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

(11) EP 1 391 913 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
25.02.2004 Bulletin 2004/09

(51) Int Cl.[7]: **H01J 61/28**, H01J 61/72, H01J 65/04, H01J 9/395

(21) Application number: **03016255.6**

(22) Date of filing: **17.07.2003**

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

(30) Priority: **22.08.2002 US 225718**
23.08.2002 US 226556
29.08.2002 US 230621

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

(72) Inventors:
- **Cleary, Louise D.**
  Salem MA 01970 (US)
- **Lester, Joseph E.**
  Lincoln, MA 017736 (US)
- **Lima, Joseph V.**
  Salem, MA 01970 (US)
- **Speer, Richard S.**
  Concord, MA 01742 (US)

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

(54) Fluorescent lamp and amalgam assembly therefor

(57) An amalgam assembly for a fluorescent lamp includes a glass exhaust tubulation extending toward a base portion of the lamp, the tubulation being closed at an end thereof adjacent the lamp base portion, and a retaining structure disposed in the tubulation and retained by a pinched portion of the tubulation. A mercury amalgam body is disposed in the tubulation between the retaining structure and the tubulation closed end. The amalgam body includes means for wetting internal surfaces of the glass tubulation to cause the amalgam to adhere to the tubulation internal surfaces when the amalgam body is liquidized, and to thereby prevent the amalgam from flowing past the retaining structure and into the lamp envelope.

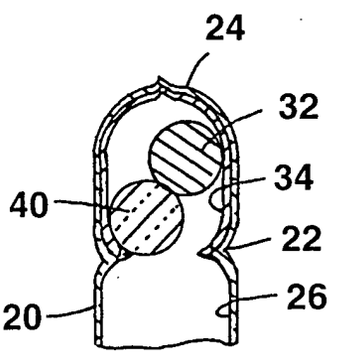

FIG. 3

EP 1 391 913 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] This invention relates to fluorescent lamps and is directed more particularly to an amalgam assembly, and more particularly including an improved amalgam for use within an exhaust tubulation of a fluorescent lamp, and to a fluorescent lamp including the amalgam assembly. The fluorescent lamp may be for example linear, or compact, and with or without electrodes.

2. Description of the Prior Art

[0002] The light output of fluorescent lamps is critically dependent upon mercury vapor pressure (vapor density) within the lamp envelope. The mercury vapor pressure, in turn, is controlled by the temperature of excess liquid mercury which condenses in the coldest part of the lamp envelope, the so-called "cold spot". Fluorescent lamps typically include at least one tubulation that has an opening into the interior of the lamp envelope and which, in construction of the lamp, is used as an exhaust and fill tubulation. At completion of manufacture, the exhaust tubulation is hermetically tipped off and the tipped end typically becomes the lamp "cold spot".

[0003] The amalgam is commonly located in the exhaust tubulation cold spot. Such amalgams reduce the mercury vapor pressure relative to that of pure mercury at any given temperature and thereby permit optimum light output at elevated temperatures. Such amalgams also provide a broadened peak in the light output versus temperature curve, so that near optimum light output is obtained over an extended range of ambient temperatures.

[0004] When lamps are operated at temperatures lower or higher than the optimum ambient temperature, light output decreases by as much as 30% or more relative to peak value. This is a common occurrence when lamps are operated in enclosed or semi-enclosed fixtures. In addition to reduced light output, the color of the light varies as a result of the varying contribution of blue spectral emission from the mercury vapor in the discharge.

[0005] The problem of mercury vapor pressure control under varying temperature conditions is solved, at least in part, through the use of various alloys capable of absorbing mercury from its gaseous phase. Alloys of low temperature melting metals are often placed within fluorescent lamps to amalgamate with the excess mercury, and to regulate the mercury vapor pressure within the lamp. Alloys known to be particularly useful in forming amalgams with mercury include a lead-bismuth-tin alloy, a bismuth-indium alloy, a bismuth and tin alloy, and a zinc, indium and tin alloy, see for example WO 96/37909 and EP 373 567. Other useful amalgams may be formed with pure indium, pure lead, and pure zinc.

[0006] The lamp typically is provided with an excess amount of mercury amalgam, that is, more amalgam than is needed to supply the mercury vaporized when the lamp reaches a stabilized operating condition. As the lamp ages, some of the excess amalgam is required to replace the mercury chemically bound elsewhere in the lamp during the life of the lamp.

[0007] When an amalgam fluorescent lamp is turned off, the amalgam cools and the mercury vapor within the lamp is gradually absorbed into the amalgam. When the lamp is turned on, the lumen output is significantly reduced until the amalgam is warmed up to a point at which the amalgam emits sufficient mercury vapor to permit efficient lamp operation.

[0008] In some types of lamps, particularly electrodeless fluorescent lamps or compact electroded fluorescent lamps, it is important that the amalgam be prevented from settling within the arc environment in the lamp envelope where the amalgam can cause deleterious changes in the lumen output and the lumen-temperature performance of the lamp.

[0009] In base-up lamps, there has been a particular problem in that, in use, the sealed end of the tubulation is pointed upwardly and the end of the tubulation that opens into the lamp envelope is disposed downwardly of the amalgam, and the amalgam has tended to drop by gravity downwardly into the lamp envelope, where a much higher temperature is present, causing a sudden rise in mercury vapor pressure and an increase in lamp voltage, resulting in the occurrence of black spots on the glass envelope. If the lamp voltage exceeds the maximum sustaining voltage of the ballast provided in the lamp, the lamp extinguishes. There is thus required a means for retaining liquid amalgam in the tubulation, but permitting mercury vapor to exit the tubulation and flow into the lamp envelope.

[0010] Accordingly, there is a need for an amalgam assembly including an improved amalgam and/or an improved amalgam retaining means or retainer, for limiting the amalgam to the tubulation sealed end region. There is further a need for a fluorescent lamp provided with such an amalgam assembly and/or amalgam retention means. Such retention means are disclosed for example in US-A 5 757 129 including the prior art cited therein.

SUMMARY OF THE INVENTION

[0011] An object of the invention is, therefore, to provide an amalgam assembly featuring an improved amalgam for disposition in an exhaust tubulation of a fluorescent lamp to prevent migration of liquid amalgam into the lamp envelope.

[0012] A further object of the invention is to provide an electrodeless fluorescent lamp having therein an amalgam assembly featuring an improved amalgam and/or an improved amalgam retention means in the ex-

haust tubulation.

[0013] With the above and other objects in view, as will hereinafter appear, a feature of the present invention is the provision of an amalgam assembly for a fluorescent lamp as outlined in the characterizing part if claim 1. Preferred embdoimetns are given in the dependent claims.

The assembly comprises a glass exhaust tubulation, typically extending toward a base portion of the lamp, the tubulation being closed at an end thereof, typically adjacent the lamp base portion, and a retaining structure disposed in the tubulation, preferably a retaining structure being a pinched portion of the tubulation.

A mercury amalgam body is disposed in the tubulation between the retaining structure and the tubulation closed end, the amalgam body including a means for wetting internal surfaces of the glass tubulation to cause the amalgam to adhere to tubulation internal surfaces when the amalgam body is liquidized, and to thereby prevent the amalgam body from flowing past the retaining structure and into the interior of the lamp envelope. In a preferred embodiment the wetting means is lithium which is used for wetting internal surfaces of the glass tubulation to cause the amalgam to adhere to tubulation internal surfaces when the amalgam body is liquidized, and to thereby prevent the amalgam body from flowing past the retaining structure and into the lamp envelope.

[0014] In accordance with a further feature of the invention, there is provided an amalgam assembly for a fluorescent lamp. The assembly comprises a glass exhaust tubulation extending toward a base portion of the lamp, the tubulation being closed at an end thereof adjacent the lamp base portion, and a layer of metal containing lithium adhered to an inside surface of the exhaust tubulation to act as an wetting agent. A mercury amalgam body is disposed in the tubulation between the tubulation closed end and a pinched portion of the tubulation. Upon liquidizing of the amalgam body, the liquid amalgam adheres to the layer, to thereby prevent the amalgam from flowing past the tubulation pinched portion and into the lamp envelope.

[0015] In accordance with a still further feature of the invention, there is provided a special embodiment of a electrodeless fluorescent lamp assembly comprising a light-transmissive envelope containing an ionizable, gaseous fill for sustaining an arc discharge when subjected to a radio frequency magnetic field and for emitting ultraviolet radiation as a result thereof, the envelope having typically an interior phosphor coating for emitting visible radiation when excited by the ultraviolet radiation - of course the assembly is also usable for mercury low pressure lamps without a fluorescent phosphor-, and the envelope having typically a re-entrant cavity formed therein. An excitation coil is contained within the re-entrant cavity for providing the radio frequency magnetic field when excited by a radio frequency power supply. A glass exhaust tubulation extends through the re-entrant cavity and into the envelope, the exhaust tubulation having a closed end proximate a base portion of the lamp. A pinched configuration is formed in the exhaust tubulation at a predetermined distance from the tubulation closed end, and a retaining structure is disposed in the tubulation and retained by the pinched configuration. A mercury amalgam body is disposed in the tubulation between the retaining structure and tubulation closed end, the amalgam body including lithium for wetting internal surfaces of the glass tubulation touched by the amalgam to cause the amalgam to adhere to the tubulation internal surfaces when the amalgam body is liquidized and to thereby prevent the amalgam body from flowing past the retaining structure and into the lamp envelope.

[0016] In accordance with still another feature of the invention, there is provided an electrodeless fluorescent lamp assembly comprising a light-transmissive envelope containing an ionizable, gaseous fill for sustaining an arc discharge when subjected to a radio frequency magnetic field and for emitting ultraviolet radiation as a result thereof, the envelope having an interior phosphor coating for emitting visible radiation when excited by the ultraviolet radiation, and the envelope having a re-entrant cavity formed therein. An excitation coil is contained within the re-entrant cavity for providing the radio frequency magnetic field when excited by a radio frequency power supply. A glass exhaust tubulation extends through the re-entrant cavity and into the envelope, the exhaust tubulation having a closed end proximate a base portion of the lamp. A pinched configuration is formed in the exhaust tubulation at a predetermined distance from the tubulation closed end, and a retaining structure is disposed in the tubulation and retained by the pinched configuration. A mercury amalgam body is disposed in the tubulation between the retaining structure and tubulation closed end, and a layer of metal containing lithium is adhered to an inside surface of the exhaust tubulation, wherein upon liquidizing of the amalgam body, the liquid amalgam adheres to the layer, to thereby prevent the amalgam from flowing past the retaining structure and into the lamp envelope.

[0017] 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 devices embodying the invention are shown by way of illustration only and not as limitations 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.

[0018] A further embodiment of the present invention is the provision of an amalgam assembly which comprises a glass exhaust tubulation extending toward a base portion of the lamp, the tubulation being closed at an end adjacent the base portion and a metal cup is disposed in the tubulation and is retained by a ,preferably pinched, portion of the tubulation. The cup defines an

annular outer wall having a free edge extending toward the tubulation closed end, a tubular central core portion extending toward the tubulation closed end, and an annular trough formed by the core portion and the outer wall. A mercury amalgam ball is disposed between the metal cup and the tubulation closed end, a diameter of the ball exceeding an inner diameter of the core portion, and a coating of a metal wetting agent is disposed on interior surfaces of the trough. When the amalgam body liquidizes, the liquid amalgam adheres to the cup trough surfaces and mercury vapor is flowable through the cup core portion.

[0019] In accordance with a further feature of the invention, there is provided an electrodeless fluorescent lamp comprising a light-transmissive envelope containing an ionizable, gaseous fill for sustaining an arc discharge when subjected to a radio frequency magnetic field and for emitting ultraviolet radiation as a result thereof. The envelope is provided with an interior phosphor coating for emitting visible radiation when excited by the ultraviolet radiation, and with a re-entrant cavity formed therein. An excitation coil is contained within the re-entrant cavity for providing the radio frequency magnetic field when excited by a radio frequency power supply. An exhaust tubulation extends through the re-entrant cavity and into the envelope for evacuating and filling the lamp in manufacture, the exhaust tubulation extending toward a base portion of the lamp and having a closed end proximate the lamp base portion. A dimple configuration is formed in the exhaust tubulation at a predetermined distance from the tubulation closed end. A metal cup retains an amalgam in a location in the exhaust tubulation between the metal cup and the closed end of the exhaust tubulation, the metal cup defining an annular wall having a free edge extending toward the exhaust tubulation closed end, a tubular central core portion extending toward the exhaust tubulation closed end, and an annular trough formed by the core portion and the outer wall. A coating of a metal wetting agent is disposed on interior surfaces of the trough. When the amalgam body liquidizes, the liquid amalgam adheres to the cup trough surfaces and mercury vapor is flowable through the cup core portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Reference is made to the accompanying drawings in which are shown illustrative embodiments of the invention, from which its novel features and advantages will be apparent.

[0021] In the drawings:

FIG. 1 is an elevational broken-away and partly sectional view of a prior art electrodeless fluorescent lamp (fig. 1a) and a prior art compact fluorescent lamp (fig. 1b);

FIG. 2 is a diagrammatic sectional illustration of an improved amalgam assembly for preventing movement of liquid amalgam into a lamp of the type shown in FIG. 1 from the preferred amalgam location; and

FIG. 3 is similar to FIG. 2 but illustrative of an alternative embodiment.

FIG. 4 is a perspective view of an improved retainer for preventing movement of liquid amalgam from the preferred amalgam location in a lamp of the type shown in FIG. 1;

FIG. 5 is a diagrammatic illustration of the retainer of FIG. 4 disposed in an exhaust tubulation portion of a fluorescent lamp of the type shown in FIG. 1; and

FIG. 6 is similar to FIG. 5, but illustrative of an alternative embodiment.

FIG. 7 is a diagrammatic illustration of an improved amalgam assembly for preventing movement of liquid amalgam in a lamp of the type shown in FIG. 1 from the preferred amalgam location;

FIG. 8 is similar to FIG. 7, but illustrative of the amalgam of FIG 7 after liquidizing thereof;

FIG. 9 is similar to FIG. 7, but illustrative of an alternative embodiment of amalgam assembly; and

FIG. 10 is similar to FIG. 9, but illustrative of the amalgam of FIG. 9 after liquidizing thereof.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0022] Referring to FIG. 1a it will be seen that a known base-up compact fluorescent lamp 10 is provided with a light-transmissive envelope 12 containing an ionizable gaseous fill for sustaining an arc discharge. In manufacture, the lamp 10 is dosed with the fill via an exhaust tubulation 20 having an inside surface 26 in well-known manner. A suitable fill, for example, comprises a mixture of a rare gas (e.g., krypton and/or argon) and mercury vapor. This is an electrodeless configuration. An excitation coil 14 is situated within, and removable from, a re-entrant cavity 16 within the envelope 12. For purposes of illustration, the coil 14 is shown schematically as being wound about the exhaust tubulation 20. However, the coil 14 may be spaced apart from the exhaust tubulation 20 and wound about a core of insulating material (not shown), or may be free standing (not shown), as desired. The interior surfaces of the envelope 12 are coated in well-known manner with a suitable phosphor 18. The envelope 12 fits into one end of a base assembly 17 containing a radio frequency power supply (not shown) with a standard (e.g., Edison type) lamp base 19. A similar concept of prior art showing al lamp with electrodes is shown in fig. 1b.

[0023] A mercury amalgam body 32 is placed and retained in a location optimized for the particular amalgam in a particular lamp. Each amalgam has its own optimum range of operating temperatures to provide a suitable mercury vapor pressure.

[0024] A retaining means, for example an indentation, or dimple, 22 is situated toward a tip-off region of the

exhaust tubulation 20. The tip-off region is the area at the top of the exhaust tubulation which is sealed, or "tipped off" to form the closed end 24 of the exhaust tubulation after evacuating and filling the lamp therethrough.

[0025] After the lamp is evacuated and filled through the exhaust tubulation 20, an appropriately sized and shaped dose locating member, preferably comprising at least one (or several) glass ball 40, is inserted into the exhaust tubulation 20 through the opening at the tip-off region. By virtue of the presence of the dimple 22 and the size and shape of glass ball 40, the dose locating member remains on the side of the dimple away from the re-entrant cavity 16. The amalgam 32 is then inserted into the exhaust tubulation 20 through the opening in the tip-off region. The combination of dimple 22 and glass ball 40 results in placement and retention of the amalgam 32 at a predetermined location. As noted above, the exhaust tubulation is tipped-off above the amalgam 32 to provide the tubulation closed end 24.

[0026] In operation, current flows in the coil 14 as a result of excitation by the radio frequency power supply. A radio frequency magnetic field is thereby established within the envelope 12 which ionizes and excites the gaseous fill contained therein, resulting in a toroidal discharge 23 and emitting ultraviolet radiation therefrom. The phosphor 18 absorbs the ultraviolet radiation and emits visible radiation.

[0027] Referring to FIG. 2, it will be seen that in accordance with the present invention there is provided an amalgam retaining structure comprising one or more glass balls 40 disposed in the glass tubulation 20 and retained by at least one pinched portion 22 of the tubulation. The mercury amalgam body 32 is disposed between the glass balls 40 and the exhaust tubulation closed end 24, as shown in FIG. 2.

[0028] The amalgam body 32 is generally spherically shaped, when in a solid state, and, in accordance with one embodiment of the invention, is provided with a lithium component. The lithium provides the amalgam, when liquidized, with the property of wetting the glass tubulation 20, especially the inside surface 26, and the glass balls 40. When the liquid amalgam is wetted to the glass, that is, adhered to the glass, the amalgam is prevented from flowing past the glass balls 40 disposed in the tubulation 20 and thereby prevented from entering the lamp envelope 12.

[0029] In accordance with an alternative embodiment of the invention, a layer 34 of a metal alloy including a lithium component is coated on an inside surface 26 of the exhaust tubulation 20 (FIG. 3) between the tubulation closed end 24 and the pinched portion 22 of the tubulation, that is, in the area of the amalgam body 32. The presence of the lithium alloy layer 34 causes the amalgam, when liquidized, to wet, or adhere, to the lithium alloy layer, preventing the liquid amalgam from flowing past the retaining structure 40 and into the lamp envelope 12.

[0030] In the embodiment shown in FIG. 3, the metal layer 34 is adhered to the tubulation inside surface 26 during manufacture of the tubulation. In operation of the lamp 10, the liquid amalgam adheres to the layer 34, to prevent the amalgam from flowing by gravity into the lamp envelope 12.

[0031] It has been found, that in base-up lamps the glass ball type of locating member 40 sometimes fails to retain liquidized amalgam in the upper region of the tubulation. As noted hereinabove, escape of the amalgam from the tubulation closed end region and into the envelope can lead to lamp failure.

[0032] Referring to FIG. 4, it will be seen that in accordance with a further embodiment of the present invention there is provided an amalgam retainer comprising a metal cup 140 disposed in the glass tubulation 20 (FIG. 5) and retained by at least one pinched portion 22 of the tubulation.

[0033] The cup 140 defines an annular outer wall 142 having a free edge 144 extending toward the tubulation closed end 24. The cup 140 further defines a tubular central core portion 146 extending toward the tubulation closed end 24. The core portion 146 is provided with a free edge 147 which extends toward the tubulation closed end 24 further than the cup outer wall free edge 144. An annular trough 148 is formed by the core portion 146 and the outer wall 142.

[0034] The cup 140 is provided with a coating of metal wetting agent disposed on surfaces of the trough 148 opposed to the tubulation closed end 24. Appropriate coatings to serve as wetting agents include silver and indium. The cup 140 fits snugly in the tubulation and the peripheral outer walls 142 of the cup 140 engage the inner walls of the tubulation. Preferably, the metal cup 140 exhibits a leaf spring like quality, the walls 142 being thereby biased into engagement with the tubulation inner walls. Stainless steel and iron-nickel alloys have been found to be suitable materials for the cup 140.

[0035] The mercury amalgam body 32 is disposed between the metal cup 140 and the exhaust tubulation closed end 24, as shown in FIG. 5. The amalgam body 32 is generally spherically shaped and provided with a diameter exceeding the inside diameter of the core portion 146 of the cup 140.

[0036] When the lamp is completed and placed in operation, the amalgam body 32 liquidizes and is attracted to the cup trough 148 by the wetting agent therein. Thus, the liquid amalgam occupies the trough in an annular arrangement, while mercury vapor is allowed to pass through the cup core portion.

[0037] Referring to FIG. 6, it will be seen that the metal cup 140 may be used in combination with one or more glass balls 40, such that the glass ball 40 serves its usual function of retaining the liquid amalgam but is, in effect, "backed up" by the metal cup 140 which attracts and retains any amalgam that gets by the glass ball.

Referring once again to FIG. 1, it has been found that the while the combination of tubulation pinched portion

22 and glass balls 40 serves to retain the amalgam at the closed end of the tubulation most of the time, there are occasions when the liquid amalgam finds its way around the glass balls and into the lamp envelope, causing malfunction and/or failure of the lamp.

[0038] In accordance with a further embodiment of the invention, a layer 226 of a metallic mercury wetting agent is disposed on an inside surface 228 of the tubulation 20 in an area between the pinched portion 22 and the closed end 24 of the tubulation. The wetting agent layer 226 may be of indium or silver or gold, or alloys having at least one of such metals as a component thereof. The wetting agent layer 226 may be disposed in a band 230, as shown in FIG. 7.

[0039] When the amalgam body 32 in a base-up lamp is liquidized, the liquid amalgam tends to flow downwardly and, on occasion flows around the glass body or bodies 40 resulting in patches 232 on the surface 234 of the bodies 40 and into the lamp envelope 12. However, with the wetting agent band 30 in place, the liquid amalgam is attracted to, and adheres to, the band 30 (FIG. 8) and is thereby prevented from moving further towards the lamp envelope 12.

[0040] Referring to FIG. 9, it will be seen that in an alternative embodiment the metallic mercury wetting agent is disposed on the surface 234 of the glass body or bodies 40 disposed in the tubulation 20. When the amalgam liquidizies, it is attracted to the glass bodies 40 and as an unstructered cluster 233 attaches thereto (FIG. 10), rather than flowing around the glass bodies and toward the lamp envelope.

[0041] It will be understood that many additional changes in the details, materials, and arrangement of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principles and scope of the invention as expressed in the appended claims.

Claims

1. An amalgam assembly for a mercury low-pressure lamp, preferably a fluorescent lamp, the assembly comprising:

   a glass exhaust tubulation being connected to an envelope portion of the lamp, said tubulation being closed at one end thereof; and having an opening into the interior of the envelope;

   characterized in:

   a retaining structure disposed in said tubulation; and

   a mercury amalgam body disposed in said tubulation between said retaining structure and the tubulation closed end,

   said amalgam assembly comprising a means for wetting internal surfaces within said glass tubulation to cause said amalgam to adhere to said tubulation internal surfaces when said amalgam body is liquidized and to thereby prevent said amalgam from flowing past said retaining structure and into the interior of the envelope.

2. An amalgam assembly for a fluorescent lamp in accordance with claim 1, wherein said mercury amalgam body (32), which is disposed in said tubulation (20) between said retaining structure (22) and the tubulation closed end (24), is including lithium for wetting internal surfaces of said glass tubulation to cause said amalgam to adhere to the tubulation internal surfaces when said amalgam body is liquidized and to thereby prevent said amalgam from flowing past said retaining structure and into the lamp envelope.

3. The amalgam assembly in accordance with claim 2 wherein said amalgam body comprises an alloy composition selected from a group of alloy compositions consisting of (i) bismuth and indium and lithium, (ii) bismuth and tin and lead and lithium, (iii) bismuth and tin and lithium, (iv) zinc and indium and tin and lithium, (v) indium and lithium, (vi) lead and lithium, and (vii) zinc and lithium.

4. The amalgam assembly in accordance with claim 2 wherein said retaining structure comprises at least one glass body, and wherein the lithium causes said amalgam to wet the glass body to cause the amalgam to adhere further to the glass body when said amalgam body is liquidized, to further prevent said amalgam from flowing into the lamp envelope.

5. The amalgam assembly in accordance with claim 1 wherein said amalgam body is spherically or cylindrically shaped when in a solid state.

6. The amalgam assembly in accordance with claim 1 wherein said retaining structure comprises a pinched portion (22) of said tubulation

7. The amalgam assembly in accordance with claim 1 wherein said wetting means is a layer of metal containing lithium adhered to an inside surface of said exhaust tubulation between the tubulation closed end and the retaining structure;
   wherein upon liquidizing of said amalgam body, the liquid amalgam adheres to said layer, to thereby prevent the amalgam from flowing past the retaining structure and into the lamp envelope.

8. The amalgam assembly in accordance with claim 7, further comprising a retaining member disposed in said tubulation between a tubulation pinched portion as retaining structure and said amalgam body.

9. The amalgam assembly in accordance with claim 8 wherein said retaining member comprises a glass body or a metal body, which is preferably spherically shaped.

10. The amalgam assembly in accordance with claim 1, wherein said wetting means is a two-part structure, with a metal cup being disposed, as a first part of said wetting means, in said tubulation and retained by said retaining structure of said tubulation, said cup defining a trough open towards the tubulation closed end and an aperture extending through said cup; wherein said mercury amalgam body is disposed in said tubulation between said metal cup and the tubulation closed end; and a coating of a metal wetting agent, as a second part of said wetting means, is disposed on surfaces of the trough opposed to the tubulation closed end;
whereby when said amalgam body liquidizes, the liquid amalgam adheres to the cup trough surfaces and mercury vapor is flowable through the cup aperture.

11. The amalgam assembly in accordance with claim 10 wherein said metal cup snugly fits in said tubulation and peripheral walls of said cup are engaged with interior walls of said tubulation.

12. The amalgam assembly in accordance with claim 11 wherein said cup is of a metal having sufficient springiness to bias the cup peripheral walls against the interior walls of the tubulation.

13. The amalgam assembly in accordance with claim 12 wherein said cup is of a metal selected from (i) stainless steel and (ii) iron-nickel alloy.

14. The amalgam assembly in accordance with claim 10 wherein said cup trough comprises an annular trough defined by a cup outer wall having a free edge extending toward the tubulation closed end, and by a cup tubular central core portion defining the aperture and extending toward the tubulation closed end.

15. The amalgam assembly in accordance with claim 10 wherein said amalgam body is generally spherically shaped and is provided with a diameter exceeding an inner diameter of the core portion aperture.

16. The amalgam assembly in accordance with claim 10 wherein the metal wetting agent comprises a selected one of (i) silver and (ii) indium.

17. The amalgam assembly in accordance with claim 14 wherein said cup core portion extends closer to the tubulation closed end than does the cup outer wall.

18. The amalgam assembly in accordance with claim 10, said assembly comprising a metal cup disposed in said tubulation and retained by a pinched portion of said tubulation, said cup defining an annular outer wall having a free edge extending toward the tubulation closed end, a tubular central core portion extending toward the tubulation closed end, and an annular trough formed by said core portion and the outer wall;

a mercury amalgam ball disposed between said metal cup and the tubulation closed end, a diameter of said ball exceeding an inner diameter of said core portion; and

a coating of a metal wetting agent disposed on interior surfaces of said trough;

whereby when said amalgam body liquidizes, the liquid amalgam adheres to the wetting agent in the cup trough and mercury vapor is flowable through the cup core portion.

19. The amalgam assembly in accordance with claim 10 and further comprising a glass ball disposed in said tubulation between said metal cup and the tubulation closed end.

20. The amalgam assembly in accordance with claim 1, further comprising a glass body disposed in said tubulation and retained by said retaining structure, pref. a pinched portion of said tubulation, said glass body being disposed between said retaining structure of said tubulation and the closed end of said tubulation;

said mercury amalgam body disposed between the glass body and the closed end of said tubulation; and
a mercury wetting metallic layer disposed, as a wetting means, on a selected one of (i) an inside surface of said tubulation between the pinched portion and the closed end of said tubulation, and (ii) a surface of said glass body;

whereby to wet at least one of (i) an interior surface of said glass tubulation and (ii) the surface of said glass body, to prevent liquid amalgam from flowing past the tubulation pinched portion and into the lamp envelope.

21. The amalgam assembly in accordance with claim 20 wherein said mercury wetting metallic layer is of a selected one of silver, gold, and indium, and alloys thereof, respectively.

22. The amalgam assembly in accordance with claim 20 wherein said amalgam body is generally spheroid in configuration prior to liquidizing thereof and wherein said glass body is of a spheroid configuration, and further comprising a second glass spheroid disposed between the reatining strucuture, pref. a pinched portion, of said tubulation and said amalgam body, said second glass spheroid obstructing movement of said amalgam body in the tubulation past the second glass spheroid when said amalgam body is in a solid state.

23. The amalgam assembly in accordance with claim 20 wherein said mercury wetting metallic layer is disposed on the inside surface of said tubulation and upon liquidizing of said amalgam body the liquid amalgam adheres to an inside surface of said tubulation in an area of said metallic layer.

24. The amalgam assembly in accordance with claim 20 wherein said mercury wetting metallic layer is disposed on the surface of the glass body and upon liquidizing of said amalgam body the liquid amalgam adheres to the surface of the glass body.

25. A fluorescent lamp with an amalgam assembly in accordance with one of the previous claims.

26. An electrodeless fluorescent lamp assembly, comprising:

a light-transmissive envelope containing an ionizable, gaseous fill for sustaining an arc discharge when subjected to a radio frequency magnetic field and for emitting ultraviolet radiation as a result thereof, said envelope having an interior phosphor coating for emitting visible radiation when excited by the ultraviolet radiation, said envelope having a re-entrant cavity formed therein;

an excitation coil contained within the re-entrant cavity for providing the radio frequency magnetic field when excited by a radio frequency power supply;

a glass exhaust tubulation extending through the re-entrant cavity and into said envelope, said exhaust tubulation having a closed end proximate a base portion of the lamp;

a pinched configuration formed in said exhaust tubulation at a predetermined distance from the tubulation closed end;

a retaining structure disposed in said tubulation and retained by said pinched configuration; and

a mercury amalgam body disposed in said tubulation between said retaining structure and the tubulation closed end, said amalgam body including lithium for wetting internal surfaces of said glass tubulation to cause said amalgam to adhere to the tubulation internal surfaces when said amalgam body is liquidized and to thereby prevent the amalgam from flowing past said retaining structure and into the lamp envelope.

27. The lamp assembly in accordance with claim 26 wherein said amalgam body comprises an alloy composition selected from a group of alloy compositions consisting of (i) bismuth and indium and lithium, (ii) bismuth and tin and lead and lithium, (iii) bismuth and tin and lithium, (iv) zinc and indium and tin and lithium, (v) indium and lithium, (vi) lead and lithium, and (vii) zinc and lithium.

28. The lamp assembly in accordance with claim 26, wherein said retaining structure comprises a glass body, and wherein the lithium is adapted to wet the glass body to cause the amalgam to adhere further to the glass body when said amalgam body is liquidized, to further prevent the amalgam from flowing past the glass body and into the lamp.

29. The lamp assembly in accordance with claim 26 wherein said amalgam body is spherically shaped when in a solid state.

30. The lamp assembly in accordance with claim 26 wherein said retaining structure comprises a glass body.

31. The lamp assembly in accordance with claim 30 wherein the glass body is spherically shaped.

32. An electrodeless fluorescent lamp assembly, comprising:

a light-transmissive envelope containing an ionizable, gaseous fill for sustaining an arc discharge when subjected to a radio frequency magnetic field and for emitting ultraviolet radiation as a result thereof, said envelope having an interior phosphor coating for emitting visible radiation when excited by the ultraviolet radiation, said envelope having a re-entrant cavity formed therein;

an excitation coil contained within the re-entrant cavity for providing the radio frequency

magnetic field when excited by a radio frequency power supply;

a glass exhaust tubulation extending through the re-entrant cavity and into said envelope, said exhaust tubulation having a closed end proximate a base portion of the lamp;

a pinched configuration formed in said exhaust tubulation at a predetermined distance from the tubulation closed end;

a retaining structure disposed in said tubulation and retained by said pinched configuration;

a mercury amalgam body disposed in said tubulation between said retaining structure and tubulation closed end; and

a layer of metal containing lithium adhered to an inside surface of said exhaust tubulation between the tubulation closed end and said tubulation pinched configuration;

wherein upon liquidizing of said amalgam body, the liquid amalgam adheres to said layer, to thereby prevent the amalgam from flowing past said retaining structure and into the lamp envelope.

33. The lamp assembly in accordance with claim 32 wherein said amalgam body comprises an alloy composition selected from a group of alloy compositions consisting of (i) bismuth and indium and lithium, (ii) bismuth and tin and lead and lithium, (iii) bismuth and tin and lithium, (iv) zinc and indium and tin and lithium, (v) indium and lithium, (vi) lead and lithium, and (vii) zinc and lithium.

34. The lamp assembly in accordance with claim 32 wherein said retaining structure comprises a glass body, and wherein the layer of metal is adapted to wet the glass body to cause the amalgam to adhere further to the glass body when said amalgam body is liquidized, to further prevent the amalgam from flowing into the lamp envelope.

35. The lamp assembly in accordance with claim 34 wherein the glass body is spherically shaped.

36. An electrodeless fluorescent lamp, comprising:

a light-transmissive envelope containing an ionizable, gaseous fill for sustaining an arc discharge when subjected to a radio frequency magnetic field and for emitting ultraviolet radiation as a result thereof, said envelope having an interior phosphor coating for emitting visible radiation when excited by the ultraviolet radiation, said envelope having a re-entrant cavity formed therein;

an excitation coil contained within the re-entrant cavity for providing the radio frequency magnetic field when excited by a radio frequency power supply;

an exhaust tubulation extending through the re-entrant cavity and into said envelope for evacuating and filling said lamp, said exhaust tubulation having a closed end proximate a base portion of the lamp;

a dimple configuration formed in said exhaust tubulation at a predetermined distance from the tubulation closed end;

a mercury amalgam body disposed in said tubulation;

a metal cup for retaining said amalgam body in a location in said exhaust tubulation between said metal cup and the closed end of said exhaust tubulation, said metal cup defining an annular wall having a free edge extending toward the exhaust tubulation closed end, a tubular central core portion extending toward the exhaust tubulation closed end, and an annular trough formed by the core portion and the outer wall; and

a coating of a metal wetting agent disposed on interior surfaces of the trough;

whereby when said amalgam body liquidizes, the liquid amalgam adheres to the cup trough surfaces, and mercury vapor is flowable through the cup core portion.

37. The lamp in accordance with claim 36 wherein said metal cup snugly fits in said tubulation and peripheral walls of said cup are engaged with interior walls of said tubulation.

38. The lamp in accordance with claim 37 wherein said cup is of a metal having sufficient springiness to bias the cup peripheral walls against the interior walls of the tubulation.

39. The lamp in accordance with claim 38 wherein said cup is of a metal selected from (i) stainless steel and (ii) iron-nickel alloy.

40. The lamp in accordance with claim 36 wherein the metal wetting agent comprises a selected one of (i) silver and (ii) indium.

41. The lamp in accordance with claim 36 wherein said cup core portion extends closer to the tubulation distal end than the cup outer wall.

42. The lamp in accordance with claim 36 and further comprising a glass ball disposed in said exhaust tubulation between said metal cup and the closed end of said exhaust tubulation.

43. An electrodeless fluorescent lamp assembly, comprising:

a light-transmissive envelope containing an ionizable, gaseous fill for sustaining an arc discharge when subjected to a radio frequency magnetic field and for emitting ultraviolet radiation as a result thereof, said envelope having an interior phosphor coating for emitting visible radiation when excited by the ultraviolet radiation, said envelope having a re-entrant cavity formed therein;

an excitation coil contained within the re-entrant cavity for providing the radio frequency magnetic field when excited by a radio frequency power supply;

an exhaust tubulation extending through the re-entrant cavity and into said envelope, said exhaust tubulation having a closed end proximate a base portion of the lamp;

a pinched portion formed in said exhaust tubulation at a selected distance from said closed end;

a mercury amalgam body disposed in said exhaust tubulation between the exhaust tubulation closed end and said pinched portion of said exhaust tubulation;

a glass body disposed in said exhaust tubulation and retained by said pinched portion, said glass body being disposed between said pinched portion of said tubulation and said amalgam body; and

a coating of a metal wetting agent disposed on a selected one of (i) an inside surface of said tubulation between said pinched portion and the closed end of said tubulation, and (ii) a surface of said glass body;

whereby to wet at least one of (i) the interior surface of said glass tubulation, and (ii) the surface of said glass body, to prevent said amalgam from flowing past the tubulation pinched portion into the lamp envelope.

44. The lamp assembly in accordance with claim 43 wherein said mercury wetting metallic layer is of a selected one of silver, gold, and indium, and alloys thereof, respectively.

45. The lamp in accordance with claim 43 wherein said amalgam body is generally spheroid in configuration prior to liquidizing thereof.

46. The lamp assembly in accordance with claim 43 wherein said glass body is of a spheroid configuration.

47. The lamp assembly in accordance with claim 46 and further comprising a second glass spheroid disposed between said pinched portion of said tubulation and said amalgam body, said second glass spheroid obstructing movement of said amalgam body in said tubulation past the tubulation pinched portion when said amalgam is in a solid state.

48. The lamp assembly in accordance with claim 43 wherein said mercury wetting metallic layer is disposed on the inside surface of said tubulation and upon liquidizing of said amalgam body the liquid amalgam adheres to the inside surface of said tubulation in an area of said metallic layer.

49. The lamp assembly in accordance with claim 43 wherein said mercury wetting metallic layer is disposed on the surface of the glass body and upon liquidizing of said amalgam body the liquid amalgam adheres to the surface of the glass body.

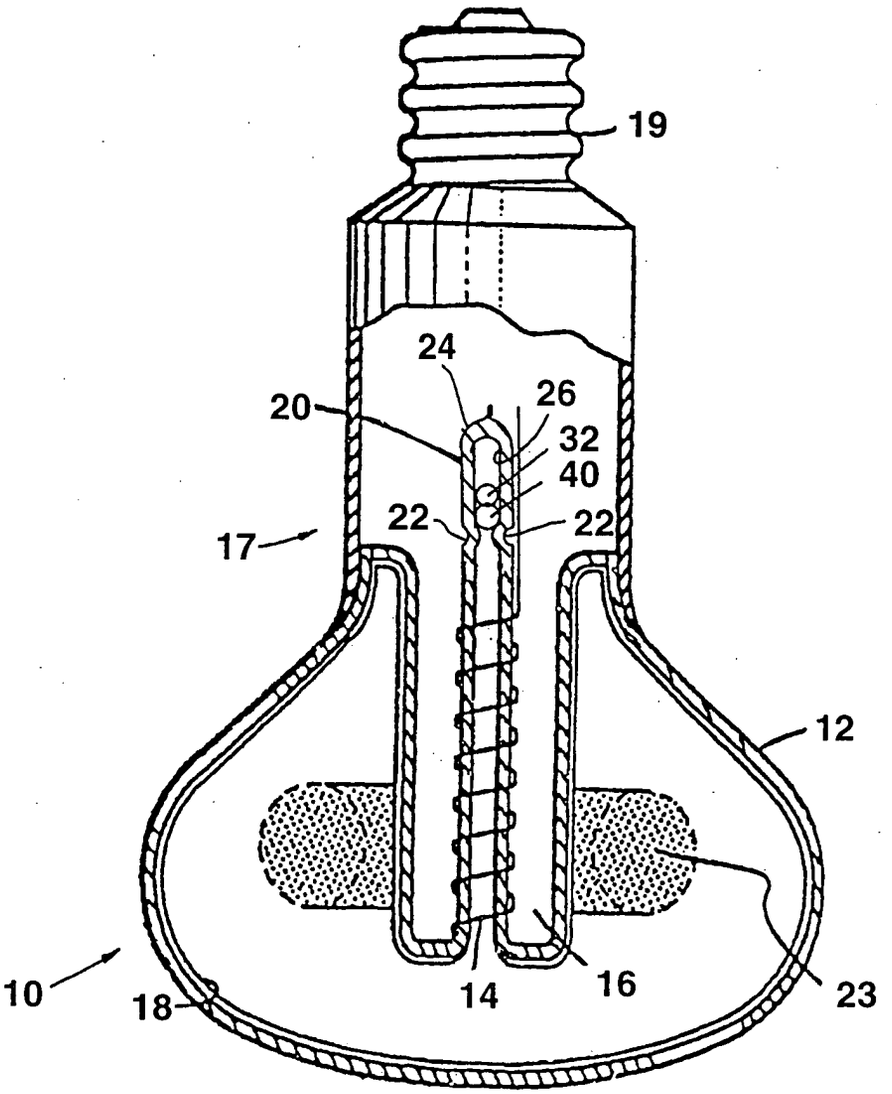

FIG. 1a

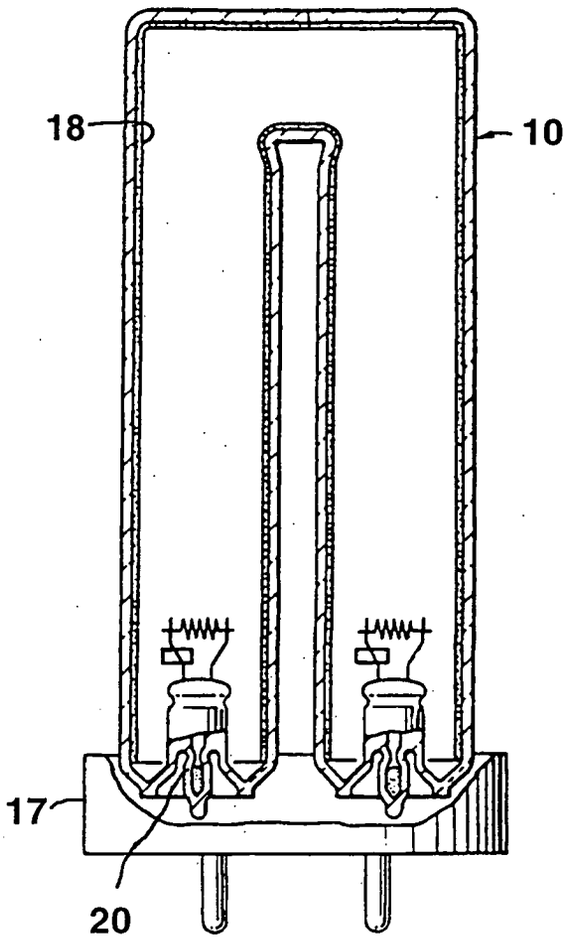

FIG. 1b

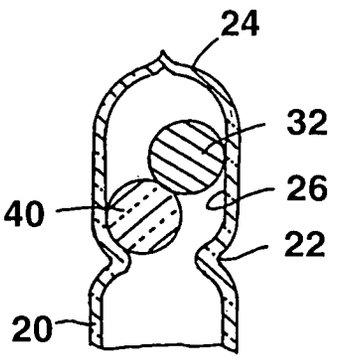

FIG. 2

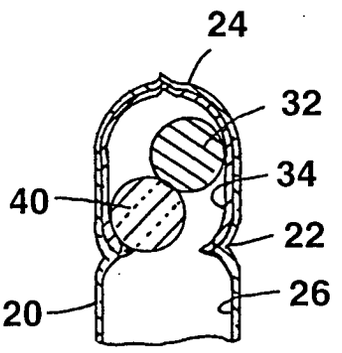

FIG. 3

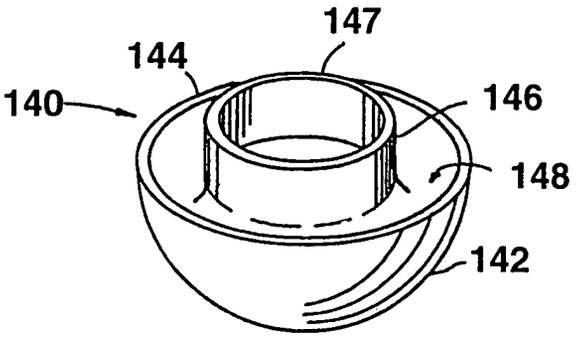

FIG. 4

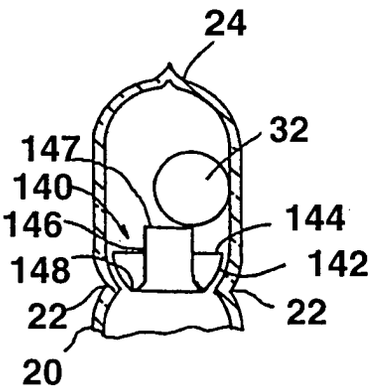

FIG. 5

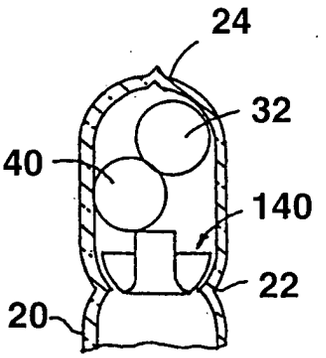

FIG. 6

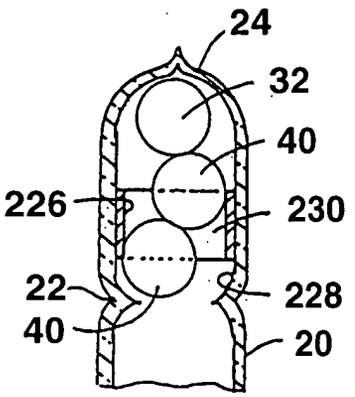

FIG. 7

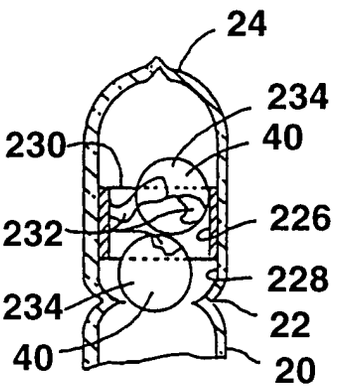

FIG. 8

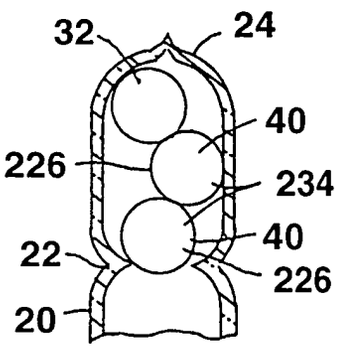

FIG. 9

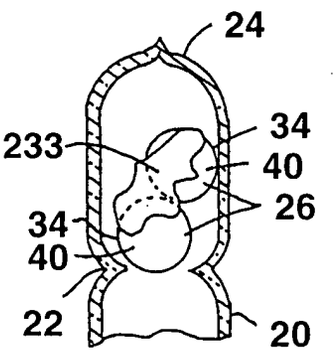

FIG. 10

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 01 6255

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 4 288 715 A (VAN OVERVELD JOHAN B J ET AL) 8 September 1981 (1981-09-08) * abstract * * column 1, line 62 - column 2, line 31 *	1-49	H01J61/28 H01J61/72 H01J65/04 H01J9/395
A	US 5 294 867 A (GROSSMAN MARK W) 15 March 1994 (1994-03-15) * column 6, line 4 - line 23; figures 2A-2D *	1,9,13, 18	
A	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 12, 29 October 1999 (1999-10-29) & JP 11 185704 A (OSRAM MELCO KK), 9 July 1999 (1999-07-09) * abstract *	1-49	
A	US 5 629 584 A (BOROWIEC JOSEPH C ET AL) 13 May 1997 (1997-05-13) * the whole document *	1,26,32, 36,43	
A	US 5 757 129 A (LAUTER FRIEDRICH ET AL) 26 May 1998 (1998-05-26) * the whole document *	1	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
MUNICH	2 December 2003	Zuccatti, S

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 03 01 6255

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.

02-12-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4288715 A	08-09-1981	NL 7810213 A	15-04-1980
		BE 879295 A1	09-04-1980
		CA 1142212 A1	01-03-1983
		DE 2940563 A1	24-04-1980
		FR 2438912 A1	09-05-1980
		GB 2040554 A ,B	28-08-1980
		JP 1420482 C	14-01-1988
		JP 55053053 A	18-04-1980
		JP 62021223 B	12-05-1987
US 5294867 A	15-03-1994	AU 3906793 A	05-10-1993
		CA 2092601 A1	14-09-1993
		DE 69303336 D1	01-08-1996
		DE 69303336 T2	20-02-1997
		EP 0585446 A1	09-03-1994
		WO 9318542 A1	16-09-1993
JP 11185704 A	09-07-1999	NONE	
US 5629584 A	13-05-1997	CA 2133509 A1	05-04-1995
		DE 69403597 D1	10-07-1997
		DE 69403597 T2	18-12-1997
		EP 0646942 A1	05-04-1995
		JP 7192628 A	28-07-1995
US 5757129 A	26-05-1998	DE 19512129 A1	02-10-1996
		CA 2171599 A1	01-10-1996
		DE 59602416 D1	19-08-1999
		EP 0735568 A1	02-10-1996
		HU 9600831 A2	28-01-1997
		IN 186168 A1	30-06-2001
		JP 8287868 A	01-11-1996

EPO FORM P0459

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