden.

30 Revendications

1. Tube à arc (5; 59) pour une lampe à décharge à haute pression de vapeur métallique, le dit tube comprenant une ampoule tubulaire céramique (6), un remplissage chimique enfermé dans la dite ampoule, un bouton de scellement (1) à chaque extrémité de la dite ampoule, le dit bouton de scellement présentant une ouverture le traversant pour recevoir un élément traversant (2), le dit élément traversant comportant une électrode (3) faisant saillie de celui-ci, traversant la dite ouverture du bouton de scellement et étant orientée de telle manière que l'électrode fasse saillie à l'intérieur de la dite ampoule tubulaire céramique, le dit élément traversant étant scellé à l'intérieur du dit bouton de scellement au moyen d'un joint non fritté entre le dit bouton de scellement et le dit élément traversant, un matériau (7) de scellement fritté scellant le dit bouton de scellement dans les extrémités de la dite ampoule tubulaire céramique, caractérisé en ce que les dits boutons de scellement (1) comprennent un matériau céramique et ont été contractés sur le dit élément traversant lors du brûlage pour former les dits joints non-frittés.
2. Tube à arc selon la revendication 1 caractérisé en ce que les dits boutons de scellement (1) sont substantiellement en alumine avec des additions d'oxy-

des d'yttrium et de magnésium.

3. Tube à arc selon la revendication 2 caractérisé en ce que les dits boutons de scellement (1) comprennent 0,05 % d'oxyde de magnésium et 0,02 % d'oxyde d'yttrium. 5
4. Tube à arc selon la revendication 2 caractérisé en ce que les dits boutons de scellement (1) comprennent 0,05 % d'oxyde de magnésium et 1,7 % d'oxyde d'yttrium. 10
5. Tube à arc selon l'une quelconque des revendications précédentes caractérisé en ce que le dit remplissage comprend du sodium, du mercure et un gaz d'amorçage. 15
6. Tube à arc selon la revendication 5 caractérisé en ce que le dit remplissage comprend, en outre, une espèce élémentaire rayonnante. 20
7. Tube à arc selon l'une quelconque des revendications précédentes caractérisé en ce que le dit remplissage comprend du mercure, des additifs d'halogénures métalliques et un gaz d'amorçage. 25
8. Tube à arc selon l'une quelconque des revendications précédentes caractérisé en ce que le dit matériau fritté comprend, avant scellement, de l' Al_2O_3 , du CaO et du BaO. 30
9. Tube à arc selon la revendication 8 caractérisé en ce que le dit matériau fritté (7) comprend, avant scellement, 47,0 % d' Al_2O_3 , 37,0 % de CaO et 16,0 % de BaO. 35
10. Tube à arc selon l'une quelconque des revendications précédentes caractérisé en ce que le dit matériau fritté (7) comprend, avant scellement, de l' Al_2O_3 , du CaO, du BaO, du MgO et du B_2O_3 . 40
11. Tube à arc selon la revendication 10 caractérisé en ce que le dit matériau fritté (7) comprend, avant scellement, 45,6 % d' Al_2O_3 , 39,0 % de CaO, 8,6 % de BaO, 5,2 % de MgO et 1,6 % de B_2O_3 . 45
12. Lampe à décharge à haute pression de vapeurs métalliques caractérisée en ce que la dite lampe comprend un tube à arc (5; 59) selon l'une quelconque des revendications précédentes. 50
13. Procédé de fabrication d'un tube à arc (5; 59) pour une lampe à décharge à haute pression de vapeurs métalliques (51), le dit procédé comprenant les étapes suivantes : 55

former des joints non-frittés entre des boutons de scellement (1) et des éléments traversants

(2) à chaque extrémité d'une ampoule (6) du tube à arc,
fixer une électrode (3) de façon permanente à l'élément traversant de chaque ensemble élément traversant / bouton de scellement non-fritté,
sceller un premier ensemble élément traversant / bouton de scellement non-fritté, ayant l'électrode fixée à lui, à une extrémité de l'ampoule du tube à arc en utilisant un matériau fritté (7),
déposer un remplissage chimique à l'intérieur de l'ampoule du tube à arc scellée à une extrémité, et
sceller un deuxième ensemble élément traversant / bouton de scellement non-fritté, ayant l'électrode fixée à lui, à une extrémité de l'ampoule du tube à arc en utilisant un matériau fritté,

caractérisé en ce que les dits boutons de scellement (1) sont réalisés dans un matériau céramique, et en ce que les dits scellements non-frittés sont formés en contractant le bouton de scellement en céramique sur l'élément traversant lors d'un brûlage du bouton de scellement céramique.

FIG. 1

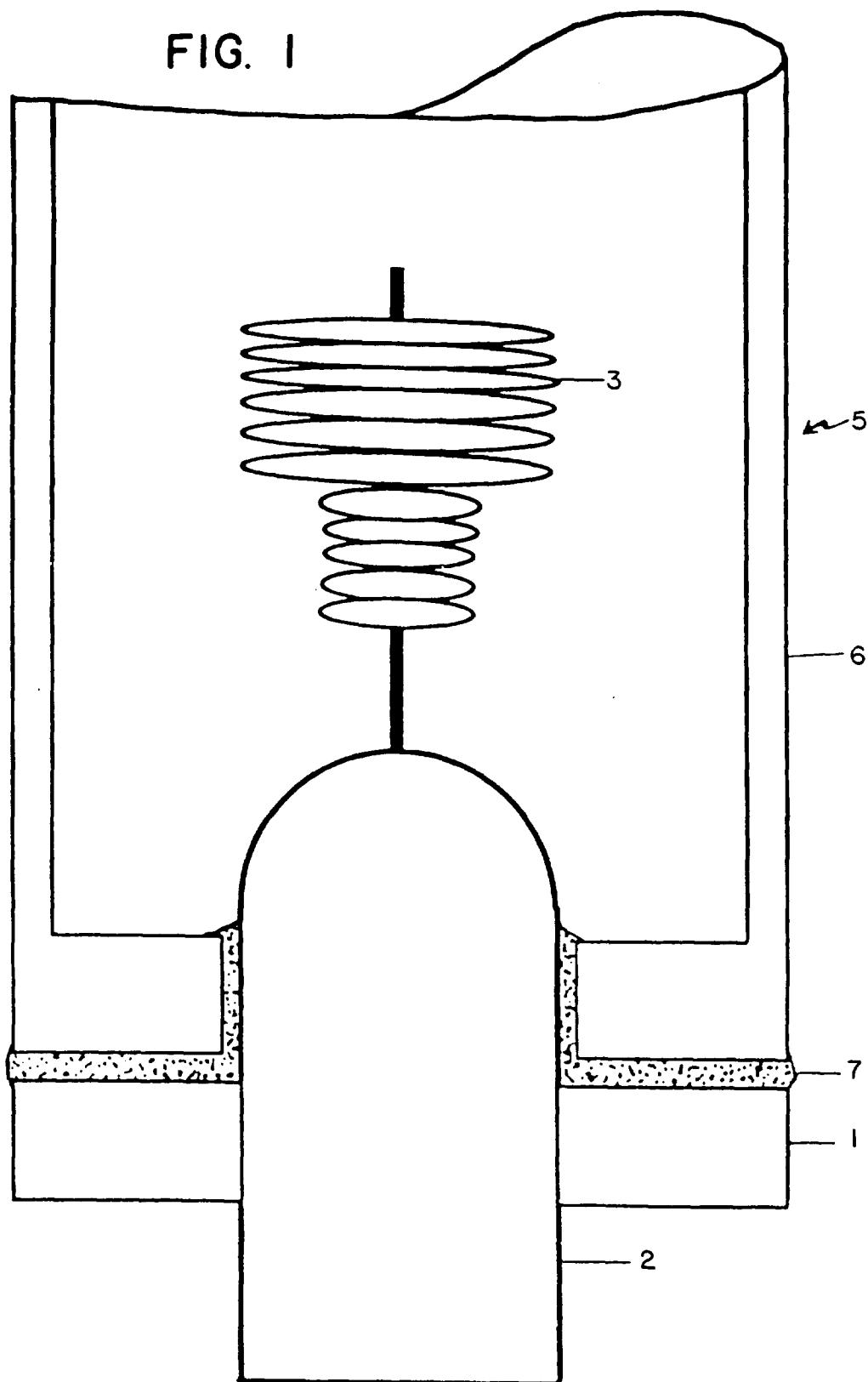
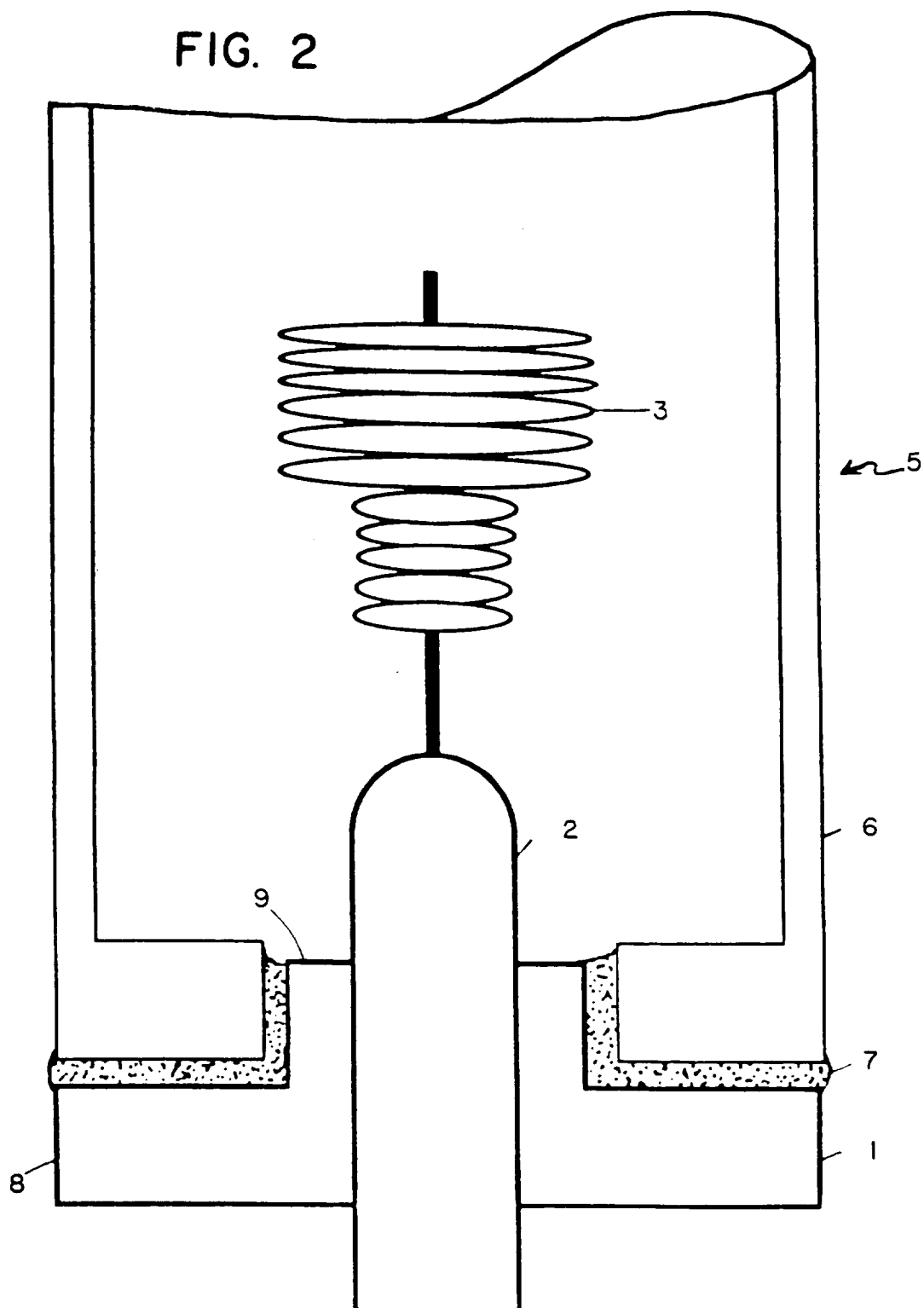


FIG. 2



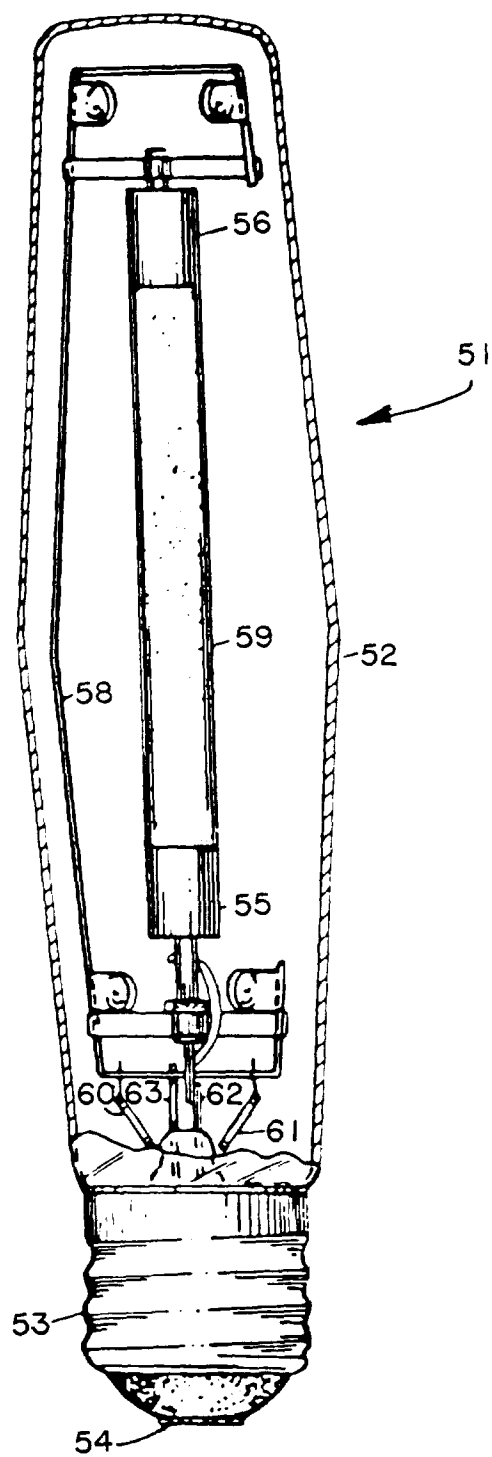


FIG. 3