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(71) Applicant: **Valeo Iluminacion**
23600 Martos (ES)

(72) Inventors:
• **MAYOR, Raquel**
23600 MARTOS (ES)
• **ABRIL, Raimundo**
23600 MARTOS (ES)

(54) **LIGHTING DEVICE AND MANUFACTURING METHOD**

(57) The invention provides a lighting device (1) comprising a housing (2), a flexible element (3) located inside the housing (2) and a first bezel (4). The first bezel (4) is

attached to the flexible element (3) and comprising at least one slot (41) through which a visible portion of the flexible element (3) is seen.

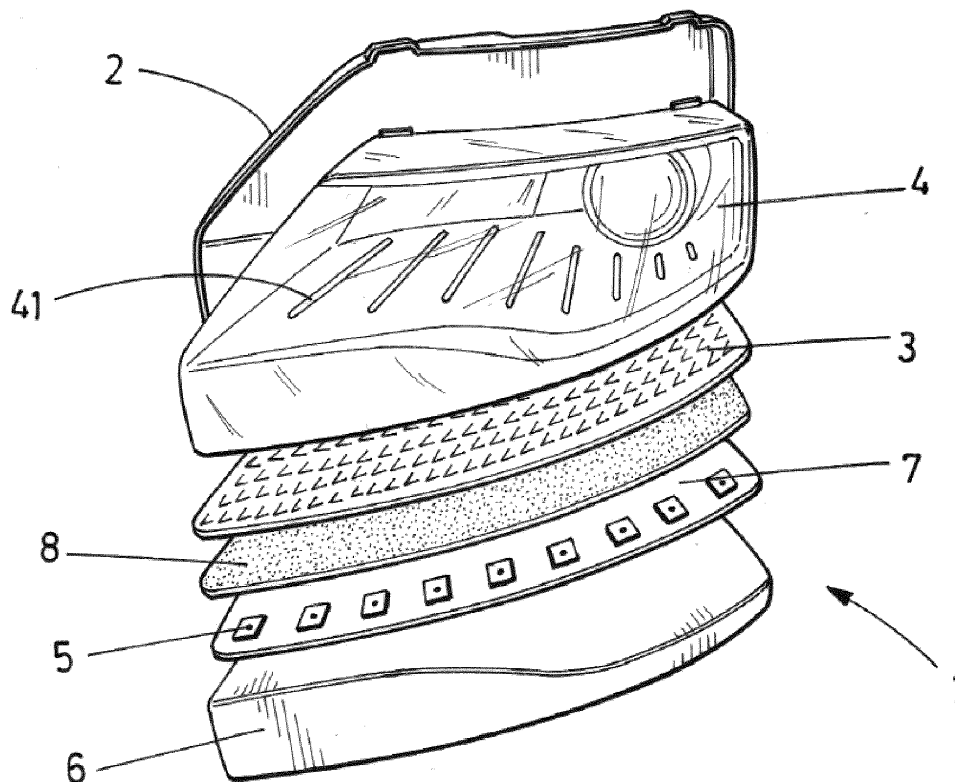


FIG.1

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Description

TECHNICAL FIELD

[0001] This invention belongs to the field of lighting devices installed in automotive vehicles, and more specifically to the design and manufacturing of said lighting devices when comprising complex shapes.

STATE OF THE ART

[0002] Lighting device must fulfil many complex and different requirements. Some of them are aesthetic, but many of them are technical as well. Flexibility in the manufacturing of these devices affect to their cost and ability to present new prototypes more frequently.

[0003] Non-plane arrangements require the use of special molds to create different pieces, and also require strict tolerances to be met, since when two non-plane pieces are not well assembled, uncomfortable noises or even mechanical failures may take place.

[0004] To avoid these problems, a new way of manufacturing complex non-plane lighting devices is desired.

DESCRIPTION OF THE INVENTION

[0005] The invention provides a solution for this problem by means of a lighting device according to claim 1 and a method for manufacturing a lighting device according to claim 12. Preferred embodiments of the invention are defined in dependent claims.

[0006] In an inventive aspect, the invention provides a lighting device comprising

a housing;
a flexible element located inside the housing; and
a first bezel attached to the flexible element and comprising at least one slot through which a visible portion of the flexible element is seen.

[0007] The feature of an element being flexible should be understood as that this element has a Hardness Shore D0 (after being 24h at room temperature, according to ISO 868-2003) lower than 70.

[0008] This lighting device present a manufacturing advantage, since the flexible element may follow any complex shape required or desired inside the lighting device. The flexible element may be manufactured as a plane element, and can adopt the required shape without the need of complex molds.

[0009] In a particular embodiment, the lighting device further comprises a light source arranged to emit light towards the flexible element.

[0010] This light source provides the light source with active lighting possibilities. In the embodiments where the lighting device does not provide a light source, passive lighting is still possible, by e.g., reflecting ambient light. This may be used in, e.g.: an ambient light, a DRL,

a position lamp, a turn-indicator, a stop lamp or a brake lamp.

[0011] In a particular embodiment, the lighting device further comprises a second bezel supporting the light source and the flexible element.

[0012] This second bezel provides for a design flexibility, and allow both the light source and the flexible element being more robust, since they are supported by a rigid element.

[0013] In a particular embodiment, the light source is arranged on a flexible electronic base.

[0014] The light source being incorporated into a flexible electronic base provides with more flexibility in the design of the lighting device, since the light source may follow the shape of the flexible element, thus being able of fulfilling complex lighting requirements, or providing a new way of fulfilling standard requirements.

[0015] In a particular embodiment, the light source is arranged in contact with the flexible element.

[0016] This arrangement of the light source may be useful when light hotspots are required.

[0017] In a particular embodiment, the lighting device further comprises a diffusive element, such as a diffusion filter, between the light source and the flexible element.

[0018] The introduction of this diffusive element between the light source and the flexible element may dim the hotspots intensity when they are not desired.

[0019] In a particular embodiment, the flexible element is a flexible catadioptric element. In a more particular embodiment, the flexible catadioptric element comprises prisms adapted to provide light with a predetermined light pattern.

[0020] The introduction of a catadioptric element in the lighting device provides it with the ability of taking advantage of ambient light, since the catadioptric elements may reflect either ambient light or the light coming from an active light source.

[0021] In a particular embodiment, the flexible element comprises a predetermined or customized pattern. This pattern allows the identification of the lighting device or just the communication of some information.

[0022] In a particular embodiment, the visible portion of the flexible element is able to reflect light received through the slot of the first bezel.

[0023] In a particular embodiment, the first bezel is opaque and the flexible element is clear.

[0024] In this context, the word "clear" should be understood as the opposite of "opaque", thus meaning "transparent" or "translucid". Accordingly, an opacity contrast between the first bezel and the flexible element is desired in these embodiments.

[0025] Thus, this lighting device is that it allows light to be used in many different new purposes, by coming from the flexible element or the first bezel (provided some of them are clear) or just by reflecting outer light.

[0026] In a further inventive aspect, the invention provides a method for manufacturing a lighting device according to any of the preceding claims, comprising the

steps of

manufacturing a sheet of a flexible material with a mold;
cutting a flexible element out of the sheet of the flexible material, by means of a die; and
arranging the flexible element in a lighting device.

[0027] This method allows the manufacturing of non-plane devices without using non-plane molds. A flexible plane element is cut, and then adapted to the particular lighting device. As a consequence, there is no need to use different molds for different designs, but just different dies to define the contour of the flexible element.

[0028] In a particular embodiment, the method further comprises the step of providing a light source to the lighting element, in such a way that the lighting source is arranged to emit light towards the flexible element.

[0029] In a particular embodiment, the die is designed to cut the shape of a projection of a part of the lighting device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] To complete the description and in order to provide for a better understanding of the invention, a set of drawings is provided. Said drawings form an integral part of the description and illustrate an embodiment of the invention, which should not be interpreted as restricting the scope of the invention, but just as an example of how the invention can be carried out. The drawings comprise the following figures:

Figure 1 shows an exploded view of a lighting device 1 according to the invention.

Figures 2a to 2d show steps of a method according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0031] Figure 1 shows an exploded view of a lighting device 1 according to the invention. This lighting device 1 comprises

a housing 2;
a flexible element 3 intended to be located inside the housing 2;
a first bezel 4 intended to be attached to the flexible element 3 and comprising at least one slot 41 through which a visible portion of the flexible element 3 is seen;
a light source 5 intended to be arranged to emit light towards the flexible element 3; and
a second bezel 6 intended to support the light source 5 and the flexible element 3.

[0032] The flexible element 3 is a flexible catadioptric

element, comprising prisms adapted to provide light with a predetermined light pattern. In different embodiments, these prisms have many different shapes, causing different optical patterns. Further, they may provide different effects depending on if a light source is emitting light toward them or they just reflect ambient light.

[0033] The visible portion of the flexible element 3 is able both to reflect light received through the slot 41 of the first bezel 4 and to refract light received from the light source 5 which is located under the flexible element 3.

[0034] In this embodiment, the light source 5 is arranged on a flexible electronic base 7. This is not necessary, but makes the manufacturing and assembly easier.

[0035] In this embodiment, the lighting device further comprises a diffusive element 8, such as a diffusion filter between the light source 5 and the flexible element 3. This diffusive element helps to minimize the hotspot effect when the light source 5 is very close to the catadioptric flexible element 3. In some different embodiments, the light source 5 is arranged directly in contact with the flexible element 3, without comprising a diffusive element, as it is not essential, and sometimes a hotspot effect may be desirable. In other embodiments, the light source 5 is far enough from the catadioptric flexible element 3 so that no diffusive element is needed to avoid the hotspot effect.

[0036] In this embodiment, the first bezel 4 is opaque and the flexible element 3 is clear.

[0037] This lighting device is able both to reflect ambient light when the light source 5 is turned off and to refract the light received by the light source 5 when it is turned on. Thus, different effects and functions may be achieved by this arrangement.

[0038] Figures 2a to 2d show steps of a method according to the invention.

[0039] The first step of this method, shown in Figure 2a, comprises the manufacturing of a sheet 30 of a flexible material by means of a mold 11. The shape of the sheet 30 is not relevant. To make the most of this method, the sheet should be relatively big.

[0040] The second step, shown in Figure 2b, comprises cutting a flexible element 3 out of the sheet 30 of the flexible material, by means of a die 9. The die 9 is designed to cut the shape of a projection of a part of the lighting device 1.

[0041] The third step, shown in Figure 2c, comprises the step of providing a light source 5 to the lighting element 1, in such a way that the lighting source 5 is arranged in a flexible electronic base 7 on the second bezel 6 to emit light towards the flexible element 3.

[0042] The fourth step, shown in Figure 2d, comprises arranging the flexible element 3, the diffusive element 8 and the first bezel 4 to finish the manufacturing of the lighting device 1.

Claims**1.** Lighting device (1) comprising

a housing (2);
 a flexible element (3) located inside the housing (2); and
 a first bezel (4) attached to the flexible element (3) and comprising at least one slot (41) through which a visible portion of the flexible element (3) is seen.

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2. Lighting device (1) according to claim 1, further comprising a light source (5) arranged to emit light towards the flexible element (3).

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3. Lighting device (1) according to claim 2, further comprising a second bezel (6) supporting the light source (5) and the flexible element (3).

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4. Lighting device (1) according to any of claims 2 or 3, wherein the light source (5) is arranged on a flexible electronic base (7).**5.** Lighting device (1) according to any of claims 2 to 4, wherein the light source (5) is arranged in contact with the flexible element (3).

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6. Lighting device (1) according to any of the preceding claims, wherein the flexible element (3) is a flexible catadioptric element.

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7. Lighting device (1) according to claim 6, wherein the flexible element (3) comprises prisms adapted to provide light with a predetermined light pattern.

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8. Lighting device (1) according to any claims 1 to 5, wherein the flexible element (3) comprises a predetermined or customized pattern, suitable for identifying the lighting device or for showing information.

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9. Lighting device (1) according to any of claims 6 to 8, further comprising a diffusive element (8) between the light source (5) and the flexible element (3).

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10. Lighting device (1) according to any of the preceding claims, wherein the visible portion of the flexible element (3) is able to reflect light received through the slot (41) of the first bezel (4).

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11. Lighting device (1) according to any of the preceding claims, wherein the first bezel (4) is opaque and the flexible element (3) is clear.**12.** Method for manufacturing a lighting device (1) according to any of the preceding claims, comprising the steps of

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manufacturing a sheet (30) of a flexible material with a mold (11);
 cutting a flexible element (3) out of the sheet (30) of the flexible material, by means of a die (9); and
 arranging the flexible element (3) in a lighting device (1).

13. Method according to claim 12, further comprising the step of providing a light source (5) to the lighting element (1), in such a way that the lighting source (5) is arranged to emit light towards the flexible element (3).**14.** Method according to any of claims 12 or 13, wherein the die (9) is designed to cut the shape of a projection of a part of the lighting device (1).

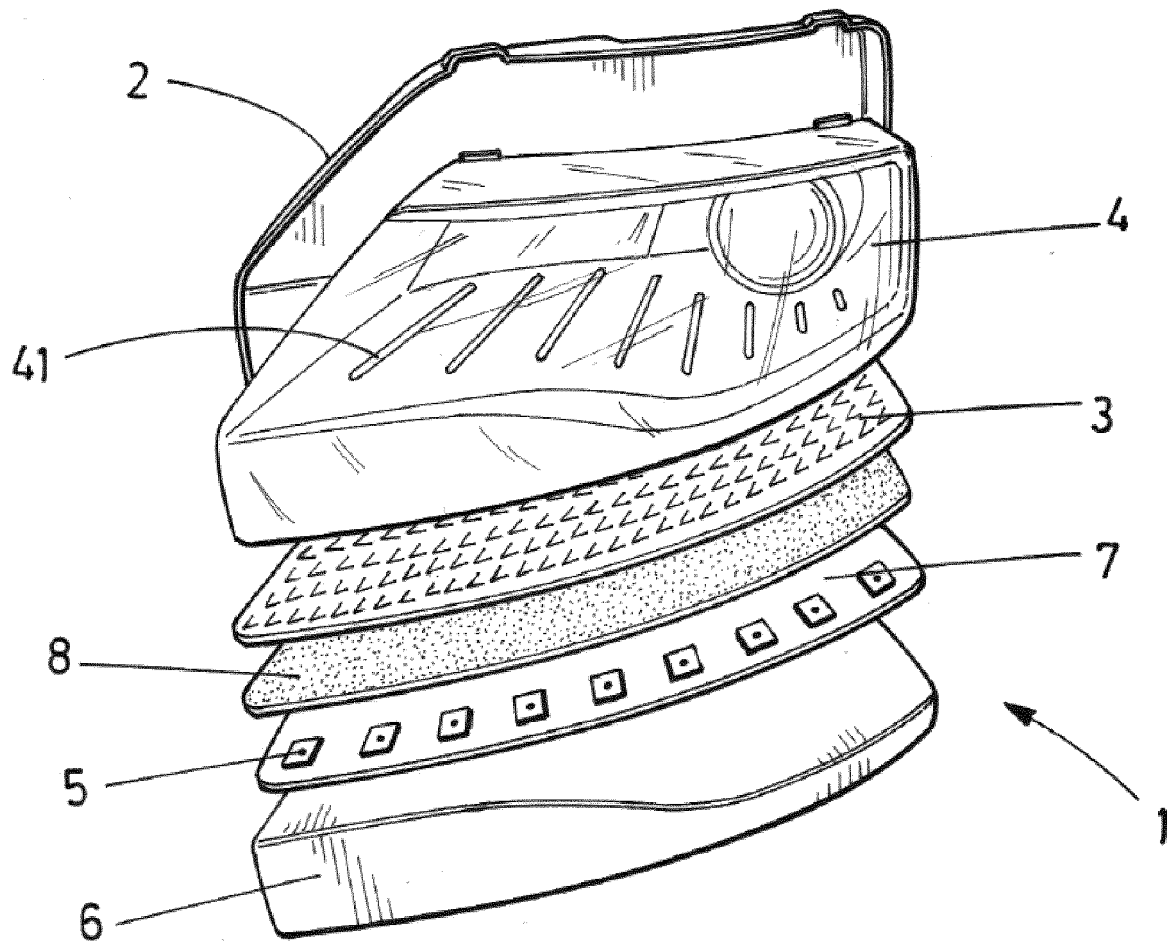


FIG.1

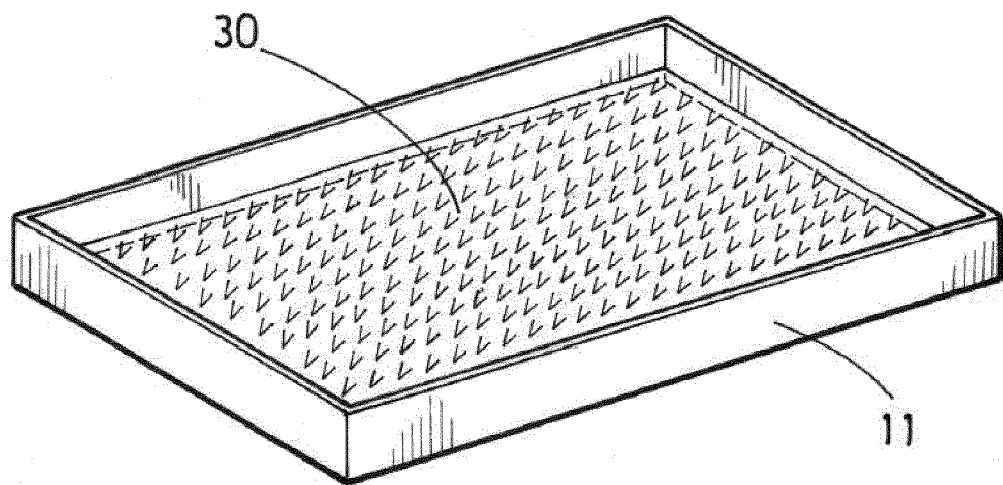


FIG. 2a

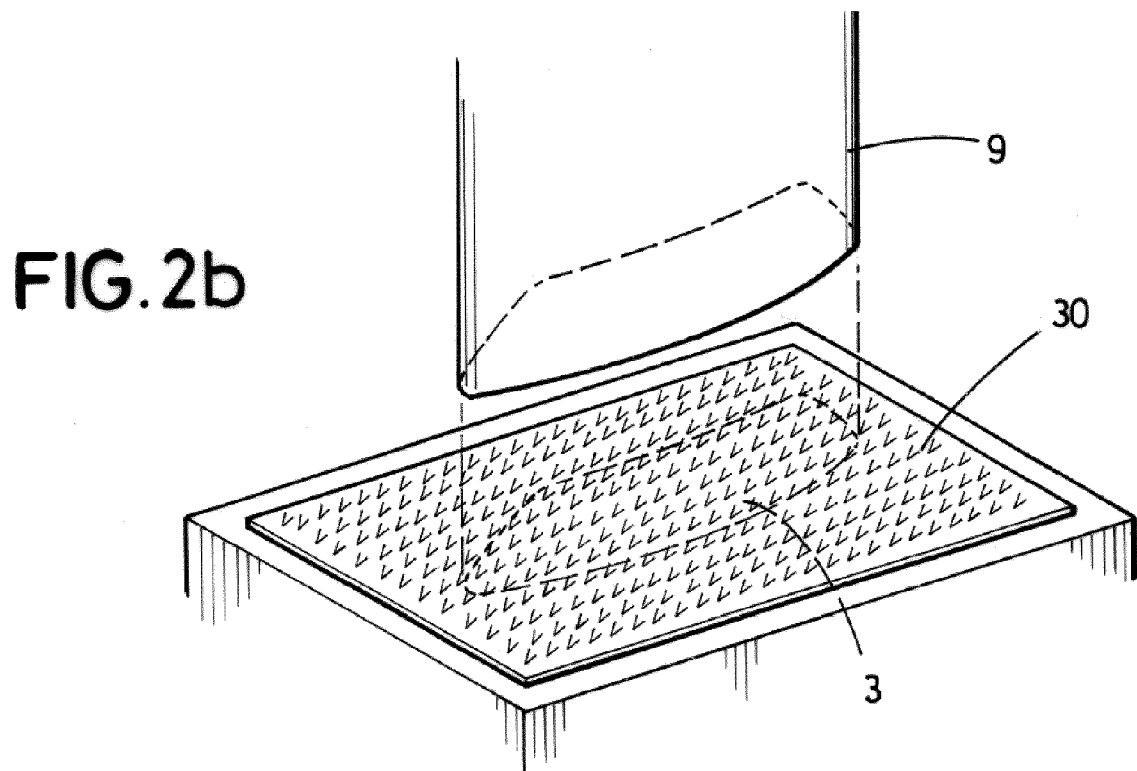


FIG. 2b

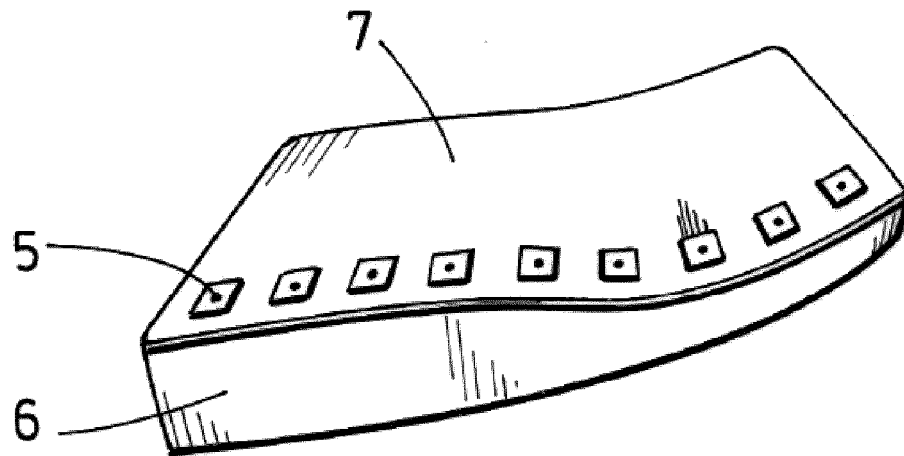


FIG. 2c

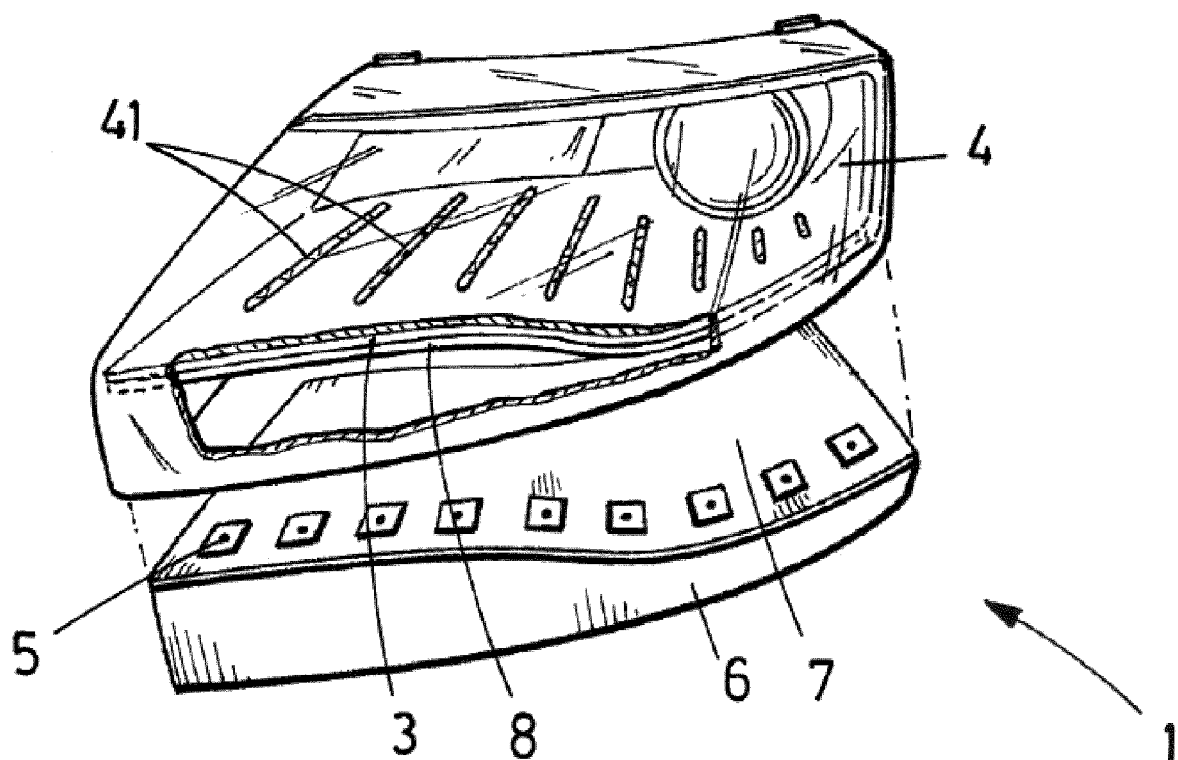


FIG. 2d



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Application Number
EP 17 38 2205

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 6 October 2017	Examiner Goltes, Matjaz
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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