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(54) **Vehicle light provided with at least one light source of light-emitting diode type and the assembly method therefor**

(57) Vehicle light (4) comprising a container body (8) and a lenticular body (12) which define a housing chamber (16) hosting a light-emitting diode light source (20), which comprises an electric support and connection component (28), at least one support wall (36), at least one light-emitting diode (40) having an encapsulation (48) which projects overhanging from the support wall (36). The light (4) comprises guide and attachment means (52) which define at least one housing seat (56) for the electric

support and connection component (28), wherein the guide and attachment means (52) comprise at least one front wall (60) directly facing the encapsulation (48). The vehicle light comprises at least one protection device (50) at least partially joined around said encapsulation (48) so as to allow the insertion of the diode light source (20) in the housing seat (56), and to prevent any impact or contact between the encapsulation (48) and the front wall (60), in the step of inserting the diode light source (20) in the respective housing seat (56).

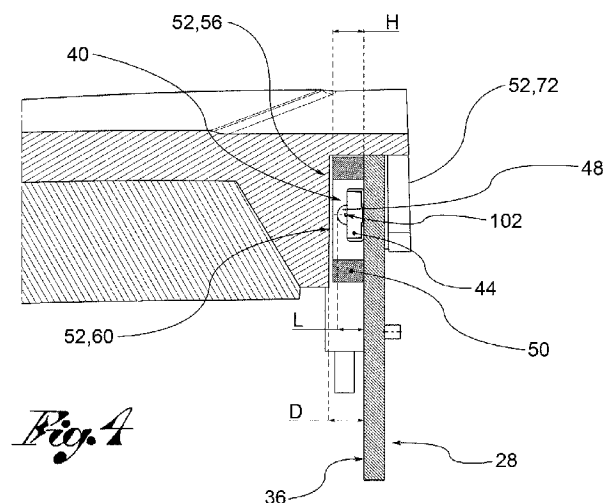


Fig. 4

Description

[0001] The present invention relates to a vehicle light provided with at least one light source of the light-emitting diode type, so-called LEDs, wherein the term vehicle light refers regardless to a rear vehicle light or a front vehicle light, the latter also called a projector or headlight. The present invention also relates to an assembly method of said vehicle light.

[0002] As is known, a vehicle light is a lighting and /or signalling device comprising at least one outer light of the vehicle having a function of lighting or signalling outwards of the vehicle.

[0003] A vehicle light, taken at its simplest, comprises a container body, a lenticular body and at least one light source.

[0004] The lenticular body is placed so as to close the mouth of the container body so as to form a housing chamber. The light source is arranged inside the housing chamber, which may face so as to emit light towards the lenticular body, when powered with electricity.

[0005] The light-emitting diode light source comprises an electric support and connection component to mechanically support and electrically connect electronic components and at least one electronic component composed of a light-emitting diode.

[0006] The electric support and connection component may be composed for example, of a rigid, rigid-flexible or flexible printed circuit, while a typical light-emitting diode comprises a plate of a semi-conductor circuit material, the so-called "chip" and an encapsulation.

[0007] The encapsulation may include, in addition, an optical element which is generally composed of a lens in silicone resin or a lens in epoxy resin, which encompasses a conductor wire, the so-called wire-bonding.

[0008] Conventional light-emitting diode light sources are vulnerable to mechanical stress, such as impact, chafing and the like which may jeopardise the integrity of the encapsulation of the light-emitting diode.

[0009] In fact, the light-emitting diode light source may be subject to incorrect assembly manipulations during the step of mounting the vehicle light, which may cause the detachment of the silicone resin lens or damage the conductor wire or semi-conductor plate.

[0010] As a result the light-emitting diode may break or be damaged. In the case in which the light-emitting diode is broken, the formation of light is always impaired, while in the case in which the light-emitting diode is damaged, the formation of light may be suspended in certain operating conditions difficult to identify during testing, or the lifespan of the light-emitting diode may be reduced.

[0011] Think, for example of the case in which the conductor wire is moved out of its original position. In this case, the light-emitting diode may function during testing but stop functioning in certain conditions or prematurely.

[0012] As a consequence of such fact the production rejects or returns under warranty regarding the vehicle light increase considerably, thereby affecting the final

production costs.

[0013] The purpose of the present invention is to make a vehicle light provided with at least one light source of the light-emitting diode type able to assure greater reliability and to prevent breakages of the diode light source during assembly of the light.

[0014] Such purpose is achieved by a vehicle light according to claim 1, and by an assembly method according to claim 15.

[0015] Other embodiments of the vehicle light according to the invention are described in the subsequent claims.

[0016] Further characteristics and advantages of the present invention will be more clearly comprehensible from the description given below of its preferred and non-limiting embodiments, wherein:

[0017] figure 1 is a perspective view in separate parts of a vehicle light according to one embodiment of the invention;

[0018] figure 2 shows a perspective view of some components of the light in figure 1;

[0019] figure 3 shows an enlargement of the particular III in figure 2;

[0020] figure 4 shows a cross-section view along the section plane IV-IV in figure 3;

[0021] figure 5 shows a perspective view of a particular of the light according to the present invention;

[0022] figures 6-7 respectively show a ground view and a lateral view of the particular VI in figure 5;

[0023] figure 8 is a partial cross-section of a particular of a light according to one embodiment of the present invention;

[0024] figure 9 shows a ground view of the particular in figure 8;

[0025] figure 10 is a partial cross-section of a particular of a light according to one embodiment of the present invention;

[0026] figure 11 shows a ground view of the particular in figure 10;

[0027] The elements or parts of elements common to the embodiments described below will be indicated using the same reference numerals.

[0028] With reference to the aforementioned figures, reference numeral 4 globally denotes a vehicle light; the definition of vehicle light is to be understood in a general sense, comprising a light suitable for being used on any type of motorised vehicle.

[0029] The vehicle light 4 comprises a container body 8 and a lenticular body 12 which at least partially define a housing chamber 16 hosting a light-emitting diode light source 20.

[0030] The container body 8 comprises a mouth 10 through which it usually receives and contains the various components of the light; the container body 8 in addition permits the attachment of the light 4 to the relative vehicle.

[0031] The lenticular body 12 is made with a partially transparent, semi-transparent or translucent material and

may also include an opaque portion.

[0032] The lenticular body 12 is placed so as to close the mouth 10 of the container body 8 so as to enclose said housing chamber 16.

[0033] Further components of the vehicle light 4 may be placed inside the housing chamber 16 such as, for example, a reflector body 22, a collimator body (not shown) and a light guide body 24.

[0034] The reflector body 22 is usually made of an opaque material and shaped substantially concave with one of its inner surfaces mirror-treated, that is metallised. The reflector body 22 is, moreover, coupled to the light source, so as to form an optical system in which the light emitted by the light source 20 is reflected on the inner metallised surface of the reflector body 22 and projected at a great distance after crossing the lenticular body 12.

[0035] The collimator body is usually made from transparent material and bases its functioning principle on the physical phenomenon of refraction. The collimator body is placed adjacent to the light source to collect and propagate therein the light emitted by the light source. The light propagated inside the collimator body is therefore emitted in the form of a beam of light substantially concentrated in a predetermined projection area or point.

[0036] The collimator body is usually made from transparent material and bases its functioning principle on the physical phenomenon of refraction which regulates the transmission of light inside optic fibres. The light guide body 24 is placed beside the light source, so as to collect and propagate therein the light emitted by the light source. The light propagated inside the light guide body 24 is then distributed in the surrounding space in a desired manner. The light guide body 24 may, in addition, be fitted with a plurality of light deviation/extraction elements to deviate/extract light propagated therein towards the outside of said light guide body.

[0037] The light-emitting diode light source 20 comprises an electric support and connection component 28 having electrical connection means 32 and at least one support wall 36.

[0038] The electric support and connection component 28 may be typically composed of a rigid printed circuit, of a rigid-flexible printed circuit or flexible printed circuit, depending on the type of application. The electric connection means 28 are composed for example of electric contacts, wires, tracks applied to the printed circuit, suitable for electrically connecting electronic components.

[0039] The diode light source 20 further comprises at least one light-emitting diode 40 electrically connected to the electrical connection means 32.

[0040] According to one embodiment, the light-emitting diode 40 comprises a substrate, or package, 44 fixed to the support wall 36 and an encapsulation 48, which encompasses a chip 102 so as to project overhanging from said support wall 36, for a maximum distance "L".

[0041] The encapsulation 48 comprises an optical element such as for example a silicone resin lens or an epoxy resin lens.

[0042] The encapsulation 48 is positioned so as to encompass the chip 102 and a conductor wire, the so-called wire-bonding, thereby performing a dual function of protecting from foreign bodies and directing a luminous flow emitted by the chip 102.

[0043] Advantageously, the vehicle light 4 comprises at least one protection device 50 joined to the support wall 36 at least partially around said encapsulation 48, as described further below.

[0044] The light 4 comprises guide and attachment means 52 for the diode light source 20 which define at least one housing seat 56 at least partially counter-shaped to the electric support and connection component 28.

[0045] The guide and attachment means 52 comprise at least one front wall 60 directly facing the encapsulation 48 so that the distance D measured perpendicular between the front wall 60 and the support wall 36 is from 1 to 2.5 times the maximum distance 'L'; preferably said distance D is from 1.3 to 1.7 times the maximum distance 'L'.

[0046] According to one embodiment, the guide and attachment means 52 identify a housing seat 56 having an access hole 64 for the light-emitting diode 40, positioned laterally in relation to the front wall 60 so as to identify an insertion direction X-X of the light-emitting diode 40 substantially parallel to the front wall 60 and perpendicular to the overhanging portion of the encapsulation 48.

[0047] In other words, the light-emitting diode 40 is inserted laterally to the front wall 60 so that the encapsulation is directed perpendicular to the insertion direction X-X.

[0048] According to one embodiment, the guide and attachment means 52 comprise a pair of rails 68 which jut out from said front wall 60 towards the diode light source 20, the rails 68 being parallel to the insertion direction X-X of the diode 40 and being positioned in such a way that, in an assembled configuration of the light, they embrace and perimetally contain the protection device 50.

[0049] Preferably, the guide and attachment means 52 comprise a pair of brackets 72, positioned opposite the front wall 60 so as to block in position the electric support and connection component 28, placed between the brackets 72 and the front wall 60 according to an interference coupling.

[0050] In other words, the bracket 72 and/or the rails 68 guide the insertion of the electric support and connection component 28 inside the housing seat 56 and, once inserted, ensure it is blocked in position.

[0051] In particular, the brackets 72, rails 68 and/or front wall 60 receive one insertion end 76 of the electric support and connection component 28 and guide the component as far as the respective limit stop in the housing seat 56.

[0052] According to one embodiment, the guide and attachment means 52 for the light source 20 make it pos-

sible to insert the electric support and connection component 28, so that the light produced by the light-emitting diode 40 is directly received and transmitted by the light reception and propagation element of the vehicle light 4, such as the collimator body, the light guide body 24 or the lenticular body 12 described above.

[0053] According to one embodiment, so that the light produced by the light-emitting diode 20 is directly received and transmitted by the light reception and propagation element of the vehicle light 4, such as the collimator body, the light guide body 24 or the lenticular body 12 described above. in other words, the guide and attachment means 52 are positioned next to the light reception and propagation element, so as to permit the arrangement of the light-emitting diode 40 next to said light reception and propagation element to prevent the dispersion of the beam of light emitted.

[0054] In one embodiment, so that the light produced by the light-emitting diode 20 is directly received and transmitted by the light reception and propagation element of the vehicle light 4, such as the collimator body, the light guide body 24 or the lenticular body 12 described above.

[0055] For example, a light guide body 24 is shown in the figures, which terminates at a first end with said guide and attachment means 52 so as to house at least one light-emitting diode.

[0056] As mentioned above, advantageously, the vehicle light 4 of the present invention comprises at least one protection device 50 joined to the support wall 36 at least partially around said encapsulation 48, so as to protect the encapsulation 48 from any contact/impact against the front wall 60.

[0057] A height H of said protection device 50, measured perpendicular to the support wall 36 is from 0.8 to 2.5 times the maximum distance 'L', and preferably, the height H of said protection device 50 is from 1 to 2.5 times the maximum distance 'L', and in any case compatible with the distance 'D' as specified further below, so as to permit the insertion of the diode light source 20 in the housing seat 56 and prevent any impact or contact between the encapsulation 48 and the front wall 60 in the step of inserting the diode light source 20 in the respective housing seat 56, according to the insertion direction X-X imposed by the guide and attachment means 52.

[0058] According to a preferred embodiment, the protection device 50 is at least partially glued and/or welded to the support wall 36.

[0059] To facilitate the welding, the protection device 50 is preferably fitted with at least one metal terminal 92 suitable for being welded to the support wall 36, according to methods of the prior art, for example, by means of the known surface mount technology SMT, or equivalently, SMD wherein no drilling of the electric support and connection component is performed.

[0060] According to one embodiment, the protection device 50 may be attached to the support wall 36 in a detachable manner. For example, the support wall 36

may comprise a through hole 80 and the protection device 50 may comprises at least one attachment tooth 84 suitable for realising a snap coupling with said through hole 80. For example, the attachment tooth 84 may comprise a chamfer 86 to facilitate insertion in the through hole 80; a chock 88 of the attachment tooth 84 may thereby form an undercut at the through hole 80, on the side opposite the support wall 36, so as to block it.

[0061] According to a further embodiment, the protection device 50 is fitted with at least one metal peg 96 inserted in the through hole 80 of the electric support and connection component 28 and riveted on the opposite side to the support wall 36.

[0062] According to one embodiment, the protection device 50 is fitted with at least one protection wall 100 positioned on the side of an insertion end 76 of the light-emitting diode 40 in the respective housing seat 56, said protection wall 100 being positioned between the insertion end 76 and the encapsulation 48 along the insertion direction X-X, so as to prevent contact between the encapsulation 48 and the front wall 60 during the insertion of the diode 40 in the housing seat 56.

[0063] For example, the at least one protection wall 100 of the protection device 50 extends along a closed line which completely surrounds the light-emitting diode 40.

[0064] For example, the protection wall 100 extends along a quadrangular, circular, elliptical perimeter: obviously any other geometric shape may also be envisaged.

[0065] The protection wall 100 of the protection device 50 is positioned and dimensioned in such a way as to leave unperturbed a beam of light emitted by the light-emitting diode 40 when the light-emitting diode light source 20 is powered with electricity.

[0066] In other words, the height H and the distance of the protection wall 100 from the encapsulation 48 are chosen so as not to interfere with the luminous beam emitted by the diode 40. More specifically, the height H of the protection wall depends on the breadth α of a luminous beam emitted by a light-emitting diode, so that the protection wall 100 does not perturb said luminous beam. For example, a formula of the height H of the protection wall in relation to the breadth α may be as follows:

[0067] $H = K \cotg (\alpha/2)$

[0068] wherein the constant K accounts for the parameters imposed by the topology of the circuit.

[0069] Obviously, the choice of the H value must comply with the requisites of non interference with the front wall 60 explained above so as to permit the insertion of the diode light source 20 in the housing seat 56: in other words, the height H must be less than or equal to D.

[0070] According to a further embodiment, the protection device 50 comprises a box-like protective cover 104 substantially transparent or semi-transparent to the light, said box-like protective cover 104 covering the chip 102 and the encapsulation 48.

[0071] For example, said box-like protective cover 104 is hemispherical. Moreover said box-like protective cover

104 may comprise at least one hole at the encapsulation 48: thereby favouring the heat exchange of the diode 40 and reducing interference with the luminous beam produced by the diode 40 as much as possible.

[0072] The assembly method of a vehicle light according to the invention will now be described.

[0073] In particular, the container body 8 and the lenticular body 12 which at least partially define the housing chamber 16 for hosting at least one light-emitting diode light source 20 are prepared. At least one light-emitting diode light source 20 comprising an electric support and connection component 28 having electrical connection means 32 and at least one support wall 36, and comprising at least one light-emitting diode 40 electrically connected to the electrical connection means 32 are prepared. The light-emitting diode 40 comprises, as observed, a substrate 44 fixed to the support wall 36 and the encapsulation 48, joined to the chip 102 so as to project overhanging from the support wall 36, for a maximum distance (L).

[0074] The method further comprises the step of providing guide and attachment means 52 for the diode light source 20 which define at least one housing seat 56 at least partially counter-shaped to the electric support and connection component 28, wherein the guide and attachment means 52 comprise at least one front wall 60 directly facing the encapsulation 48 so that the distance D measured perpendicular between the front wall 60 and the support wall 36 is from 1 to 2.5 times the maximum distance L. Preferably, said distance D is from 1 to 2.5 times the maximum distance 'L'.

[0075] The connection of at least one protection device 50 to the support wall 36 at least partially around said encapsulation 48, in which the height H of said protection device 50, measured perpendicular to the support wall 36 is from 1 to 2.5 times the maximum distance L and in any case compatibly with the distance 'D', is advantageously envisaged.

[0076] The protection device 50 may be of any shape or size according to the above description.

[0077] After connecting the protection device 50 to the diode 40, the diode light source 20 is inserted in the housing seat 56 through the guide and attachment means 52, so as to prevent any impact or contact between the encapsulation 48 and the front wall 60 during said insertion step.

[0078] Preferably, the insertion of the diode light source 20 in the housing seat 56 takes place through the guide and attachment means 64, positioned laterally in relation to the front wall 60 so as to identify an insertion direction X-X of the light-emitting diode 40 substantially parallel to the front wall 60 and perpendicular to the overhanging portion of the encapsulation 48.

[0079] As may be appreciated from the description, the vehicle light according to the invention makes it possible to overcome the drawbacks of the prior art presented.

[0080] In fact, the light-emitting diode, and in particular the encapsulation, which constitutes the most delicate

element, is protected from impact/ collision at all times during the assembly step of the light.

[0081] This way breakages and damage of the diode are avoided and as a result the production rejects and returns under warranty relative to the vehicle light are drastically reduced, thereby also reducing the final production costs.

[0082] The protection devices according to the present invention not only make it possible to protect the most sensitive parts of the light-emitting diode but do not substantially interfere with the optics of the vehicle light: in other words do not modify the luminous beam produced.

[0083] Moreover, the protection devices permit an adequate heat exchange of the diode with the environment such as to prevent possible overheating thereof.

[0084] A person skilled in the art may make numerous modifications and variations to the vehicle lights described above so as to satisfy contingent and specific requirements, all contained within the sphere of the invention as defined by the appended claims.

Claims

1. Vehicle light (4) comprising

- a container body (8) and a lenticular body (12) which at least partially define a housing chamber (16) hosting a light-emitting diode light source (20),
- said light-emitting diode light source (20) comprising an electric support and connection component (28) having electrical connection means (32) and at least one support wall (36),
- the diode light source (20) further comprising at least one light-emitting diode (40) electrically connected to the electrical connection means (32),
- the light-emitting diode (40) comprising a substrate (44) fixed to the support wall (36) and an encapsulation (48), associated with a chip (102) so as to project overhanging from said support wall (36), for a maximum distance (L),

characterised in that

- the light (4) comprises guide and attachment means (52) for the diode light source (20) which define at least one housing seat (56) at least partially counter-shaped to the electric support and connection component (28),
- wherein the guide and attachment means (52) comprise at least one front wall (60) directly facing the encapsulation (48), so that the distance (D) measured perpendicular between the front wall (60) and the support wall (36) is from 1 to 2.5 times the maximum distance (L),
- wherein the vehicle light (4) comprises at least one protection device (50) joined to the support wall (36) at least partially around said encapsu-

- lation (48), in which the height (H) of said protection device (50), measured perpendicular to the support wall (36) is from 1 to 2.5 times the maximum distance (L), said protection device (50) being suitable for allowing the insertion of the diode light source (20) in the housing seat (56), so as to prevent any impact or contact between the encapsulation (48) and the front wall (60) in the step of inserting the diode light source (20) in the respective housing seat (56), wherein the housing seat (56) has an access hole (64) for the light-emitting diode (40), positioned laterally in relation to the front wall (60) so as to identify an insertion direction (X-X) of the light-emitting diode (40) parallel to the front wall (60) and perpendicular to the overhanging portion of encapsulation (48), wherein the guide and attachment means (52) comprise a pair of rails (68) which jut out from said front wall (60) towards the diode light source (20), the rails (68) being parallel to the insertion direction (X-X) of the diode (40) and being positioned in such a way that, in an assembled configuration of the vehicle light (4), they embrace and perimetally contain the protection device (50).
2. Vehicle light (4) according to claim 1, wherein the guide and attachment means (52) comprise a pair of brackets (72), positioned opposite the front wall (60) so as to block in position the electric support and connection component (28), placed between the brackets (72) and the front wall (60) according to an interference coupling.
 3. Vehicle light (4) according to any of the previous claims, wherein the guide and attachment means (52) for the light source (20), are directly joined to and/or facing an element for receiving and propagating the light of the vehicle light, such as a collimator body, a light guiding body (24) or a lenticular body (12).
 4. Vehicle light (4) according to any of the previous claims, wherein the attachment means for the light source (20), are in one piece with an element for receiving and propagating the light of the vehicle light, such as a collimator body, a light guiding body (24) or a lenticular body (12) of the light (4).
 5. Vehicle light (4) according to any of the previous claims, wherein said protection device (50) is attached to the support wall (36) in a detachable manner.
 6. Vehicle light (4) according to any of the previous claims, wherein said support wall (36) comprises a through hole (80) and the protection device (50) comprises at least one attachment tooth (84) suitable for realising a snap coupling in said through hole (80).
 7. Vehicle light (4) according to any of the previous claims from 1 to 4 wherein the protection device (50) is at least partially glued and/or welded to the support wall (36).
 8. Vehicle light (4) according to any of the previous claims from 1 to 4 wherein the protection device (50) is fitted with at least one metal peg (96) inserted in the electric support and connection component (28) and riveted on the opposite side to the support wall (36).
 9. Vehicle light (4) according to any of the previous claims, wherein the protection device (50) is provided with at least one protection wall (100) positioned on the side of an insertion end (76) of the light-emitting diode (40) in the respective housing seat (56), said protection wall (100) being positioned between the insertion end (76) and the encapsulation along the insertion direction (X-X), so as to prevent contact between the encapsulation (48) and the front wall (60) during the insertion of the diode (40) in the housing seat (56).
 10. Vehicle light (4) according to claim 9, wherein the at least one protection wall (100) of the protection device (50) extends along a closed line which completely surrounds the light-emitting diode (40).
 11. Vehicle light (4) according to claim 9 or 10, wherein the protection wall (100) of the protection device (50) is positioned and dimensioned in such a way as to leave unperturbed a beam of light emitted by the light-emitting diode (40) when the light-emitting diode light source (20) is powered with electricity.
 12. Vehicle light (4) according to any of the previous claims from 1 to 10 wherein the protection device (50) comprises a box-like protective cover (104) substantially transparent or semi-transparent to the light, said box-like protective cover (104) covering the chip (102) and the encapsulation (48).
 13. Vehicle light (4) according to claim 12, wherein said box-like protective cover (104) is hemispherical.
 14. Vehicle light (4) according to claim 12 or 13, wherein said box-like protective cover (104) comprises at least one hole at the encapsulation (48).
 15. Method of assembly of a vehicle light according to any of the claims from 1 to 14, comprising the steps of:
 - preparing the container body (8) and the len-

ticular body (12) which at least partially define the housing chamber (16) for hosting a light-emitting diode light source (20),

- preparing at least one light-emitting diode light source (20) comprising an electric support and connection component (28) having electrical connection means (32) and at least one support wall (36), and comprising at least one light-emitting diode (40) electrically connected to the electrical connection means (32), the light-emitting diode (40) comprising a substrate (44) fixed to the support wall (36) and an encapsulation (48), associated with a chip (102) so as to project overhanging from said support wall (36), for a maximum distance (L),

- the method being **characterised in that** it comprises the steps of:

- providing guide and attachment means (52) for the diode light source (20) which define at least one housing seat (56) at least partially counter-shaped to the electric support and connection component (28), said guide and attachment means (52) comprising at least one front wall (60) directly facing the encapsulation (48) so that the distance (D) measured perpendicular between the front wall (60) and the support wall (36) is from 1 to 2.5 times the maximum distance (L),

- connecting at least one protection device (50) to the support wall (36), at least partially around said encapsulation (48), in which the height (H) of said protection device (50), measured perpendicular to the support wall (36) is from 1 to 2.5 times the maximum distance (L),

- inserting the diode light source (20), previously fitted with the protection device (50), in the housing seat (56) through the guide and attachment means (52), so as to prevent any impact or contact between the encapsulation (48) and the front wall (60) during said insertion step, providing an access hole (64) in the housing seat (56) for the diode (40), positioned laterally in relation to the front wall (60) so as to identify an insertion direction (X-X) of the light-emitting diode (40) parallel to the front wall (60) and perpendicular to the overhanging portion of encapsulation (48).

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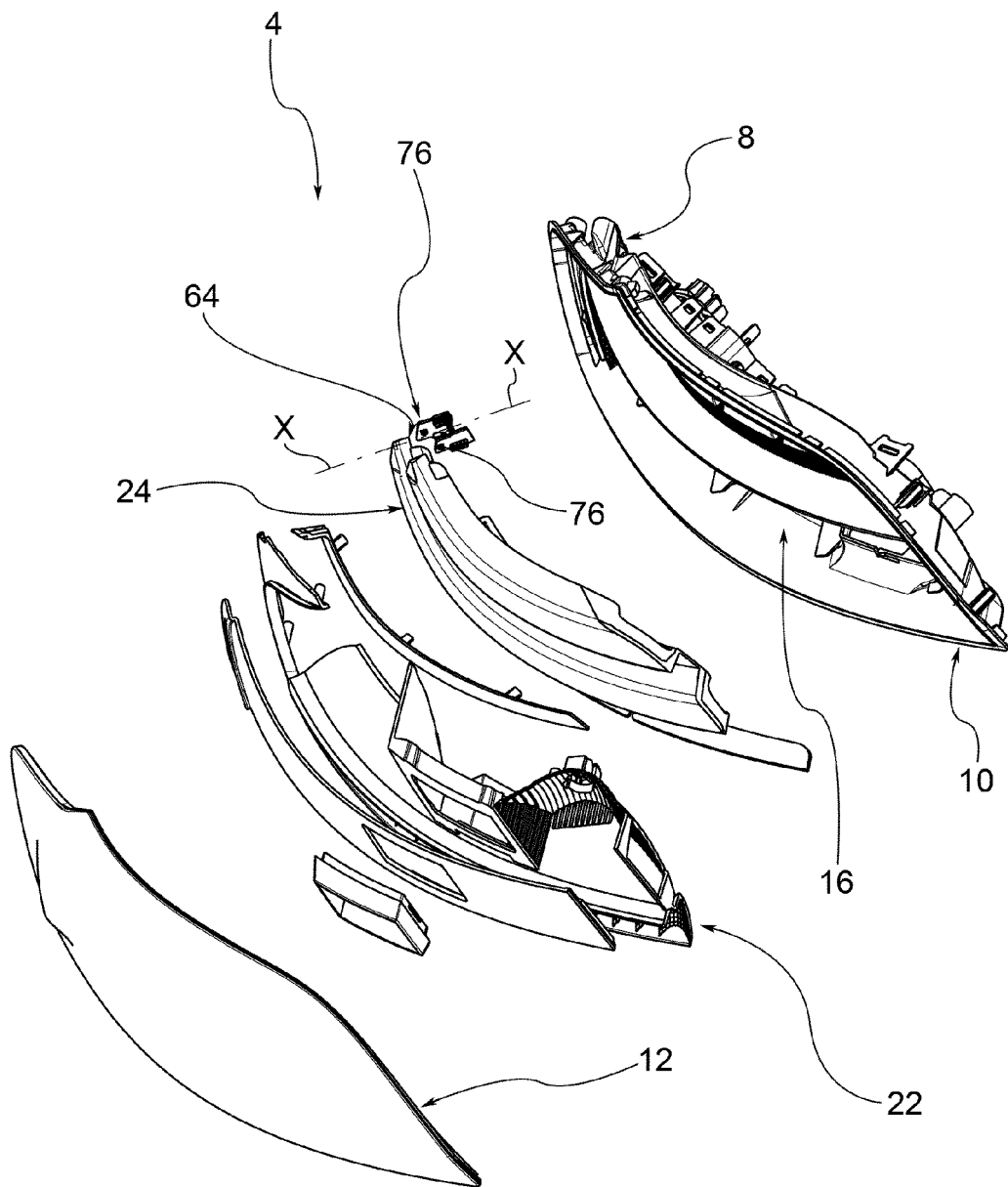
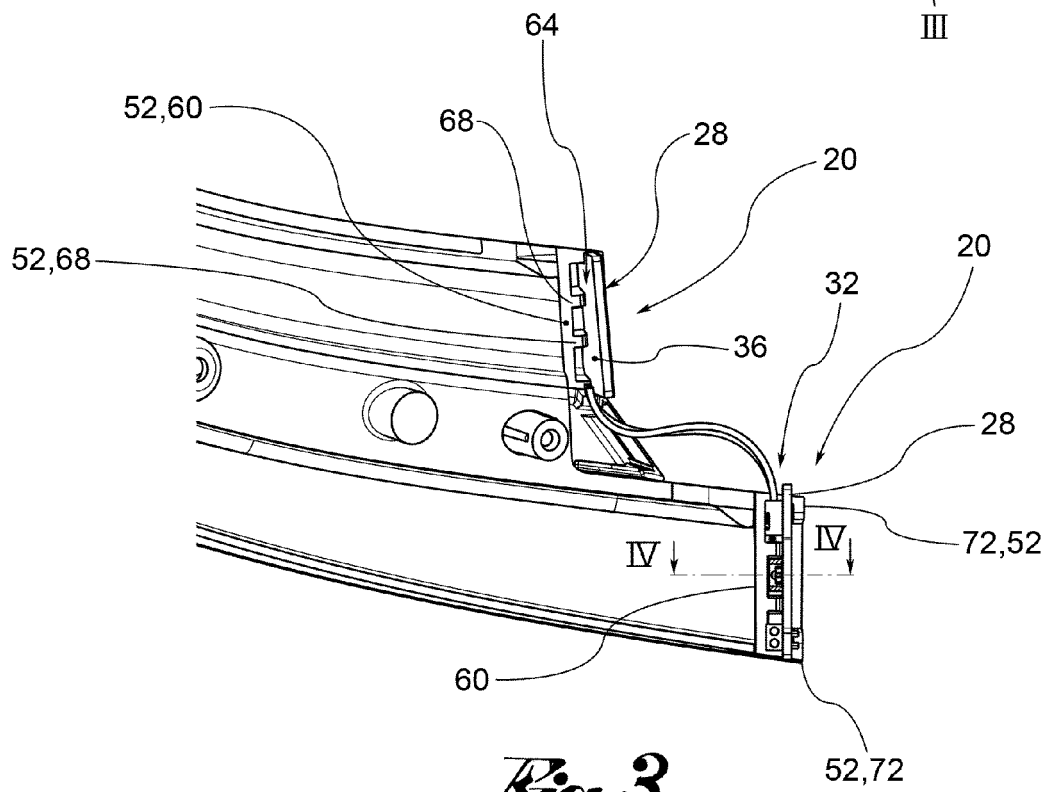
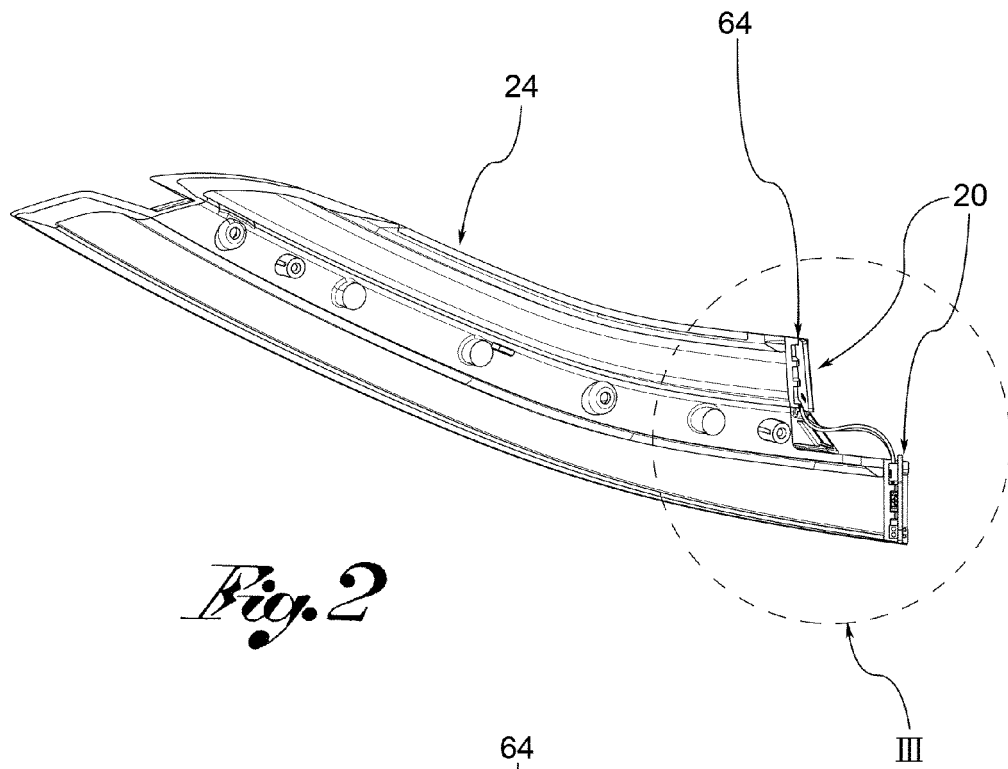
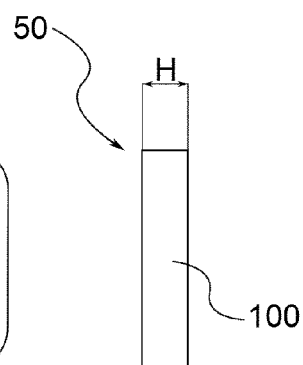
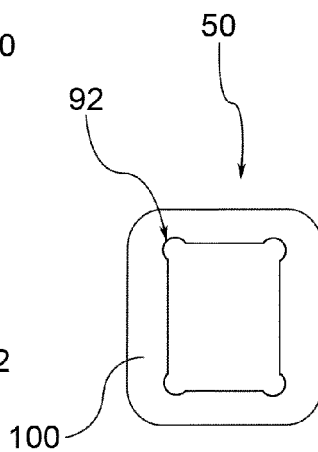
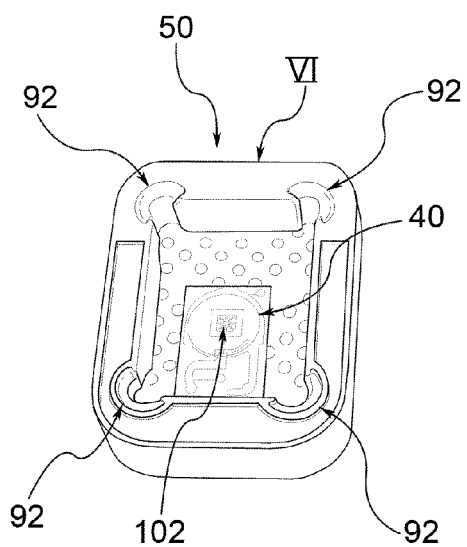
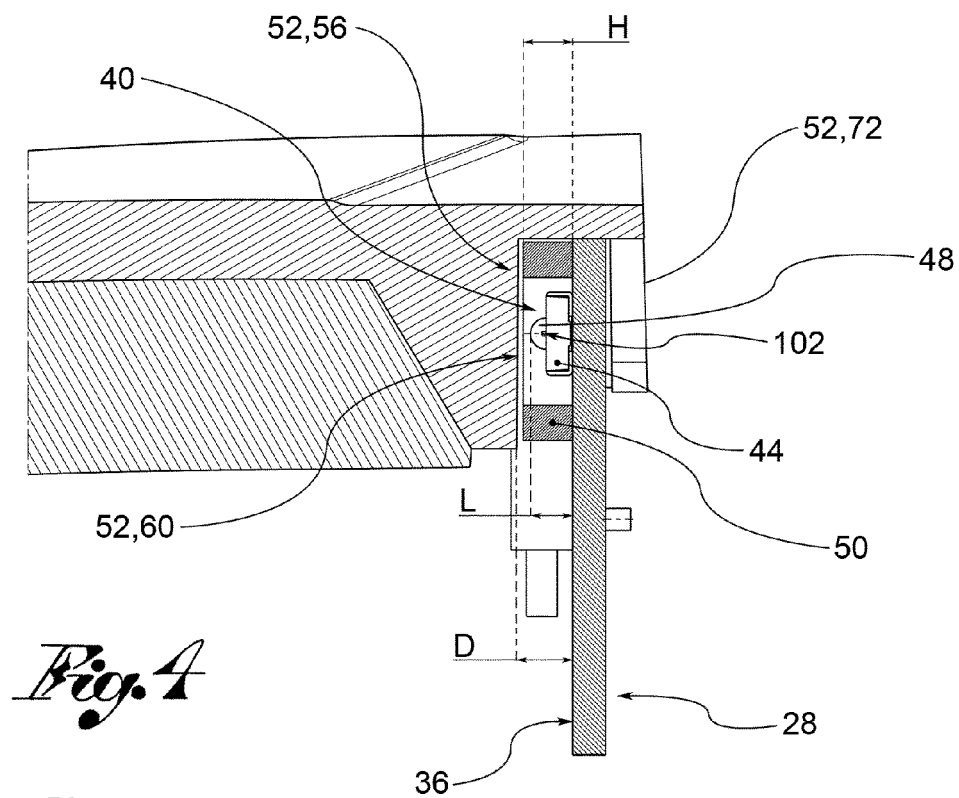


Fig. 1





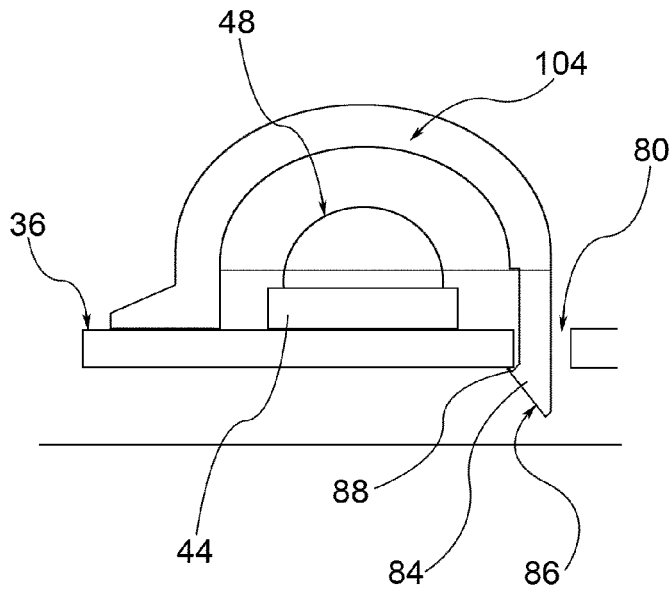


Fig. 8

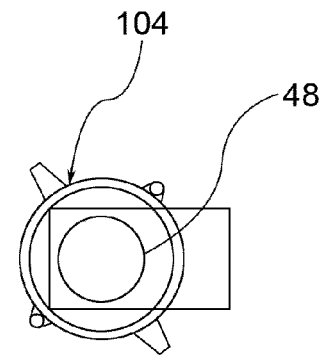


Fig. 9

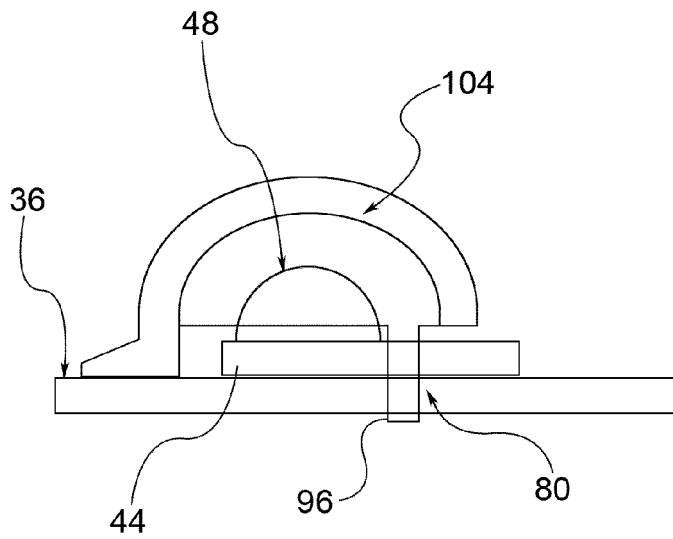


Fig. 10

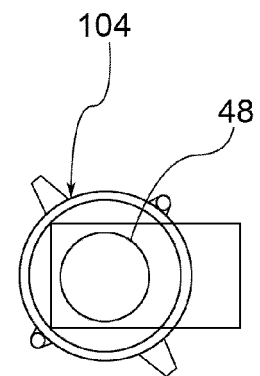


Fig. 11



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Application Number
EP 12 18 8960

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