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(54) **Electrodeless lamp bulb**

Elektrodenlose Lampe

Lampe sans électrode

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(73) Proprietor: **FLOWIL INTERNATIONAL LIGHTING
(HOLDING) B.V.**
NL-1077 ZX Amsterdam (NL)

(72) Inventors:

- **Feuersanger, Alfred E.**
Framingham MA 01701 (US)
- **Struck, Charles William**
Medfield MA 02052 (US)

- **Keeffe, William M.**
Rockport MA 01966 (US)
- **Shea, Michael J.**
Salem MA 01970 (US)

(74) Representative: **Butler, Michael John et al**
Frank B. Dehn & Co.,
European Patent Attorneys,
179 Queen Victoria Street
London EC4V 4EL (GB)

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WO-A-93/18541 **GB-A- 2 030 762**
US-A- 271 911 **US-A- 3 979 624**

- **PATENT ABSTRACTS OF JAPAN vol. 3, no. 126**
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(MITSUBISHI ELECTRIC CORP.) 11 August 1979

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Description

[0001] This invention relates a lamp bulb. More particularly, this invention relates to a lamp bulb for electrodeless lamps having a metal iodide fill with improved colour rendering.

[0002] High frequency electromagnetic field excitation of gas discharges has been studied and applied for many years. Originally, microwaves were applied in gas discharge devices such as Noise Sources, Transmit-Receive (TR) Tubes, and, generally, as Gas Discharge Circuit Elements. The interaction of microwaves with gas discharges was treated by S. C. Brown, Introduction to Electrical Discharges in Gases, John Wiley & Sons, Inc., New York, (1966). An early application to lamps is given in "Microwave Discharge Cavities Operating at 2450 MHz" by F. C. Fehsenfeld et al., Rev. Sci. Instruments, 36, No. 3, (March 1965), where, in a resonant discharge cavity power, is transferred from the source to the lamp. The lamp is substantially enclosed by the resonant cavity impeding the transmission of light from the gas discharge source.

[0003] The first practical microwave light sources, often called electrodeless lamps, were described by a group at GTE Laboratories in 1975. Using an electrodeless lamp and a termination fixture, having an inner and outer conductor, it is excited by high frequency power at 915 or 2450 MHz, or in the possible frequency range from 100 MHz to 300 GHz. This work is described and covered in the following patents: US-A-3,942,058; US-A-3,942,068; US-A-3,943,401; US-A-3,943,402; US-A-3,943,403; US-A-3,943,404; US-A-3,993,927; US-A-3,995,195; US-A-3,997,816; US-A-4,001,631; US-A-4,001,632; US-A-4,002,944; US-A-4,041,352; US-A-4,053,814; US-A-4,065,701; US-A-4,070,603; US-A-4,178,534; and US-A-4,266,162.

[0004] The possible frequency bands available for microwave lamp operation are regulated by the Federal Communications Commission, Rules and Regulations, Vol. II, Part 18, Industrial, Scientific, and Medical Equipment, Federal Communication Commission, July 1981. See 18.13, page 180. Guidelines for threshold limit values for microwave radiation are published by the American Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1989-1990; American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, pp. 108-111.

[0005] Microwave-powered lamps are comprised of a gas discharge in a sealed envelope containing a chemical fill of mercury, metal halides and starting gas, such as argon. The microwave power from a (solid state, magnetron or other tube) power source is coupled over a transmission line (e.g. waveguide, coaxial line or microstrip line). Impedance matching efficiently couples the EM-field into the chemical fill to start, develop, and maintain the discharge for efficient generation of light. The light emitting plasma discharge, the lamp fill, the arc tube and the field coupler comprise the effective imped-

ance matched load (field coupled lamp load) that the power supplying microwave transmission line sees.

[0006] US-A-4,427,921 describes such an application of high frequency power to an electrodeless lamp containing metal iodide or iodine. Optical emission is described as being dominated from excited iodine atoms which emit ultraviolet light at 206.2 nm. Additional emissions are described as being produced in the visible and ultraviolet portions of the spectrum from radiative transitions in I, I₂, HgI₂, HgI, Cd, CdI₂, CdI, etc., depending on the composition of the fill material.

[0007] US-A-4,206,387 describes scandium iodide and sodium iodide chemical fills for an electrodeless lamp to provide high efficacy (about 100LPW) but only fair colour rendering (CRI=65). As set forth, the use of rare earth fills in electroded lamps results in "very high wall loadings ... resulting in a rapid decrease in colour temperature ... and a very short effective lifetime of about 200 hours". The improved electrodeless lamp, is set forth in column 6, lines 50 to 55, "mercury is needed for a high pressure discharge, argon is used to initiate the discharge, and a rare-earth halide is used to achieve atomic plus molecular emission". The results are described as being improved with the addition of cesium halide, but only mercury, argon, and a rare-earth halide are described as necessary. The improved fill includes a rare earth compound, i.e., dysprosium iodide, holmium iodide.

[0008] Because of their superior efficacy and operating life, conventional electroded lamps utilizing a chemical fill of alkali and scandium iodides are highly desirable. GTE's Metalarc M100/U lamp, with a NaI/ScI₃/CsI chemistry, has a colour rendering index (CRI) of 65, an initial lumens per watt (LPW) of 85, and a 10,000 hour lifetime. The above chemistry can be modified by the replacement of the element cesium with lithium to form a chemistry of NaI/ScI₃/LiI. The resulting lamp has an improved CRI of 73 while still maintaining the 10,000 hour life and the 85 LPW efficacy. However, a CRI of 73 must be further improved for the excellent colour rendering needed for showroom lighting, displays in stores, and decorative illumination, both for indoor and outdoor use. Without such further improvement, their colour rendering properties limit their commercial use in certain colour-critical applications.

[0009] Certain advantages are attendant with the electrodeless lamp, or microwave powered lamp as compared to the conventional electroded lamp. The absence of conduction current electrodes, i.e., the elimination of tungsten from the inside of the gas discharge tube, reduces significantly the limitations imposed by the high temperature chemical reactions of the active light producing lamp fill with the container and electrical lamp materials. The electrode feedthroughs (eg. press seals) that can lead to lamp defects are also not required. In addition, lamp efficacy is improved, compared to equivalent electroded lamps, by absence of the electrical and thermal conduction losses generated in lamps

with conduction electrodes. Electrolysis of fill species, such as sodium, is reduced to give good colour stability. The improved lamp performance may be more easily achieved without increase of wall temperatures.

[0010] These advantages, of themselves, do not improve the CRI of electrodeless lamps. With rare earth fills they also do not allow low enough temperatures at the wall of the gas discharge tube to promote long life. Further improvements in chemical fills for high frequency microwave powered lamps are desirable, especially fills which desirably contribute to improved colour rendering, superior efficacy, and longer operating life.

[0011] Certain terms as used in this specification have meanings which are generally accepted in the lighting industry. These terms are described in the IES LIGHTING HANDBOOK, Reference Volume, 1984, Illuminating Engineering Society of North America. The colour rendering index of light source (CRI) is a measure of the degree of colour shift objects undergo when illuminated by the light source as compared with the colour of those same objects when illuminated by a reference source of comparable colour temperature. The CRI rating consists of a General Index, Ra, based on a set of eight test-colour samples that have been found adequate to cover the colour gamut. The colour appearance of a lamp is described by its chromaticity coordinates which can be calculated from the spectral power distribution according to standard methods. See CIE, Method of Measuring and Specifying Colour Rendering Properties of Light Sources (2nd ed.), Publ. CIE No. 13.2 (TC-3,2), Bureau Central de la CIE, Paris, 1974. The CIE standard chromaticity diagram includes the colour points of black body radiators at various temperatures. The locus of black-body chromaticities on the x,y-diagram is known as the Planckian locus. Any emitting source represented by a point on this locus may be specified by a colour temperature. A point near but not on this Planckian locus has a correlated colour temperature (CCT) because lines can be drawn from such points to intersect the Planckian locus at this colour temperature such that all points look to the average human eye as having nearly the same colour. Luminous efficacy of a source of light is the quotient of the total luminous flux emitted by the total lamp power input as expressed in lumens per watt (LPW or lm/W).

[0012] An electroded lamp having a fill containing mercury, an inert starting gas, sodium and/or lithium iodide, scandium iodide and a small concentration of a rare earth is known from US-A-3,979,624. This document suggests that the molar ratio of alkali metal halide to scandium halide should be from 1.7:1 to 5:1.

[0013] An electrodeless lamp having a fill containing mercury, an inert gas, calcium halide, a sodium halide and a rare earth halide is known from EP-A-0,271,911, over which claim 1 is characterised. The calcium halide is present to increase the red emission and thereby lower the lamp's colour temperature.

[0014] It is known from WO-A-93/18541 to provide an

electroded lamp having a chemical fill in the discharge tube comprising an inert starting gas, mercury, alkali metal iodides, scandium iodide and at least one iodide of a rare earth. This document has a priority date of 3 March 1992 and a publication date of 16 September 1993, and accordingly falls within the terms of Article 54 (3) EPC.

[0015] According to the present invention there is provided an electrodeless lamp having a lamp bulb comprising a sealed envelope containing a fill material for supporting a gas discharge, said fill material comprising an inert starting gas, mercury, and alkali metal iodides, and at least one iodide of a rare earth, characterised in that the alkali metal iodides consist substantially of sodium iodide and lithium iodide, the fill further comprises scandium iodide, and in that the molar ratio of said iodide of a rare earth to scandium iodide is between 1:1 to 30:1.

[0016] Preferably, the lamp bulb comprises a sealed transparent envelope with a continuous wall and containing a chemical fill. During operation of the bulb by energization of the chemical fill with a high frequency electromagnetic field, the bulb may be operable at a desirable wall temperature conducive to long life while emitting the visible radiation.

[0017] The chemical fill comprises an inert starting gas, mercury, alkali metal iodides, scandium iodide, and at least one iodide of a rare earth. The alkali metal iodides comprise substantially sodium iodide and lithium iodide. The iodide of a rare earth and scandium iodide are preferably present in amounts sufficient to form a complex for increasing the density of the rare earth in the discharge gas during lamp operation to effect a colour rendering index greater than about 80 and a colour temperature between about 3000 to about 5000 Kelvin. Due to the increased density of the rare earth in the discharge gas at lower temperatures of operation, the wall temperature of the gas discharge tube is desirably maintained at a temperature to enhance the life of the bulb.

[0018] An embodiment of the present invention will now be discussed by way of example only and with reference to the accompanying drawings, in which:

[0019] FIG. 1 shows a representation of a microwave lamp system showing a schematic representation of the bulb during operation.

[0020] FIGS. 2A-2D show a process for preparing bulbs by a three part construction. FIG. 2A shows bulb components. FIG. 2B and FIG. 2C show construction steps. FIG. 2D shows the completed tube.

[0021] FIG. 1 shows a microwave lamp bulb in accordance with an embodiment of the invention. A bulb 1 is a transparent envelope containing a chemical fill 4 within an exterior wall 3. The fill forms a gas discharge during lamp operation. The wall material is preferably a fused silica or ceramic alumina (PCA). Yttria or sapphire which is a single crystalline alumina may be used. Since the bulb 1 is utilized in an electrodeless lamp, the continuous wall has an internal surface uninterrupted by an

electrically conducting path extending through the wall 3 as is found in conventional electroded bulbs.

[0022] The purpose of the metal halide chemical fill 4 is to generate sufficient optical rare earth emissions without chemical interaction with wall 3. The arc tube can have various shapes, however, a cylindrical arc tube with hemispherical end chambers is most practical. A football shape is more difficult to fabricate, but it will have a desirable increased end-temperature.

[0023] A chemical fill which forms an electrical discharge sustaining gas for emitting radiation is disposed within the transparent envelope. The chemical fill contains a base chemistry of an inert starting gas, mercury, alkali metal iodides, and scandium iodide. The desired base chemistry contributes to the desirable lamp characteristics of low wall temperature, high LPW, moderate CRI, and long life. The lamp emission due to the base chemistry is approximately on the black body chromaticity locus.

[0024] In addition to the appropriate base chemistry, the chemical fill comprises at least one iodide of a rare earth element which is at least partially vapourized during lamp operation. The iodide of a rare earth and scandium iodide are present in a molar ratio sufficient to form a complex for increasing the concentration of the rare earth in the discharge gases during lamp operation at a low arc tube wall temperature. Due to the formation of the complex, the vapour phase concentration of the rare earth is increased at the arc tube wall temperature beyond what is obtainable using the rare earth iodide alone. The wall temperature of the arc tube in the lamp of the present invention is preferably maintained between 690 and 960 degrees Celsius, more preferably between 690 and 730 degrees Celsius.

[0025] In accordance with the principles of the present invention, the improved chemical fill comprising the base chemistry and at least one rare earth iodide may enhance the colour rendering index of the lamp. Due to the presence of the rare earth atoms in the discharge gas, the lamp has a colour rendering index greater than 80. Preferably, the colour rendering index is greater than 85 and more preferably greater than 90.

[0026] High colour rendering indices, on the order of about 90, are easier to realize at high correlated colour temperatures (CCT). In a preferred embodiment, the present invention achieves high Ra at relatively low CCT between 3000 and 4000 Kelvin.

[0027] During lamp operation, the amount of rare earth in the gas discharge is sufficient to produce an enhanced colour rendering index while maintaining the relatively low arc tube wall temperature that is conducive to long lamp life. The formation of complex molecules of the rare earth with scandium iodide results in an increased density of rare earth atoms in the gas discharge.

[0028] In preferred embodiments of the present invention, rare earth is present in an amount sufficient to complex with scandium iodide in order to increase the

density of the rare earth atoms in the vapour during lamp operation to the desired level. The molar ratio of the rare earth iodide to scandium iodide in the fill is between 1:1 to 30:1, and more preferably between 5:1 to 20:1.

[0029] Due to their many emission lines, all rare earths may enhance the arc performance of a lamp, at least to some degree and in some respect. The rare earths are selected from the group consisting of La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu and mixtures thereof. The choice of rare earth depends on the desired radiation characteristics. The preferred rare earths for enhanced CRI are the iodides of cerium (Ce), praseodymium (Pr), neodymium (Nd), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), and lutetium (Lu). According to one embodiment the rare earth iodide is present as a single rare earth iodide selected from the above preferred group. Even more preferred are the rare earth iodides of cerium, praseodymium, dysprosium, holmium, and thulium.

[0030] A charge of mercury is present in a sufficient amount so as to establish the electrical characteristics of the lamp by desirably increasing the electric field strength to sustain a desirable power loading. Such an amount should provide an operating mercury pressure between 10 kPa (1 atmosphere) to about 1 MPa (100 atmospheres), and preferably between about 10 kPa (1 atmosphere) to about 200 kPa (20 atmospheres).

[0031] In addition to mercury, a small charge of an inert ionizable starting gas such as argon is contained within the transparent envelope. It is contemplated that other noble gases can be substituted for argon provided an appropriate pressure is maintained that is conducive to starting the lamp.

[0032] To achieve the above discussed desirable lamp properties, the scandium iodide and the alkali metal iodides are present in the fill and in the discharge gas during lamp operation. These ingredients form a base chemistry which is conducive to the low wall temperature and long lamp life. These ingredients also improve colour quality by adding a variety of lines to the emission spectrum and are preferably present in amounts for producing emission with its colour substantially on the black body radiator chromaticity locus. The molar ratio of sodium iodide to scandium iodide is preferably between 5:1 to 25:1. The ratio of sodium iodide to lithium iodide is preferably between 1:1 to 5:1.

[0033] The alkali metal iodides adjust the current-voltage characteristics, improve the colour quality, and contribute to lumen output of the lamp through strong emissions. The scandium iodides significantly improves the "efficacy" in lumens per watt (LPW) and the CRI. The addition of rare earth iodides further improves the LPW to greater than 90 and preferably greater than 100, and, also, improves the CRI to greater than 80 while maintaining CCT between 3000 and 5000 Kelvin.

[0034] In embodiments of the present invention, the selection of fill ingredients results in a desirable colour temperature between 3000 K and 5000 K, more prefer-

ably between about 3000 to about 4000 Kelvin. The molar ratios of the ingredients are selected also so that the resulting emission colour is near the highly desirable black body (BB) chromaticity locus at this desired colour temperature.

[0035] In addition to the above-mentioned fill ingredients, scandium, thorium, cadmium, or zinc may be added to the fill as metals or alloys to adjust the metal/iodine ratio in the lamp and to getter oxygen impurities. The preferred additive is scandium. For a low wattage metal iodide discharge lamp with a lamp wattage less than 175 watts, e.g., between 40 to 150 watts, the scandium metal weight dosage is preferably about 100 micrograms per cubic centimeter of arc tube volume at all wattages. The total fill weight varies with lamp operating power between about 4 and about 20mg. For example, the 100 watt lamp fill is preferably between about 4mg and about 8 mg, and more preferably between about 5.5 and about 6.5 mg.

[0036] As illustrated schematically in FIG. 1, a microwave power source 7 may be solid state, magnetron or some other tube coupled over a transmission line 9 in the form of a waveguide, coaxial line or microstrip line. The impedance matching network 11 and EM-field coupler 13 delivers power to the bulb 1. A - A is the impedance reference plane. The light emitting plasma discharge, the lamp fill 4, the bulb 1 and the field coupler 13 comprise the effective impedance matched load (field coupled lamp load) that the power supplying microwave transmission line sees.

[0037] The lamp is powered by high frequency (microwave) excitation of the discharge that is the matched load of a microwave circuit (for maximum power transfer) operating in the frequency range from 100 MHz to 300 GHz. The lamp is impedance matched to the impedance of the transmission line 9 from the driving source for such load circuit conditions the lamp represents when it is operating in equilibrium at lamp design input power. The range of design input power for the microwave lamps is typically from 10 Watt to 1 kWatt.

[0038] When the lamp is fully warmed up and operating in equilibrium at the design power, the arc tube wall temperature at the center is preferably in the range of 690 to 730 degrees Celsius. This, of course, depends on the lamp design parameters such as mercury pressure, arc tube wall thickness and wall-loading (W/cm^2) of the arc tube.

[0039] Preferably, bulb 1 is a high purity fused silica with zero hydroxyl ion content, such as GTE-Sylvania water free fused silica or General Electric GE 214A hydroxyl free fused silica. The bulb 1 is formed from tubing having a size (I.D. and O.D.) which is determined according to the desired and allowable wall loading for the particular discharge lamp.

[0040] As shown in FIG. 2A, the quartz tube 43 is first attached to a quartz rod or support member 45. As shown in FIG. 2B, a funnel 47 is inserted into the resulting assembly. The charge of chemical fill is introduced

through the funnel 47. FIG. 2C shows the quartz tube 43 necked down at a constriction 49 for evacuation and sealing. FIG. 4D shows the completed bulb 1 which includes support 45 which may be used to hold and position the bulb 1 in the EM-field coupling structure.

[0041] Because the chemical fill is highly hygroscopic, the bulb blanks as shown in Fig. 2B are prepared for filling by baking them in a furnace at temperatures of 1000°C and ultra high vacuum by attaching them to a vacuum system. This is done by means of a NUPRO^R B series valve (SS 8BG TSW) that is equipped with a quick-connect (CAJON, Ultra-Torr) for attaching the fill tube of bulb blank to the valve. The baked bulb still under vacuum is put into an argon filled drybox and opened to the argon. The bulb is then filled with the liquid and solid components of the fill, the valve is again closed, and then the bulb is transferred from the drybox and attached to the gas fill system. After the argon is pumped out, the bulb is filled to the desired pressure with a noble gas such as argon, xenon or a Penning mixture and then tipped off. The backfilled gas serves as the starting gas in the lamp. The following fill is for a bulb with a volume of 1.25 cm³ and the total fill weight is 19 mg. Typical fill weights are from about 4 to about 50 mg/cm³.

Hg	67.30	μmol
Li	4.03	μmol (as iodide)
Na	10.20	μmol (as iodide)
Sc	0.42	μmol (as iodide)
Tm	6.82	μmol (as iodide)
I	35.95	μmol (as metal iodide)
Sc	2.89	μmol (as metal)
Ar	0.5 to 50	torr (as gas)

[0042] A preferred embodiment of the present invention may provide a lamp bulb with increased colour rendering index for an electrodeless high intensity discharge lamp utilizing the NaI₃ScLi chemistry while maintaining the efficacy and long life characteristic of such lamps; may improve the colour rendering properties of the emitted light while maintaining a long bulb life; may increase the density of the rare earth species above the density obtainable with a rare earth iodide alone; may increase the density of the rare earth atoms in the gas discharge by forming a complex molecule containing the rare earth element; and may have a low wall temperature of the gas discharge envelope which is conducive to a long lamp life.

Claims

1. An electrodeless lamp having a lamp bulb comprising a sealed envelope (3) containing a fill material (4) for supporting a gas discharge, said fill material comprising an inert starting gas, mercury, alkali metal iodides, and at least one iodide of a rare earth,

characterised in that the alkali metal iodides consist substantially of sodium iodide and lithium iodide, the fill further comprises scandium iodide, and in that the molar ratio of said iodide of a rare earth to scandium iodide is between 1:1 to 30:1.

2. A lamp as claimed in claim 1, characterised in that the molar ratio of said iodide of a rare earth to scandium iodide is between 5:1 to 20:1.

3. A lamp as claimed in claim 1 or 2, characterised in that the iodide of a rare earth and the scandium iodide are present in amounts sufficient to form a complex molecule.

4. A lamp as claimed in any of the preceding claims, characterised in that the molar ratio of said sodium iodide to said scandium iodide is between 5:1 to 25:1.

5. A lamp as claimed in any of the preceding claims, characterised in that the molar ratio of said sodium iodide to said lithium iodide is between 1:1 to 5:1.

6. A lamp as claimed in any preceding claim, characterised in that the emission from said bulb has a colour temperature of between 3000-5000 Kelvin.

7. A lamp as claimed in claim 6, characterised in that the emission from said bulb has a colour temperature of between 3000-4000 Kelvin.

8. A lamp as claimed in any preceding claim, characterised in that the lamp has a colour rendering index greater than 80.

9. A lamp as claimed in any of the preceding claims, characterised in that said iodide of a rare earth is selected from the group consisting of the iodides of cerium, praseodymium, neodymium, dysprosium, holmium, erbium, thulium, lutetium and mixtures thereof.

10. A lamp as claimed in any of the preceding claims, characterised in that said scandium iodide and said alkali metal iodides are present in amounts for producing emission with its colour substantially on the black body radiator chromaticity locus.

11. A lamp as claimed in any of the preceding claims, characterised in that in use the wall temperature is in the range of 690 to 960 degrees Celsius and said envelope (3) has a wall loading in the range of about 12 to 17 watts/cm².

12. A lamp as claimed in claim 11, characterised in that in use the wall temperature is from 690 to 730 degrees Celsius.

13. A lamp as claimed in any of the preceding claims, characterised in that said envelope (3) has a total concentration of fill between about 4 to about 50 mg/cm³.

Patentansprüche

1. Elektrodenlose Lampe mit einem Lampenkolben aus einer abgedichteten Hülle (3), welche ein Füllmaterial (4) für die Stützung einer Gasentladung enthält, wobei das Füllmaterial ein inertes Startgas, Quecksilber, Alkalimetalljodide und zumindest ein Jodid einer seltenen Erde umfaßt, dadurch **gekennzeichnet**, daß die Alkalimetalljodide im wesentlichen aus Natriumjodid und Lithiumjodid bestehen, wobei die Füllung außerdem Scandiumjodid umfaßt, und daß das Molverhältnis des Jodids der seltenen Erde zum Scandiumjodid zwischen 1:1 bis 30:1 beträgt.

2. Lampe nach Anspruch 1, dadurch **gekennzeichnet**, daß das Molverhältnis des Jodids der seltenen Erde zum Scandiumjodid zwischen 5:1 bis 20:1 beträgt.

3. Lampe nach Anspruch 1 oder 2, dadurch **gekennzeichnet**, daß das Jodid der seltenen Erde und das Scandiumjodid in Beträgen vorhanden sind, die ausreichen, um ein Komplexmolekül zu bilden.

4. Lampe nach irgendeinem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß das Molverhältnis des Natriumjodids zum Scandiumjodid zwischen 5:1 bis 25:1 beträgt.

5. Lampe nach irgendeinem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß das Molverhältnis des Natriumjodids zum Lithiumjodid zwischen 1:1 bis 5:1 beträgt.

6. Lampe nach irgendeinem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß die Emission seitens des Kolbens eine Farbtemperatur zwischen 3000 bis 5000 Kelvin besitzt.

7. Lampe nach Anspruch 6, dadurch **gekennzeichnet**, daß die Emission des Kolbens eine Farbtemperatur von zwischen 3000 bis 4000 Kelvin besitzt.

8. Lampe nach irgendeinem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß die Lampe einen Farbwiedergabeindex besitzt, der größer als 80 ist.

9. Lampe nach irgendeinem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß das Jodid der seltenen Erde aus der Gruppe ausgewählt ist,

die aus den Jodiden von Zerium, Praseodym, Neodym, Dysprosium, Holmium, Erbium, Thulium, Lutetium und Mischungen derselben besteht.

10. Lampe nach irgendeinem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß das Scandiumjodid und die Alkalimetalljodide in Beträgen zur Erzeugung einer Emission vorliegen, deren Farbe im wesentlichen auf dem Farbart- und Farbsättigungskurvenzug des Schwarzkörperstrahlers liegt.
11. Lampe nach irgendeinem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß im Betrieb die Wandtemperatur im Bereich von 690°C bis 960°C liegt und daß die Hülle (3) eine Wandladung im Bereich von etwa 12 bis 17 Watt/cm² besitzt.
12. Lampe nach Anspruch 11, dadurch **gekennzeichnet**, daß im Betrieb die Wandtemperatur von 690°C bis 730°C beträgt.
13. Lampe nach irgendeinem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß die Hülle (3) eine Gesamtfüllungskonzentration von zwischen etwa 4 bis etwa 50 mg/cm³ besitzt.

Revendications

1. Lampe depourvue d'électrodes, ayant un bulbe de lampe comprenant une ampoule étanche (3) enfermant un matériau de remplissage (4) pour maintenir une décharge dans un gaz, le dit matériau de remplissage comprenant un gaz inerte d'amorçage, du mercure, des iodures métalliques alcalins, et au moins un iodure de terre rare,
caractérisée en ce que
les iodures métalliques alcalins comprennent essentiellement de l'iodure de sodium et de l'iodure de lithium, le remplissage comprenant, en outre, de l'iodure de scandium,
et en ce que
le rapport molaire entre le dit iodure de terre rare et l'iodure de scandium est compris entre 1 et 30.
2. Lampe selon la revendication 1, caractérisée en ce que le rapport molaire entre le dit iodure de terre rare et l'iodure de scandium est compris entre 5 et 20.
3. Lampe selon la revendication 1 ou 2, caractérisée en ce que l'iodure de terre rare et l'iodure de scandium sont présents en quantités suffisantes pour former une molécule complexe.
4. Lampe selon l'une quelconque des revendications précédentes, caractérisée en ce que le rapport molaire entre le dit iodure de sodium et le dit iodure de

scandium est compris entre 5 et 25.

5. Lampe selon l'une quelconque des revendications précédentes, caractérisée en ce que le rapport molaire entre le dit iodure de sodium et le dit iodure de lithium est compris entre 1 et 5.
6. Lampe selon l'une quelconque des revendications précédentes, caractérisée en ce que l'émission issue du dit bulbe présente une température de couleur comprise entre 3000 et 5000 Kelvin.
7. Lampe selon la revendication 6, caractérisée en ce que l'émission issue du dit bulbe présente une température de couleur comprise entre 3000 et 4000 Kelvin.
8. Lampe selon l'une quelconque des revendications précédentes, caractérisée en ce que la lampe présente un indice de rendu des couleurs supérieur à 80.
9. Lampe selon l'une quelconque des revendications précédentes, caractérisée en ce que le dit iodure de terre rare est choisi dans le groupe comprenant les iodures de cérium, de praséodyme, de néodyme, de dysprosium, d'holmium, d'erbium, de thulium, de lutécium, et les mélanges de ceux-ci.
10. Lampe selon l'une quelconque des revendications précédentes, caractérisée en ce que le dit iodure de scandium et les dits iodures métalliques alcalins sont présents en quantité suffisante pour produire une émission dont la couleur est substantiellement sur le lieu de chromaticité du radiateur du corps noir.
11. Lampe selon l'une quelconque des revendications précédentes, caractérisée en ce que, lors de l'utilisation, la température de paroi est comprise entre 690 et 960 °C, et que la dite ampoule (3) présente une charge de paroi comprise entre 12 et 17 Watts/cm² environ.
12. Lampe selon la revendication 11, caractérisée en ce que, lors de l'utilisation, la température de paroi est comprise entre 690 et 730 °C.
13. Lampe selon l'une quelconque des revendications précédentes, caractérisée en ce que la dite ampoule (3) présente une concentration totale de remplissage comprise entre 4 et 50 mg/cm³ environ.

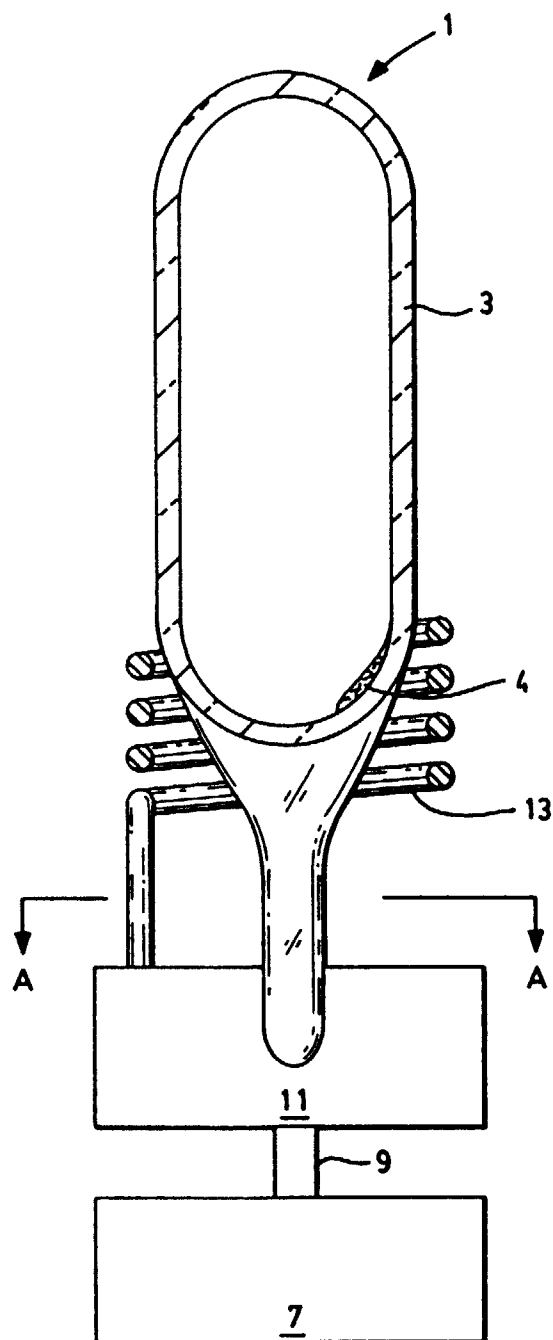


FIG. 1

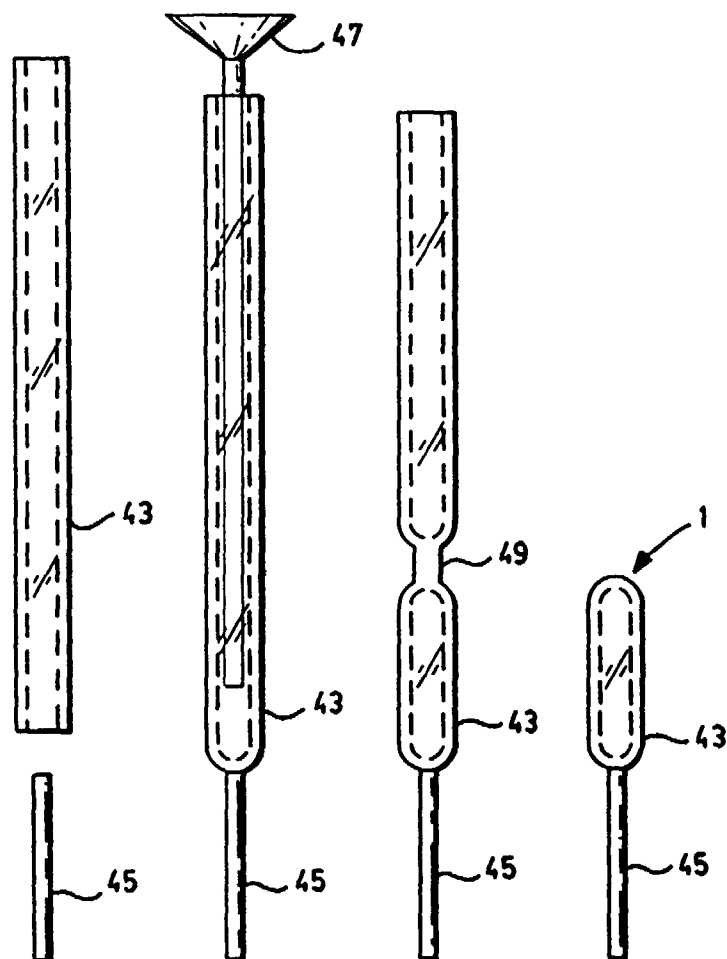


FIG.
2A

FIG.
2B

FIG.
2C

FIG.
2D