(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 001 451 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.05.2000 Bulletin 2000/20

(51) Int Cl.[7]: **H01J 61/18**, H01J 61/30

(21) Application number: **99121066.7**

(22) Date of filing: **21.10.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **10.11.1998 US 189696**

(71) Applicant: **OSRAM SYLVANIA INC.**
Danvers, MA 01923 (US)

(72) Inventors:
- **Moskowitz, Philip E.**
  Georgetown, MA 01833 (US)
- **Snellgrove, Richard A.**
  Danvers, MA 01923 (US)

(74) Representative: **Pokorny, Gerd et al**
OSRAM GmbH,
Postfach 22 16 34
80506 München (DE)

(54) Arc discharge lamp containing barium and having an arc tube of yttrium, gadolinium or terbium oxide

(57) An arc discharge lamp includes an arc tube (10) containing a rare gas and metallic barium. The arc tube (10) is constructed from a material selected from a group of materials consisting of yttria, gadolinium oxide, and terbium oxide.

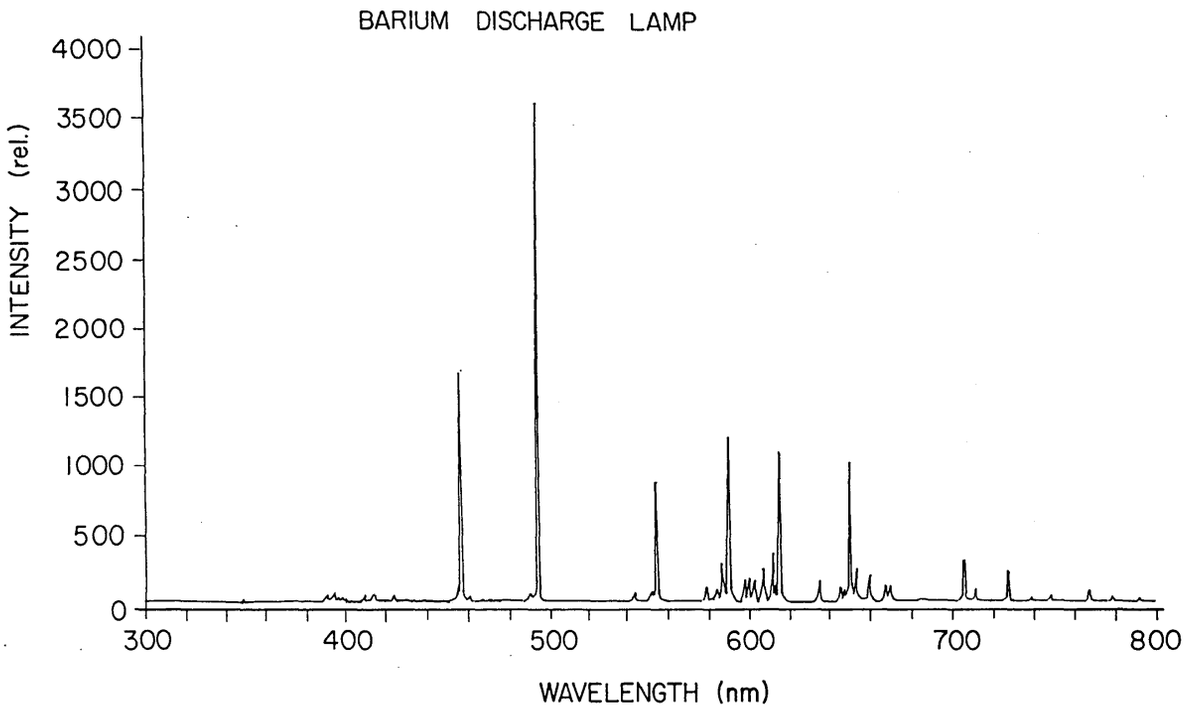

FIG. 3

EP 1 001 451 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] This invention relates to arc discharge lamps, and is directed more particularly to a mercury-free fluorescent lamp.

2. Description of the Prior Art

[0002] Arc discharge lamps, such as fluorescent lamps, are well known in the art and customarily include an arc tube filled with a rare gas and mercury. While such lamps are extensively used and in general perform quite well, the presence of mercury in the lamp may generate environmental and safety problems. Mercury is a toxic heavy metal and lamp disposal may be hazardous. The cost of safe disposal adds to the cost of the lamp. Accordingly, it is deemed advantageous to the environment, to safety in manufacture of such devices, and to reduction of costs, to provide an arc discharge lamp which includes no mercury but which performs at least as well as the traditional mercury lamp.

SUMMARY OF THE INVENTION

[0003] It is, therefore, an object of the invention to provide an arc discharge lamp in which the contents of the arc tube are substantially devoid of mercury.

[0004] With the above and other objects in view, as will hereinafter appear, a feature of the invention is the provision of an arc discharge lamp comprising an arc tube of a material selected from a group of materials consisting of yttria, gadolinium oxide, and terbium oxide, the arc tube containing a fill comprising a rare gas, and containing metallic barium. An arc tube mount supports the arc tube at either end of the arc tube. The arc tube and the arc tube mount are disposed in an outer glass jacket, and a base member closes the outer glass jacket.

[0005] The above and other features of the invention, including various novel details of construction and combinations of parts, will now be more particularly described with reference to the accompanying drawings and pointed out in the claims. It will be understood that the particular device embodying the invention is shown by way of illustration only and not as a limitation of the invention. The principles and features of this invention may be employed in various and numerous embodiments without departing from the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Reference is made to the accompanying drawings in which is shown an illustrative embodiment of the invention, from which its novel features and advantages will be apparent.

[0007] In the drawings:

FIG. 1 is a diagrammatic elevational view of one form of an arc discharge lamp illustrative of an embodiment of the invention;

FIG. 2 is a schematic representation of a lamp driving electrical circuit; and

FIG. 3 is a graph illustrating the intensity of barium emission at various wavelengths in a barium discharge lamp.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0008] Referring to the drawings, it will be seen that an illustrative lamp includes an arc tube 10 for containing a fill gas. The arc tube 10 preferably is of yttria (Y_2O_3), but may, alternatively, be of gadolinium oxide or terbium oxide, all of which have proven resistant to reaction with barium. The former is described in U.S. Patent No. 4,166,831, issued September 4, 1979 to William H. Rhodes, et al. Doping of the arc tube materials, for example with alumina or lanthana, improves the sinterability. During processing, the arc tubes may be brought to high density (about 95% or greater of theoretical density) and high translucency (at least 85% total transmission) by sintering at around 2100°C in an atmosphere of low oxygen partial pressure. Typical total transmission values for the arc tubes are around 95%. While sizes and shapes of such tubes may conform to the desired use, a particular configuration found acceptable is of a cylindrical shape and about 51.9 mm in length, end-to-end, and about 6.4 mm in diameter.

[0009] The arc tube 10 contains a fill gas which includes a rare gas, and also contains 5 to 20 milligrams of metallic barium. The rare gas may be neon or xenon, or the like and may be in the pressure range of 1-100 Torr. The arc tube 10 may further include additions, such as metallic sodium and/or calcium and/or strontium, to balance color. The barium has been found to radiate in such a manner as to produce white light, discussed further hereinbelow.

[0010] An electrically conductive arc tube mount 12 supports the arc tube 10 in known fashion. The arc tube mount 12 is of a rigid material, such as stainless steel, nickel, molybdenum, or the like. The arc tube mount 12 includes an upper crossbar 14 and a lower crossbar 16. A plurality of spring-like members 18 are affixed to the arc tube mount 12 for contact with a glass jacket 20.

[0011] The glass jacket 20 is fixed to a base member 22, typically a screw-type base member of nickel plated brass, for insertion into a threaded electrical receptacle (not shown). A glass stem member 24 is sealed to the jacket 20 and projects thereinto. Electrical connectors 26, 28 are sealed into, and pass through the stem member 24, to provide electrical connections from the exterior to the interior of the glass jacket 20.

[0012] The arc tube mount 12 is affixed to one of the electrical connectors 26. A pair of getters 30, 32 are attached to the arc tube mount 12 and serve to insure the integrity of the evacuated jacket 20 by absorbing from the interior of the jacket any oxygen present.

[0013] The arc tube 10 includes an electrode 34, 36 at either end thereof. One electrode 34 is affixed to and is supported by the crossbar 14 of arc tube mount 12, while the other electrode 36 is insulatedly supported by the other crossbar 16, but is electrically connected to the electrical connector 28 passing through the stem member 24. The electrodes 34, 36 preferably are of tungsten coated with an emitter compound for reducing the electrode operating temperature. In one embodiment, the emitter is a barium-calcium-tungsten composition of the type used in high pressure sodium lamps.

[0014] Heat conserving end seals, or bands, 38 preferably are wrapped around the arc tube 10 at each end thereof proximate the electrodes 34, 36, in order to reduce heat differential between the ends of the arc tube 10 and the center of the arc tube 10. The bands 38 may be of an axial length (i.e., width of band) of about 6.0 mm.

[0015] The glass jacket 20 is evacuated and may be provided with a interior coating 40 of phosphor.

[0016] In operation, a voltage is applied across the electrical connectors 26, 28, and thence to either end of the arc tube 10 by the electrode 36 and the arc tube mount 12 and electrode 34, ionizing the rare gas in the arc tube 10, which quickly heats the arc tube 10. The lamp's color is initially dominated by rare gas spectral emission, but as the tube heats, the barium begins to radiate. The lamp assumes its' white color from barium atomic and ionic spectral emission at 455, 493, 553, 614, 650 nanometers. A typical spectrum for a lamp made with an alumina doped yttria arc tube filled with 10 milligrams of barium and 33 Torr Xenon at a current of 2.5 amps and arc tube center temperature of 900°C is shown in FIG. 3. In an alternative embodiment, it appears that the near ultraviolet emissions from the neutral barium atom could excite the phosphor layer 40 on the inside surface of the outer jacket, which would improve the color of the lamp emission.

[0017] Inasmuch as there is a saturated vapor in the arc tube 10, the lamp must be operated on alternating current to avoid cataphoresis, that is, migration of all active ions to one end or the other of the arc tube. An alternating voltage source and ballast impedance assembly is required. Referring to FIG. 2, it will be seen that a switched direct current may be used to drive the lamp. An output of a current limited D.C. supply 50 is routed to an "H-Bridge" switching circuit 52 via a ballast impedance 54. The switching circuit 52 includes a switcher 56, the switching frequency being driven by a clock 58. The small voltage maintained across the impedance 54 protects the switching circuitry from transients.

[0018] It is to be understood that the present invention is by no means limited to the particular construction herein disclosed and/or shown in the drawings, but also comprises any modifications or equivalents within the scope of the claims. For example, while a screw-type base member has been shown and described, it will be apparent to those skilled in the art that other types of base members are in use and readily can be used in the instant lamp.

Claims

1. An arc discharge lamp comprising:

   an arc tube of a material selected from a group of materials, said group of materials consisting of yttria, gadolinium oxide, and terbium oxide;

   a fill gas disposed in said arc tube, said fill gas including a rare gas;

   metallic barium disposed in said arc tube;

   an arc tube mount supporting said arc tube at either end of said arc tube;

   an outer glass jacket in which said arc tube and said arc tube mount are disposed, said outer glass jacket being evacuated; and

   a base member closing said outer glass jacket.

2. The arc discharge lamp in accordance with claim 1 wherein said rare gas is a gas selected from a group of gases consisting of neon and xenon.

3. The arc discharge lamp in accordance with claim 1 wherein an additive is disposed in said arc tube, said additive comprising at least one of sodium, calcium, and strontium.

4. The arc discharge lamp in accordance with claim 1 wherein said outer glass jacket is coated with a layer of phosphor.

5. The arc discharge lamp in accordance with claim 1 wherein said arc tube material comprises yttria.

6. The arc discharge lamp in accordance with claim 5 wherein said yttria of said arc tube is alumina doped yttria.

7. The arc discharge lamp in accordance with claim 5 wherein said yttria of said arc tube is lanthana doped yttria.

8. The arc discharge lamp in accordance with claim 5 wherein said arc tube is of high density and high translucency.

9. The arc discharge lamp in accordance with claim 8 wherein said high density is at least about 95% of theoretical density.

10. The arc discharge lamp in accordance with claim 8 wherein said high translucency is at least about 80% of theoretical translucency.

11. The arc discharge lamp in accordance with claim 1 wherein said arc tube includes a pair of electrodes coated with an emitter compound having a barium-calcium-tungsten composition.

12. An arc discharge lamp comprising:

a base member;

a sealed outer jacket connected to said base member;

a pair of electrical connectors extending from said base member and into said sealed jacket;

an arc tube disposed within said sealed outer jacket, said arc tube containing a discharge-sustaining fill gas, a first electrode electrically connected to a first of said electrical connectors, and a second electrode electrically connected to a second of said electrical connectors, said electrodes being adapted to have an elongated arc discharge maintained therebetween;

said arc tube being of a material selected from a group of materials, said group of materials consisting of yttria, gadolinium oxide, and terbium oxide; and

metallic barium disposed in said arc tube.

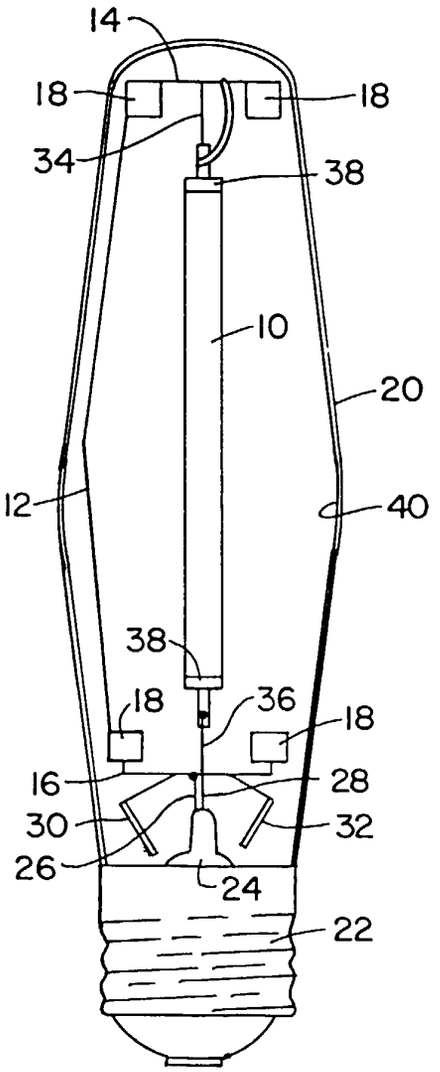
14
18
18
34
38
10
20
12
40
38
18
36
18
16
28
30
32
26
24
22

FIG. 1

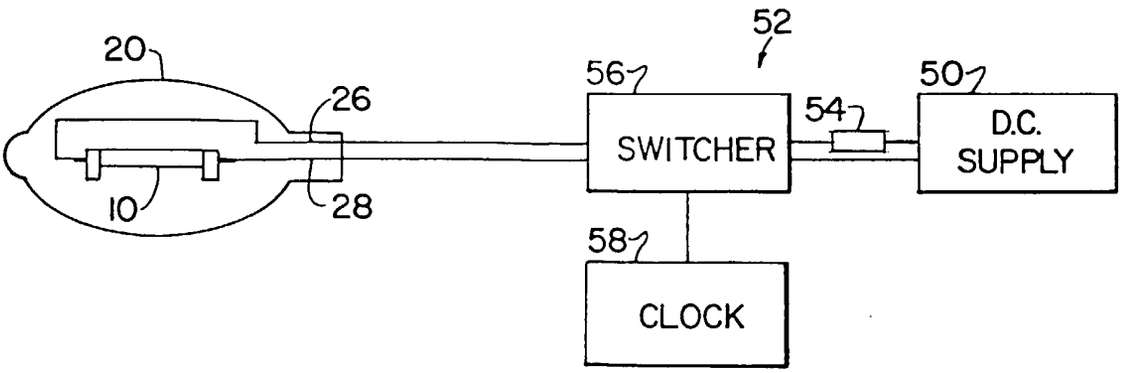
20
52
56
50
26
54
SWITCHER
D.C.
SUPPLY
10
28
58
CLOCK

FIG. 2

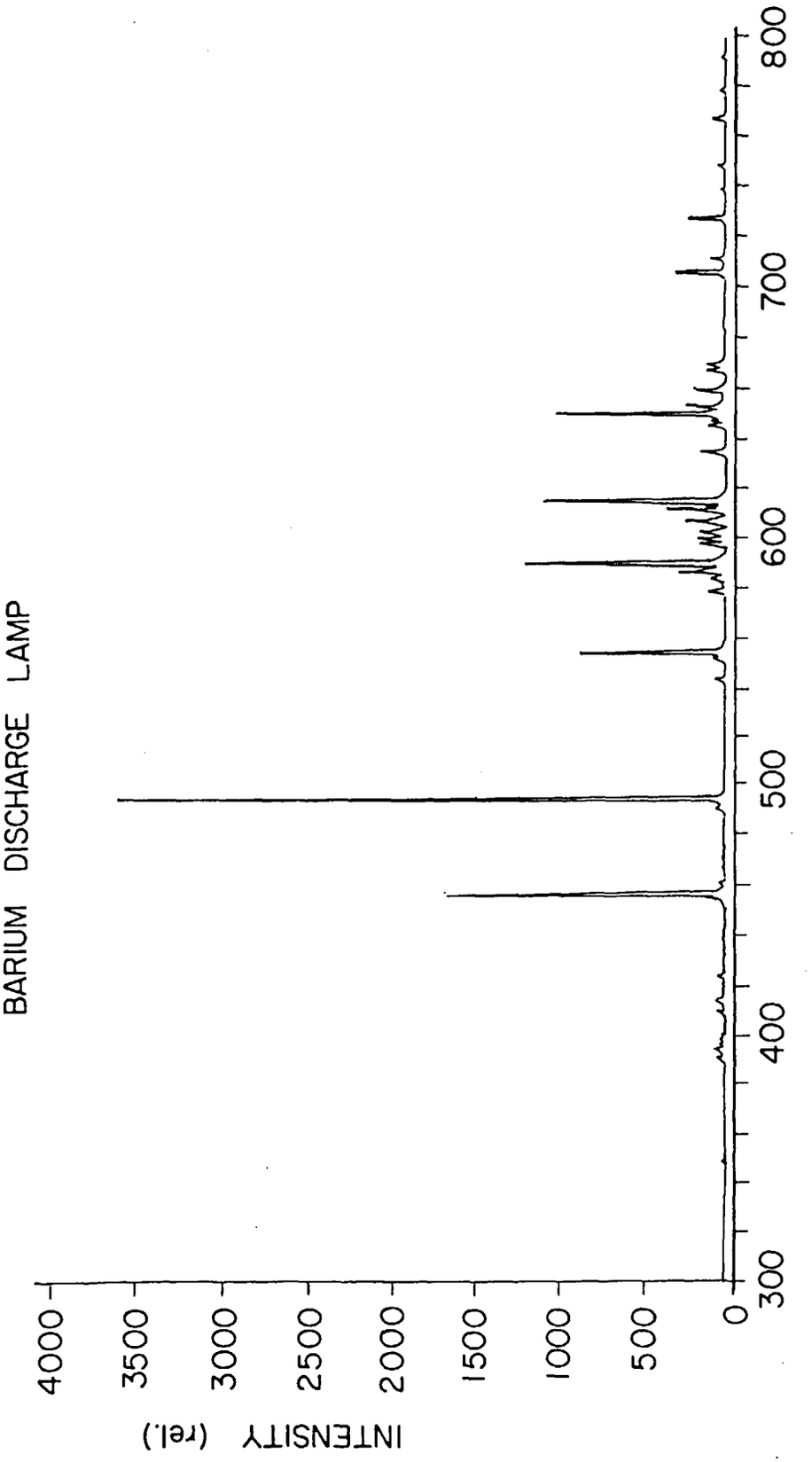
BARIUM DISCHARGE LAMP
INTENSITY (rel.)
4000
3500
3000
2500
2000
1500
1000
500
0
300
400
500
600
700
800
WAVELENGTH (nm)

FIG. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 12 1066

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 3 622 217 A (GALLO CHARLES F) 23 November 1971 (1971-11-23) * claims 1-5 * * column 2, line 65 - column 3, line 4 * * column 4, line 59 - line 62 *	1,5,12	H01J61/18 H01J61/30
D,A	US 4 166 831 A (REID F JOSEPH ET AL) 4 September 1979 (1979-09-04) * abstract *	1,5,6,8, 12	
A	GB 1 498 258 A (PHILIPS ELECTRONIC ASSOCIATED) 18 January 1978 (1978-01-18) * page 1, line 90 - line 98; figure 1 *	1,12	
A	EP 0 341 750 A (GTE PROD CORP) 15 November 1989 (1989-11-15) * column 11, line 14 - line 36; figure 4 *	1,12	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H01J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	1 February 2000	Martín Vicente, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 12 1066

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European 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.

01-02-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3622217 A	23-11-1971	NONE	
US 4166831 A	04-09-1979	US 4098612 A	04-07-1978
		BE 868861 A	03-11-1978
		CA 1101893 A	26-05-1981
		DE 2830020 A	08-02-1979
		FR 2397378 A	09-02-1979
		GB 2000752 A,B	17-01-1979
		IT 1097456 B	31-08-1985
		JP 54017910 A	09-02-1979
		NL 7807226 A	15-01-1979
GB 1498258 A	18-01-1978	DE 2422411 A	11-12-1975
		BE 828831 A	07-11-1975
		BR 7502888 A	16-03-1976
		FR 2270673 A	05-12-1975
		IT 1037912 B	20-11-1979
		JP 50152578 A	08-12-1975
		NL 7505275 A	11-11-1975
EP 0341750 A	15-11-1989	CA 1311012 A	01-12-1992
		JP 2065046 A	05-03-1990
		US 5001396 A	19-03-1991

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82