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(54) Lighting device for a motor vehicle

(57) Lighting device (1) comprising a non-parabolic reflector (3) with a continuous complex reflective surface that directly distributes the light beam in accordance with the regulations without the use of an external diffusing lens. The reflective surface is made up of four surface portions (4) generated by reflecting a portion bounded by a horizontal section line (5) and a vertical section line (6). The horizontal and vertical section lines (5) and (6) are chosen to provide the desired distribution of the luminous flux on the section in question and one is then transformed continuously into the other along a guide line (7) to generate the intermediate sections (15) in such a way that each point on the horizontal section line is moved to a corresponding point on the vertical section line.

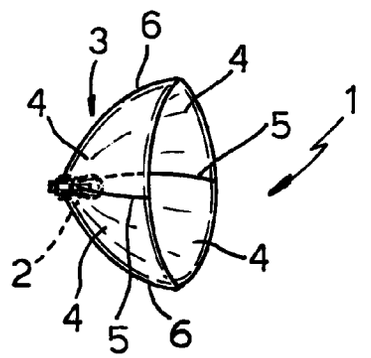

Fig.1

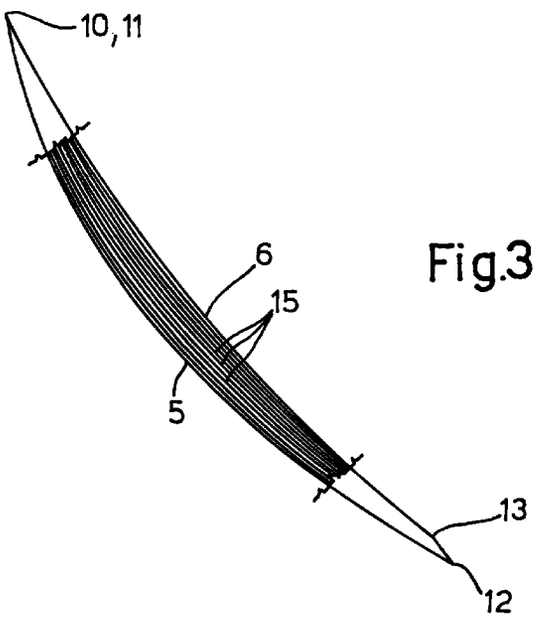

Fig.3

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Description

The present invention relates to a lighting device for a motor vehicle, especially a headlamp or other light.

As is well known, present-day lighting devices for motor vehicles comprise a source of light (bulb) that generates a light beam, a reflector that receives the light beam generated by the source and distributes it within a limited solid angle, and a prismatic transparent cover made up of a plurality of diffusing lens elements that spread the light beam within a broader solid angle in accordance with the motor vehicle lighting regulations.

Lighting devices of this kind have drawbacks in that they result in significant loss of luminous flux owing to suboptimal distribution of the flux, the light being spread uniformly by the lens, without the light gradient that would be necessary for good illumination.

The reflector, which is conventionally of parabolic shape with the light source positioned at its focal point, has been investigated in recent years and proposals have been made for generating light beams with a specific distribution better suited to the type of illumination required. Reflectors have for example been proposed with non-parabolic surfaces made up of dissimilar portions joined together with discontinuities at the tangents. The surfaces are however complicated and do not always perform as desired.

The object of the present invention is to provide a new lighting device capable of distributing the light beam generated by the source within a wide field, in accordance with the specifications of existing regulations, without requiring the use of a diffusing lens.

According to the present invention a lighting device for a motor vehicle is provided that comprises a light source capable of generating a light beam and a reflector capable of distributing said light beam in space, the device being characterized in that said reflector is a non-parabolic reflector with a continuous complex reflective surface that directly distributes said light beam in accordance with the regulations.

In order that the present invention may be more fully understood, a preferred embodiment thereof is now described purely by way of a non-restricting example with reference to the accompanying drawings, in which:

- Figure 1 is a schematic perspective view of a lighting device according to the invention;
- Figure 2 is an isometric view of the horizontal and vertical sections through the reflector of the present device;
- Figure 3 shows the modification of the sections as they pass from the horizontal section to the vertical section of the present reflector; and
- Figures 4 and 5 show the distribution of the luminous flux produced by the horizontal section and vertical section respectively.

With reference to Figure 1, this figure schematically shows a lighting device 1 according to the invention comprising a source of light 2 (bulb) and a reflector 3. No prismatic transparent cover is present.

The reflector 3 is here imagined to be divided into four portions 4 corresponding to four quarter surfaces bounded by a horizontal section line 5 and by a vertical section line 6. In the following description, first to be generated is the surface of a portion 4, after which the other three portions are generated by reflection in order together to yield the complete surface.

Figure 2 shows curve 5 defining the horizontal section and curve 6 defining the vertical section of the reflector 3; also shown is the guide line 7 for the transformation by which horizontal curve 5 is moved to vertical curve 6 (or vice versa).

In detail, in order to generate the surface of the reflector 3 according to the invention, horizontal curve 5 and vertical curve 6 are generated first of all, in such a way as to give the desired distribution of the light, already having the final output distribution of the lighting device 1. Examples of the distribution of light suitable for motor vehicle lamps for curve 5 defining the horizontal section and for curve 6 defining the vertical section are shown in Figures 4 and 5.

Curves 5 and 6 can be produced either graphically on a computer, starting with basic curves such as parabolic curves and gradually modifying them graphically until the desired distribution is obtained, or starting with non-rational parametric curves described by equations of the following type:

$$P(t) = \sum_{i=0}^{n} b_i \, B_{i,n}(t)$$

or rational curves with equations of the following type:

$$R(t) = \left(\sum_{i=0}^{n} w \, b_i \, B_i{}^{n}(t) \right) / \sum_{i=0}^{n} w \, B_i{}^{n}(t)$$

in which b_i are the co-ordinates of the vertices of the polygons, $B_i(t)$ are Bernstein functions and w are weightings.

Known examples of the two types of curves indicated above are the B-spline and Bezier curves (rational and irrational), Nurbs curves, etc.

Once curves 5 and 6 have been prepared, the surface of a portion 4 of the reflector 3 is generated by sliding the curve 5, which corresponds to the horizontal section, along the guide curve 7 and changing its shape as it moves in such a way as to transform it gradually into curve 6 which corresponds to the vertical section. This sliding advantageously performed on a computer using a graphic design programme (CAD), moves the inward end of curve 5 (marked 10 in Figure 2) to the inward end 11 of curve 6 along the guide curve 7. Likewise the outward end of curve 12 of curve 5 is moved

onto the end 13 of curve 6 and all the internal points of curve 5 are moved to corresponding internal points in curve 6. The gradual transformation of curve 5 into curve 6, whereby the many intermediate transverse sections are generated, is depicted conceptually in Figure 3, where curves 5 and 6 and some of the intermediate curves 15 of the transformation can be seen. In Figure 3 in order to show more clearly how the gradual and continuous transformation takes place, the inward ends 10 and 11 of curves 5 and 6 and of intermediate curves 15 are shown superimposed on each other, the outward ends 12, 13 of curves 5 and 6 are shown separated by a short distance, and the initial and final portions of the intermediate curves are not shown, being practically superimposed on each other and therefore not individually visible.

The surface 4 produced graphically in this way is then reflected to produce the other three surface portions 4 (axial symmetry).

The resulting complete surface gives a light beam which is not parallel but widened and spread out in space. There is consequently no need for an external diffusing lens. In turn, dispensing with the diffusing lens brings three advantages: it eliminates the stray light which in known lighting devices was caused by scattering by the external lens into regions where less light is wanted; it improves the visual appearance of the lighting device; and it lowers the cost of manufacturing the lighting device in terms of both the lens material and the moulding of the lens.

Moreover, with the proposed solution better performance can be obtained because of the possibility of easily achieving high photometric values. In addition, the device according to the invention can be made to the necessary dimensions, and the dimensions can even be reduced.

It will be clear, finally, that the lighting device described and illustrated herein can be modified and altered without thereby departing from the protective scope of the present invention. In particular the basic curves used to construct the surface may be different, provided they distribute the light in the desired manner, and may be generated mathematically or graphically by computer; the surface may also be made up of a different number of portions, for example three, with one being generated by the method described and the other two generated by reflection; indeed, the surface may even comprise only the portion generated by transformation, since this portion is already able to distribute the light in the desired manner.

Claims

1. Lighting device (1) for a motor vehicle that comprises a light source (2) capable of generating a light beam and a reflector (3) capable of distributing said light beam in space, the device being characterized in that said reflector (3) is a non-parabolic reflector with a continuous complex reflective surface that directly distributes said light beam in accordance with the regulations.

2. Lighting device according to Claim 1, characterized in that it has no diffusing prismatic lens means.

3. Lighting device according to Claim 1 or 2, characterized in that said reflective surface of said reflector (3) comprises at least one surface portion (4) bounded by a first and a second section lines (5, 6) and generated from said section lines (5, 6) in such a way as to distribute the luminous flux in the desired manner on the section line in question, said first section line (5) being transformed into said second section line (6) in such a way that each point on said first section line is moved continuously to a corresponding point on said second section line.

4. Lighting device according to Claim 3, characterized in that said transformation is carried out by sliding one end (10) of said first section line (5) along a guide line (7) to a corresponding end (11) on said second section line (6).

5. Lighting device according to Claim 3 or 4, characterized in that said first section line (5) is a horizontal section line and said second section line (6) is a vertical section line, said lines being perpendicular to each other.

6. Lighting device according to any one of Claims 3 to 5, characterized in that it comprises a plurality of surface portions (4) generated by reflecting said one or more surface portions (4).

7. Lighting device according to any one of Claims 3 to 6, characterized in that said first and second section lines (5, 6) are described by rational or irrational parametric curves.

8. Lighting device according to any one of Claims 3 to 6, characterized in that said first and second section lines (5, 6) are generated graphically by the manual deforming of parabolic basic curves.

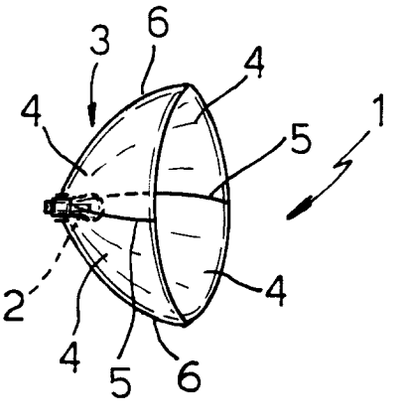

Fig.1

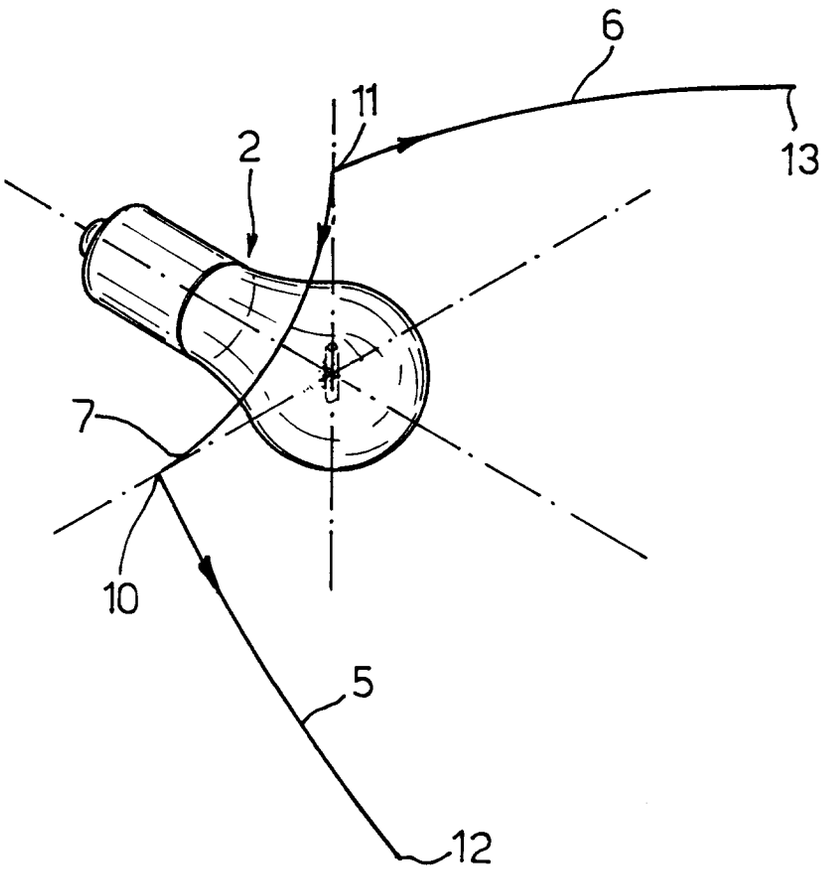

Fig 2

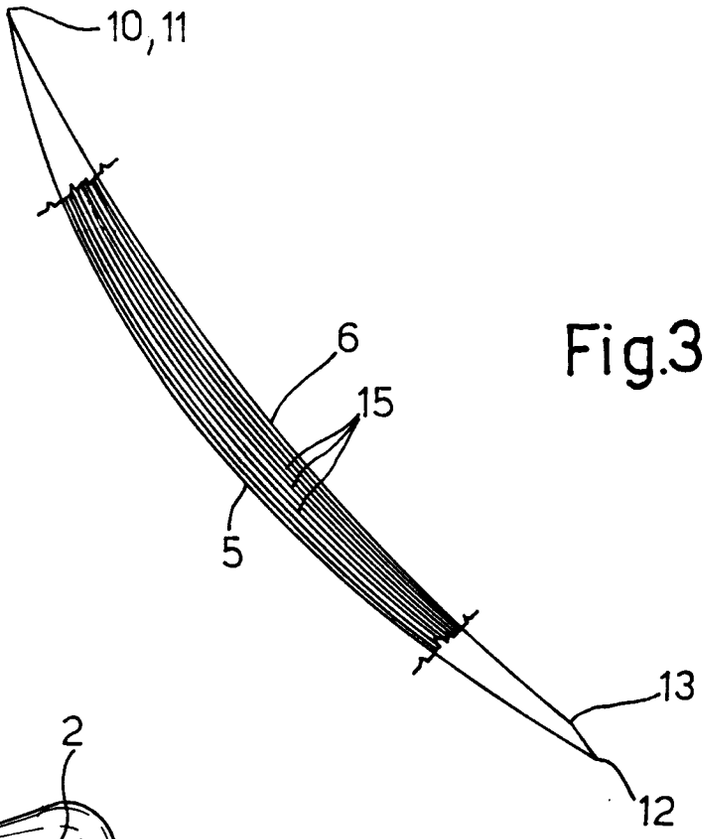

Fig.3

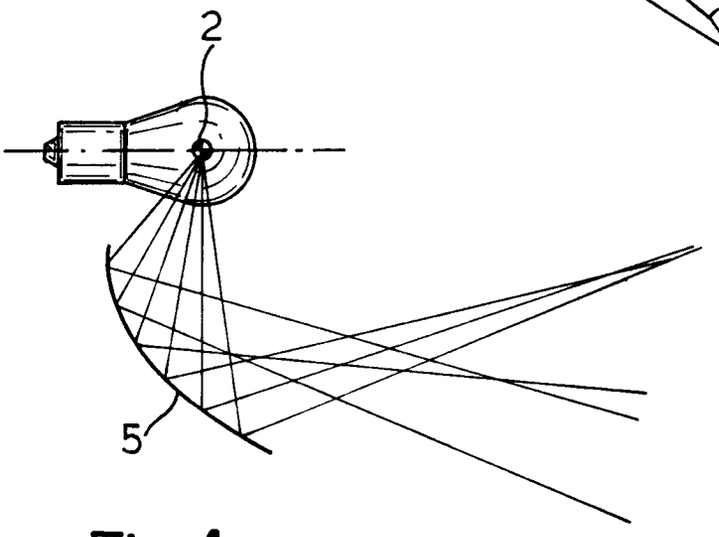

Fig.4

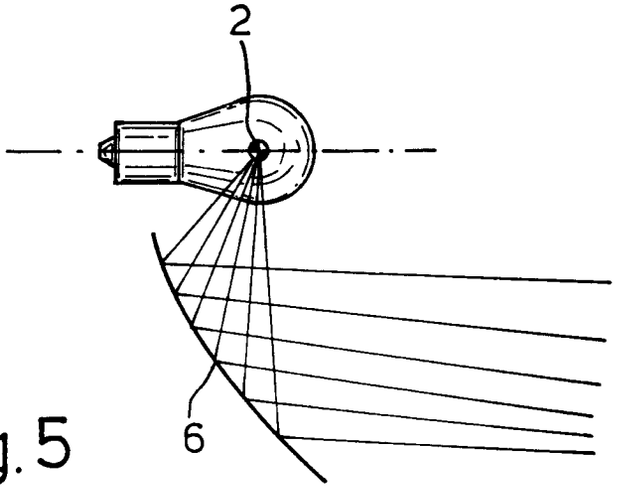

Fig.5

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EUROPEAN SEARCH REPORT

Application Number
EP 96 10 7397

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	GB-A-2 282 439 (KOITO MANUFACTURING CO. LTD.) * page 1, line 3 - line 10 * * page 3, line 9 - line 14 * * page 5, line 9 - page 7, line 20 * * page 10, line 6 - line 8 * * page 10, line 22 - line 29 * * figures 1-3,5-7 * ---	1-5,7,8	F21M3/08
X	US-A-4 495 552 (GRAFF) * column 1, line 23 - column 2, line 9 * * column 3, line 24 - line 28 * * column 3, line 42 - column 4, line 24 * * figures 1,3-6 * -----	1,2	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F21M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	1 August 1996	De Mas, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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