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(54) A combination of materials for integrated getter and mercury-dispensing devices and devices thus obtained

(57) The mercury-dispensing combination according to the invention consists of a mercury-dispensing intermetallic compound A including mercury and a second metal selected among titanium, zirconium and mixtures thereof, preferably Ti_3Hg, and a promoting alloy or intermetallic compound B including copper, tin and one or more metals selected among the rare earths, in particular misch metal (MM). There are also disclosed mercury-dispensing devices containing such a combination and in particular further including a getter material C, as well as a process for introducing mercury into the electron tubes, the process consisting in the introduction into the open tube of one of said devices, and then heating the device to get mercury free at a temperature between 600°C and 900°C for a time between 10 seconds and one minute after the tube sealing.

Fig.1

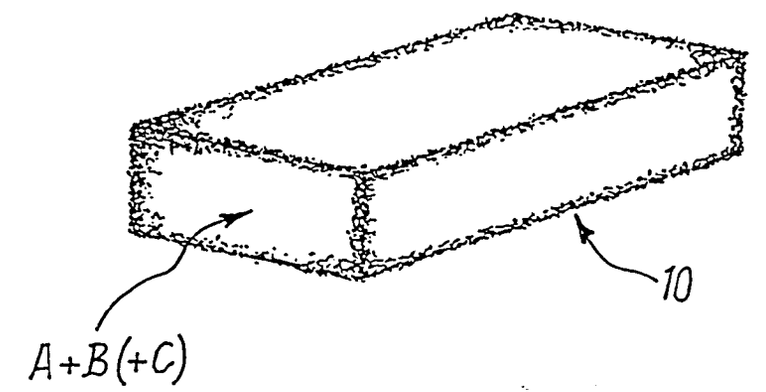

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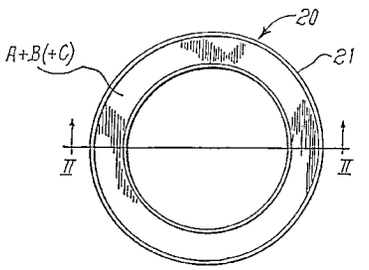
Fig.2



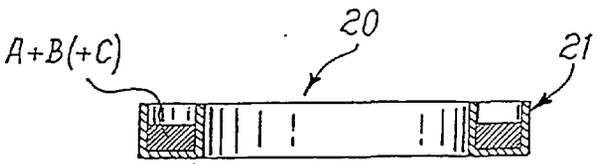


Fig.2a

Fig.3

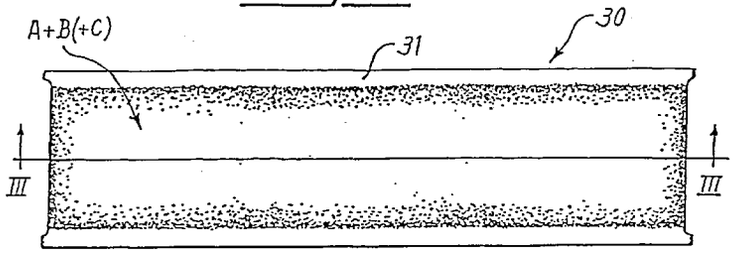


Fig.3a

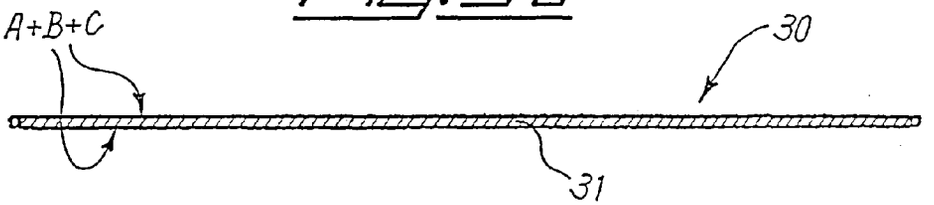
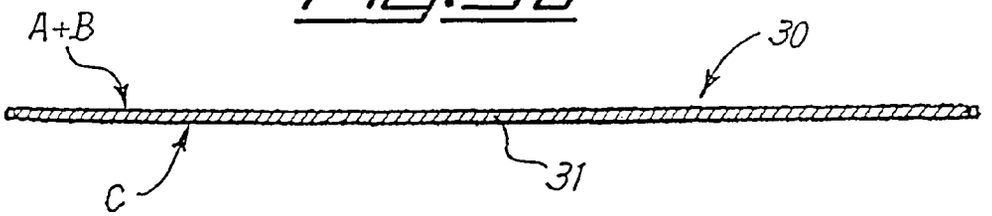


Fig.3b



Description

The present invention relates to a combination of materials for the production of devices combining the getter and mercury-dispensing functions, to the devices thus produced and to a process for the introduction of mercury inside electron tubes.

The use of small amounts of mercury in electron tubes such as, for example, mercury-arc rectifiers, lasers, various kinds of alphanumeric displays and, particularly, fluorescent lamps is well known in the art.

A precise dosage of mercury inside these devices is extremely important for the quality of the devices and most of all for ecological reasons. In fact, the high toxicity of this element implies serious problems of environmental pollution upon end-life disposal of the devices containing it, or in case of accidental break-up of the devices. These problems of ecological nature impose the use of amounts of mercury as small as possible, compatibly with the functionality of the tubes. These considerations have been lately included also in the legislative sphere, and the trend of the recent international regulations is to establish top limits for the amount of mercury which can be introduced into the devices: for example, for standard fluorescent lamps the use of a total amount of Hg not greater than 10 mg per lamp has been suggested.

Mercury can be introduced into the tubes in liquid form. However, the use of liquid mercury first of all poses problems concerning the storing and handling in the plants for the production of tubes, due to its high vapor pressure also at room temperature. Secondly, a common drawback of the techniques for the introduction into the tubes of mercury in liquid form is the difficulty in precisely and reproducibly dosing volumes of mercury in the order of microliters, which difficulty usually takes to the introduction of amounts of the element higher than needed.

These drawbacks have taken to the development of various techniques in alternative to the use of liquid mercury in free form.

The use of liquid mercury contained in capsules is disclosed in several prior art documents. This method is described, for example, in US patents nos.4.823.047 and 4.754.193, referring to the use of metallic capsules, and in US patents nos.4.182.971 and 4.278.908 wherein the mercury container is made of glass. After closing the tube, the mercury is released by means of a heat treatment which causes the breakage of the container. These methods generally have some drawbacks. First of all, the production of the capsules and their mounting inside the tubes may be complicated, especially when they have to be introduced inside small-size tubes. Secondly, the breakage of the capsule, particularly if it is made of glass, may produce fragments of material which can jeopardize the tube quality, so much that US patent no.4.335.326 discloses an assembly wherein the mercury-containing capsule is in turn located inside a capsule acting as a shield for the fragments. Moreover, the release of the mercury is often violent, with possible damages to the inner structure of the tube. Finally, these systems still have the drawback of employing liquid mercury, and therefore they do not completely solve the problem of the precise and reproducible dosage of few milligrams of mercury.

US patent no.4.808.136 and the European patent application EP-568.317 disclose the use of tablets or small spheres of porous material soaked with mercury which is then released by heating once the lamp is closed. However, also these methods require complicated operations for the loading of mercury into the tablets, and the released amount of mercury is difficult to be reproduced.

The use of amalgams of mercury, for example with indium, bismuth or zinc, is also known. However, these amalgams generally have the drawback of a low melting temperature and a high mercury vapor pressure already at temperatures not very high. For example, the zinc amalgams described in the commercial bulletins of the APL Engineered Materials Inc. have a vapor pressure at 43°C which is about 90% of that of liquid mercury. Consequently, these amalgams badly withstand the thermal treatments for the production of the lamps in which they are introduced.

These problems are overcome by US patent no.3.657.589 in the name of the Applicant, which discloses the use of intermetallic compounds of mercury having the general formula $Ti_xZr_yHg_z$, wherein x and y may vary between 0 and 13, the sum (x+y) may vary between 3 and 13 and z may be 1 or 2.

These compounds have a temperature of mercury-release start variable according to the specific compound, however they are all stable up to about 500°C both in the atmosphere and in evacuated volumes, thus resulting compatible with the operations for the assembly of the electron tubes, during which the mercury-dispensing devices may reach temperatures of about 500°C. After closing the tube, the mercury is released from the above-cited compounds by an activation operation, which is usually carried out by heating the material between 750°C and 900°C for about 30 seconds. This heating may be accomplished by laser radiation, or by induction heating of the metallic support of the Hg-dispensing compound. The use of the Ti_3Hg compound, manufactured and sold by the Applicant under the trade name St505, results particularly advantageous; in particular, the St505 compound is sold in the form of compressed powder in a ring-shaped container or of compressed powder in pills or tablets, under the trademark STAHGSORB®, or in the form of powders laminated on a metallic strip, under the trademark GEMEDIS®.

These materials offer various advantages with respect to the prior art:

- as mentioned above, they avoid the risks of mercury evaporation during the cycle of production of the tubes, in which temperatures of about 350-400°C may be reached;
- as described in the cited US patent no.3.657.589, a getter material can be easily added to the mercury-dispensing compound with the purpose of chemisorption of gases such as CO, CO_2, O_2, H_2 and H_2O, which would interfere with the tube operation; the getter is activated during the same heat treatment for the release of mercury;
- the released amount of mercury is easily controllable and reproducible.

Despite their good chemical-physical characteristics and their great ease of use, these materials have the drawback that the contained mercury is not completely released during the activation treatment. In fact, the processes for the production of mercury-containing electron tubes include a tube-closing operation performed by glass fusion (e.g. the sealing of fluorescent lamps) or by frit sealing, i.e. welding two pre-shaped glass members by means of a paste of low-melting glass. During these operations, the mercury-dispensing device may undergo an indirect heating up to about 600°C. In this step the device is exposed to gases and vapors emitted by the melted glass and, in almost all industrial processes, to air. In these conditions, the mercury-dispensing material undergoes a surface oxidation, whose final result is a yield lower than about 40% of the total mercury content during the activation process. In the particular case of compact circular lamps, during the lamp sealing and bending steps the mercury-dispensing material undergoes an indirect heating up to about 500°C. In this case the mercury yield during the activation process drops as low as about 20% of the total mercury content of the device.

The mercury not released during the activation operation is then slowly released during the life of the electron tube. This characteristic, together with the fact that the tube must obviously work from the beginning of its life cycle, leads to the necessity of introducing into the device an amount of mercury which is at least double than that which would theoretically be necessary.

In order to overcome these problems, patent application EP-A-091.297 suggests the addition of Ni or Cu powders to the Ti_3Hg or Zr_3Hg compounds. According to this document, the addition of Ni and Cu to the mercury-dispensing compounds causes the melting of the combination of materials thus obtained, favouring the release of almost all the mercury in few seconds. The melting takes place at the eutectic temperatures of the systems Ni-Ti, Ni-Zr, Cu-Ti and Cu-Zr, ranging from about 880°C for the Cu 66% - Ti 34% composition to 1280°C for the Ni81% - Ti 19% composition (atomic percent), though the document erroneously gives a melting temperature of 770°C for the Ni 4% - Ti 96% composition. The document acknowledges that the mercury-containing compound is altered during the tube working treatments, and it needs a protection. To this purpose, there is suggested to close the powder container by means of a steel, copper or nickel sheet which is broken during the activation by the pressure of the mercury vapor generated inside the container. This solution is not completely satisfactory: in fact, same as it happens in the methods employing capsules, mercury bursts out violently and can cause damages to portions of the tube; the manufacturing of the container is quite complicated, since it requires the welding of small-size metallic members. Furthermore, this document does not contain experimental data to support the stated good mercury-release characteristics of the combinations indicated. Finally, the devices in this application, contrary to those illustrated in the cited US patent no.3.657.589, do not allow to integrate a getter material, whose presence is necessary for the correct working of the lamps, into a same device.

Therefore, the object of the present invention is to provide an improved combination of materials for dispensing mercury in the electron tubes, which allows to overcomes one or more drawbacks of the prior art.

In particular, the object of the present invention is first of all to provide an improved combination of materials for dispensing mercury which is capable of releasing amounts of mercury higher than 60% during the activation step, even after partial oxidation, so as to be able to reduce the total amount of employed mercury.

Another object of the present invention is to provide a combination of materials whose residue, after the activation operation for releasing mercury, has a getter activity.

Another object of the present invention is to provide mercury-dispensing devices containing the combination of materials of the invention.

Still another object is to provide a process for introducing mercury by means of the devices of the invention into the electron tubes which require said element.

According to the present invention, these and other objects are achieved by using a mercury-dispensing combination of materials made up of:

- a mercury-dispensing intermetallic compound A including mercury and a second metal selected among titanium, zirconium and mixtures thereof;
- an alloy or an intermetallic compound B including copper, tin and one or more metals selected among the rare earths.

Further objects and advantages of the present invention will be apparent from the following detailed description

referring to the annexed drawings wherein:

Fig.1 is a perspective view of a mercury-dispensing device of the present invention according to a possible embodiment thereof;

Figs.2 and 2a are, respectively, a top plan view and a sectional view along II-II of a device of the invention according to another possible embodiment;

Figs.3, 3a and 3b are, respectively, a top plan view and two sectional views along III-III of a device of the invention according to a further embodiment, in two possible variations;

Fig.4 shows, in a ternary diagram, the alloys of the present invention.

Component A of the combination of the present invention, hereafter also defined mercury dispenser, is an intermetallic compound corresponding to formula $Ti_xZr_yHg_z$, as disclosed in the cited US patent no.3.657.589, to which reference is made for further details. Among the materials corresponding to said formula, Zr_3Hg and, particularly, Ti_3Hg are preferred.

Component B of the combination of the present invention has the function of favouring the release of mercury from component A, and hereafter will also be defined promoter. This component is a metallic alloy or an intermetallic compound including copper, tin and a metal selected among the rare earths or a mixture of rare earths. The use of a mixture of rare earths is preferred over the use of single elements in that, since these metals have a similar chemistry, the separation of the single elements is a difficult and expensive operation; on the other hand, by using a mixture of rare earths it is possible to obtain, in this application, essentially the same results obtained with the single elements. The mixtures of rare earths are known in the art by the name "misch metal"; this denomination, and its short form MM, will be used hereafter in the rest of the specification and in the claims.

The weight ratio between copper, tin and MM can vary within a wide range, but advantageous results have been obtained with compositions which, in a ternary diagram of percentage compositions on a weight basis (fig.4), fall within a polygon defined by points:

a) Cu 63% - Sn 36,5% - MM 0,5%
b) Cu 63% - Sn 10 % - MM 27%
c) Cu 30% - Sn 10 % - MM 60%
d) Cu 3% - Sn 37 % - MM 60%
e) Cu 3% - Sn 96,5% - MM 0,5%

With copper percentages higher than 63% the alloy reaches a high melting point and consequently requires excessive temperatures for its activation, while on the contrary with copper percentages lower than about 3% the alloy has a melting point too low and this implies the risk of having a low-viscosity liquid phase at the temperatures, varying about from 600 to 800°C, reached during the production of the lamps. With misch metal concentrations higher than 60% by weight the alloy becomes excessively reactive, and could give rise to violent reactions both during the lamp production step and during the activation step. Finally, with tin contents lower than 10% by weight the alloy reaches again a high melting point.

Particularly advantageous results are obtained, within said range of compositions, by means of compositions which, in a ternary diagram of percentage compositions on a weight basis (fig.4), fall within a polygon defined by points:

a) Cu 63% - Sn 36,5% - MM 0,5%
b) Cu 63% - Sn 10 % - MM 27%
f) Cu 50% - Sn 10 % - MM 40%
g) Cu 30% - Sn 30 % - MM 40%
h) Cu 30% - Sn 69,5% - MM 0,5%

A particularly preferred alloy has the percentage composition Cu 40% - Sn 30% - MM 30%, corresponding to point i) in the composition ternary diagram of fig.4.

The weight ratio between components A and B of the combination of the invention may vary within a wide range, but it is generally included between 20:1 and 1:20, and preferably between 10:1 and 1:5.

Components A and B of the combination of the invention may be employed in various physical forms, not necessarily the same for the two components. For example, component B may be present in the form of a coating of the metallic support, and component A as a powder adhered to component B by rolling. However, the best results are obtained when both components are in the form of a fine powder, having a particle size lower than 250 μm and preferably between 10 and 125 μm.

The present invention, in a second aspect thereof, relates to the mercury-dispensing devices which use the above-

described combinations of A and B materials.

As previously mentioned, one of the advantages of the combination of materials of the invention with respect to prior art systems is that they do not need a mechanical protection from the environment, thus not posing the limit of a closed container. Consequently, the mercury-dispensing devices of the present invention can be manufactured with the most different geometric shapes, and materials A and B of the combination can be employed without support or on a support, usually metallic.

Some classes of electron tubes for which the mercury dispensers are intended further require, for their correct operation, the presence of a getter material which removes traces of gases such as CO, CO_2, H_2, O_2 or water vapor: it is the case, for example, of fluorescent lamps. An important advantage offered by the combinations of the present invention is that the residue remaining after the evaporation of mercury has a getter activity. The amount of gas which can be absorbed by said residue, and the absorption velocity, are sufficient to assure an adequate degree of vacuum for many applications. In order to increase the total gas absorption velocity and capacity of this device, it is obviously possible to add thereto another getter material C, according to the manners described in the cited US patent no. 3.657.589. Obviously, in this case the amount of getter material C is lower than that required in prior art devices used in the same application. Examples of getter materials include, among the others, metals such as titanium, zirconium, tantalum, niobium, vanadium and mixtures thereof, or alloys thereof with other metals such as nickel, iron, aluminum, like the alloy having a weight percentage composition Zr 84% - Al 16%, manufactured and sold by the Applicant under the name St101, or the intermetallic compounds Zr_2Fe and Zr_2Ni, manufactured and sold by the Applicant respectively under the name St198 and St199. The getter material is activated during the same heat treatment by which mercury is released inside the tube.

The getter material C may be present in various physical forms, but it is preferably employed in the form of a fine powder, having a particle size lower than 250 μm and preferably between 10 and 125 μm.

The ratio between the overall weight of the A and B materials and that of the getter material C may generally range from about 10:1 to 1:10, and preferably between 5:1 and 1:2.

Some possible embodiments of the devices of the invention are illustrated hereunder with reference to the drawings.

In a first possible embodiment, the devices of the invention can simply consist of a tablet 10 made up of compressed and unsupported powders of the A and B (and possibly C) materials, which for ease of production generally has a cylindrical or parallelepipedal shape; this latter possibility is shown in fig.1.

In the case of supported materials, the device may have the shape of a ring 20 as shown in fig.2, which represents a top plan view of the device, and in fig.2a which represents a cross-section along II-II of device 20. In this case, the device is made up of a support 21 having the shape of a toroidal channel containing the A and B (and possibly C) materials. The support is generally metallic, and preferably of nickel-plated steel.

Alternatively, the device may be made in the shape of a strip 30 as shown in fig.3, which represents a top plan view of the device, and in figs.3a and 3b wherein a section along III-III of device 30 is depicted. In this case, support 31 consists of a strip, preferably made of nickel-plated steel, onto which the A and B (and possibly C) materials are adhered by cold compression (rolling). In this case, whenever the presence of the getter material C is required, materials A, B and C may be mixed together and rolled on one or both faces of the strip (fig.3a), or materials A and B are rolled on one surface of the strip and material C on the opposite surface, as shown in fig.3b.

The invention, in a further aspect thereof, relates to a method for introducing mercury into the electron tubes by using the above-described devices.

The method includes the step of introducing inside the tube the above-described mercury-dispensing combination of materials and preferably in one of the above-described devices 10, 20 or 30, and then the combination heating step to get mercury free. The heating step may be carried out with any suitable means such as, for example, by radiation, by high-frequency induction heating or by having a current flow through the support when the latter is made of a material having a high electric resistivity. The heating is effected at a temperature which causes the release of mercury from the mercury-dispensing combination, comprised between 600 and 900°C for a time of about 10 seconds to one minute. At temperatures lower than 600°C mercury is almost not dispensed at all, whereas at temperatures higher than 900°C there is the danger of the development of noxious gases by outgassing from the portions of the electron tube adjacent to the device or of the formation of metal vapors.

The invention will be further illustrated by the following examples. These non-limiting examples illustrate some embodiments intended to teach to those skilled in the art how to put in practice the invention and to show the accomplishment of the invention which is considered the best. Examples 1 to 3 concern the preparation of the mercury-dispensing and promoting materials, while examples 4 to 9 concern the tests for the mercury release after the heat treatment simulating the sealing operation. Examples 10 to 14 concern the tests for the functionality as getter materials of the residues remaining after the mercury release. All the metals used for the preparation of alloys and compounds for the following tests have a minimum pureness of 99,5%. In the compositions of the examples all percentages are on a weight basis if not differently specified.

EXAMPLE 1

This example illustrates the synthesis of the mercury-dispensing material Ti_3Hg.

143,7 g of titanium are placed in a steel cradle and degassed by a furnace treatment at a temperature of about 700°C and a pressure of 10^{-6} mbar for 30 minutes. After cooling the titanium powder in an inert atmosphere, 200,6 g of mercury are introduced in the cradle by means of a quartz tube. The cradle is then closed and heated at about 750°C for 3 hours. After cooling, the product is ground until a powder passing through a 120μm mesh-size standard sieve is obtained.

The resulting material essentially consists of Ti_3Hg, as confirmed by a diffractometric test carried out on the powder.

EXAMPLE 2

This example concerns the preparation of a promoting alloy which makes part of the combinations of the invention.

40 g of Cu, 30 g of Sn and 30 g of MM in powder form, are placed into an alumina cradle and then introduced in a vacuum induction furnace. The misch metal used contains about 50% by weight of cerium, 30% of lanthanum, 15% of neodymium and the rest are other rare earths.

The mixture is heated at a temperature of about 900°C, kept at that temperature for 5 minutes to encourage the homogeneity thereof, and finally cast into a steel ingot-mould. Each ingot is ground in a blade mill and the powder is sieved like in example 1. The composition of the obtained alloy is Cu 40% - Sn 30% - MM 30%, and corresponds to point i) in the diagram of fig.4.

EXAMPLE 3

This example concerns the preparation of a promoting alloy which makes part of the combinations of the invention. The procedure of example 2 is repeated using 60 g of Cu, 30 g of Sn and 10 g of MM in powder form. The composition of the obtained alloy is Cu 60% - Sn 30% - MM 10%, and corresponds to point l) in the diagram of fig.4.

EXAMPLES 4-9

Examples 4 to 9 concern the tests for the mercury release after a heat treatment in air which simulates the frit conditions to which the device is subjected during the tube closing (hereafter generally referred to as sealing). Examples 4 to 7 are comparative examples which show the release after frit sealing respectively by the dispensing component alone (ex.4) and by the same mixed only with copper, tin and the above-cited getter alloy St101 (ex.5-7); a similar comparative test on a mixture of Ti_3Hg and MM powders was not possible due to the excessive reactivity of this mixture.

For the simulation of the sealing, 150 mg of each powder mixture have been loaded in a ring-shaped container like in fig.1 or on a strip like in fig.3, and have been subjected to the following thermal cycle in air:

- heating from room temperature to 450°C in about 5 seconds;
- isotherm at 450°C for 60 seconds;
- cooling from 450°C to 350°C, requiring about 2 seconds;
- isotherm at 350°C for 30 seconds;
- spontaneous cooling to room temperature, requiring about 2 minutes.

Thereafter, the mercury release tests have been carried out on the thus treated samples by induction heating thereof at 850°C for 30 seconds inside a vacuum chamber and by measuring the mercury remained in the dispensing device through the method of the complexometric titration according to Volhart.

The results of the tests are summarized in Table 1, which shows the mercury-dispensing compound A, the promoting material B (letters (i) or (l) in examples 8 and 9 refer to the composition of the Cu-Sn-MM alloy as shown in the diagram of fig.4), the weight ratio between components A and B and the mercury yield as a percentage of released mercury on the total content of the device.

The comparative examples are marked by a star.

Table 1

EXAMPLE N.	A	B	A/B	Hg yield (%)
4*	Ti_3Hg	-	-	35,2
5*	Ti_3Hg	Cu	7/3	34,0

Table 1 (continued)

EXAMPLE N.	A	B	A/B	Hg yield (%)
6*	Ti_3Hg	Sn	5/1	25,0
7*	Ti_3Hg	St 101	1/1	22,4
8	Ti_3Hg	Cu-Sn-MM (i)	2/1	80,0
9	Ti_3Hg	Cu-Sn-MM (I)	2/1	87,0

EXAMPLES 10-14

Examples 10 to 14 concern the tests for the functionality as getter materials of the residues remaining after the mercury release by the combinations of the invention and by some comparative combinations.

These tests have been carried out by simulating the frit conditions to which the materials are subjected during the bending and sealing operations of the compact fluorescent circular lamps, which conditions, as mentioned above, are harder that those reached for straight lamps. In particular, the combinations of the examples have been subjected to the following thermal cycle in air:

- heating from room temperature to 600°C in about 10 seconds;
- isotherm at 600°C for 15 seconds;
- spontaneous cooling to room temperature, requiring about 2 minutes.

The mercury release tests (activation) have been carried out after simulation of the frit sealing on the samples. The fritted samples have been introduced inside a vacuum chamber having a volume of 1 liter, and heated under vacuum at 850°C for 10 seconds and kept at said temperature for 20 seconds.

The capacity of the residue to work as a getter is measured after the activation; this measurement is performed by introducing in the chamber an amount of hydrogen such as to bring the pressure to 0.1 mbar at a temperature of 30°C, and by measuring the time required for the pressure in the chamber to decrease to 0.01 mbar. The measure of the pressure is taken by means of a capacitive manometer. The results of these tests are summarized in Table 2, which shows the composition of the sample and the hydrogen absorption velocity at 30°C. The "SAMPLE COMPOSITION" column gives the weight percentages of the component materials. The comparative combinations are marked by a star.

Table 2

EXAMPLE N.	SAMPLE COMPOSITION	H_2 absorption velocity (cc/s)
10*	Ti_3Hg	not measurable
11*	Ti_3Hg: 50% St 101: 50%	7,2
12	Ti_3Hg: 60% Cu-Sn-MM (i): 40%	6,9
13	Ti_3Hg: 60% Cu-Sn-MM (I): 40%	3,5
14	Ti_3Hg: 30% Cu-Sn-MM (i): 20% St 101: 50%	15,3

It may be noted from the data of Table 1 that the combinations with promoter of the invention allow mercury yields higher than 80% during the activation step even after frit sealing in air at 450°C, thus permitting the reduction of the overall mercury amount introduced in the electron tubes.

Furthermore, as shown by the data in Table 2, the residue remaining after the mercury release has a getter activity: in fact, while the residue remaining after the mercury release by the Ti_3Hg compound alone has no getter activity, the sample of example 13 to which no getter has been added exhibits a significant hydrogen absorption velocity. Moreover, sample 12 has a hydrogen absorption velocity comparable to that of the sample of example 11, which is a combination of a mercury dispenser with a getter, widely used by lamp manufacturers.

When a getter material is added to the combination of example 12, the hydrogen absorption velocity becomes nearly twice that of example 11, with the same percentage of getter. These properties of the combination of the invention make it possible to use very small amounts of additional getter material or even none, while retaining the functionality

of the devices in which it is used.

The combinations with promoter of the present invention offer another important advantage, consisting in the possibility of carrying out the activation operation at temperatures or with times lower than those allowed by prior art materials. In fact, in order to have industrially acceptable activation times, Ti_3Hg alone requires an activation temperature of about 900°C, whereas the present combinations allow the reduction of the operation time and of the size of the lines for the production of the lamps; in both cases a double advantage is achieved of causing less pollution inside the tube due to the outgassing of all the materials present therein and of reducing the amount of energy required for the activation.

Claims

1. A mercury-dispensing combination consisting of:

   - a mercury-dispensing intermetallic compound A including mercury and a second metal selected among titanium, zirconium and mixtures thereof;
   - a promoting alloy or intermetallic compound B including copper, tin and one or more metals selected among the rare earths.

2. A mercury-dispensing combination according to claim 1, wherein the intermetallic compound A is Ti_3Hg.

3. A mercury-dispensing combination according to claim 1, wherein the promoting compound B is an alloy having a composition such that, in a ternary diagram of percentage compositions on a weight basis, it falls within a polygon defined by points:

   a) Cu 63% - Sn 36,5% - MM 0,5%
   b) Cu 63% - Sn 10 % - MM 27%
   c) Cu 30% - Sn 10 % - MM 60%
   d) Cu 3% - Sn 37 % - MM 60%
   e) Cu 3% - Sn 96,5% - MM 0,5%

4. A mercury-dispensing combination according to claim 3, wherein the promoting compound B is an alloy having a composition such that, in a ternary diagram of percentage compositions on a weight basis, it falls within a polygon defined by points:

   a) Cu 63% - Sn 36,5% - MM 0,5%
   b) Cu 63% - Sn 10 % - MM 27%
   f) Cu 50% - Sn 10 % - MM 40%
   g) Cu 30% - Sn 30 % - MM 40%
   h) Cu 30% - Sn 69,5% - MM 0,5%

5. A mercury-dispensing combination according to claim 4, wherein the promoting compound is an alloy having a percentage composition Cu 40% - Sn 30% - MM 30%.

6. A mercury-dispensing combination according to claim 4, wherein the promoting compound is an alloy having a percentage composition Cu 60% - Sn 30% - MM 10%.

7. A mercury-dispensing combination according to claim 1, wherein the weight ratio between components A and B ranges from 20:1 to 1:20.

8. A mercury-dispensing combination according to claim 7, wherein the weight ratio between components A and B ranges from 10:1 to 1:5.

9. A mercury-dispensing device containing a combination of materials A and B of claim 1.

10. A mercury-dispensing device according to claim 9, wherein the materials A and B are in the form of powder.

11. A mercury-dispensing device according to claim 10, consisting of a tablet (10) of compressed powders of materials

A and B.

12. A mercury-dispensing device according to claim 10, wherein the materials A and B are contained in a metallic support (21) having the shape of a toroidal channel.

13. A mercury-dispensing device according to claim 10, wherein the combination of materials A and B is rolled on the surface of a support having the shape of a strip (31).

14. A mercury-dispensing device according to claim 9, further containing a getter material C.

15. A mercury-dispensing device according to claim 14, wherein the getter material C is selected among titanium, zirconium, tantalum, niobium, vanadium and mixtures thereof, or alloys of these materials with nickel, iron or aluminum.

16. A mercury-dispensing device according to claim 15, wherein the getter material C is an alloy having the composition Zr 84% - Al 16% on a weight basis.

17. A mercury-dispensing device according to claim 15, wherein the getter material C is Zr_2Fe.

18. A mercury-dispensing device according to claim 15, wherein the getter material C is Zr_2Ni.

19. A mercury-dispensing device according to claim 14, wherein the mercury dispenser A, the promoter B and the getter material C are in the form of powder.

20. A mercury-dispensing device according to claim 19, consisting of a tablet (10) of compressed powders of materials A, B and C.

21. A mercury-dispensing device according to claim 19, wherein materials A, B and C are contained in a metallic support (21) having the shape of a toroidal channel.

22. A mercury-dispensing device according to claim 19, wherein the combination of materials A and B is rolled on the surface of a support having the shape of a strip (31), and material C is rolled on the opposite surface of the same strip (31).

23. A mercury-dispensing device according to claim 19, wherein the combination of materials A, B and C is rolled on a single surface of a support having the shape of a strip (31).

24. A mercury-dispensing device according to claim 14, wherein the ratio between the overall weight of materials A and B and the weight of the getter material C is between 10:1 and 1:10.

25. A mercury-dispensing device according to claim 24, wherein the ratio between the overall weight of materials A and B and the weight of the getter material C is between 5:1 and 1:2.

26. A mercury-dispensing device according to claim 19, wherein the mercury-dispensing material, the promoter and the getter are in the form of powders having a particle size lower than 250 μm.

27. A mercury-dispensing device according to claim 26, wherein the mercury-dispensing material, the promoter and the getter are in the form of powders having a particle size between 10 and 125 μm.

28. A process for introducing mercury inside electron tubes, consisting in the introduction into the open tube of one of the devices of claims 9 to 27, and heating the device to get mercury free at a temperature between 600°C and 900°C for a time between 10 seconds and one minute after the tube sealing.

29. A process according to claim 28, wherein the electron tube consists of a straight fluorescent lamp.

30. A process according to claim 28, wherein the electron tube consists of a compact circular fluorescent lamp.

Fig.1

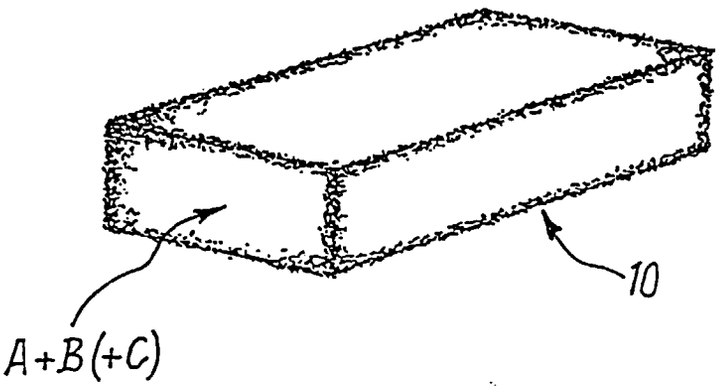
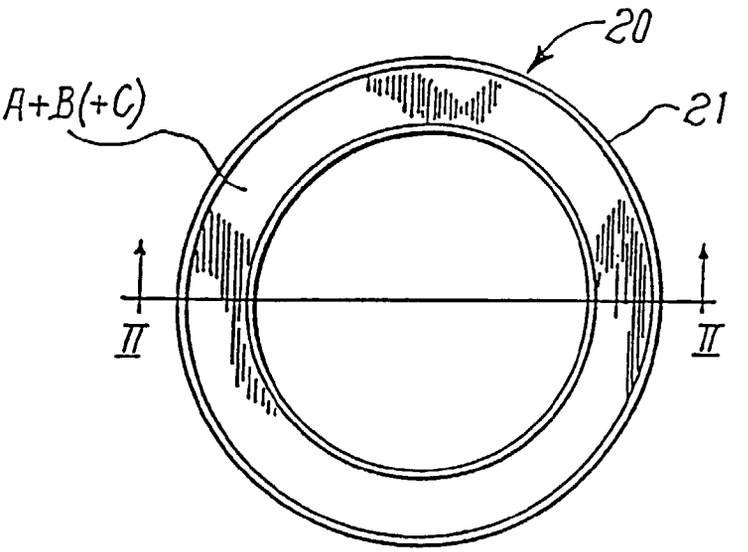


Fig.2



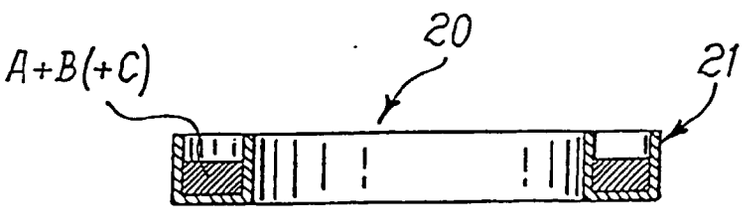


Fig.2a

Fig.3

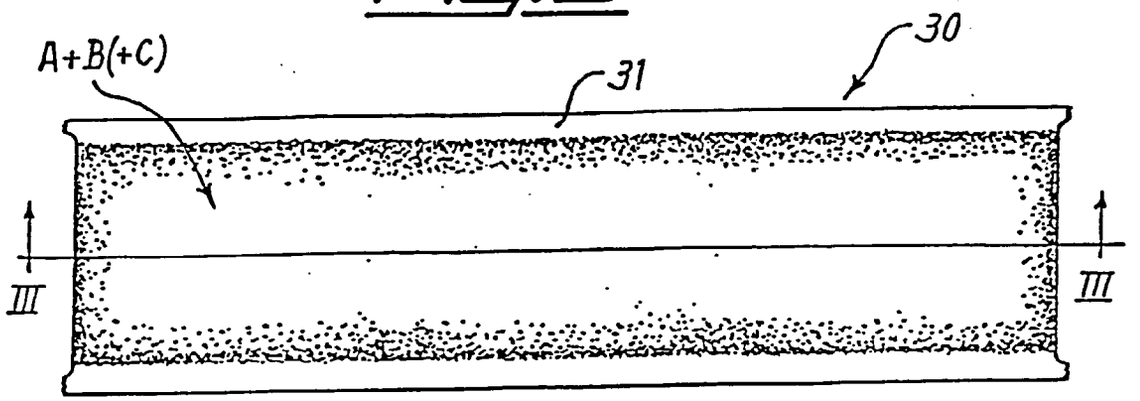


Fig.3a

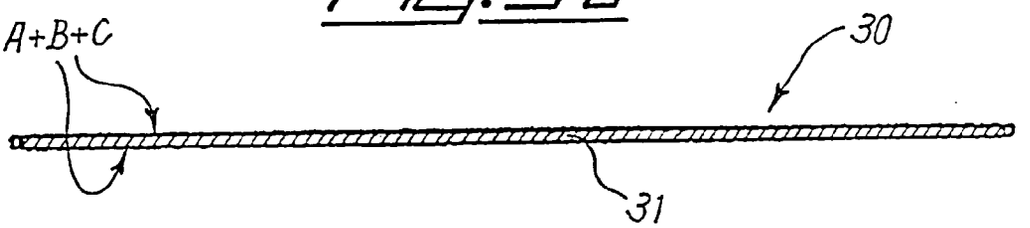
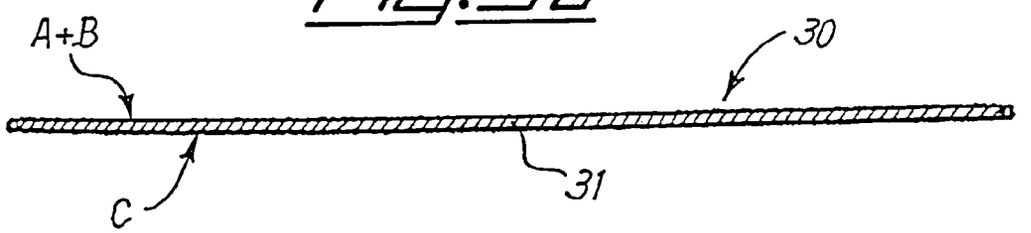


Fig.3b



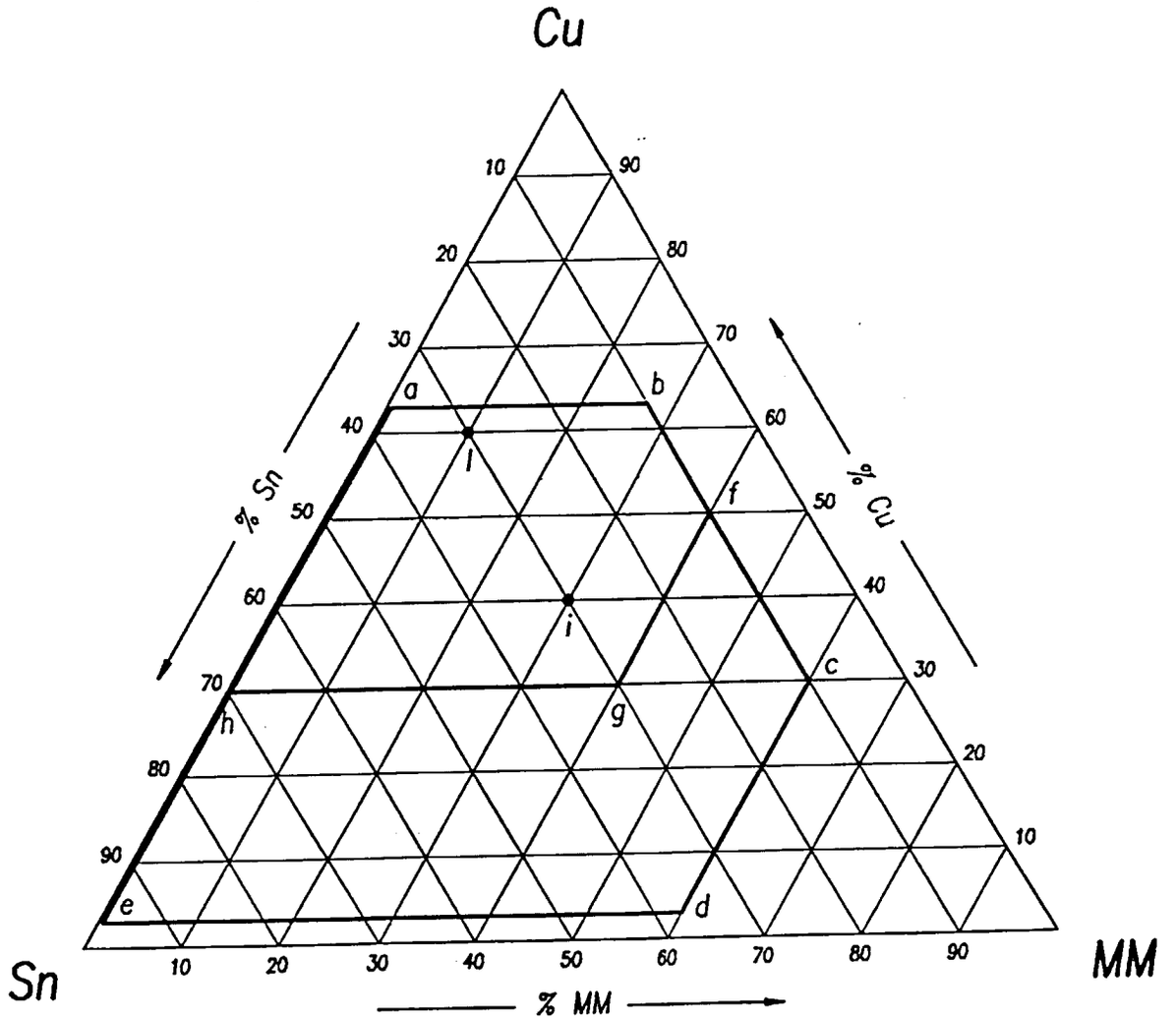


Fig. 4