



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 1 130 618 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.09.2001 Bulletin 2001/36

(51) Int Cl.7: **H01J 9/24, H01J 9/22**

(21) Application number: **00830144.2**

(22) Date of filing: **29.02.2000**

(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

(72) Inventor: **Bozzetti, Elio Tito**
20152 Milano (IT)

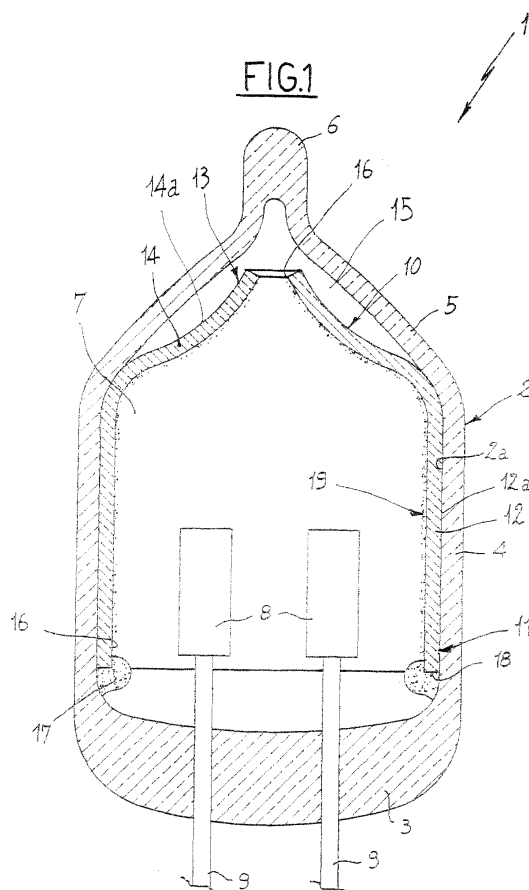
(74) Representative: **Tansini, Elio Fabrizio**
C/O Bugnion S.p.A.,
Viale Lancetti, 17
20158 Milano (IT)

(71) Applicant: **SIGNAL LUX ITALIA S.p.A.**
20122 Milano (IT)

(54) **Fluorescent lamp and process for making the same**

(57) A fluorescent lamp (1) comprises a bulb (2) having a holding cavity (7) within which a pair of electrodes (8) is disposed. A gas is enclosed in the holding cavity (7) and a diffusion capsule (10) carrying phosphorescent substances (19) is rigidly in engagement with

the inner surface of the bulb (2). This lamp (1) is made by a process that first involves formation of the diffusion capsule (10) together with the phosphorescent substances (19), then association of this diffusion capsule (10) with the bulb (2) of the lamp itself.



EP 1 130 618 A1

Description

[0001] The present invention relates to a process for making lamps comprising the features set forth in the preamble of claim 1.

[0002] The present invention also pertains to a lamp to be obtained by the above process comprising the features set forth in the preamble of claim 10.

[0003] The invention particularly applies to production of fluorescent lamps.

[0004] It is known that fluorescent lamps are usually made up of a glass envelope containing inert gases, the inner surface of which is coated with a thin layer of phosphorescent substances and which is provided with a pair of electrodes for firing and maintaining the electrical discharge necessary to cause emission of visible radiations.

[0005] The type of gas contained within the envelope, the phosphorescent substances for glass coating and the amount of current circulating between the electrodes determine colour and intensity of the light emitted by the lamp.

[0006] For making fluorescent lamps, small glass tubes of circular section are usually employed. These small tubes are first submitted to a powdering step consisting in dipping an end portion being processed into a mixture made up of phosphorus powders and appropriate glues. Phosphorus powders deposit on the dipped surfaces of the small tube which is then drawn out of the mixture and heated in a furnace at about 350°C. Under this situation solvent evaporation and fixing of the phosphorus layer to the small tube surfaces is achieved. Subsequently, a step of removing the layer of the phosphorescent substances in excess, i.e. the layer of phosphorescent substances deposited on the outer surface, on the end edge of the treated end portion and on a final annular portion of the inner surface of the small tube, is provided.

[0007] A pair of electrodes is fitted in the treated end portion of the small tube, and a positioning member usually consisting of a mandrel or similar template is subsequently introduced into the small tube through the opposite end with respect to the treated end portion until engagement of the pair of electrodes at respective seatings is accomplished. Once positioning steadiness of the electrodes in the small tube is ensured, the end edge of the treated end portion is heated to a temperature close to the melting temperature to cause closing of same.

[0008] Subsequently the positioning member is drawn out of the small tube and a portion of said small tube is heated to the melting temperature (700°C - 900°C) so as to reduce the section thereof causing formation of a capillary duct defining a holding cavity in the treated end portion. Afterwards, suction of the air present within the holding cavity and the small tube is carried out as well as subsequent filling of the same with an inert gas.

[0009] Finally, the capillary duct is heated again till causing occlusion and subsequent separation of same from the rest of the small tube structure.

[0010] The Applicant has found that the known process for making fluorescent lamps has some drawbacks affecting the production costs and impairing the quality of the obtained product.

[0011] It should be in fact recognized that insertion and extraction of the positioning member can cause rubbing actions between said member and the inner surface of the small tube, which will bring about partial removal of the layer of phosphorescent substances or, even worse, full removal of the phosphorescent substances from some regions, which will result in discarding of the product being processed.

[0012] In addition, continuous heating operations to the melting temperature cause partial sintering of the phosphorescent substances in contact with the molten glass of the small tube. Under this situation, the phosphorescent substances are incorporated into the molecular structure of the glass and consequently they become insensitive to the ionizing effect produced by the electrodes. This involves an unavoidable drop in the light efficiency of the lamp.

[0013] Generally, in order to obviate this drawback, there is a tendency to increase the intensity of the supply current of the lamp, to achieve a greater incandescence of the lamp itself. However, an increase in the current intensity causes quick deterioration of the electrodes and consequent premature age coating.

[0014] It is also to be noted that the manufacturing cost of each lamp is high because an important amount of phosphorescent substances is thrown away during the removal step.

[0015] In addition, for some processing steps, such as removal of the phosphorescent substances from the outer surface of the small tube or insertion and extraction of the positioning member, high-precision machinery is required which is very expensive and therefore affects costs of the final products.

[0016] It is an aim of the present invention to substantially solve the problems encountered in the known art by providing a process for making lamps ensuring the integrity of the layer of the phosphorescent substances applied.

[0017] The above and further aims that will become more apparent during the present description are substantially achieved by a process for making lamps comprising the features set forth in the characterizing part of claim 1 and by a lamp to be manufactured in accordance with such a process and comprising the features set forth in the characterizing part of claim 10.

[0018] Further features and advantages will be best understood from the detailed description of some preferred, but non-exclusive, embodiments of a process for making lamps and of a lamp to be manufactured by such a process, in accordance with the present invention. This description will be taken hereinafter with reference

to the accompanying drawings, given by way of non-limiting example, in which:

- Fig. 1 shows a longitudinal section of a lamp being the object of the present invention;
- Fig. 2 diagrammatically shows a step during which a pair of electrodes is about to be introduced into a tubular element;
- Fig. 3 diagrammatically shows a step following the one shown in Fig. 2, during which a positioning member is about to be inserted into the tubular element;
- Fig. 4 is a diagrammatic representation of the positioning member in engagement with the pair of electrodes;
- Fig. 5 diagrammatically shows a step during which closing of an end portion of the tubular element is carried out;
- Fig. 6 diagrammatically shows an extraction step of the positioning member;
- Fig. 7 diagrammatically shows a step during which a diffusion capsule is about to be inserted into the tubular element;
- Fig. 8 shows a step of fastening the diffusion capsule to the tubular element;
- Fig. 9 diagrammatically shows a step of reducing the section of the tubular element.

[0019] With reference to the drawings, a lamp in accordance with the present invention has been generally identified by reference numeral 1.

[0020] As shown in Fig. 1, lamp 1 comprises a bulb 2 of transparent material and of substantially circular section having a base wall 3 from which a side wall 4 extends at right angles. On the opposite side from the base wall 3, the side wall 4 has a conical portion 5 terminating with a melting point 6. The base wall 3, side wall 4, conical portion 5 and melting point 6 define a holding cavity 7 within which at least one inert gas is enclosed. In addition, within the holding cavity 7 at least one pair of electrodes 8 is disposed, said electrodes being fixed relative to the bulb and having conductive elements 9 extending through the base wall 3 for connection with the ends of an electric circuit.

[0021] Lamp 1 further comprises at least one diffusion capsule 10 of transparent material engaged at the inside of bulb 2 and circumscribing electrodes 8 at least partly.

[0022] The body of the diffusion capsule 10 has a substantially bell-shaped conformation with an open end 11 defined by a substantially cylindrical portion 12 and a closed end 13 defined by a substantially frusto-conical portion 14 integral with the cylindrical portion 12.

[0023] In detail, the cylindrical portion 12 of the diffusion capsule 10 has an outer diameter substantially equal to the inner diameter of bulb 2 and consequently brings an outer surface 12a thereof into direct contact with an inner surface 2a of bulb 2. The frusto-conical portion 14 seen in a diametrical section has a substan-

tially curved profile defining a concave outer surface 14a. This concave surface 14a, in turn, advantageously defines a hollow space 15 between the frusto-conical portion 14 of the diffusion capsule 10 and the conical portion 5 of bulb 2.

[0024] Still with reference to Fig. 1, the diffusion capsule 10 has at least one communication opening 16 which is preferably formed in a central region of the frusto-conical portion 14.

[0025] The diffusion capsule 10 is advantageously glued to bulb 2 by appropriate fixing substances to be preferably applied to at least one end edge 18 of the open end 11, at one or more gluing points 17. Said fixing substances can be applied along the whole extension of the end edge 18 so as to form a continuous rib.

[0026] Also applied to the diffusion capsule 10 is a thin layer of phosphorescent substances (or phosphor) 19. In this instance this phosphor layer 19 extends over the whole inner surface extension of the diffusion capsule 10.

[0027] Diagrammatically shown in Figs. 2 to 9 are the operating steps of a process for making the above described lamp. This process will be described in detail in the following of the present specification.

[0028] With reference to Fig. 2, electrodes 8 are first introduced into a first end portion 20 of a tubular element 21 of circular section. Subsequently, a positioning member 22 is inserted into a second end portion 23 of the tubular element 21, opposite to the first end portion 20 (Fig. 3), to engage electrodes 8 in a preestablished position (Fig. 4). More specifically, the positioning member 22 that can consist for example of a mandrel or similar template, is inserted into the tubular element 21 until engagement of a pair of seatings 24 formed in one end 25 of the positioning member itself, with the corresponding pair of electrodes 8.

[0029] After the step of inserting the positioning member 22, a heating step is provided for heating of the first end portion 20 of the tubular element 21 to a temperature close to the melting temperature (about 700°C-900°C) to cause occlusion of the first end portion itself. In fact, during this operating step, the material forming the first end portion 20 that meanwhile has become malleable and easily deformable, is disposed in the configuration shown in Figs. 5 to 9, thereby forming the base wall 3 of lamp 1. Heating and consequent closure of the first end portion 20 of the tubular element 21 further causes fastening of electrodes 8 with respect to the tubular element itself (Fig. 5), since the conductive elements 9 are incorporated into the base wall 3, at an intermediate region of their longitudinal extension.

[0030] Consecutively, extraction of the positioning member 2 is carried out (Fig. 6) to enable subsequent insertion and gluing of the diffusion capsule 10 (Figs. 7, 8) which has been previously treated for application of the phosphorescent substances 19.

[0031] In this instance, before being inserted into the tubular element 21, the diffusion capsule 10 is at least

partly and preferably completely dipped into a mixture consisting of phosphorescent substances 19 suspended in appropriate solvents and fixing substances, so that the diffusion capsule 10 surfaces are completely coated with the above mentioned mixture. Then, the diffusion capsule 10 is heated, to a temperature of about 350°C for example, to ensure solvent evaporation and fixing of the phosphorescent substances 19.

[0032] Subsequently, a removal step is carried out for removing the phosphorescent substances 19 in excess deposited on the outer surface of the diffusion capsule 10. Removal of the phosphorescent substances is preferably executed by a tumbling process, in which a series of diffusion capsules 10 carrying the phosphorescent substances 19 are inserted into a rotating vessel. Under this situation, the diffusion capsules 10 are intimately mixed and the continuous mutual rubbing of their outer surfaces causes cleaning of same.

[0033] In addition, in order to carry out gluing of the diffusion capsule 10 in the tubular element 21, one or more gluing points 17 are applied to the end edge 18 of the open end 11.

[0034] Positioning of the diffusion capsule 10 within the tubular element 21 takes place by introducing said capsule through the second end portion 23 until the first end portion 20 is reached. When the diffusion capsule 10 is positioned in the first end portion 20 close to the pair of electrodes 8, the fixing substances present on the end edge 18 ensure a rigid connection between the diffusion capsule 10 and the tubular element 21.

[0035] At this point a first heating step of the tubular element 21 to a temperature close to the melting temperature, preferably included between 700°C and 900°C, is carried out to cause a diametrical shrinking of the tubular element itself (Fig. 9). The diametrical shrinking of the tubular element 21 gives rise to formation of a communication duct 26 located at a position substantially spaced apart from, and intermediate between the end portions 20, 23. Formation of the communication duct 26 in addition defines the limits of the holding cavity 7 housing electrodes 8.

[0036] Afterwards, the air contained in the holding cavity 7 is sucked off through the communication duct 26 and the second end portion 23 of the tubular element 21. Then, at least one inert gas is admitted to the holding cavity 7 through the second end portion 23 and the communication duct 26.

[0037] Finally, a second heating step of the tubular element 21 is carried out to cause occlusion of the communication duct 26 and consequent separation of bulb 2 of lamp 1 from the remaining structure of the tubular element 21.

[0038] The present invention achieves the intended purposes.

[0039] The above described process for making fluorescent lamps ensures preservation of the phosphorescent substances 19 required for enabling the optimal operation of the produced lamp 1, in connection with effi-

ciency and duration of same. More specifically, the presence of a diffusion capsule 10 carrying the phosphorescent substances 19 protects said substances from possible sintering with bulb 2 of lamp 1.

[0040] In addition, the diffusion capsule 10 protects the phosphorescent substances 19 against removal and scratching to which they are subject in the known art due to insertion and extraction of the positioning member 22. In fact, in the process in reference insertion and extraction of the positioning member 22 take place before insertion of the diffusion capsules 10. In this manner any risk of damaging or reducing the amount of phosphorescent substances 19 is avoided even in the presence of lack of precision in centring the positioning member 22 with respect to the tubular element 21, because the positioning member 22 can only come into contact with the tubular element 21.

[0041] In addition, the process is speeded up and optimized in the steps of fixing the phosphorescent substances 19, removing the phosphorescent substances 19 from the outer surfaces of the diffusion capsules 10 and drying the solvents. In fact, these operations can be each carried out simultaneously on a great amount of diffusion capsules 10.

[0042] It should be also recognized that reduction in the amount of the phosphorescent substances 19 thrown away and elimination of high-precision machinery, intended for carrying out centring of the positioning member 22 with respect to the tubular element and removal of the phosphorescent substances 19 from the surfaces of the tubular elements 21, involve a great reduction in the overall manufacturing costs of lamp 1.

Claims

1. A process for making fluorescent lamps comprising the steps of:

- associating phosphorescent substances (19) with at least one first end portion (20) of a tubular element (21) of transparent material;
- introducing a pair of electrodes (8) into said first end portion (20) of the tubular element (21);
- occluding said first end portion (20) of the tubular element (21) by heating the first end portion itself to a temperature close to the melting temperature;
- sucking off the air contained in the tubular element (21) through a second end portion (23) of the latter;
- admitting at least one gas to the tubular element (21) through the second end portion (23),
- forming a bulb (2) by heating the tubular element at an intermediate region between the first and second end portions (20, 23),
- **characterized in that** association of the phosphorescent substances (19) with the tubular el-

ement (21) comprises the steps of:

- applying the phosphorescent substances (19) to a diffusion capsule (10) of transparent material; 5
 - positioning said diffusion capsule (10) into said first end portion (20) of the tubular element (21).
2. A process as claimed in claim 1, wherein application of the phosphorescent substances (19) takes place by dipping said diffusion capsule (10) at least partly into a mixture comprising said phosphorescent substances (19). 10
3. A process as claimed in claim 1, wherein positioning of said diffusion capsule (10) comprises the steps of: 15
- introducing said diffusion capsule (10) into the tubular element (21) through the second end portion (23); 20
 - moving said diffusion capsule (10) from the second end portion (23) to the first end portion (20). 25
4. A process as claimed in claim 2, wherein before positioning of said diffusion capsule (10) a step is provided for removal of a layer of phosphorescent substances (19) applied to the outer surface (12a, 14a) of the diffusion capsule itself. 30
5. A process as claimed in claim 4, wherein said removal of the layer of phosphorescent substances (19) applied to the outer surface (12a, 14a) of said diffusion capsule (10) takes place by a tumbling process. 35
6. A process as claimed in claim 1, further comprising the step of forming at least one gluing point (17) between said diffusion capsule (10) and tubular element (21) to fasten the diffusion capsule to said first end portion (20). 40
7. A process as claimed in claim 6, wherein said gluing point (17) is formed by application of a glue at an end edge of an open end (11) of said diffusion capsule (10), before positioning of said capsule in said first end portion (20). 45
8. A process as claimed in claim 1, comprising the step of inserting a positioning member (22) into said second end portion (23) of the tubular element (21), to engage and retain said electrodes (8) to a preestablished position during the heating step of the first end portion (20). 50
9. A process as claimed in claim 1, wherein formation of the bulb (2) of the lamp (1) comprises:
- a first heating step of the tubular element (21) to a temperature close to the melting temperature, said first heating step being carried out subsequently to the capsule (10) positioning step to cause a diametrical shrinking of the tubular element so as to define a communication duct (26) therein which confines a holding cavity (7) containing said electrodes (8); and
 - a second heating step of the tubular element (21) to a temperature close to the melting temperature, said second heating step being carried out subsequent to introduction of said at least one inert gas, to cause occlusion of the communication duct (26) and separation of said second end portion (23) from the formed bulb (2). 55
10. A fluorescent lamp comprising:
- a bulb (2) of transparent material having a holding cavity (7);
 - at least one pair of electrodes (8) which are fixed with respect to said bulb (2) and disposed within said holding cavity (7);
 - at least one gas enclosed in said holding cavity (7), **characterized in that** it further comprises at least one diffusion capsule (10) of transparent material engaged internally of said bulb (2) and carrying at least one phosphorescent substance (19), said diffusion capsule (10) circumscribing said electrodes (8) at least partly.
11. A lamp as claimed in claim 10, wherein the shape of said diffusion capsule (10) substantially matches the shape of the inner surface of said bulb (2).
12. A lamp as claimed in claim 10, wherein said diffusion capsule (10) has an open end (11) and a substantially closed end (13).
13. A lamp as claimed in claim 12, wherein said diffusion capsule (10) has a substantially bell-shaped conformation with a substantially cylindrical portion (12) and a substantially frusto-conical portion (14) tapering away from the cylindrical portion (12).
14. A lamp as claimed in claim 13, wherein said open end (11) is defined by the cylindrical portion (12) and said closed end is defined by the frusto-conical portion (14).
15. A lamp as claimed in claim 13, wherein said frusto-conical portion (14) seen in longitudinal section has a substantially curved profile defining a concave outer surface (14a).
16. A lamp as claimed in claim 12, wherein said diffusion capsule (10) has a communication opening

(16) formed at said frusto-conical portion (14).

17. A lamp as claimed in claim 10, wherein the outer diameter of the diffusion capsule (10) is substantially the same as the inner diameter of the bulb (2). 5
18. A lamp as claimed in claim 12, wherein said diffusion capsule (10) is rigidly in engagement with the bulb (2) through at least one gluing point (17). 10
19. A lamp as claimed in claim 18, wherein said gluing point (17) is applied to at least one end edge (18) of the open end (11) of said diffusion capsule (10).
20. A lamp as claimed in claim 10, wherein said phosphorescent substance (19) is fixed to at least one inner surface of the diffusion capsule (10). 15

20

25

30

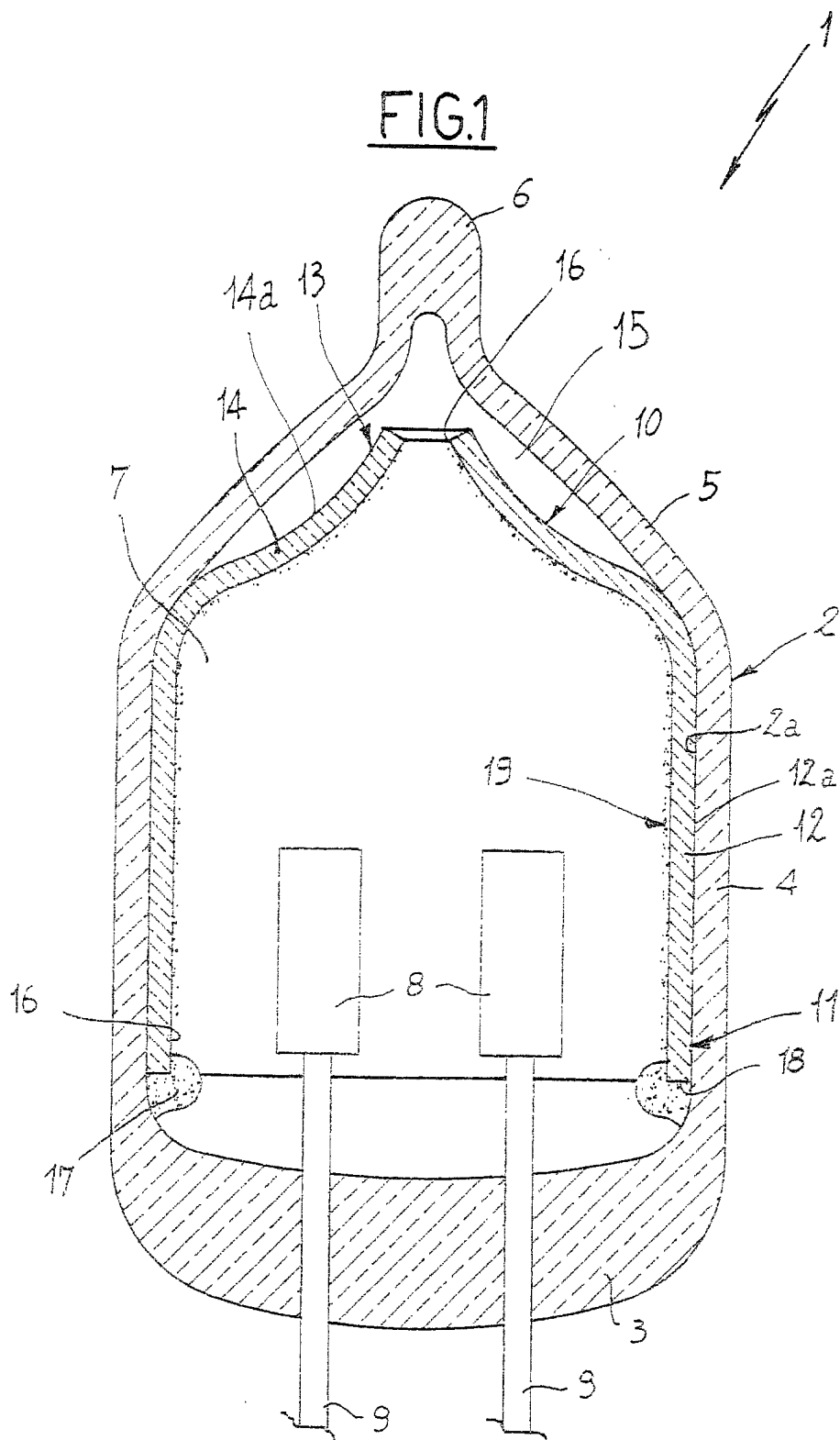
35

40

45

50

55



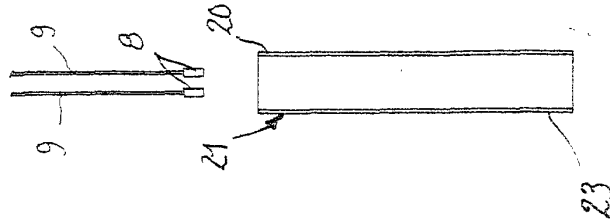


FIG. 2

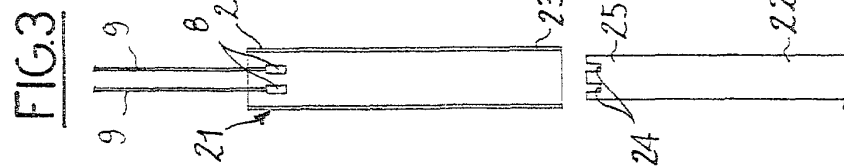


FIG. 3

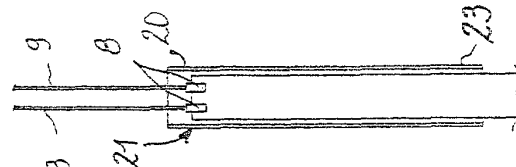


FIG. 4

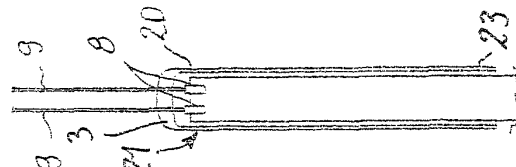


FIG. 5

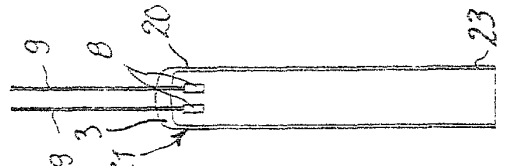


FIG. 6

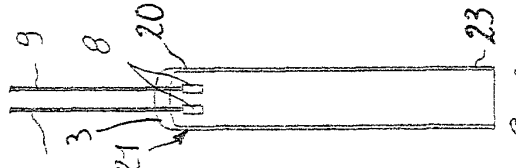


FIG. 7

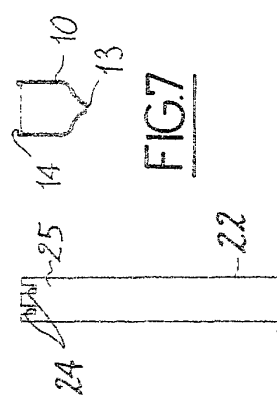


FIG. 8

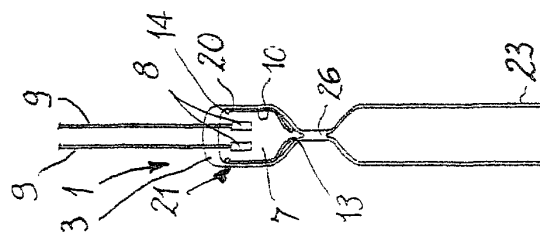


FIG. 9



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 83 0144

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 4 754 194 A (FELICIANO WILSON ET AL) 28 June 1988 (1988-06-28) * abstract; figure 2 *	1,10	H01J9/24 H01J9/22
A	EP 0 782 217 A (SIGNAL LUX SPA) 2 July 1997 (1997-07-02) * figure 2 *	1,10	
A	US 5 323 087 A (ZASLAVSKY GREGORY ET AL) 21 June 1994 (1994-06-21) * abstract; figures 2,3 *	1	
A	EP 0 369 370 A (PATRA PATENT TREUHAND) 23 May 1990 (1990-05-23) * abstract; figures *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H01J
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 1 August 2000	Examiner 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 00 83 0144

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.

01-08-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4754194 A	28-06-1988	NONE	
EP 0782217 A	02-07-1997	AT 184135 T	15-09-1999
		DE 69511880 D	07-10-1999
		DE 69511880 T	31-05-2000
		ES 2137482 T	16-12-1999
		US 5749749 A	12-05-1998
US 5323087 A	21-06-1994	CA 2109542 A	21-05-1994
		DE 69302357 D	30-05-1996
		DE 69302357 T	05-12-1996
		EP 0599581 A	01-06-1994
		US 5397259 A	14-03-1995
EP 0369370 A	23-05-1990	DE 3838697 A	17-05-1990
		DE 58907829 D	14-07-1994
		JP 2186530 A	20-07-1990
		US 5037342 A	06-08-1991

EPO FORM P0459

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