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(54) **Lighting device for a motor vehicle**

Kfz-Leuchte

Dispositif d'éclairage pour véhicule automobile

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Description

[0001] The present invention relates to a lighting device for a motor vehicle, especially a headlamp or other light.

[0002] 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.

[0003] 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.

[0004] 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.

[0005] 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.

[0006] According to the present invention a lighting device for a motor vehicle is structured according to Claim 1.

[0007] 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.

[0008] 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.

[0009] 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.

[0010] 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).

[0011] 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.

[0012] 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:

$$R(t) = \left[\sum_{i=0}^n w_i b_i B_i^n(t) \right] / \sum_{i=0}^n w_i B_i^n(t)$$

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

[0013] Known examples of the two types of curves indicated above are the B-spline and Bezier curves (rational and irrational), Nurbs curves, etc.

[0014] 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.

[0015] The surface 4 produced graphically in this way is then reflected to produce the other three surface portions 4 (axial symmetry).

[0016] 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.

[0017] 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.

[0018] 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, comprising a light source (2) capable of generating a light beam and a reflector (3) capable of distributing said light beam in space, said reflector (3) being a non-parabolic reflector with a continuous complex reflective surface; the device being **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), said section lines (5, 6) being designed in such a way as to directly distribute the luminous flux in a desired manner, according to the regulations, on the section line in question; said at least one surface portion (4) is generated from said section lines (5, 6) by a transformation of said first section line (5) into said second section line (6) 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), in such a way that each point on said first section line is moved continuously to a corresponding point on said second section line.
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 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.

4. Lighting device according to any one of Claims 1 to 3, characterized in that it comprises a plurality of surface portions (4) generated by reflecting said one or more surface portions (4).
5. Lighting device according to any one of Claims 1 to 4, characterized in that said first and second section lines (5, 6) are described by rational or irrational parametric curves.
6. Lighting device according to any one of Claims 1 to 4, characterized in that said first and second section lines (5, 6) are generated graphically by the manual deforming of parabolic basic curves.

Patentansprüche

1. Beleuchtungsvorrichtung (1) für ein Kraftfahrzeug, die mit einer Lichtquelle (2) versehen ist, die einen Lichtstrahl erzeugen kann, und einem Reflektor (3), der den Lichtstrahl im Raum verteilen kann, wobei der Reflektor (3) ein nicht-parabolischer Reflektor mit einer kontinuierlichen komplexen Reflexionsoberfläche ist, wobei die Vorrichtung dadurch gekennzeichnet ist, daß die Reflexionsoberfläche des Reflektors (3) wenigstens einen Oberflächenabschnitt (4) umfaßt, der durch eine erste und eine zweite Schnittlinie (5, 6) begrenzt ist, wobei die Schnittlinien (5, 6) so konfiguriert sind, daß sie den Lichtfluß in der gewünschten Weise gemäß den Bestimmungen auf der in Frage kommenden Schnittlinie direkt verteilen, wobei der wenigstens eine Oberflächenabschnitt (4) aus den Schnittlinien (5, 6) durch eine Transformation der ersten Schnittlinie (5) in die zweite Schnittlinie (6) erzeugt ist, die mittels Verschieben eines Endes (10) der ersten Schnittlinie (5) längs einer Führungslinie (7) zu einem entsprechenden Ende (11) auf der zweiten Schnittlinie (6) derart durchgeführt ist, daß jeder Punkt der ersten Schnittlinie kontinuierlich zu einem entsprechenden Punkt der zweiten Schnittlinie bewegt wird.
2. Beleuchtungsvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß sie keine prismatische Streulinseneinrichtung besitzt.
3. Beleuchtungsvorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die erste Schnittlinie (5) eine horizontale Schnittlinie ist und die zweite Schnittlinie (6) eine vertikale Schnittlinie ist, wobei die Linien aufeinander senkrecht stehen.
4. Beleuchtungsvorrichtung nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß sie mehrere Oberflächenabschnitte (4) umfaßt, die durch Spiegelung des einen oder von mehreren Oberflächenabschnitten (4) erzeugt sind.
5. Beleuchtungsvorrichtung nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die erste und die zweite Schnittlinie (5, 6) durch rationale oder irrationale parametrische Kurven beschrieben sind.
6. Beleuchtungsvorrichtung nach irgendeinem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die erste und die zweite Schnittlinie (5, 6) graphisch durch manuelle Verformung parabolischer Basis-Kurven erzeugt sind.

Revendications

1. Dispositif d'éclairage (1) pour un véhicule automobile, comprenant une source de lumière (2) apte à produire un faisceau de lumière et un réflecteur (3) apte à distribuer ledit faisceau de lumière dans l'espace, ledit réflecteur (3) étant un réflecteur non parabolique, possédant une surface réfléchissante complexe continue; le dispositif étant caractérisé en ce que ladite surface réfléchissante dudit réflecteur (3) comprend au moins un élément de surface (4) réunie à des première et seconde lignes de coupe (5,6), lesdites lignes de coupe (5,6) étant agencées de manière à distribuer directement le flux lumineux d'une manière désirée, conformément aux réglementations, sur la ligne de coupe en question; ledit au moins un élément de surface (4) est produit par lesdites lignes de coupe (5,6) par une transformation de ladite première ligne de coupe (5) en ladite seconde ligne de coupe (6), exécutée par glissement d'une extrémité (10) de la première ligne de coupe (5) le long d'une ligne de guidage (7) jusqu'à une extrémité correspondante (11) située sur ladite seconde ligne de coupe (6), de telle sorte que chaque point de ladite première ligne de coupe est déplacé continûment jusqu'à un point correspondant situé sur ladite seconde ligne de coupe.
2. Dispositif d'éclairage selon la revendication 1, caractérisé en ce qu'il ne comporte aucun moyen en forme de lentille

prismatique diffusante.

3. Dispositif d'éclairage selon la revendication 1 ou 2, caractérisé en ce que ladite première ligne de coupe (5) est une ligne de coupe horizontale et ladite seconde ligne de coupe (6) est une ligne de coupe verticale, lesdites lignes étant perpendiculaires entre elles.

4. Dispositif d'éclairage selon l'une quelconque des revendications 1 à 3, caractérisé en ce qu'il comprend une pluralité d'éléments de surface (4) produits par reproduction par symétrie desdits un ou plusieurs éléments de surface (4).

5. Dispositif d'éclairage selon l'une quelconque des revendications 1 à 4, caractérisé en ce que lesdites première et seconde lignes de coupe (5,6) sont décrites par des lignes paramétriques rationnelles ou irrationnelles.

6. Dispositif d'éclairage selon l'une quelconque des revendications 1 à 4, caractérisé en ce que lesdites première et seconde lignes de coupe (5,6) sont produites graphiquement au moyen de la déformation manuelle de courbes de base paraboliques.



