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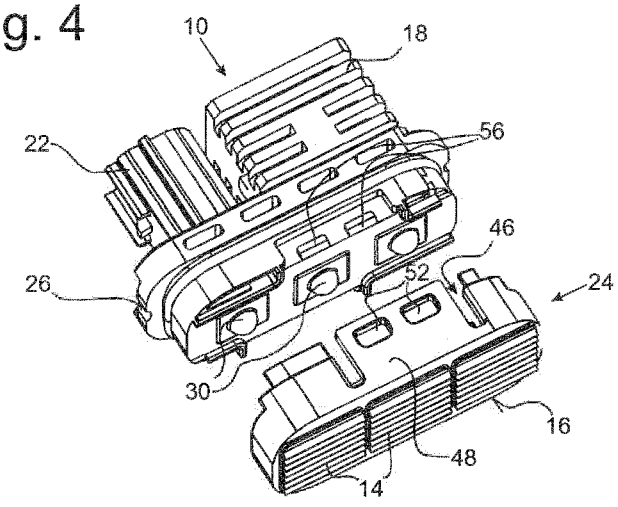
Fig. 4




(57) Abstract: A lighting module 10, a set of lighting modules 10, 10a and a method of producing lighting modules 10, 10a are described. A lighting module 10 has at least one LED lighting element 30 attached to a base unit 26. A front unit 24 is attached to the base unit 26. The front unit 24 comprises at least one lens element 14. The front unit 24 is fixed to the base unit 26 by interlocking elements 52, 56 provided on the base unit 26 and on the front unit 24 in form-fitting engagement. To provide a first and a second lighting module 10, 10a, identical base units 26 may be provided with different front units 24, 24a, such that an intensity distribution of a beam 50 emitted from a first lighting module 10 differs from an intensity distribution of a 10 beam 50a emitted from the second lighting module 10a.

*[Continued on next page]*

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# MODULAR LIGHTING DEVICES

## FIELD OF THE INVENTION

The invention relates to a lighting module, to a set of lighting modules and to a method of producing lighting modules. Most specifically, the invention relates to lighting modules to be installed in a vehicle, for example as signaling lamps.

## BACKGROUND OF THE INVENTION

Motor vehicles are equipped with a plurality of different lamps, in particular signaling lamps, such as e.g. turning indicator, brake light, reverse lamp, etc. Each of these lamp types fulfills different specific photometric requirements.

LED lighting devices are already in use for automotive signaling lamps. However, for each of the different types of lamps required, different individual designs are used.

EP 2 886 939 A2 discloses a lighting device including a body section, a cover section provided on an end surface of the body section and a light emitting module provided between the body section and the cover section, having a light emitting element. A position of the end section of the light emitting module is equal to a position of the end section of the body section, or is nearer to the side of the cover section than the position of the end section of the body section. The position of the end section on the side of the body section in a portion in which the cover section comes into contact with the body section is nearer to the side of the body section than the position of the end section of the light emitting module on the side of the cover section.

## SUMMARY OF THE INVENTION

It may be considered an object to propose a lighting module suited to fulfill different photometric requirements.

This object may be achieved by a lighting module according to claim 1, a set of lighting modules according to claim 11 and by a method of producing lighting modules according to claim 12. Dependent claims refer to preferred embodiments of the invention.

The present inventors have considered that for each of the different lamp types which may be installed in a motor vehicle, a complete design and verification process

including reliability tests is usually required. In order to simplify both design and production, the inventors propose as one concept to provide a universal lighting module easily adaptable by different optical elements to achieve light radiation patterns suited for the various purposes.

One aspect relates to a lighting module for a vehicle. At least one LED lighting element is attached to a base unit. In the present context, the term "LED lighting element" refers to one or more solid state lighting elements, such as in particular light emitting diodes.

The LED lighting element is attached to a base unit of the lighting module. As will become apparent in connection with preferred embodiments, the base unit may serve a plurality of purposes, such as e.g. providing a mechanical interface, i.e. elements for fixing and positioning of the lighting module within the vehicle, and/or providing an electrical interface, i.e. an electrical connection to deliver operating power to the LED lighting element. The LED lighting element may generally be arranged on a front surface of the base unit, so that the body of the base unit may be arranged behind the LED element if viewed along the optical axis, i.e. the center of the light beam being emitted from the LED lighting element.

A front unit is attached to the base unit. The front unit comprises at least one lens element. The term "lens element" will here be used for any fully or partially transparent element that serves an optical function due to refraction of light passing though it. This comprises any conceivable shape of lenses, such as e.g. convex, concave, planar etc, including shapes with one or multiple prism-shaped portions such as in a Fresnel lens.

Preferably, according to one embodiment, the lens element may be disposed to provide an intensity distribution of emitted light suited for a vehicle signaling lamp.

The front unit may be fixed to the base element in such a position that light emitted from the LED lighting element is emitted through the lens element to form an emitted beam. The photometric properties of the emitted beam, in particular the intensity distribution, will depend both on the beam shape of the light emitted from the LED lighting element and on the optical effect caused thereon by the lens element. Depending on the properties of desired intensity distributions of the emitted beam of light, the lens element may be shaped to fulfill different optical functions. For example, the lens element may be shaped to collimate the beam emitted from the LED lighting element, or it may be shaped to broaden the beam. The lens element may be shaped symmetrically to preserve the direction of the

center of the emitted beam, or it may have an asymetrical shape to direct the center of the emitted beam under a desired angle to the optical axis of the LED lighting element.

The front unit is fixed to the base unit by interlocking elements provided on the base unit and on the front unit in form-fitting engagement. Such interlocking elements may be provided on the base unit and on the front unit and form an interlocking form-fitting engagement. This can ensure both mechanical fixing of the front and base unit and exact relative positioning of the units. The interlocking elements may be for example one or more recesses and/or one or more projections provided on one of the units and corresponding recesses/projections provided on the other unit. The connection may be e.g. a snap connection. The connection may also be formed by screws or interlocking pins, or such elements may be provided in combination with interlocking recesses/projections. In addition, the front and base unit may be connected by gluing, heat staking, ultrasonic welding or other methods.

Thus, the lighting module according to the described aspect is comprised of the described base unit including the LED lighting element and the front unit comprising the lens element. By providing different front units with different lens elements, the same base unit may be used to obtain different emitted beams.

According to one aspect, a set of lighting modules may be provided, comprising at least a first lighting module and a second lighting module, each comprising of a base unit and a front unit. The base units of both lighting modules are identical in construction. The front units of the first and second lighting modules are however different such than that an intensity distribution of a beam emitted from the first lighting unit differs from an intensity distribution of a beam emitted from the second lighting unit. For example, lens elements of the different front units may have different collimating properties, i.e. lens elements from a first front unit may be shaped to collimate light more strongly than lens elements from a second front unit. Also, the lens elements may differ in the direction of the emitted beam, i.e. lens elements from a first front unit may be shaped such that the center of the emitted beam is arranged under an angle with the optical axis of the LED lighting element, and lens elements from a second front unit may be shaped such that the center of the emitted beam is arranged under a different angle with the optical axis, or in parallel thereto.

Thus, by fixing different front units to the same type of base unit, lighting modules may be provided for serving different optical purposes, in particular different signaling lamp purposes onboard of a motor vehicle. In fact, any signaling lamp of a motor vehicle may be provided as a combination of the same type of base unit combined with

different front units including different lens elements. Corresponding lighting modules may be used e.g. as turning indicator, reverse lamp, front and rear fog lamp, brake light, tail lamp, stop lamp, license plate lamp, side marker lamp, etc.For each lighting module, the emitted beam depends on the front unit, and in particular on the optical properties of the lens element therein. The LED element provided on all base units will preferably have a relatively wide opening angle of the emitted light in which a beam is emitted with relatively uniform intensity distribution. The acutal LED die will act as a Lambertian emitter, and the emitted light may be lightly collimated by primary optics, such as e.g. a dome provided over the LED die, such that the beam emitted from the LED element has a wide opening angle. For example, at least 90% of the luminous flux may be emitted within an opening angle of less than or equal to +/- 65°, preferably 40° - 60°, further preferred 45°-55°.

By means of the optical properties of the different lenses that may be used within different types of front units, this generally broad and uniform beam may be transformed to achieve desired intensity distributions that are, for example, more narrow. The lenses are provided with optical properties depending on the purpose that the lighting module should serve. For the emitted beam, specific photometric requirements can thus be achieved conforming to regulations regarding the intended type of lamp, in particular automotive signaling lamp.

According to one aspect, the production of corresponding lighting modules may be achieved by providing at least a first and second identical base unit and attaching different first and second front units comprising different first and second lens elements.

According to another aspect of the invention, the base unit comprises a solid portion made out of a plastic material and the LED lighting element is electrically connected to a lead frame element embedded within the plastic material. The solid portion may preferably be entirely filled, without voids, fully embedding the lead frame. A lead frame in this context is understood to be comprised of electrically conductive metal elements which are preferably of flat shape and may be produced e.g. by punching and bending of sheet metal as a very cost effective metal forming process. The LED lighting element may be fixed to the lead frame, such that elements of the lead frame serve as electrical conductors, e.g. connecting the LED element to a source of electrical energy, such as a plug terminal. The lead frame may be connected to further electrical elements forming an operating circuit for the LED lighting element, such as e.g. one or more electrical resistors, diodes, etc.

Different types of plastic material may be used, e.g. polyamide, polyethylene, etc. Preferably, a plastic material is chosen that is suited for an injection molding process.

Further preferred is a good thermal conductivity of the plastic material, so that it can serve to dissipate heat generated in operation by the LED lighting element. For example, the plastic material may have a thermal conductivity of at least 0,8 W/(mK). Further preferred is a thermal conductivity of above 1 W/(mK), still further a thermal conductivity of above 2 W/(mK). Examples of plastic materials with correspondingly high thermal conductivity are e.g. Stanyl ® TC168 from DSM or FR73200 from DuPont.

The solid portion of the base unit may be provided in direct contact with the LED lighting element. In fact, the base unit may be entirely comprised of the solid body of plastic material with an embedded lead frame. Also, a plug housing comprising an electrical plug terminal may be provided besides the solid body. In order to improve heat dissipation, heat fins may be provided on an outer surface of the solid body.

According to a preferred embodiment, the front unit may be positioned at the front portion of the base unit such that an enclosed, sealed inner space may be provided between the LED lighting element and the lens element. It is possible to provide a water tight seal.

While it is possible to provide only one LED lighting element at the base unit, it may be preferred to provide two or more LED elements next to each other on the base unit. In a particularly preferred embodiment, three elements are arranged in a line, spaced from each other. The front unit comprises a matching number of lens elements to be arranged in front of the LED elements.

According to one preferred embodiment, the front element may comprise a front surface and at least one side wall extending from the front surface. One or more lens elements may be arranged within the front surface, e.g. within at least one opening, or provided in one piece with the front surface and/or side wall. The side wall may define an enclosed space in which the LED element may be received. In particular, the front unit may be fitted over a front portion of the base unit. In order to fix the front unit to the base unit by form-fitting engagement, at least a first recess or first projection may be provided within the side wall, and a second recess or second projection may be provided at the base unit. The first recess or projection may be shaped and arranged to engage the second recess or second projection to form interlocking elements.

According to one embodiment, the base unit may be provided with an electrical plug terminal. The electrical plug terminal may be electrically connected to the LED lighting element in order to supply electrical operating power thereto. The electrical plug terminal may be provided by a portion of a lead frame, or may be electrically connected

thereto. Different plug connections, e.g. differently shaped plug housings may be provided at the base unit, depending on the intended use. For example, the plug connection may be sealed.

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described herein after.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a perspective view of a first embodiment of a lighting module;

Figure 2 shows a top view of the lighting module of figure 1;

Figure 3 shows a sectional view of the lighting module of figure 1, figure 2 with the section along line A..A in figure 2;

Figures 4-6 show the lighting module of figure 1-3 with separated base and front units in a perspective view, top view and side view;

Figure 7 shows a front view of the base unit of figure 4-6;

Figure 8 shows a sectional view of the base unit of figure 7 with the section along the line B..B in Fig. 7;

Figure 9 shows an enlarged portion of Fig. 3;

Figure 10 shows a perspective, exploded view of a second embodiment of a lighting module;

Figure 11 shows a sectional view of a front unit of the second embodiment of figure 10;

Figure 12 shows a perspective view of the lighting module of figure 10;

Figure 13 shows a circuit diagram for the lighting modules,

Figure 14 shows a diagram of photometric requirements of an intensity distribution of a reverse lamp,

Figure 15 shows a diagram of photometric requirements of an intensity distribution of a rear fog lamp.

DETAILED DESCRIPTION OF EMBODIMENTS

Figures 1, 2 show a first embodiment of a lighting module 10 disposed to emit light from a front portion 12 thereof generally into the direction of an optical axis X.

Three adjacent lens elements 14 are provided within a front surface 16 through which light is emitted. To the rear the lighting module 10 comprises a heat dissipation portion 18 provided with heat fins 20 and a plug connection portion 22.

As visible from figures 4-6, the lighting module 10 is comprised of a front unit 24 and a base unit 26.

Provided on the front of the base unit 26 are three LED elements 30. The LED elements 30 form part of an electrical circuit 32 shown in fig. 13. The three LEDs 30 which are arranged on the base unit 26 spaced from each other are electrically connected in series to electrical terminals 34. The electrical circuit 32 comprises a small number of further electrical elements such as resistors R arranged in series and in parallel to the LEDs 30, a Zener diode Z connected in series and, a transient voltage suppressor diode T connected in parallel to the series connection of the LEDs 30.

As shown in the sectional view of fig. 8, the base unit 26 is comprised of a solid body of plastic material 36, in the example a special polyamide material with high thermal conductivity of above 2 W/(mK). One preferred example is FR73200 from DuPont, which has a thermal conductivity of 2.9 W/(mK).

Embedded within the plastic material 36 are the elements of a lead frame 40. The lead frame 40 is electrically connected to each of the LEDs 30. Further, the lead frame 40 is connected to plug terminals 34 projecting into the hollow interior of the plug connector housing 22. The elements of the lead frame form the conductors of the circuit shown in fig. 13.

The LEDs 30 are connected to the lead frame 40 as a die-on-leadframe connection, i. e. the LEDs 30 are not separately packaged, but the semiconductor dies are directly connected to the lead frame. As shown in an enlarged sectional view in fig. 9, the LEDs 30

comprise a transparent dome 42 moulded over the LED die. The lead frame 40 and a rear portion of the dome 42 are embedded within the plastic material 36 of the base unit 26, thus mechanically fixing all components.

By virtue of the good thermal conduction provided by the lead frame 40 and the plastic material 36, the solid portion 18 of the base unit 26 serves as a heat sink. Heat generated at the LEDs 30 during operation is conducted through the lead frame 40 and the surrounding plastic material 36 to be dissipated at the outer surface of the solid portion 18 of the base unit 26. The fins 20 increase the surface area and allow to dissipate a substantial amount of heat.

The die of the LED 30 shown in fig. 9 emits, in operation, light as a Lambertian emitter, i.e. over a wide angular range. The emitted beam is optically modified by the transparent dome 42 and thereby lightly collimated, i.e. focused more towards the optical axis X. In the example, the dome 42 achieves a collimation of 90% of the luminous flux within an opening angle of +/- 50°.

This modified, i.e. lightly collimated beam is then further modified by the lens 14 as shown in fig. 9. In the example shown, lighting module 10 is intended to be used as an automotive signaling lamp, more specifically a reverse lamp. The lens 14 is shaped to achieve the required intensity distribution therefor. Fig. 14 shows a diagram of the photometric requirements, the values in the circles providing the required minimum intensity in cd.

The lens 14 is shaped to direct the light emitted from the LED 30 through the transparent dome 42, forming an emitted beam 50 of desired photometric properties, i. e. exhibiting a spatial intensity distribution depending on the shape of the dome 42 and in particular on the shape of the lens 14.

In the example shown in Fig. 9, the lens 14 comprises a TIR collimator body 43 arranged to receive light emitted from the LED 30. The lens 14 comprises at its front a plurality of prism-shaped surface elements 44. As shown e.g. in Fig. 1, the prism elements 44 are bar-shaped and extend straight in a direction perpendicular to the optical axis X. In the enlarged view of Fig. 9, the asymetric shape of the prism elements 44 is visible, such that the

center of the emitted beam 50 is arranged at an angle to the optical axis X. Thus, the emitted beam 50 is asymetrical with regard to the optical axis X.

The beam 50 emitted from the lighting module 10 according to the first embodiment is suited for a reverse lamp, fulfilling the photometric requirementsshown in Fig. 14. The above described asymetric intensity distribution may in addition be used to direct the beam 50 downwards to illuminate the ground behind a motor vehicle for observation with a rear view camera.

As shown e.g. in fig. 4, 5, the lenses 14 are part of the front unit 24. The front unit 24 has a concave shape with a front surface 16 in which the lenses 14 are arranged. An inner cavity 46 is bordered by a surrounding side wall 48 extending from the front surface 16, as shown e.g. in the sectional view of fig. 3.

Formed within the side wall 48 of the front unit 24 are cutouts 52 and protruding lips 54. The lighting module 10 is assembled by installing the front unit 24 onto the front portion of the base unit 26, such that the LEDs 30 are received within the cavity 46. The front unit 24 is fitted over the front portion of the base unit 26 such that protruding elements 56 projecting to the side, i.e. perpendicular to the optical axis X, are received in the cutouts 52 within the side wall 48 as interlocking elements, thus achieving a form-fitting engagement.

At the same time, the protruding lips 54 are received in corresponding grooves 58 in the front portion of the base unit 26. Glue may be dispensed within the grooves 58 to achieve a permanent connection.

The lighting module 10 is one example of a signaling lamp that may be installed onboard of the motor vehicle. The base unit 26 is fixed within the motor vehicle, and an electrical plug connection is made to the plug terminals 34 to supply electrical operating power.

In order to provide a lighting unit 10 that emits an output beam 50 of desired optical properties, different front units 24 including different lenses 14 may be used. The lighting module 10 represents only one example of how a base unit 26 may be combined with one type of front unit 24 chosen among a plurality of different types of front units.

Figure 10 shows an example of a second lighting module 10a, which comprises a base unit 26 identical to the base unit 26 of the lighting module 10 according to the first embodiment, but combined with a different front unit 24a.

The front unit 24a corresponds in its overall shape to the front unit 24 according to the first embodiment, thus comprising a front surface 16 and a side wall 48 extending therefrom with cutouts 52 and protruding lips 54 formed in the side wall 48.

While thus the second type of front unit 24a is identical to the first type of front unit 24 with respect to the mechanical aspects and in particular to the connection to the base unit 26, the optical effect is different due to the different lenses 14a.

Therefore, while the base units 26 and the LED elements 30 provided thereon are identical between the two types of lighting modules 10, 10a, the resulting beams emitted therefrom in operation have different optical properties.

Fig. 11 is a sectional view, showing a portion of the front unit 24a of the lighting module 10a according to the second embodiment. The lens 14a is of different shape as compared to the lens 14 of the first embodiment (Fig. 9). In the example shown in Fig. 11, the lens 14a comprises a lens body 43a arranged to receive light emitted from the LED 30. At its front, the lens 14a comprises circular prism elements 44a. As shown e.g. in Fig. 10, the prism elements 44a extend concentrically around the optical axis X. The arrangement and thus the emitted beam 50a is symmetrical with regard to the optical axis X.

The beam 50a emitted from the lighting module 10a according to the second embodiment is suited for a rear fog lamp. Fig. 15 shows the photometric requirements for a rear fog lamp fulfilled by the beam 50a.

While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments.

As the skilled person will realize, the two types of lighting modules 10, 10a described in detail are only two examples of lighting modules that may be achieved as a combination of

the base unit 26 with different types of front units 24, 24a. By providing further types of front units with still different lenses, many more types of lighting modules may be achieved, fulfilling different photometric requirements.

Also, the individual features of the lighting modules 10, 10a shown are only exemplary. For example, rather than providing three LEDs 30, a different number of LEDs could be provided. Instead of the plug housing 22, different types of plug housings for differently shaped plug connectors may be provided at the base unit 26.

Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims.

In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article ("a" or "an") does not exclude a plurality.

The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS:

1. Lighting module for a vehicle, comprising
- at least one LED lighting element (30) attached to a base unit (26),
- and a front unit (24, 24a) attached to said base unit (26), said front unit (24, 24a)) comprising at least one lens element (14, 14a),
- said front unit (24, 24a) being fixed to said base unit (26) by interlocking elements (52, 56) provided on said base unit (26) and on said front unit (24, 24a) in form-fitting engagement,- said base unit (26) comprising a solid portion (18) made out of a plastic material (36),
characterized in that
- said LED lighting element (30) is electrically connected to a lead frame element (40), wherein said lead frame element (40) is embedded within said plastic material (36) and wherein said LED lighting element (30) is connected to said lead frame element (40) as a die-on-leadframe connection with a transparent dome (42) moulded over the LED die.

2. Lighting module according to claim 1, wherein
- said solid portion (18) is provided with heat fins (20) on an outer surface thereof.

3. Lighting module according to claim 2, wherein
- said plastic material (36) has a thermal conductivity of at least 0.8 W/(mK).

4. Lighting module according to one of the above claims, wherein
- said plastic material (36) has a thermal conductivity of at least 2 W/(mK) and
- said solid portion (18) of the base unit (26) is in direct contact with the LED lighting element (30).

5. Lighting module according to one of the above claims, wherein
- said lead frame (40) and a rear portion of said dome (42) are embedded within the plastic material (36) of the base unit (26).

6. Lighting module according to one of the above claims, wherein

- said dome (42) achieves a collimation of 90% of the luminous flux within an opening angle of +/- 50°.

7. Lighting module according to one of the above claims, wherein

- said front unit (24, 24a) is positioned at a front portion of said base unit (26) such that an enclosed, inner sealed space (46) is provided between said LED lighting element (30) and said lens element (14, 14a).

8. Lighting module according to one of the above claims, wherein

- said lens element (14, 14a) is disposed to provide an intensity distribution of emitted light (50) suited for a vehicle signaling lamp.

9. Lighting module according to one of the above claims, wherein

- at least two LED elements (30) are provided next to each other on said base unit (26)

- and said front unit (24, 24a) comprises at least two lens elements (14, 14a) arranged in front of said LED elements (30).

10. Lighting module according to one of the above claims, wherein

- said front unit (24, 24a) comprises a front surface (16) and at least one side wall (48) extending from said front surface (16),

- said lens (14, 14a) being arranged within said front surface (16).

11. Lighting module according to claim 10, wherein

- at least a first recess (52) or a first projection is provided within said side wall (48)

- and a second recess or second projection (56) is provided at said base unit (26),

- wherein said first recess (52) or said first projection is in engagement with said second recess or said second projection (56) to form said interlocking elements (52, 56).

12. Set of lighting modules, comprising

- at least a first and a second lighting module (10, 10a) according to one of the above claims, said base unit (26) of said first and second lighting module (10) being identical,

- wherein said front units (24, 24a) of said first and second lighting modules (10) are different, such that an intensity distribution of a beam (50) emitted from said first lighting module (10) differs from an intensity distribution of a beam (50a) emitted from said second lighting module (10a).

13. Set of lighting modules according to claim 12, wherein

- said first and second lighting modules (10) are installed in a motor vehicle as signaling lamps.

14. Method of producing at least two lighting modules (10), wherein

- a first base unit (26) and an identical second base unit (26) are provided, said first base unit (26) comprising at least a first LED lighting element (30) and said second base unit (26) comprising at least a second LED lighting element (30),

- said first and second base unit (26) each comprising a solid portion (18) made out of a plastic material (36),

- said first and second LED lighting element (30) each being electrically connected to a lead frame element (40), wherein said lead frame element (40) is embedded within said plastic material (36) and wherein said LED lighting element (30) is connected to said lead frame element (40) as a die-on-leadframe connection with a transparent dome (42) moulded over the LED die,

- a first front unit (24) comprising at least a first lens element (14) is attached to said first base element (26) such that said first lens element (14) is arranged in front of said first LED lighting element (30),

- and a second front unit (24a) comprising at least a second lens element (14a) is attached to said second base element (26) such that said second lens element (14a) is arranged in front of said second LED lighting element (30),

- said first and second lens elements (14, 14a) differing from one another such that said lighting units (10) are disposed to emit light (50) with different intensity distributions.

Fig. 1

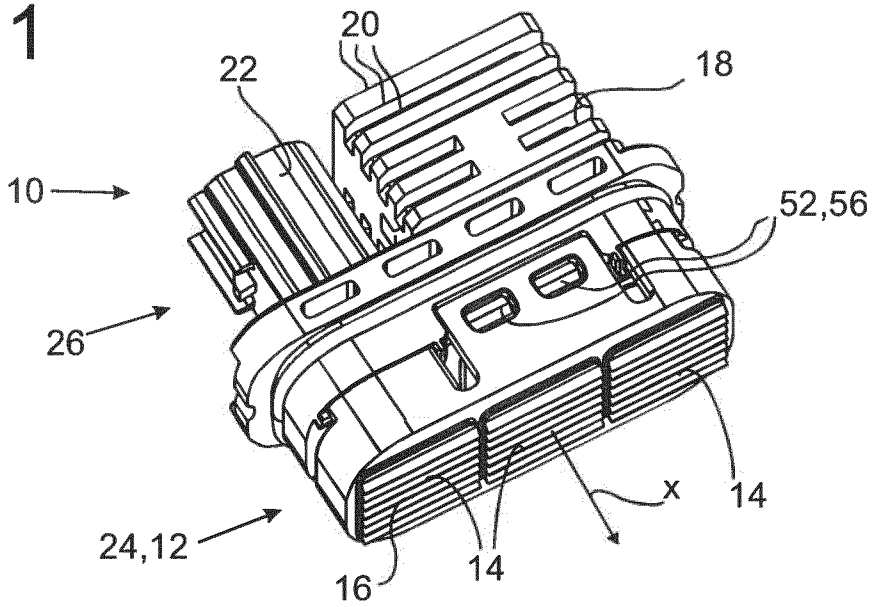



Fig. 2

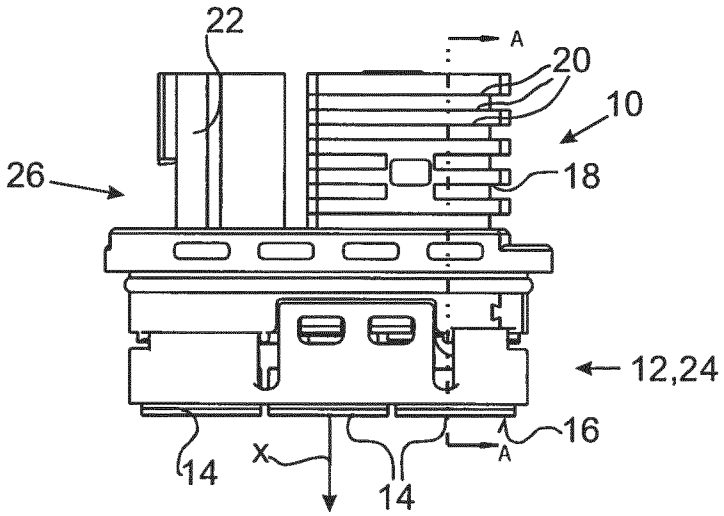



Fig. 3

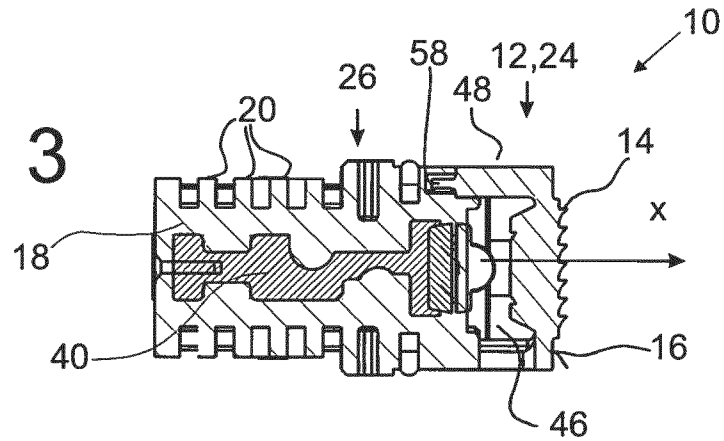


Fig. 4

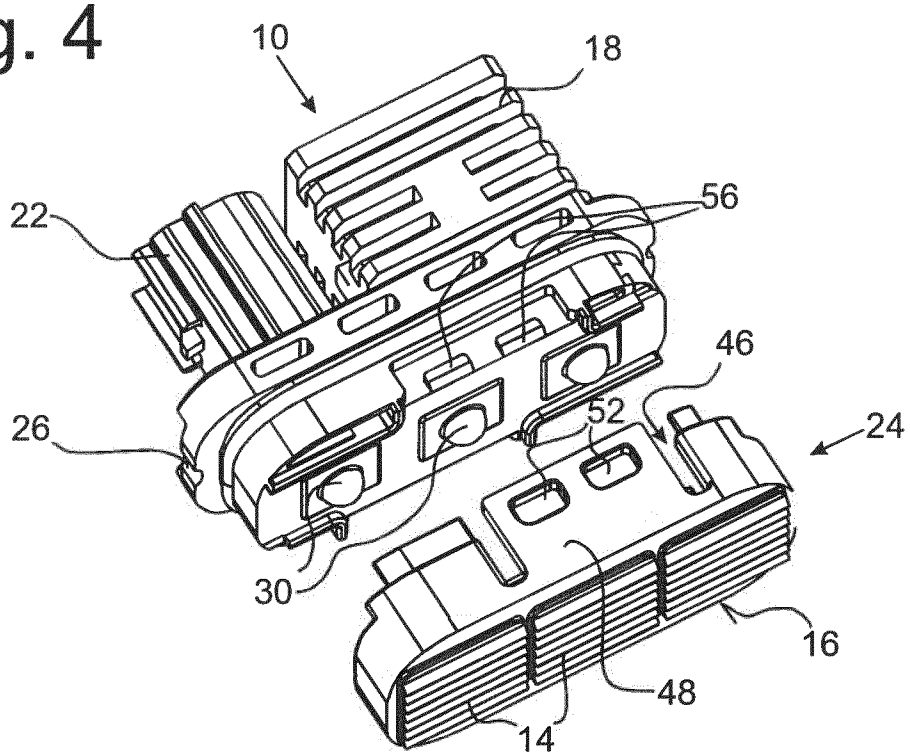



Fig. 5

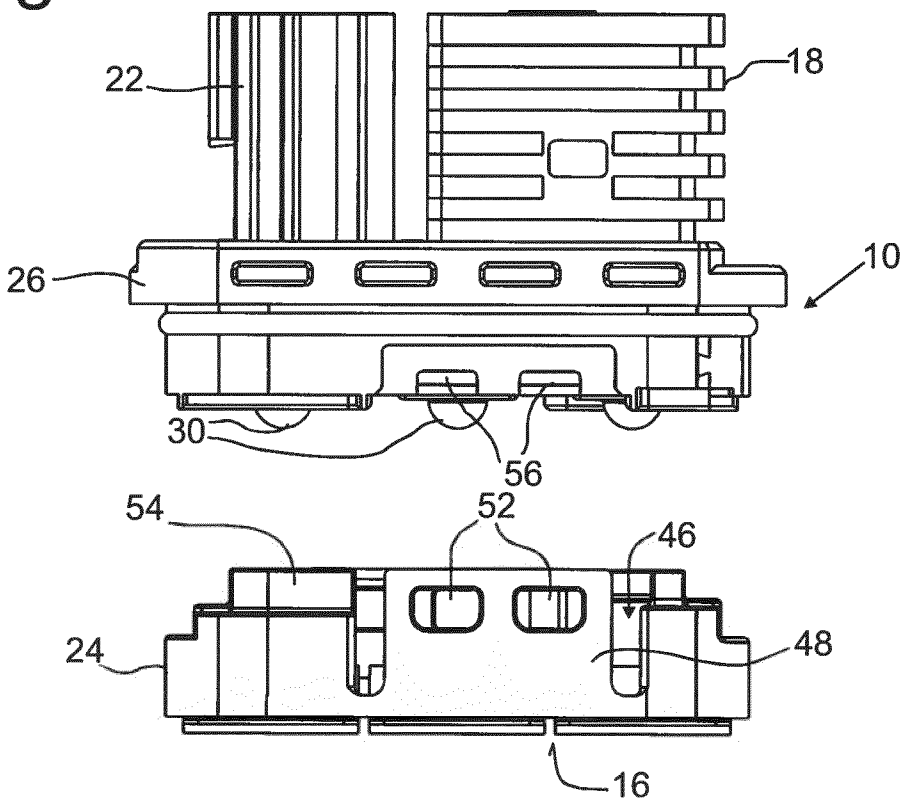


Fig. 6

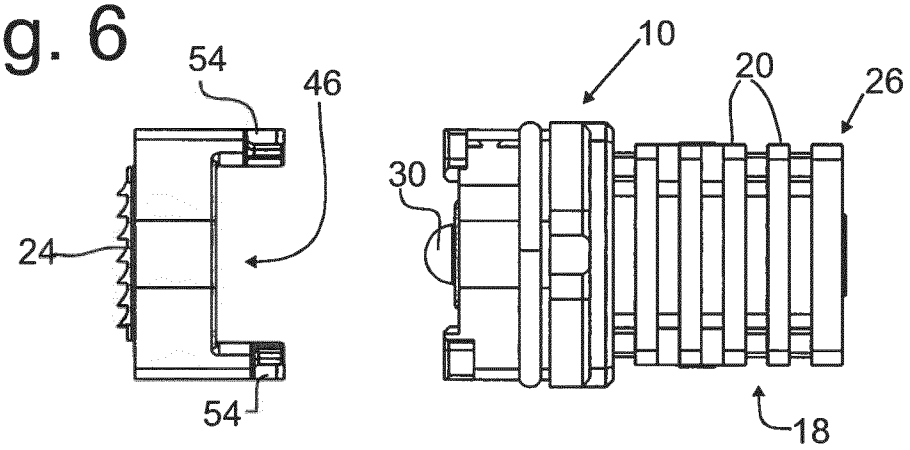



Fig. 7

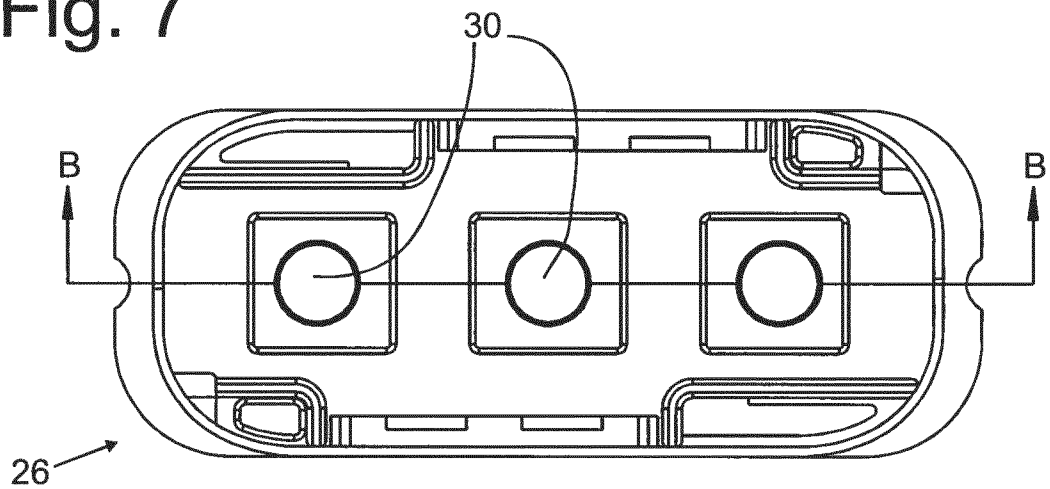



Fig. 8

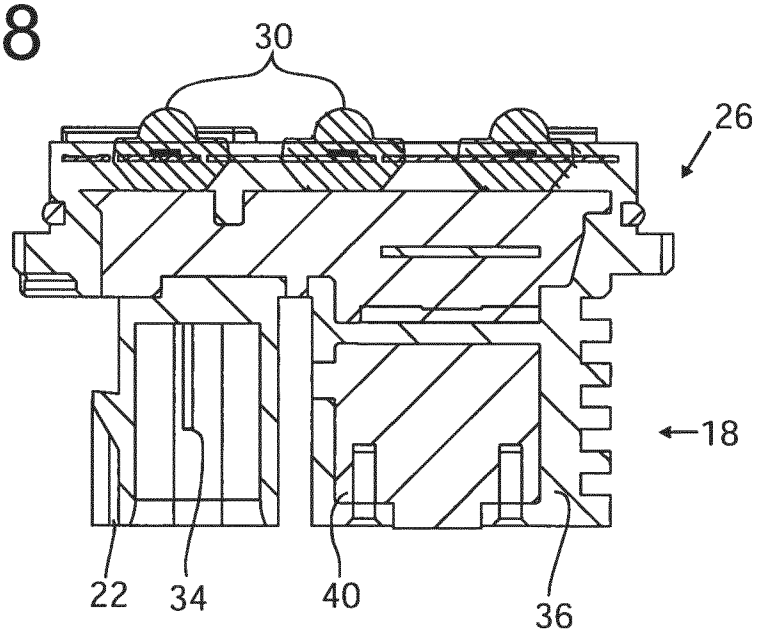


Fig. 9

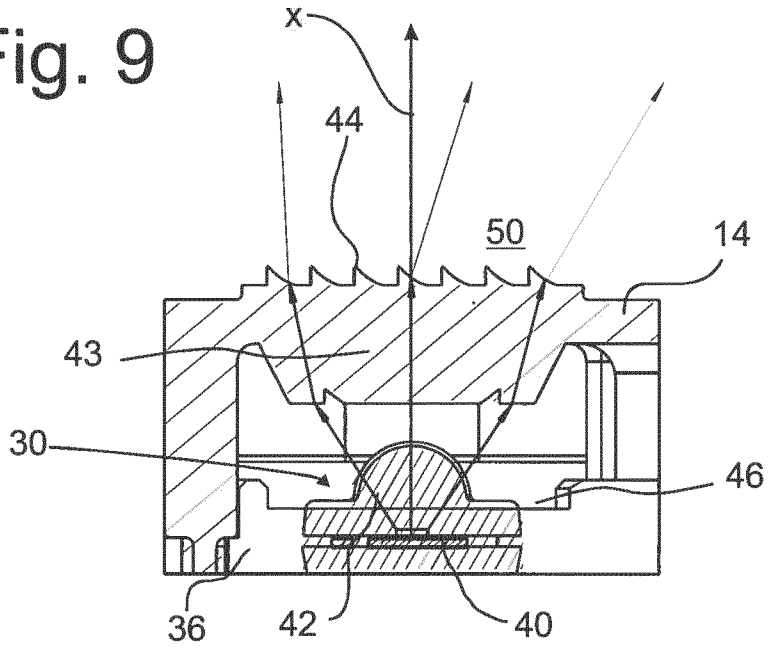



Fig. 10

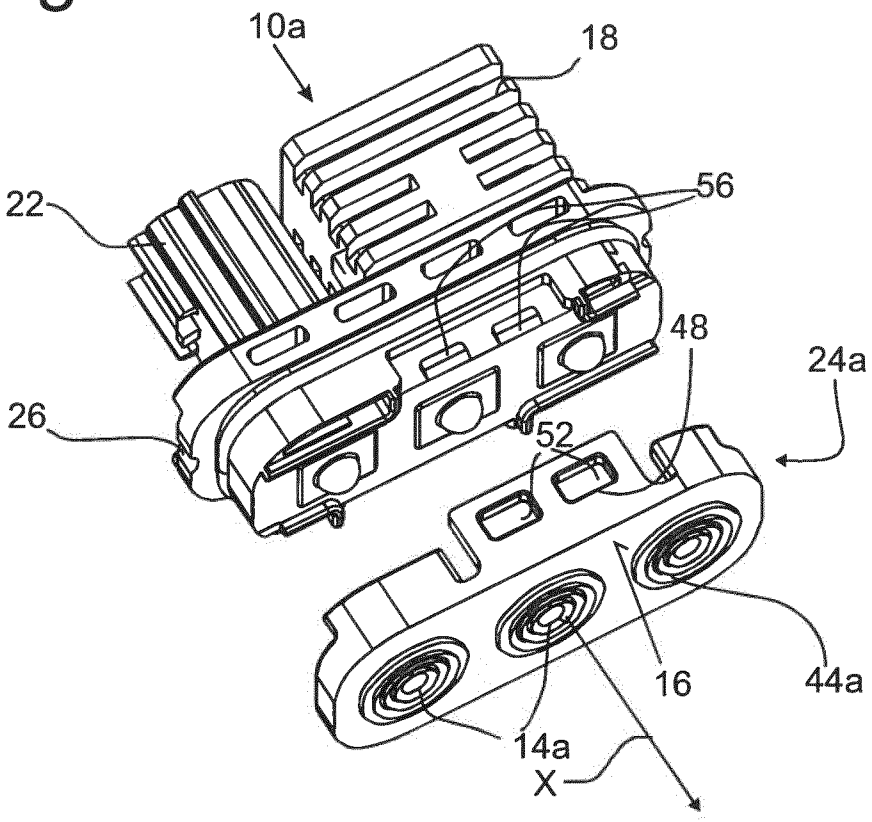


Fig. 11

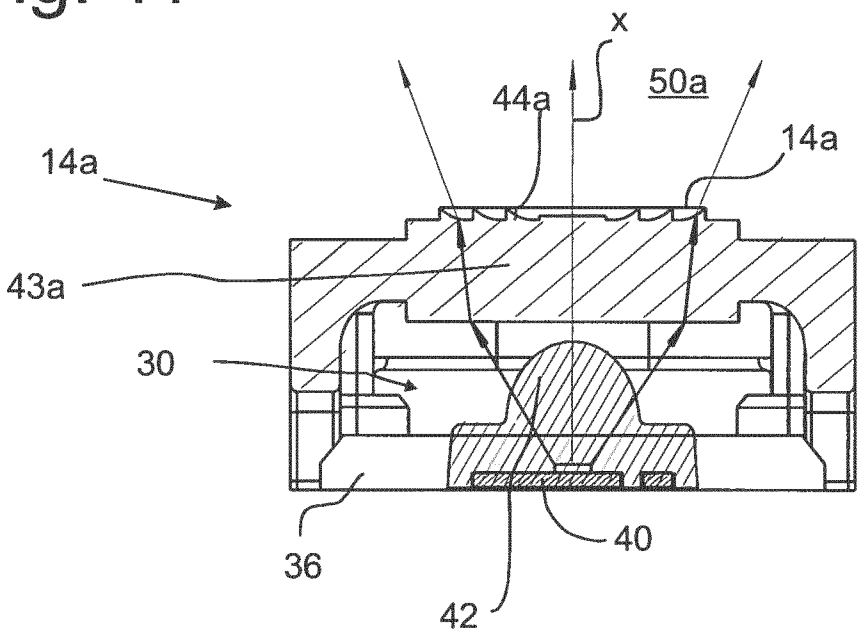



Fig. 12

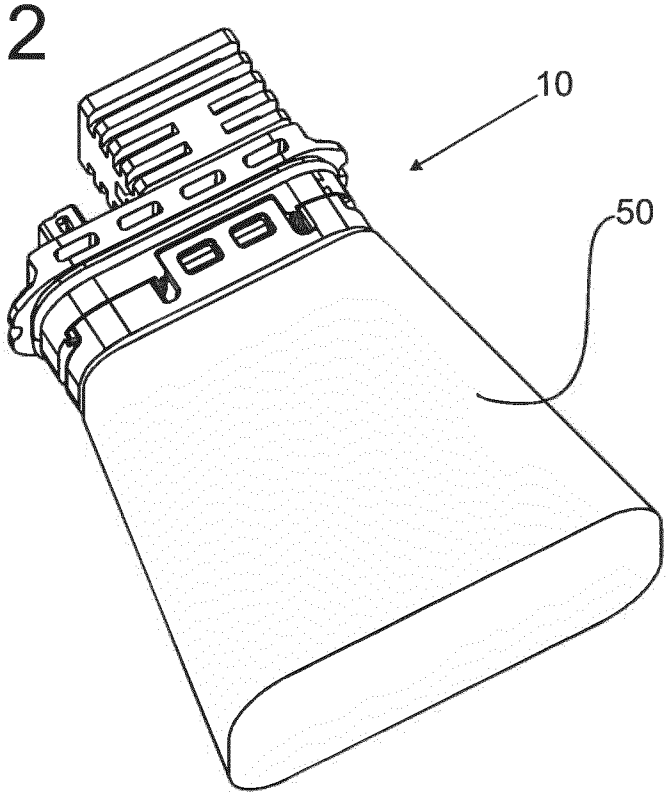


FIG. 13

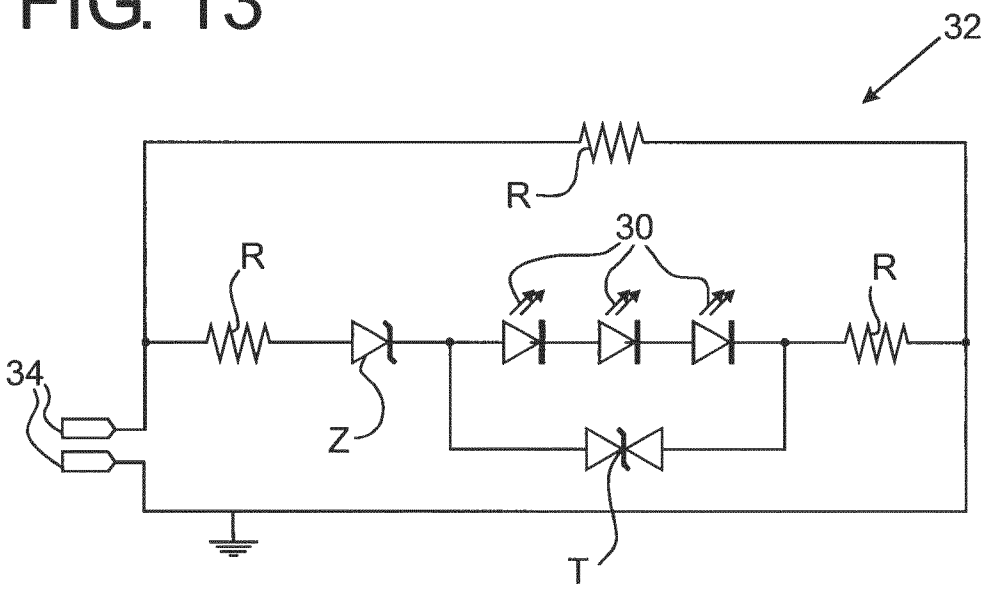



FIG. 14

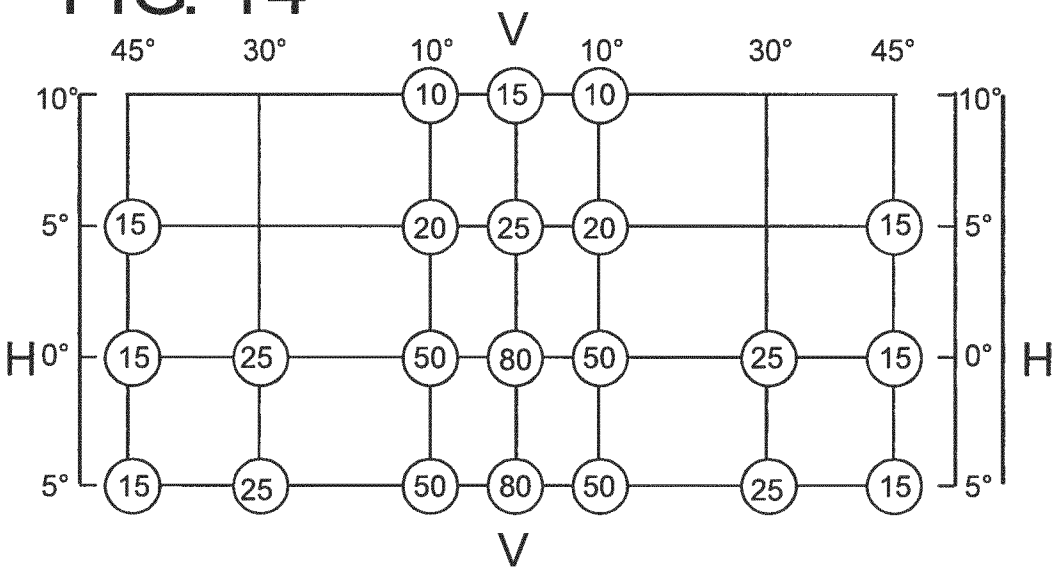
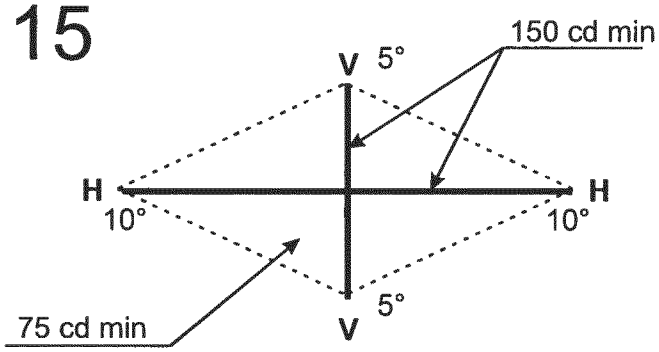



FIG. 15



# INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/066614

A. CLASSIFICATION OF SUBJECT MATTER
INV. F21S8/10 F21V5/04 F21V17/16 F21V23/00
ADD. F21V29/74 F21V29/87

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F21S F21V F21Y

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
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| Y<br>A | WO 2015/052324 A1 (VALEO VISION BELGIQUE [BE]) 16 April 2015 (2015-04-16)<br>page 7, line 17 - page 13, line 21;<br>figures 4, 5, 8 | 9<br>1,7,8,<br>10,11 |
| X<br>Y | US 2009/175044 A1 (VEENSTRA THOMAS J [US] ET AL) 9 July 2009 (2009-07-09)<br>paragraphs [0021], [0022], [0027], [0030] - [0035], [0037]; figures 1-9, 11-18 | 1,6,7,<br>10,11<br>2-5,<br>12-14 |
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 14 November 2017 | 27/11/2017 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016 | von der Hardt, M |

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International application No
PCT/EP2017/066614

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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