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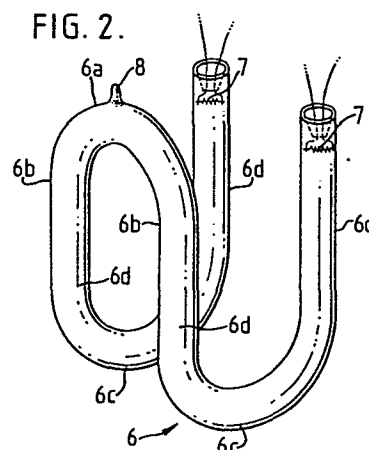
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54 **A fluorescent lamp and a method of manufacturing a fluorescent lamp.**

57 A fluorescent lamp and a method of manufacturing a fluorescent lamp are disclosed. The fluorescent lamp (5) has a winding envelope (6) which is made by bending a straight glass tube (10) into a U-shape to form a first bent part (6a) and a pair of first leg parts (6b), followed by bending each of the leg parts of the pair of first leg parts into a second U-shape to form a pair of second bent parts (6c) and two pairs of second leg parts (6d). Electrodes (7) are provided at the ends of the winding envelope. A projection (8) is provided on the first bent part, a quantity of mercury and a quantity of rare gas having been introduced into the envelope.



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A FLUORESCENT LAMP AND A METHOD OF MANUFACTURINGA FLUORESCENT LAMP

The present invention relates to a fluorescent lamp and a method of manufacturing a fluorescent
5 lamp.

Fluorescent lamps have been used as a general source of illumination for many years. A fluorescent lamp has high lighting efficiency and a low consumption of electric power in
10 comparison with an incandescent lamp and a fluorescent lamp employing a lamp base of an incandescent lamp, e.g. a screw base, has been developed. However, in order to interchange such a fluorescent lamp with a compact incandescent lamp,
15 it is necessary for the fluorescent lamp to have a folded envelope because, in order to obtain about the same brightness as with an incandescent lamp, it is necessary for the fluorescent lamp's envelope to have a certain length. Such a fluorescent lamp
20 is known, for example, from U.S. Patents Nos. 3,551,736 and 4,199,708. Such a folded or winding

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envelope is usually surrounded with a bowl or a cover. Consequently, the temperature of the fluorescent lamp rises on account of heat being retained in the bowl, the resulting heat causing
5 the lighting efficiency of the lamp to fall.

In the manufacture of such a fluorescent lamp having a folded or winding envelope, such as a U-shaped or M-shaped envelope, it has been found to be difficult to apply a uniform layer of
10 phosphor material to the winding inner surface of the envelope. For example, when a straight tube uniformly coated with phosphor material is bent into a U-shape or M-shape, the inner surface of the tube at the outside portion(s) of the bent
15 part(s) is apt to have a thin layer of phosphor material due to the extending of the tube surface. On the other hand, the inner surface of the tube at the inside(s) of the bent part(s) is apt to have a thick layer of phosphor material due to the
20 compressing of the tube surface and the excess phosphor material is apt to come off.

Conversely, when the coating is provided after the straight tube has been bent, it is also difficult to have a uniform layer of phosphor
25 material in such a winding envelope. This is because, when the extra phosphor material suspension is drained from the openings of the winding

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envelope after the coating step, some of the extra suspension is apt to remain at the bend(s) so there is apt to be a thick layer of phosphor material at the bent part(s) of the winding envelope.

According to the present invention from one aspect there is provided a fluorescent lamp comprising:

a winding envelope formed by bending a straight glass tube into substantially a U-shape , thereby forming a first bent part and a pair of first leg parts, and bending each leg part of the said pair of first leg parts into a second substantially U-shape, thereby forming a pair of second bent parts and two pairs of second leg parts;

a projection formed on the said first bent part;

a respective electrode positioned in the envelope at or adjacent each end of the envelope; and

a quantity of mercury and a quantity of rare gas in the said envelope.

According to the present invention from another aspect there is provided a method of manufacturing a fluorescent lamp which comprises a winding envelope, the method including the steps of:

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providing a straight glass tube having openings at the ends thereof;

bending the said tube into substantially a U-shape thereby forming a first bent part and
5 a pair of first leg parts and bending each leg part of the said pair of first leg parts into a second substantially U-shape thereby forming a pair of second bent parts and two pairs of second leg parts, to form the said envelope;

10 connecting an exhaust tube to the said first bent part;

providing a coating of phosphor material on the inner surface of the said winding envelope

sealably affixing a respective electrode
15 in the envelope at or adjacent each of the said openings;

evacuating the said winding envelope and introducing predetermined amounts of mercury and rare gas into the evacuated envelope through the said exhaust
20 tube; and

sealing off at the said exhaust tube to form a projection.

The present invention will now be described by way of example with reference to the accompanying
25 drawings, in which:-

Figure 1 is a perspective view of a fluorescent

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lamp device using a fluorescent lamp according to one example of this invention;

Figure 2 is a perspective view of the fluorescent lamp;

5 Figures 3a, 3b, 3c, 3d, 3e and 3f show a method of manufacturing the fluorescent lamp.

Referring to the drawings, and first to Figure 1 and Figure 2 thereof, a bowl-shaped base member 1 having a plurality of ventilating
10 holes 1' provides a conventional incandescent lamp base 2 at one end thereof and at the other end of the base member 1 there is formed a globe 3. A partition plate 4 divides the base member from the globe and defines two spaces, i.e. a
15 base member space and a globe space. Reference numeral 5 refers designates a fluorescent lamp, the latter having a compact, winding envelope 6 formed as follows. The envelope 6 is made by bending a straight glass tube into a U-shape
20 to form a first bent part 6a and a pair of first leg parts 6b, followed by the bending of each leg part of the pair of leg parts 6b into a second U-shape to form a pair of second bent parts 6c and two pairs of second leg parts 6d. The
25 thus formed envelope 6 is of a small and compact shape and may be referred to as a saddle-shaped envelope. The winding envelope 6 has a layer of

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phosphor material on the inner surface thereof.

A respective electrode 7 is mounted at each end of the envelope 6 and predetermined amounts of mercury and rare gas are sealed in the envelope 6. The envelope 6 is formed with a projection, i.e. a sealed-off tip part 8, at the first bent part 6a.

The fluorescent lamp 5 is fixed to the partition plate 4 with first bent part 6a facing the partition plate 4, the tip part 8 projecting into the base member space through a hole 4' formed in the partition plate 4.

A ballast 9 is also fixed to the partition plate 4 adjacent the fluorescent lamp 5.

In such a small and compact, winding fluorescent lamp 5, since the first bent part 6a is positioned remote from the electrodes 7, heat from the electrodes 7 is not easily transferred to the first bent part. The part 8 is formed at substantially the centre of the first bent part 6a, so that tip part 8 is at a point of symmetry of the fluorescent lamp 5. Consequently, the part 8 not only exerts no influence on the lamp characteristics, but also forms a reservoir for the condensation of extra mercury in the fluorescent lamp 5. Moreover, on account of the part

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8 having been provided as a result of an exhaust tube, it is not necessary for the electrodes 7 to employ exhaust tubes.

Using the fluorescent lamp 5, the tip part 5 8 is shielded by the partition plate 4 so that heat radiated from the fluorescent lamp and the ballast 9 is shielded by the partition plate 4. Moreover, the part 8 is exposed to open air via the ventilating holes 1' of the base member 1.

10 Consequently, the part 8 becomes the lowest temperature part of the fluorescent lamp 5. It is thus possible for the fluorescent lamp 5 to maintain high lighting efficiency in spite of relatively high surrounding temperatures such 15 as in the bowl 3. This is due to the fact that the mercury vapour pressure in the fluorescent lamp 5 is now determined by the coolest wall part of the fluorescent lamp.

In order to more effectively control the 20 mercury vapour pressure, it is preferable to provide an amalgam using indium in the part 8.

In the method of manufacture of the envelope 6, first, as shown in Figure 3a, a centre part 10a of a conventional straight glass tube 10 having 25 openings 10' is heated to a working temperature by a heater (not shown). The glass tube, made

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of soda-lime glass, has a diameter of approximately 17.5mm and has a softening point of about 700°C. Next, the straight tube 10 softened by the heater is bent into a U-shape having the first bent part 6a and the pair of first leg parts 6b as shown in Figure 3b. Then, each of the pair of leg parts 6b is heated to a working temperature and each is bent into a second U-shape in a direction perpendicular to the plane of the first U-shape to form the pair of second bent parts 6c and the two pairs of second leg parts 6d, as shown in Figure 3c.

Next, an exhaust tube 20 made of soda-lime glass is fixed to the first bent part 6a in a manner so as to point in the same direction as the openings 10', as shown in Figure 3d.

The winding envelope 6 provided with the exhaust tube 20, is then positioned with the openings 10' thereof facing upward. Then, a suspension of phosphor material is poured into the openings 10'. Following this, the envelope 6 is turned upside down so that the openings 10' face downward. Thus, excess suspension from the coating step is drained through the exhaust tube 20 and the openings 10'. Therefore, after drying the suspension of phosphor material, a uniform

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layer of phosphor material 12 is formed on the inner surface of the winding envelope 6.

Next, electrode assemblies 13 without the commonly used exhaust tubes are sealed in the openings 10', see Figure 3e.

Then, after evacuating the winding envelope 6 through the exhaust tube 20, predetermined amounts of mercury and a rare gas are introduced into the evacuated envelope through the exhaust tube 20.

Then, the exhaust tube 20 is fused together near the bent part 6a to form the tip part 8 and seal the envelope, the remainder of the tube 20 being removed. Thereby, the tip part 8 is formed at the first bent part 6a.

According to the above method, it is possible to form a uniform thickness of the layer 12 of phosphor material, by employing the exhaust tube 20 at the first bent part 6a. That is, since the position of the exhaust tube 20 is at a point of symmetry of the winding envelope 6, on draining the excess phosphor material suspension, it drains evenly from the openings 10' and the exhaust tube 20 and is prevented from collecting at the bent parts 6a and 6b.

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Moreover, by providing the exhaust tube 20
at the first bent part 6a of the winding envelope
6, it is not necessary to use an exhaust tube at
an electrode assembly, so it becomes easier to
5 manufacture the electrode assemblies.

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CLAIMS

1. A fluorescent lamp (5) comprising:

a winding envelope (6) formed by bending a straight glass tube into substantially a U-shape, thereby forming a first bent part (6a) and a pair of first leg parts (6b) and bending each leg part of the said pair of first leg parts (6b) into a second substantially U-shape, thereby forming a pair of second bent parts (6c) and two pairs of second leg parts (6d);

a projection (8) formed on the said first bent part (6a) ;

a respective electrode (7) positioned in the envelope (6) at or adjacent each end of the envelope (6); and

a quantity of mercury and a quantity of rare gas in the said envelope (6).

2. A fluorescent lamp according to claim 1, wherein the said first bent part (6a) is at a distance from the said electrodes (7).

3. A fluorescent lamp according to claim 2, wherein the said projection (8) is located substantially at the centre of the said first bent part (6a).

4. A fluorescent lamp according to claim 3, wherein the said projection (8) is substantially on an axis of symmetry of the said envelope (6).

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5. A fluorescent lamp according to either of claims 3 and 4, wherein the said electrodes (7) are not provided with exhaust tubes.

6. A fluorescent lamp according to any of claims 3 to 5, wherein the said projection (8) comprises a sealed tip part provided from an exhaust tube (20) used during manufacture of the lamp.

7. A fluorescent lamp according to any of claims 3 to 6, wherein the said projection (8) contains an amalgam.

8. A fluorescent lamp according to claim 7, wherein the said amalgam comprises indium.

9. A method of manufacturing a fluorescent lamp (5) which comprises a winding envelope (6), the method including the steps of:

providing a straight glass tube (10) having openings (10') at the ends thereof;

bending the said tube (10) into substantially a U-shape thereby forming a first bent part (6a) and a pair of first leg parts (6b) and bending each leg part of the said pair of first leg parts (6b) into a second substantially U-shape thereby forming a pair of second bent parts (6c) and two pairs of second leg parts (6d), to form the said envelope;

connecting an exhaust tube (20) to the said first bent part;

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providing a coating (12) of phosphor material on the inner surface of the said winding envelope (6);

sealably affixing a respective electrode (7) in the envelope (6) at or adjacent each of the said openings (10');

evacuating the said winding envelope (6) and introducing predetermined amounts of mercury and rare gas into the evacuated envelope through the said exhaust tube (20); and

sealing off at the said exhaust tube (20) to form a projection.

10. A method according to claim 9, wherein the said exhaust tube (20) is connected so as to extend in the same direction as the said second leg parts (6d) of the said winding envelope (6).

11. A method according to claim 10 or 11, wherein the said coating (12) is provided after the bending operations are performed.

12. A method according to claim 11, wherein the coating step further comprises:

positioning the said openings (10') of the winding envelope (6) to face upward;

pouring a suspension of phosphor material into the said openings (10'); and

turning the said winding envelope (6) upside down and draining excess suspension from the said openings (10') and from the said exhaust tube (20).

FIG. 1.

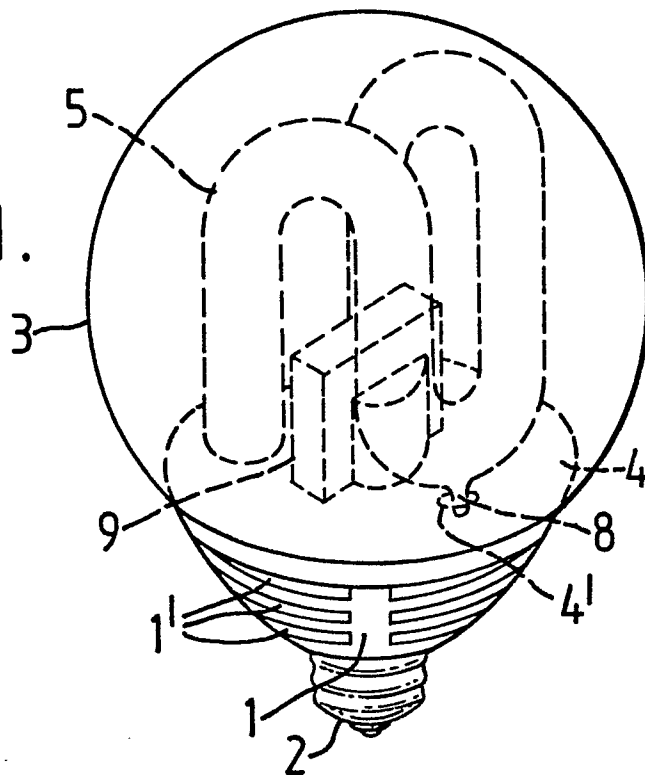
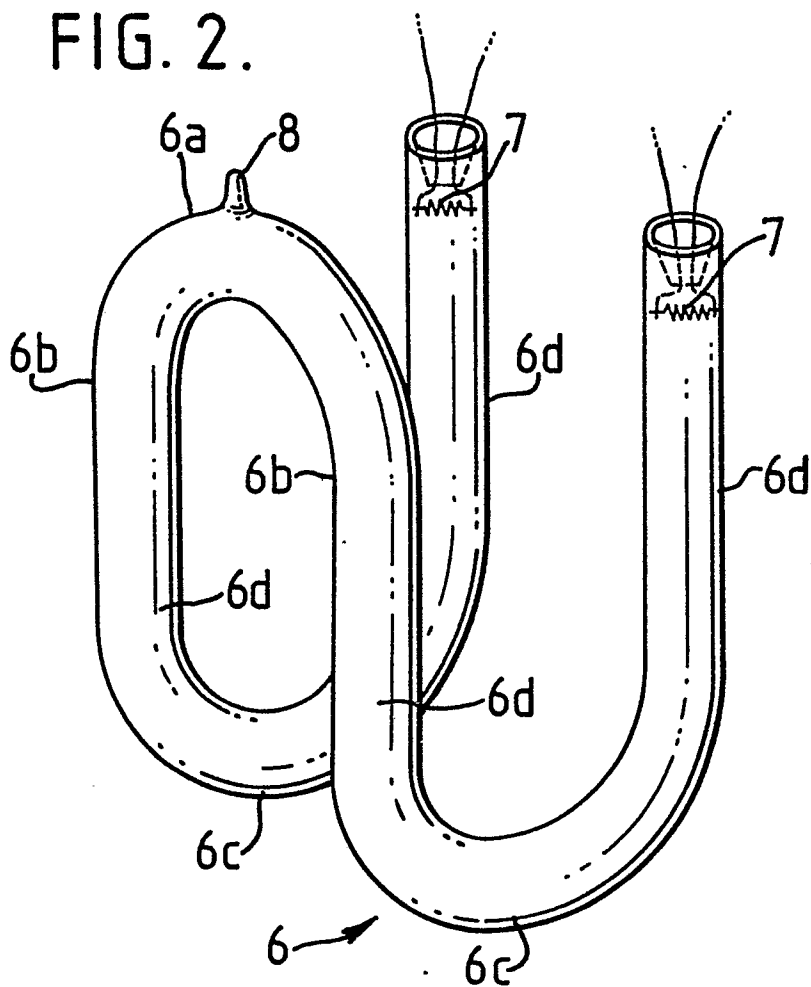
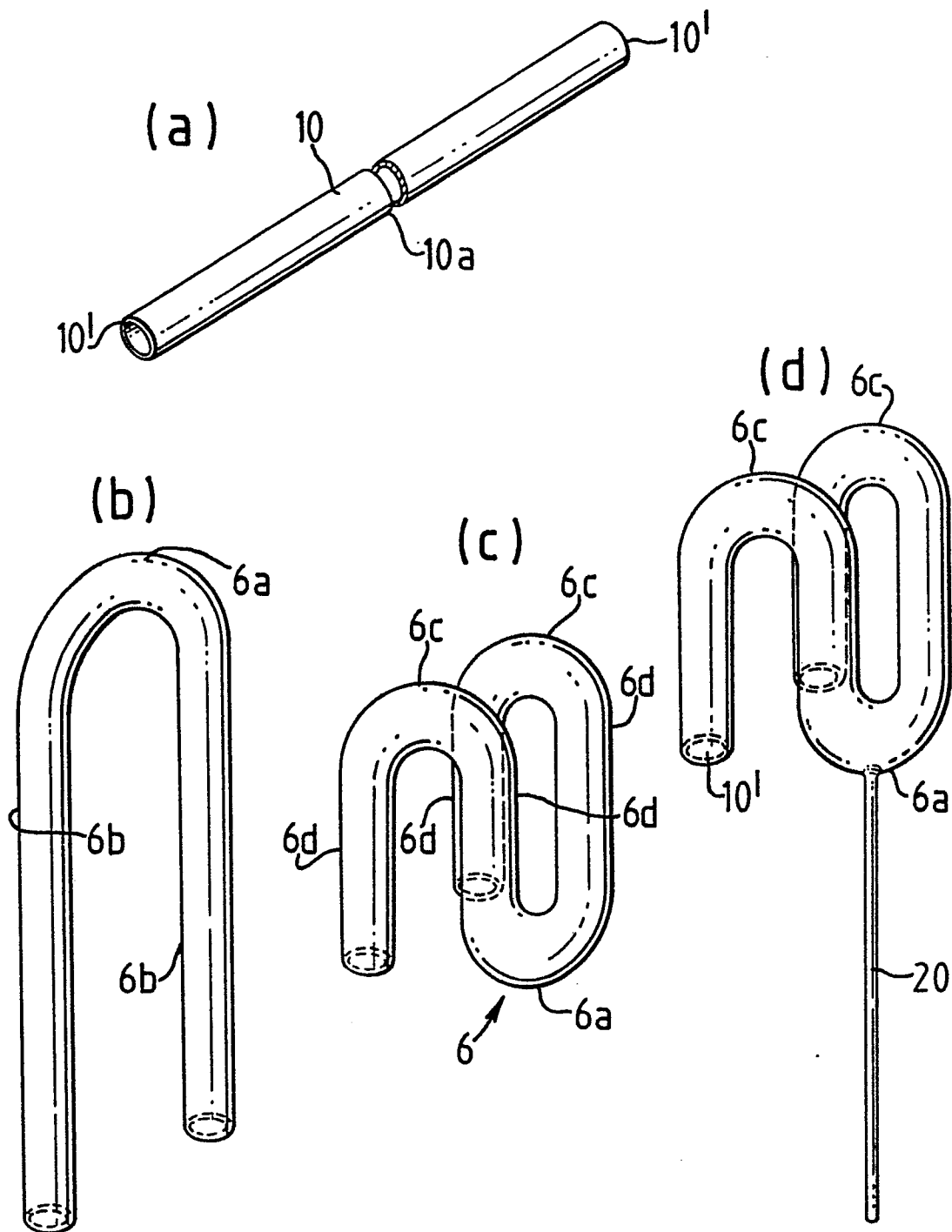


FIG. 2.



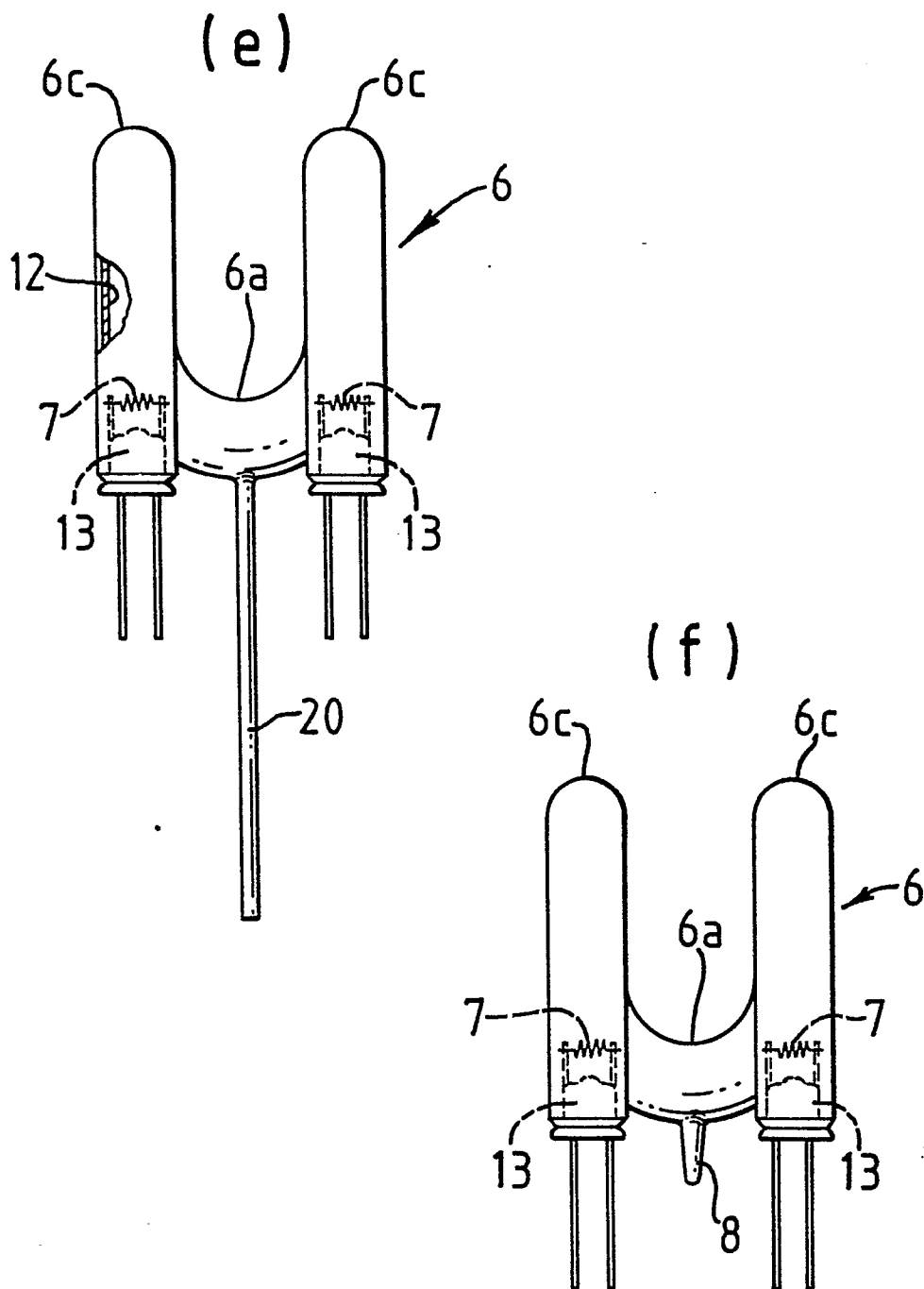
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FIG. 3.



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FIG. 3.





European Patent
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EUROPEAN SEARCH REPORT

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Application number

EP 81301574.0

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	<u>GB - A - 2 033 653 (PHILIPS)</u> * Abstract; fig.; page 1, lines 5-64; page 2, claim 1* --	1-3,5,6	H 01 J 61/30
	<u>EP - A1 - 0 000 966 (PHILIPS)</u> * Fig. 1; page 4, lines 24,25 * --	1	
	<u>GB - A - 1 503 636 (PHILIPS ELECTRONIC)</u> * Page 1, lines 56-85 * --	7,8	TECHNICAL FIELDS SEARCHED (Int. Cl.)
	<u>GB - A - 668 259 (THOMSON-HOUSTON)</u> * Page 1, lines 10-45; page 2, lines 41-59 * --	1,9	H 01 J 61/00 H 01 J 9/00 H 05 B 41/00
	<u>GB - A - 1 068 704 (PHILIPS ELECTRONIC)</u> * Page 1, lines 53-60; fig. 1 * --	6,10	
	<u>US - A - 3 152 278 (DZIERGWA)</u> * Page 1, lines 47,48 * --	7,8	CATEGORY OF CITED DOCUMENTS
D,A	<u>US - A - 4 199 708 (LAUWERIJSSSEN)</u> * Totality * --		X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
D,A	<u>US - A - 3 551 736 (DOEHNER)</u> * Totality * ----		
X	The present search report has been drawn up for all claims		&: member of the same patent family, corresponding document
Place of search		Date of completion of the search	Examiner
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