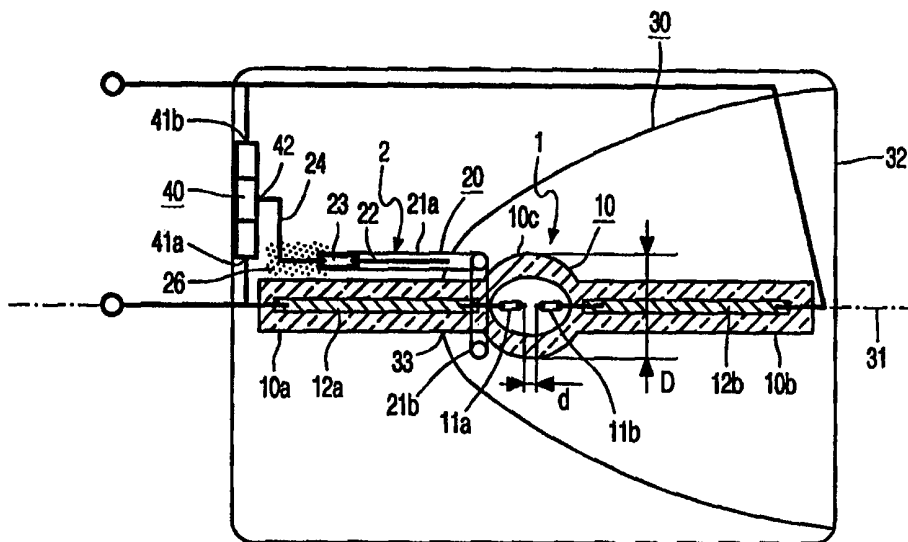




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : H01J 51/54	A1	(11) International Publication Number: WO 99/48133 (43) International Publication Date: 23 September 1999 (23.09.99)
<p>(21) International Application Number: PCT/IB99/00372</p> <p>(22) International Filing Date: 4 March 1999 (04.03.99)</p> <p>(30) Priority Data: 98200887.2 19 March 1998 (19.03.98) EP</p> <p>(71) Applicant: KONINKLIJKE PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).</p> <p>(71) Applicant (for SE only): PHILIPS AB [SE/SE]; Kottbygatan 7, Kista, S-164 85 Stockholm (SE).</p> <p>(72) Inventors: LEERS, Dieter; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). LOHN, Klaus; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). OSSMANN, Martin; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). DE REGT, Johannes, M.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). DERRA, Gunther, H.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). VAN DEN NIEUWENHUIZEN, Hubertus, C., M.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).</p> <p>(74) Agent: DUSSELDORP, Jan, C.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).</p>		<p>(81) Designated States: CN, JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</p> <p>Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</p>

(54) Title: UNIT COMPRISING A SHORT-ARC DISCHARGE LAMP WITH A STARTING ANTENNA



(57) Abstract

A short-arc discharge lamp (1) of the invention is provided with a translucent lamp vessel (10) which is closed in a gas-tight manner and which is provided with an ionizable fill. A first and a second electrode (11a, 11b) are arranged in the lamp vessel (10) which are each connected to its own current conductor (12a, 12b) which extends to outside the lamp vessel. A starting antenna (2) is arranged near to the lamp vessel, which antenna is connected to a further current conductor (24). The starting antenna comprises an antenna container (20) and a further electrode (22) which antenna container (20) is closed in a gas-tight manner and contains an ionizable fill, the further electrode (22) being connected to the further current conductor (24). This makes it possible to realize a shorter reignition time by means of a higher reignition voltage on the starting antenna while spark-over from the starting antenna (2) to the lamp vessel (10) is avoided.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

Unit comprising a short-arc discharge lamp with a starting antenna.

The invention relates to a unit comprising a short-arc discharge lamp and a starting antenna, the short-arc discharge lamp including a translucent, gas-tight lamp vessel with an ionizable fill, while a first and a second electrode are arranged in the lamp vessel of which either one of the two electrodes is connected to a current conductor of its own extending to outside the lamp vessel, a starting antenna connected to a further current conductor being arranged near to the lamp vessel.

Such a unit comprising a short-arc discharge lamp and starting antenna is known from US 4,053,809. A short-arc discharge lamp, hereinafter to be denoted lamp, is understood to mean a discharge lamp of which the distance between the electrodes is smaller than half the widest outside diameter of the lamp vessel. The short discharge arc makes a proper bundling of the light generated by the lamp possible. This renders the lamp highly suitable as, for example, a projection lamp or a car headlamp. Short-arc discharge lamps have a fill that adopts a very high pressure of the order of several tens of bars and upwards during the operation of the lamp. The fact that the high pressure decreases only gradually after switch-off renders it difficult to reignite the lamp shortly afterwards. With the known lamp, the lamp vessel has a central portion and neck-shaped end portions on either one of the two sides thereof. Alongside the lamp vessel is extended a metal conductor which is attached encircling one of the end portions at a distance from the central portion. The further current conductor to which the metal conductor is connected is in its turn connected to one of the current conductors of the electrodes. The metal conductor realizes a shortening of the time (reignition time) that is necessary for reigniting the lamp and therefore operates as a starting antenna. The reignition time is shorter as a higher reignition voltage is applied to the starting antenna. The permissible reignition voltage on the starting antenna, however, is limited because spark-over from the starting antenna to the lamp vessel occurs when voltages are too high. This causes damage to the lamp vessel which considerably shortens the life of the lamp.

It is an object of the invention in a unit of the type defined in the opening paragraph to provide a measure which makes a further reduction of the reignition time possible and which avoids spark-over from the starting antenna to the lamp vessel. According to the invention the unit of the type defined in the opening paragraph is therefore characterized

in that the starting antenna has a gas-tight antenna container with an ionizable fill and includes a further electrode which is connected to the further current conductor. When the further current conductor produces a reignition voltage, the further electrode causes an ionization to occur of the ionizable fill of the antenna container. The fill of the antenna container has then
5 become conductive, so that this generates an electric field in the lamp vessel similarly to a metal conductor. Surprisingly, however, it has appeared that with the unit according to the invention a considerably higher reignition voltage can be produced on the starting antenna without spark-over from the starting antenna to the lamp vessel. This makes a further reduction of the reignition time possible.

10 It is noted from US 5,248,918 that an electrodeless HID lamp is known in which, by means of magnetic induction, an electric discharge in the ionizable fill of the lamp vessel is maintained during operation. Due to the lack of electrodes, such lamps in cold state are generally harder to ignite than conventional lamps which do have electrodes. An important cause of this is a shortage of free electrons in the lamp vessel of the electrodeless lamp in that
15 state. To improve the ignition of this electrodeless lamp, a tube containing an ionizable medium is attached to the lamp vessel. When the electrodeless lamp is ignited, a high voltage is offered at a free end of the tube. The measure according to the invention is especially effective when the short-arc discharge lamp is reignited in hot condition. For the hot reignition of short-arc discharge lamps, a lack of free electrons does not play any role.

20 Furthermore, there is noted that from US 3,828,214 is known a high-pressure sodium lamp of which the lamp vessel is included in an envelope which contains an ionizable fill. Further electrodes are arranged inside the envelope. With this lamp, the distance between the electrodes of the lamp is considerably larger than the diameter of the lamp vessel. When a voltage is applied to the lamp, the fill in the envelope enveloping the lamp vessel is ionized.
25 The fill in the lamp vessel is heated as a result, so that the starting voltage of the high-pressure sodium lamp drops. In this patent application is stated that the ionized plasma in the envelope acts as a conductive body. A conductive body, for example, a conducting strip, in the vicinity of the lamp vessel is used in high-pressure sodium lamps to shorten the distance to be bridged on ignition. First a capacitive discharge arises over a relatively short distance between the
30 conductive strip and a neighboring electrode. After that, the discharge in the lamp vessel is extended to between the electrodes in the lamp vessel.

Experimental examination of the unit according to the invention has shown the inventors that after a reignition voltage is applied to the starting antenna, there is first an initial

discharge over a relatively long path along an inside surface of the wall of the lamp vessel. Subsequently, this initial discharge turns into an arc discharge between the electrodes.

In a short-arc discharge lamp the density of the ionizable fill in hot condition is very high. This makes it difficult to sufficiently accelerate free electrons present in the lamp vessel, so as to realize a discharge. Consequently, a rise of the temperature of the lamp vessel when the short-arc discharge lamp is ignited actually leads to an increase of the starting voltage. In an advantageous embodiment of the unit according to the invention, the lamp vessel is for this reason arranged outside the antenna container. As a result, the heating of the lamp vessel as a result of the discharge in the antenna container is substantially avoided.

For counteracting optical losses, the antenna container is preferably made of a translucent material, for example, a ceramic material such as monocrystalline metal oxide, for example, sapphire, polycrystalline metal oxide, for example, translucent gas-tight aluminum oxide (DGA), yttrium aluminum garnet (YAG) or yttrium oxide (YOX), or polycrystalline non-oxidic material such as aluminum nitride (AlN). Glass, for example quartz glass, is also suitable as a translucent material and has the additional advantage that it provides a relatively large freedom of form of the starting antenna.

In a unit according to the invention, the nature and intensity of the radiation generated in the antenna container for achieving a shorter reignition time is not of prime importance. However, for achieving a short ignition time when the lamp is ignited in cold condition, in the absence of ambient light, it is favorable if the starting antenna in an activated condition generates UV radiation, preferably in a wavelength band from 190 to 260 nm. For example, the starting antenna has a fill of mercury and argon.

The further electrode may be included in the antenna container and connected to the further current conductor via a gas-tight lead-in. However, an embodiment in which the further electrode is attached to an outside surface of the antenna container is easier to manufacture. A gas-tight lead-in is then not necessary. In addition, this enhances the options with respect to the materials for the further electrode and with respect to the components of the fill, because the wall of the antenna container in this case avoids any chemical interactions between the further electrode and the fill inside the antenna container.

The reignition voltage produced on the starting antenna is, for example, a high-frequency A.C. voltage, but, on the other hand, may be a possibly recurrent, pulsatory voltage.

In an advantageous embodiment, the unit according to the invention is further characterized by voltage-transforming means in which the current conductors are connected to an input of the voltage-transforming means and in that the further current conductor is

connected to an output of their own of the voltage-transforming means. Since the unit includes voltage-transforming means, it may be connected to a power supply which needs to supply only a relatively low voltage both on ignition of the lamp and during nominal operation of the lamp. Therefore, relatively cost-effective components may be used for the power supply. The voltage-transforming means are arranged, for example, as a transformer, for example having a primary winding and a secondary winding around a core of magnetizable material. On the other hand, the transforming means may be arranged as a spiral line transformer.

It is attractive if the voltage-transforming means are formed by a piezoelectric transformer. For a frequency near to its resonance frequency, a transformer of this type produces a considerably higher output voltage than for a frequency that deviates more from the resonance frequency. This is especially advantageous in embodiments in which the transformer and the lamp are connected to the same power supply, because in this manner the voltage on the output of the transformer may be changed without this having an appreciable effect on the voltage on the electrodes of the lamp.

An attractive embodiment of the unit according to the invention is characterized in that the lamp vessel has a relatively wide central portion and on either one of the two sides thereof neck-shaped end portions, with the electrodes being arranged in the central portion of the lamp vessel, the current conductors extending each through a respective end portion, and the antenna container of the starting antenna being a tube which encircles one of the end portions near to the central portion. This double-sided short-arc discharge lamp lends itself fairly easily for manufacture on an industrial scale.

Owing to the short distance between the electrodes, the short-arc discharge lamp is eminently suitable for use in a unit with a reflector, for example, for projection purposes.

Preferably, the unit includes the above-described double-sided short-arc discharge lamp. A practical and compact embodiment of such a unit is characterized in that the reflector is a converging reflector having an optical axis, a light emission window and, opposite this window, a further window with the reflector encircling the central portion of the lamp vessel, the neck-shaped portions of the lamp vessel extending along the optical axis and the end portion encircled by the starting antenna extending outwardly through the further window.

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

In the drawings:

Fig. 1 shows in longitudinal section a first embodiment of a unit comprising a short-arc discharge lamp and a starting antenna according to the invention, with the unit further including a reflector and voltage-transforming means,

Fig. 2A shows in more detail the starting antenna of the first embodiment also in longitudinal section,

Fig. 2B shows the starting antenna in cross-section along II-II in Fig. 2A,

Fig. 3 shows in more detail the voltage-transforming means of the unit shown in Fig. 1,

Fig. 4A shows in more detail the ignition antenna of a second embodiment of the unit according to the invention,

Fig. 4B shows the ignition antenna in cross-section along III-III in Fig. 4A,

Fig. 5 shows in longitudinal section a third embodiment of a unit comprising a short-arc discharge lamp and a starting antenna according to the invention, with the unit further including a reflector and voltage-transforming means, and

Fig. 6 shows in more detail the voltage-transforming means of the unit shown in Fig. 5.

Fig. 1 shows a unit comprising a short-arc discharge lamp 1 and a starting antenna 2. The short-arc discharge lamp comprises a translucent gas-tight lamp vessel 10 with an ionizable fill. In this case the fill contains one or more rare gases, argon here under a filling pressure of 100 Mbar, at least 0.2 mg/mm³ mercury and, for example, 10⁻⁶-10⁻⁴ mol/mm³ of one or more of the halogens Cl, Br, I, here in the form of mercury bromide. The lamp vessel in Fig. 1 is made of quartz glass but may be of a different ceramic material. In the lamp vessel 10 are arranged a first and a second electrode 11a, 11b having a mutual distance d of 1 mm. The lamp vessel 10 has a widest outside diameter D of 9 mm. The mutual distance d between the electrodes is in the present embodiment therefore smaller than half the widest outside diameter D of the lamp vessel. Either one of the two electrodes 11a, 11b is connected to a current conductor 12a, 12b of its own which extends to outside the lamp vessel 10. In the vicinity of the lamp vessel 10 is arranged a starting antenna 2 which is connected to a further current conductor 24.

In the embodiment shown in Fig. 1 the lamp vessel 10 of the short-arc discharge lamp has a relatively wide central part 10c and on either side thereof neck-shaped end portions 10a, 10b having an outside diameter of 6.1 mm. The electrodes 11a, 11b are

arranged in the central portion 11c of the lamp vessel 10, and the current conductors 12a, 12b extend each through its own end portion 10a, 10b.

The starting antenna 2 is shown in more detail in Figs. 2A and 2B. In these Figures is also shown in a dotted line a part 10a, 10c of the lamp vessel 10. The starting antenna 2 has a gas-tight antenna container 20 which contains an ionizable fill here formed by argon under a filling pressure of 100 Mbars. In another embodiment, the ionizable fill also includes, for example, 0.5 mg of mercury. The starting antenna 2 furthermore has a further electrode 22 which is connected to the further current conductor 24. In this case the starting antenna 2 has an internal electrode 22 which is arranged as a tungsten pin. The pin 22 is connected to the further current conductor 24 of molybdenum via a strip-shaped lead-in element 23 also of molybdenum. In another embodiment, there is no tungsten pin and a free end of the lead-in element serves as the internal electrode. The antenna container 20 of the starting antenna 2 is here a quartz glass tube which has a wall thickness of 0.4 mm. The tube has a first, relatively wide, part 21a which has a length of 25 mm and an inside diameter of 1.6 mm which extends along the neck-shaped end portion 10a. It has a second, relatively narrow, part 21b encircling the neck-shaped end portion 10a, which part 21b has an inside diameter of 0.6 mm near to the central part 10c. In this case the second part 21b makes a 360° bend around the end portion 10a.

In the embodiment shown the lamp vessel 10 is arranged outside the antenna container 20.

The unit shown in Fig. 1 furthermore has a reflector 30. The reflector is a converging reflector 30 having an optical axis 31, a light emission window 32 and a further window 33 opposite the light emission window. In this case the reflector is a parabolic reflector. The reflector 30 surrounds the central portion 10c of the lamp vessel 10. One of the end portions 10a extends outwardly through the further window 33 of the reflector 30.

The unit furthermore comprises voltage-transforming means 40. The current conductors 12a, 12b are each connected to an input 41a, 41b of their own of the voltage-transforming means 40 and the further current conductor 24 is connected to an output 42 of the voltage-transforming means. The voltage-transforming means 40 are arranged here as an inductively operating transformer with a primary winding 47 and a secondary winding 48 around a core 49 of soft-magnetic material (see Fig. 3).

The reignition time of the unit according to the invention as a function of the reignition voltage offered on the starting antenna was examined. This relation was also

examined for a unit not according to the invention for which the starting antenna is arranged as a solid conductor of a $\text{Fe}_{70}\text{Cr}_{25}\text{Al}_5$ (weight %) alloy.

With the unit not according to the invention there was spark-over from the starting antenna to the lamp vessel when the starting voltage exceeded 5 kV. This rendered it more difficult to realize a shorter reignition time than 45s in practice for the lamp not according to the invention. With the unit according to the invention and a reignition voltage of 8 kV peak on the starting antenna 20 and an starting voltage of 800 V peak between the electrodes, a reignition time of 30 s was realized. No spark-over occurred from the starting antenna 20 to the lamp vessel 10. Spark-over from the further current conductor 24 to the neck-shaped portion 10a is avoided with kit 26 based on a ceramic material applied for insulation purposes.

Elements in Figs. 4A and 4B corresponding to the elements of Figs. 1, 2A or 2B have reference numerals 100 up. These Figures show the starting antenna 102 in a second embodiment of the unit according to the invention. Dotted lines therein show a part 110a, 110c of the lamp vessel 110 of the short-arc discharge lamp 101. In this embodiment, the antenna container 120 of the starting antenna 102 is completely made of a quartz glass tube having an inside diameter of 0.6 mm and a wall thickness of 0.45 mm. The electrode 122 is here attached to the outside surface of the antenna container. In this case the electrode 122 is arranged as a metal tube 122a which is clamped onto the free end 121a' of the straight part 121a of the antenna container 120 by means of a resilient finger 122a' moving inwardly. The bus 122a is capacitively coupled to the ionizable fill in the antenna container 120. A still better capacitive coupling is obtained in that the free end 121a' is covered with a coating 122b of a metal, platinum in this case.

A third embodiment of the unit comprising a short-arc discharge lamp and starting antenna according to the invention is shown in Fig. 5. Elements therein corresponding to those of Fig. 1 have a reference numeral that is 200 up. In this embodiment, the antenna container 220 of the starting antenna is arranged as a straight tube of a ceramic material, in this case aluminum oxide. The antenna container 220 is arranged transversely to the end portion 210a of the lamp vessel 210. The voltage-transforming means 240 are formed here by a piezoelectric transformer (shown diagrammatically in Fig. 6). The piezoelectric transformer is arranged, for example, as described with reference to Fig. 1 in aforementioned patent application WO98/15985. The elements 243, 244, 245, 246, 243', 244', and PEB of Fig. 6 in that case correspond to 1, 2, 3, EL1, 1', 2' and PEB respectively, of the former application.

Obviously, within the framework of the claims there are many variations possible. For example, in a variant of a unit comprising a short-arc discharge lamp and a reflector according to the invention, the starting antenna is arranged near to the lamp end portion turned towards the light emission window. In that variant, the further current
5 conductor is extended, for example, radially from the antenna container to the reflector and is led via a lateral opening in the reflector to the voltage-transforming means or to another high-voltage source.

CLAIMS:

1. A unit comprising a short-arc discharge lamp (1) and a starting antenna (2), the short-arc discharge lamp including a translucent, gas-tight lamp vessel (10) with an ionizable fill, while a first and a second electrode (11a, 11b) are arranged in the lamp vessel of which either one of the two electrodes is connected to a current conductor (12a, 12b) of its own
5 extending to outside the lamp vessel, a starting antenna connected to a further current conductor (24) being arranged near to the lamp vessel, characterized in that the starting antenna (2) comprises a gas-tight antenna container (20) containing an ionizable fill and includes a further electrode (22) which is connected to the further supply current conductor (24).
10
2. A unit as claimed in claim 1, characterized in that the lamp vessel (10) is arranged outside the antenna container (20).
3. A unit as claimed in claim 1 or 2, characterized in that the antenna container
15 (20) is made of a translucent material.
4. A unit as claimed in claim 1 or 2, characterized in that the starting antenna (2) in an activated state generates UV radiation.
- 20 5. A unit as claimed in claim 1 or 2, characterized in that the further electrode (122) is attached to an outside surface of the antenna container (120).
6. A unit as claimed in claim 1 or 2, further characterized by voltage-transforming means (40), the current conductors (12a, 12b) being each connected to an input (41a, 41b) of
25 their own of the voltage-transforming means and the further current conductor (24) being connected to an output (42) of the voltage-transforming means.
7. A unit as claimed in claim 6, characterized in that the voltage-transforming means (240) are formed by a piezoelectric transformer.

8. A unit as claimed in claim 1 or 2, characterized in that the lamp vessel (10) has a relatively wide central portion (10c) and, on either one of the two sides thereof, neck-shaped end portions (10a, 10b) with the electrodes (11a, 11b) being arranged in the central portion of the lamp vessel, the current conductors (12a, 12b) extending each through a respective end portion, and the antenna container (20) of the starting antenna (2) being a tube which encircles one of the end portions (10a) near to the central portion.

9. A unit (1) as claimed in claim 1 or 2, further characterized by a reflector (30).

10. A unit as claimed in claims 8 and 9, characterized in that the reflector (30) is a converging reflector (30) having an optical axis (31), a light emission window (32) and opposite this window, a further window (33) with the reflector encircling the central portion (10c) of the lamp vessel (10), the neck-shaped portions (10a, 10b) of the lamp vessel extending along the optical axis and the end portion (10a) encircled by the antenna container (20) of the starting antenna (2) extending outwardly through the further window.

1/4

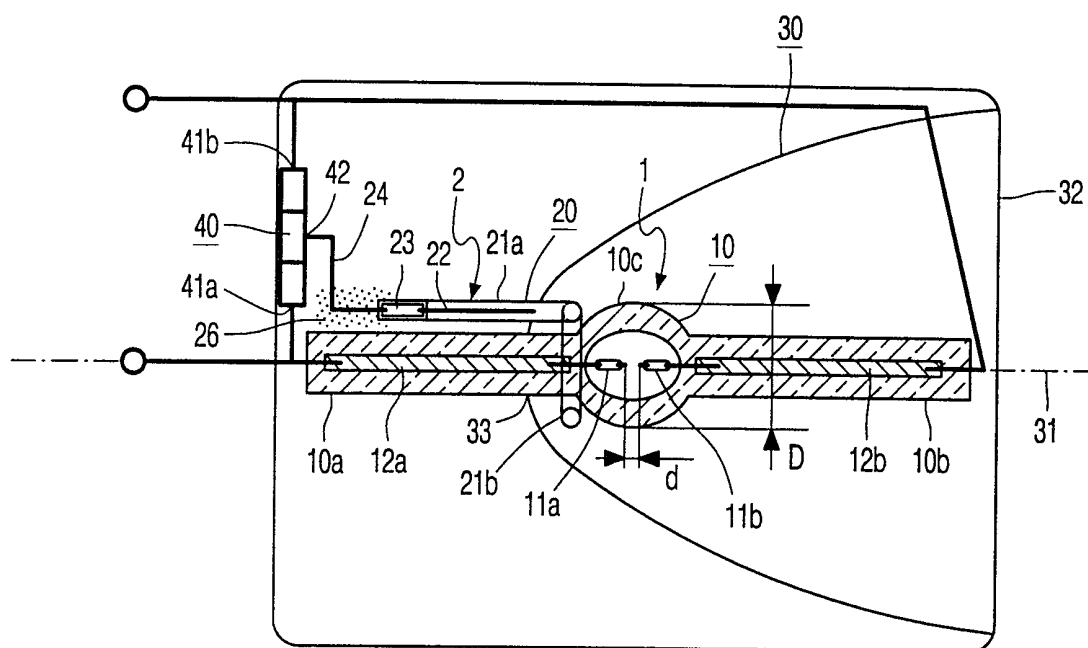


FIG. 1

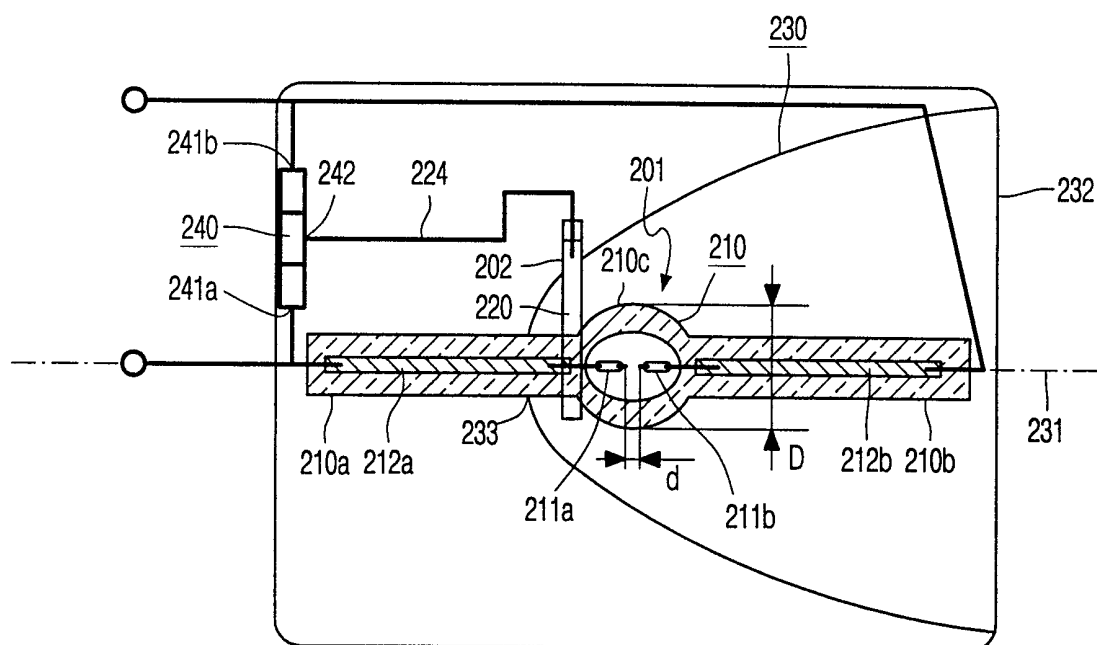


FIG. 5

2/4

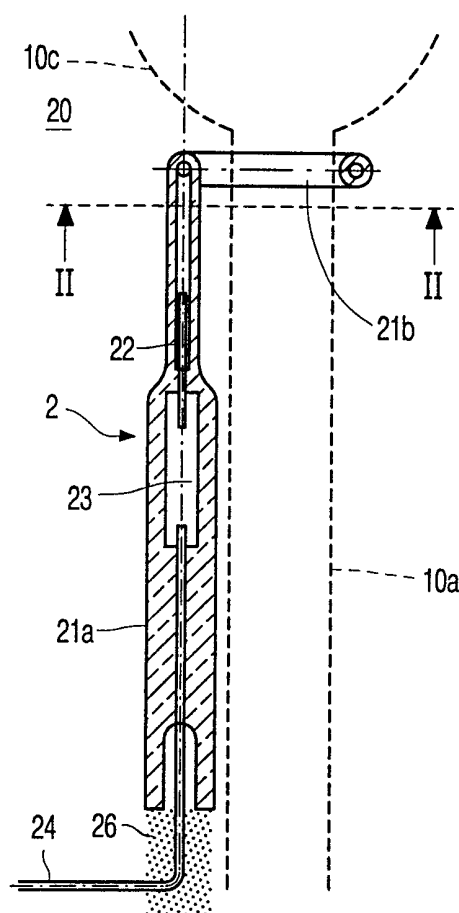


FIG. 2A

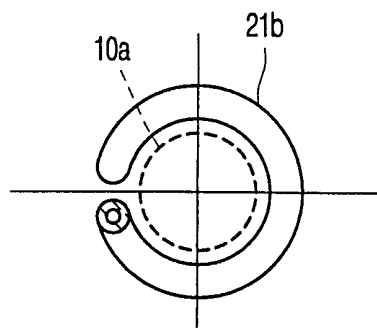


FIG. 2B

3/4

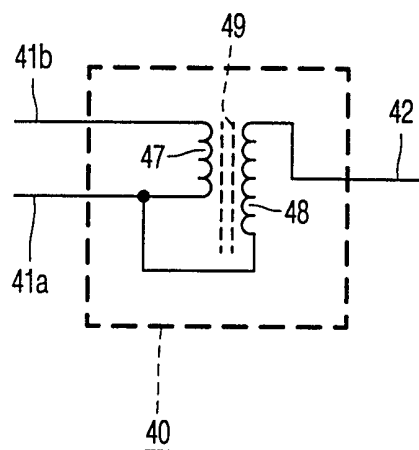


FIG. 3

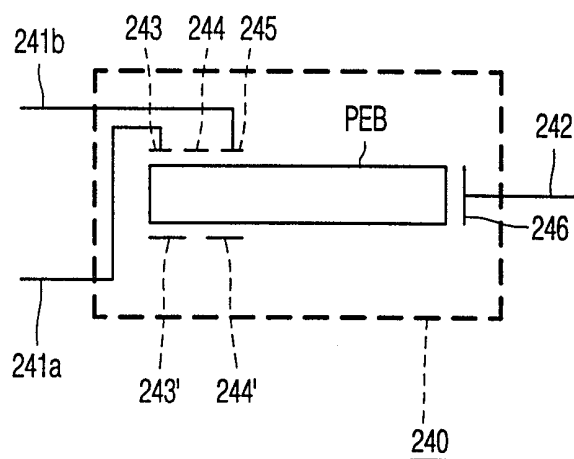


FIG. 6

4/4

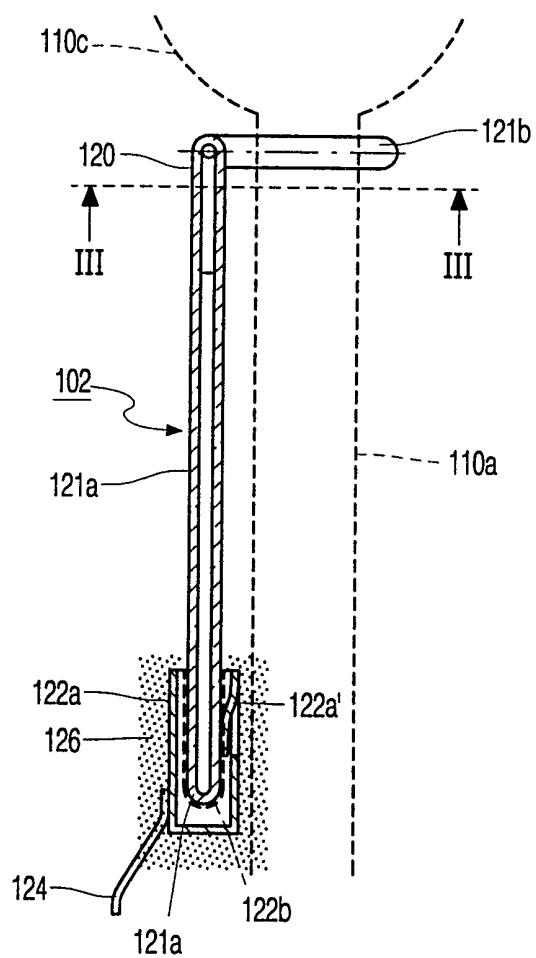


FIG. 4A

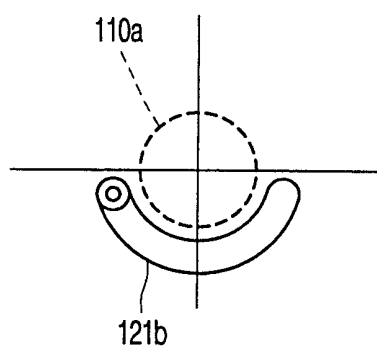


FIG. 4B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 99/00372

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H01J 51/54

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3838214 A (W.M. KEEFFE ET AL), 6 August 1974 (06.08.74), column 1, line 54 - column 2, line 9, figure --	1
A	US 4053809 A (E.G. FRIDRICH ET AL), 11 October 1977 (11.10.77), figures 3,6 --	1,9,10
A	US 5248918 A (J.T. DAKIN ET AL), 28 Sept 1993 (28.09.93), column 2, line 50 - column 3, line 4 --	1-3
A	JP 57168464 (MITSUBISHI DENKI KK) 1983-01-13 (abstract). (online)(retrieved on 1999-06-21). Retrieved from: EPO PAJ Database. --	1

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:	"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document but published on or after the international filing date	"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
"I" 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)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 22 June 1999	Date of mailing of the international search report 13 -07- 1999
Name and mailing address of the ISA Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Herman Phalén / MR Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB 99/00372

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>JP 57158944 (MITSUBISHI DENKI KK) 1982-12-17 (abstract). (online)(retrieved on 1999-06-21). Retrieved from: EPO PAJ Database.</p> <p style="text-align: center;">-- -----</p>	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/06/99

International application No.

PCT/IB 99/00372

Patent document cited in search report			Publication date		Patent family member(s)		Publication date	
US	3838214	A	06/08/74	CH	558618	A	31/01/75	
				DE	2258506	A	14/06/73	
				FR	2162447	A,B	20/07/73	
				GB	1410637	A	22/10/75	
				NL	7216523	A	08/06/73	
				SE	350892	B	06/11/72	
				US	B478234	I	30/03/76	
				US	4010421	A	01/03/77	

US	4053809	A	11/10/77	NONE				

US	5248918	A	28/09/93	CA	2056520	A	05/06/92	
				CN	1062237	A	24/06/92	
				DE	69107183	D,T	28/09/95	
				EP	0489532	A,B	10/06/92	
				ES	2067166	T	16/03/95	
				JP	1957360	C	10/08/95	
				JP	4292897	A	16/10/92	
				JP	6080596	B	12/10/94	
				MX	9102380	A	01/06/92	
				US	5140227	A	18/08/92	
