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(54) Vehicle headlight with a complex-surface reflector

(57) A headlight (1) presenting a light source (3), a reflector (5), and a prismed lens in front of the reflector, wherein the reflector (5) picks up the source emitted light 360° about the source, and wherein the source (3) is aligned with the optical axis (Ao) of the headlight; the reflector (5) presenting a complex reflecting surface (7) in turn presenting a number of different sectors (9,10,13,14,19,20,21) connected substantially seamlessly, none of which is defined by a surface of revolution, and most of which are defined by surfaces generated by translating a generating base curve - defined in a first plane - along a supporting curve defined in a second plane perpendicular to the first.

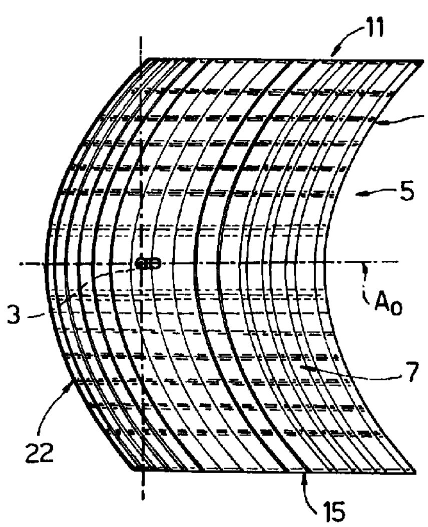

Fig.1

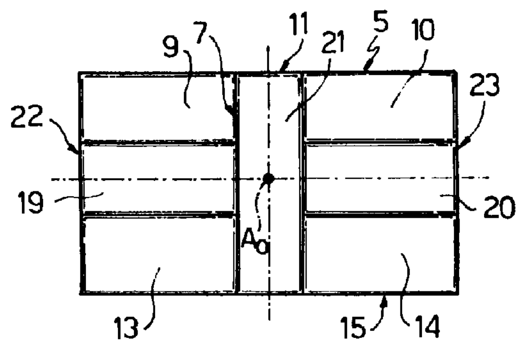

Fig.2

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Description

The present invention relates to a road vehicle headlight, in particular a lower beam or fog light, featuring a complex-surface reflector in conjunction with a prismed optical system.

By law, vehicle lower beam and/or fog lights are required to concentrate the beam below an ideal so-called cutoff line to avoid dazzling oncoming traffic. French Patent n. 2.536.502, for example, relates to a road vehicle lower beam comprising a body housing a reflector and a light source, and a prismed lens located in front of the reflector and closing the body. As opposed to a single reflecting surface of revolution, e.g. parabolic or elliptical, as normally used, the reflector is defined by a complex surface formed by the seamless connection of reflecting surfaces of different types defined by different equations. In the French patent in question, the complex surface comprises two parabolic surface portions at the same angle to each other as that required by regulations for the cutoff line; and two portions of a surface not of revolution and described by a mathematical equation which, on the one hand, provides for connecting the two parabolic portions, and, on the other, in conjunction with the lens prisms of the light, provides for picking up and distributing the source emitted beam 360° about the source.

As compared with previous known headlights, wherein cutoff was achieved by means of a dimming shield for preventing reflection of part of the beam emitted by the source, the lower beam according to the above French patent provides for exploiting all the light emitted by the source, thus enabling the use, for example, of weaker lamps (which consume less and give off less heat) or smaller reflectors for a given brightness of the beam. On the other hand, however, it fails to provide for optimum distribution of the beam. In other words, the complex reflecting surface of the above patent provides for generating a beam as required by law, but the need for seamlessly connecting the various portions of the reflecting surface seriously limits the variety of the light distribution achievable.

European Patent n. 0373065 relates to an improvement of the previous headlight, wherein the equation of two opposite intermediate portions of the complex reflecting surface is so modified as to substantially vertically divide the reflecting surface into substantially three specialized interconnected portions, each of which provides for distributing the reflected beam in a predetermined plane. Though it does in fact provide for improving distribution of the beam as compared with the French patent, the complex surface of the reflector according to the European patent nevertheless fails to provide a satisfactory solution to the problem.

Moreover, the problem is further compounded by the tendency, for design reasons, of most modern vehicle headlights to present steeply inclined lenses in which it is difficult to form highly prismed portions for correcting and optimizing distribution of the beam produced by the reflector.

It is an object of the present invention to provide a vehicle headlight featuring a reflector defined by a complex surface for optimizing distribution of the reflected beam, while at the same time ensuring a substantially seamless surface to simplify mass production of the reflector, enabling the light emitted by the source to be exploited 360° about the source itself, and maintaining the source aligned with the optical axis of the headlight.

According to the present invention, there is provided a vehicle headlight for generating a lower or fog light beam concentrated entirely below a cutoff line to prevent dazzling oncoming traffic; the headlight comprising a light source, a reflector, and a prismed lens in front of the reflector, and being of the type wherein the reflector picks up the source emitted light 360° about the source, and wherein the source is aligned coaxial with the optical axis of the headlight; the reflector presenting a complex reflecting surface including a number of different sectors connected substantially seamlessly; characterized in that none of said component sectors of the reflecting surface is defined by a surface of revolution; and most of said sectors are composed of surfaces generated by translating a generating base curve.

More specifically, the reflector is divided into seven sectors: two upper lateral, two lower lateral, two intermediate lateral, and one central sector extending along the full height of the reflector; the two intermediate lateral sectors being defined by surfaces described by a fourth-degree polynomial equation; and all the other sectors being defined by translating arcs of a circle - lying in horizontal planes and with a predetermined radius calculated according to the required light distribution - along two respective parabola branches, one above and one below the optical axis, and lying in the vertical plane through the optical axis.

In this way, and possibly also correcting the light distribution of the reflector using appropriate lens prisms, it is possible to achieve a reflector with a substantially seamless and hence easily mass producible reflecting surface, but which is also capable of picking up the maximum amount of light possible from the source (preferably consisting of the filament of an incandescent lamp) and at the same time distributing the light not only in conformance with regulations but also in such a manner as to effectively improve visibility as compared with currently marketed headlights.

A further advantage of the headlight according to the invention is the improvement in appearance by enabling the adoption of "flattened" reflectors with no impairment in light distribution, and by reducing the number of lens prisms required - especially where the lens slopes sharply for design reasons - which also provides for reducing manufacturing cost.

A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a schematic view in perspective of a vehicle headlight reflector in accordance with the present invention;

Figure 2 shows a schematic front view of the Figure 1 reflector;

Figure 3 shows a schematic side section of a headlight in accordance with the present invention;

Figures 4, 5 and 6 show, schematically, various steps in the construction of the reflecting surface of the Figure 1 reflector;

Figures 7 to 13 show the distribution, on a screen at a distance of 25 m, of the reflected images produced by the various sectors of the Figure 1 reflector;

Figure 14 shows the distribution, on a screen at a distance of 25 m, of the reflected images produced by the Figure 1 reflector as a whole.

With reference to the accompanying drawings and Figure 3 in particular, number 1 indicates a road vehicle headlight for generating a lower or fog light beam, which, as is known, are characterized by being concentrated entirely below a cutoff line 2 (shown by the dotted line in Figures 9 to 12 relative to a lower beam) to prevent dazzling other motorists.

Headlight 1 comprises a light source 3 consisting, for example, of the coiled filament of an incandescent lamp and of length Lf (Figure 4); a reflector 5; a prismed lens 6 in front of reflector 5; and a cup-shaped casing 8 (shown only partly in Figure 3) housing reflector 5 and source 3, and closed in fluidtight manner at the open end by lens 6. More specifically, headlight 1 is of the type wherein, as opposed to a specially shaped dimming shield which is eliminated, cutoff line 2 is defined by the particular light distribution provided for by reflector 5 which, by means of its reflecting surface 7 facing lens 6, picks up the source emitted light 360° about source 3.

According to the present invention, source 3 is strictly aligned coaxial with the optical axis Ao of the headlight, and extends along the optical axis from a point Pf (Figures 3 and 4) which constitutes an arbitrary focal point on the basis of which surface 7 is formed as explained later. More specifically, focal point Pf is represented by the theoretical position along optical axis Ao of the first turn (not shown in detail) of filament 3 on the side facing reflector 5; and extremely tight in-service positioning tolerances of source 3 in relation to reflector 5 are applied, which tolerances equal a third of the height of filament 3 as regards the maximum permissible radial deviation between optical axis Ao and the center of filament 3, and a fifth of the length Lf of filament 3 as regards the maximum permissible axial deviation between point Pf and the first illuminated turn of filament 3.

To enable 360° pickup of the light emitted by filament 3 and at the same time project the reflected beam below cutoff line 2, reflector 5 presents a complex reflecting surface 7, i.e. comprising a number of sectors, all connected to one another substantially seamlessly, but each defined by a surface (reflecting or deflecting) with different optical characteristics as compared with the surfaces of the adjacent sectors. According to the present invention, none of the component sectors of reflecting surface 7 is defined by a surface of revolution, and, in conjunction with this characteristic, most of the sectors comprise surfaces generated by translating a generating base curve.

In the non-limiting example shown (Figure 2), reflecting surface 7 of reflector 5 comprises seven sectors: two upper lateral sectors 9 and 10 aligned on either side of optical axis Ao along the upper edge 11 of reflector 5; two lower lateral sectors 13 and 14 aligned on either side of optical axis Ao along the lower edge 15 of reflector 5 and respectively beneath sectors 9 and 10; two intermediate lateral sectors 19 and 20, the first between and connecting sectors 9 and 13, and the second between and connecting sectors 10 and 14; and a central sector 21 centered along optical axis Ao, extending along the full height Htot (Figure 6) of reflector 5, and connecting sectors 9, 19, 13 along side 22 of reflector 5 to the opposite sectors 10, 20, 14 along the opposite side 23 of the reflector.

Reflector 5 may of course be formed differently from the non-limiting example shown in the accompanying drawings, in the sense that edges 11, 15 and sides 22, 23 may be of any, even different, lengths, and may be straight, curved or any other shape.

According to the present invention, all the above sectors, with the exception of intermediate lateral sectors 19 and 20, are defined by respective different surfaces generated by translating a generating base curve - defined in a first plane - along a supporting curve - defined in a second plane perpendicular to the first. In practice, sectors 9,10, 13,14 and 21 are all defined by surfaces generated by translating arcs of a circle 25 (Figure 5), lying in horizontal planes, along two respective parabola branches 26 (Figure 4), one located above the optical axis (Figure 4) and the other below (not shown), and both lying in the vertical plane through optical axis Ao. Arcs 25 generating the surfaces each present a different predetermined radius calculated according to the required light distribution. Intermediate lateral sectors 19 and 20, on the other hand, are defined by surfaces described by a fourth-degree polynomial equation derived, as will be seen, from a spherical surface equation.

As shown in Figure 4, along their extension, the two parabola branches 26 acting as the base curve for translating arcs 25 are preferably rotated gradually upwards and/or towards the outer edge 27 of the reflector, so that the base curve along which arcs 25 are translated is a modified parabola 28 as opposed to parabola 26.

According to the present invention, the geometry of the surfaces defining sectors 9,10, 19,20, 13,14 and 21 is so selected that each sector provides for a predetermined distribution of the images reflected by it when projection tested to regulations on a screen at a distance of 25 m. More specifically, intermediate lateral sectors 19 and 20 of reflector 5 are so formed as to distribute the reflected images exclusively below optical axis Ao, as shown in Figures 7 and 8, so as to concentrate the beam emitted by headlight 1 below cutoff line 2.

Similarly, upper lateral sector 9 and lower lateral sector 14, diagonally opposite sector 9 in relation to central sector 21, are so formed as to provide for a wider distribution of the beam, and to direct it towards respective corresponding first prismed sectors 30 of lens 6 (shown schematically in Figure 3) appropriately located on the inner face of lens 6 facing reflector 5; and, in conjunction with the design of sectors 9 and 14, prismed sectors 30 are in turn so formed (using known techniques) as to distribute the images reflected by sectors 9 and 14 as shown in Figures 9 and 10, i.e. in such a manner as to define an oblique portion 2a of cutoff line 2, or in other words, in such a manner as to achieve the 15 degree light distribution typical of the cutoff line of a lower beam.

Similarly, a horizontal portion 2b of cutoff line 2 is defined by the image distribution shown in Figures 11 and 12 and which, according to the present invention, is effected by sectors 10 and 13, i.e. the upper lateral sector opposite sector 9, and the lower lateral sector diagonally opposite to it in relation to central sector 21, and by respective corresponding second prismed sectors 33 of lens 6 (shown schematically in Figure 3).

Finally, central sector 21 is so formed as to distribute the light centrally and below optical axis Ao, so as to achieve the image distribution shown in Figure 13, which, according to the present invention, provides for improving the visibility of vehicles fitted with headlight 1. On a screen at a distance of 25 meters from headlight 1, the optical distribution of the images reflected and predistributed by reflector 5, and possibly also corrected by prismed sectors 30 and 33, is therefore as shown in Figure 14, and, as can be seen, provides for greatly improving visibility by concentrating the light precisely in front of the headlight.

As regards actual construction, the sector surfaces of reflector 5 are first computer-aided designed (CAD); the resulting drawings, complete with all the dimensions calculated point by point, are transferred directly to production machines (CIM) for machining dies of suitable material; and reflector 5 is then injection molded from plastic material (or drawn from sheet metal) using conventional techniques.

According to an entirely new method, which is also an object of the present invention, the first step in the formation of surface 7 of reflector 5 consists in arbitrarily establishing an optical axis and a focal point along the optical axis, about which to construct the required surface using a "reverse" technique. According to the invention, the axis of the filament of the selected light source 3, e.g. an incandescent lamp of predetermined power, is selected as the fictitious optical axis Ao; and the point corresponding to the assumed position, along optical axis Ao, of the first turn of filament 3 on the side facing reflector 5 is selected as focal point Pf. As already stated, since the entire construction method is based on the above parameters, once reflector 5 is formed, source 3 must be assembled extremely accurately in relation to it and strictly within the tolerances mentioned previously.

Once optical axis Ao and focal point Pf have been established and drawn, the focal distance of the two parabola branches 26 used as the base curves is calculated, which focal distance provides for univocally determining the parabolas which may then be drawn. According to the present invention, the focal distance of the two parabolas 26 is calculated according to the following equations:

$$FP1 = Pf - C \text{ and} \quad (I)$$

$$FP2 = Pf + Lf + C \quad (II)$$

where FP1 is the focal distance of a first parabola branch 26 above optical axis Ao (Figure 4); FP2 is the focal distance of a second parabola branch 26 (not shown) below the optical axis; C is a constant depending on the working tolerances; Lf is the axial length of filament 3; and Pf is the axial location of the focal point as defined.

At this point, depending on the light distribution required, the radius of curvature of the arcs for generating sectors 9,10, 13,14 and 21 is calculated.

More specifically, and as shown in Figure 5, to generate the surfaces of sectors 9, 10, 13 and 14, the respective supporting parabola 26 (the top one for sectors 9,10 and the bottom one for sectors 13,14) is plotted in the horizontal plane to a width equal to that of the sector being produced, and the parabola is replaced, between the same limit points (Pl), by an arc with a radius calculated according to the equation:

$$Rc = \sqrt{(Xc - X2)^2 + (Yc - Y2)^2} \quad (III)$$

where X2 and Y2 are the coordinates of point Pl_2 (Figure 5); and Xc and Yc are the coordinates of the center of the circumference, given by the equations:

$$Xc = \frac{(Mun * X1 - MM_{1-2} * X2 - Yn + Y2)}{Mun - MM_{1-2}} \quad (IV)$$

$$Yc = Mun * (Xc - Xn) + Yn \quad (V)$$

where X1 and Y1 are the coordinates of point PI_1; Xn and Yn are the generic coordinates of any point on the circumference between points PI; Mun is the angular coefficient of the straight line joining points PI; and MM_{1-2} is the angular coefficient of the straight line bisecting the angle formed between the straight line joining point PI_2 and filament 3, and the straight line joining point PI_2 and a corresponding point at which point PI_2 is to be projected on a screen at a distance of 25 m from the headlight.

As shown in Figure 5, various arcs 25 of different radii, e.g. arcs 25a and 25b, may obviously be inserted between the same points PI to give a wide range of different light distributions, by virtue of the geometric limitations of the construction method described so far being minimum. According to the present invention, therefore, it is possible to achieve a reflector 5 wherein the radius of the arcs of sectors 9 and 14 is such as to produce an extremely wide beam which, with the aid of appropriate prismed sectors of lens 6, may be used for producing a fog light beam as opposed to a lower beam.

Once a respective arc 25 has been drawn for each sector 9,10 and 13, 14, the surfaces defining the sectors are formed by translating arcs 25 along the two parabola branches 26. Being a straightforward mathematical operation, a CAD system is obviously capable of rapidly drawing each surface point by point, and providing the dimensions required for production.

Once the surfaces of sectors 9, 10, 13 and 14 have been defined as described above, the surfaces of sectors 19, 20 and 21 are defined in such a manner as to achieve a substantially seamless (i.e. stepless) connection between the surface defining one sector and that defining another. According to the present invention, the surfaces of sectors 19 and 20 vertically connecting upper lateral sectors 9 and 10 to lower lateral sectors 13 and 14 are defined according to the following equation:

$$a + b^*X + c^*X^2 + d^*X^3 + e^*X^4 + f + g^*Y + + h^*Y^2 + l^*Y^3 + m^*Y^4 \qquad \text{(VI)}$$

This represents a fourth-degree polynomial equation which, when values are substituted, gives the point by point dimensions of the surfaces, and is obtained (Figure 6) as follows:

- first of all, the radius of a further arc to be located in the horizontal plane through optical axis Ao is defined using equation (III);
- said arc is rotated ideally about optical axis Ao by an angle given by the equation:

$$\alpha_{min} = \alpha_{max} = \arctan (Htot / Ltot) \qquad \text{(VII)}$$

  where Htot and Ltot are the maximum height and maximum width of reflector 5, to obtain two portions of the (fictitious) surface of revolution 40 shown in Figure 6 and which obviously conforms to the equation of a sphere; and
- the equation is then modified and resolved on condition that a seamless or stepless connection be achieved with the surfaces of sectors 9, 13 and 10, 14 respectively.

The above condition gives the value of coefficients a-m to be used in (VI), as is known and described more clearly in "Mathematics" by Stephen Wolfram, published by Addison-Wesley, and the content of which is incorporated herein as required for reference purposes.

Finally, the surface of central sector 21 is defined in the same way as for sectors 9,10 and 13,14, by first calculating, using equation (III) and depending on the required light distribution, the radius of curvature of an arc for connecting sectors 9,10 and 13,14; positioning the arc along optical axis Ao; and translating the arc along the same two parabola branches 26 as for the upper and lower lateral sector surfaces. Again, this is a repetitive mathematical operation performable by a CAD system which therefore gives the detailed dimensions required for producing the surface.

With reference to Figure 4, the luminous efficiency of sectors 9, 10, 13 and 14 may be further improved using, for each pair of sectors 9,10 and 13, 14, curve 28 as opposed to parabola 26 as the base curve along which to translate arcs 25 with the radius calculated using equation (III). Curves 28 (one above optical axis Ao (as shown) and one below (not shown)) are obtained from respective parabolas 26 by plotting the parabolas in successive portions and rotating the axis of the parabola, at the end of each portion, by a predetermined angle, e.g. half a degree, and in a predetermined direction (e.g. upwards as in Figure 4, and at any rate outwards of reflector 5). Half a degree upward rotation is preferably adopted for every 10 millimeters in length of the plotted parabola 26, commencing with the axis of the parabola coincident with optical axis Ao, so that the resulting curve 28 represents the envelope of all the parabolas 26 with their axes rotated gradually by predetermined angles and in the same direction.

Claims

1. A vehicle headlight for generating a lower or fog light beam concentrated entirely below a cutoff line to prevent dazzling oncoming traffic; the headlight comprising a light source, a reflector, and a prismed lens in front of the

reflector, and being of the type wherein the reflector picks up the source emitted light 360° about the source, and wherein the source is aligned coaxial with the optical axis of the headlight; the reflector presenting a complex reflecting surface including a number of different sectors connected substantially seamlessly; characterized in that none of said component sectors of the reflecting surface is defined by a surface of revolution; and most of said sectors are composed of surfaces generated by translating a generating base curve.

2. A headlight as claimed in Claim 1, characterized in that the reflecting surface of said reflector comprises seven sectors: two upper lateral, two lower lateral, two intermediate lateral, and one central sector extending along the full height of the reflector; which sectors, with the exception of the two intermediate lateral sectors, are all defined by surfaces generated by translating a generating base curve, defined in a first plane, along a supporting curve defined in a second plane perpendicular to the first.

3. A headlight as claimed in Claim 2, characterized in that, with the exception of the two intermediate lateral sectors, said sectors are all defined by surfaces generated by translating arcs - lying in horizontal planes and with a predetermined radius calculated according to the required light distribution - along two respective parabola branches, one located above and one below the optical axis and both lying in the vertical plane through the optical axis.

4. A headlight as claimed in Claim 2 or 3, characterized in that said two intermediate lateral sectors are defined by surfaces described by a fourth-degree polynomial equation.

5. A headlight as claimed in Claim 4, characterized in that said two intermediate lateral sectors are defined by surfaces described by the following equation:

$$a + b*X + c*X^{2} + d*X^{3} + e*X^{4} + f + g*Y + + h*Y^{2} + l*Y^{3} + m*Y^{4}. \qquad (VI)$$

6. A headlight as claimed in one of the foregoing Claims from 3 to 5, characterized in that, along their extension, said two parabola branches are rotated gradually upwards and/or towards the outer edge of the reflector.

7. A headlight as claimed in one of the foregoing Claims, characterized in that it comprises means for concentrating the beam below the cutoff line; said means comprising said two intermediate lateral sectors of the reflector, which provide for distributing the reflected images below the optical axis.

8. A headlight as claimed in Claim 7, characterized in that it comprises means for defining an oblique portion of the cutoff line; said means comprising, in combination, a first said upper lateral sector, a corresponding said lower lateral sector diagonally opposite the first in relation to said central sector, and respective first prismed sectors of said lens.

9. A headlight as claimed in Claim 7 or 8, characterized in that it comprises means for defining a horizontal portion of the cutoff line; said means comprising, in combination, a second said upper lateral sector opposite the first, a corresponding said lower lateral sector diagonally opposite said second upper lateral sector in relation to said central sector, and respective second prismed sectors of said lens.

10. A headlight as claimed in one of the foregoing Claims from 7 to 9, characterized in that it comprises means for distributing the light centrally and below the optical axis; said means comprising said central sector.

11. A method of producing a complex reflecting surface for the reflector of a vehicle lower beam or fog light; characterized in that it comprises the steps of:

- establishing an arbitrary focal point along a fictitious optical axis; the axis of a filament constituting said light source being selected as the optical axis; and the position, along the optical axis, of the first turn of the filament on the side facing the reflector being selected as the focal point;
- calculating the focal distance of two parabola branches in the vertical plane through the optical axis, using the following equations:

$$FP1 = Pf - C \text{ and} \qquad (I)$$

$$FP2 = Pf + Lf + C \qquad (II)$$

where FP1 is the focal distance of a first parabola branch above the optical axis; FP2 is the focal distance of a second parabola branch below the optical axis; C is a constant depending on the working tolerances; Lf is the axial length of the filament; and Pf is the axial location of the focal point;

- calculating, according to the required light distribution, the radius of curvature of four arcs using the following equation:

$$Rc = \sqrt{(Xc - X2)^2 + (Yc - Y2)^2} \qquad (III)$$

where Xc and Yc are the coordinates of the center of the circumference, which are given by the equations:

$$Xc = \frac{(Mun * X1 - MM_{1\text{-}2} * X2 - Yn + Y2)}{Mun - MM_{1\text{-}2}} \qquad (IV)$$

$$Yc = Mun * (Xc - Xn) + Yn \qquad (V)$$

where Mun is the angular coefficient of the straight line joining the end points of the circumference; and MM_{1-2} is the angular coefficient of the straight line bisecting the angle formed between the straight line joining a first end point of the circumference to said filament, and the straight line joining the same point to a corresponding point on a screen at a distance of 25 m from the headlight and at which said point is to be projected;

- forming four lateral surface sectors of the reflector, two along the upper edge and two along the lower edge of the reflector, by translating said four arcs along said two parabola branches;
- forming two opposite intermediate lateral surface sectors of the reflector, so located as to vertically connect said upper lateral sectors to said lower lateral sectors using the following equation:

$$a + b*X + c*X^2 + d*X^3 + e*X^4 + f + g*Y + + h*Y^2 + l*Y^3 + m*Y^4 \text{ ; and} \qquad (VI)$$

- forming a central surface sector of the reflector, so located as to horizontally join all the other sectors in pairs, by calculating, according to the required light distribution, the radius of curvature of an arc using equation (III), and by translating said arc along said two parabola branches and through the optical axis.

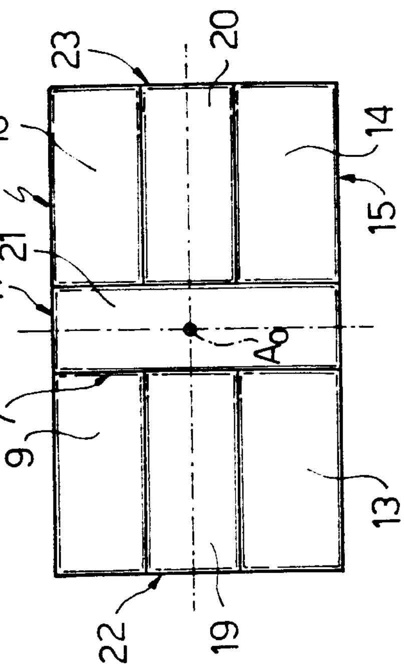


Fig.2

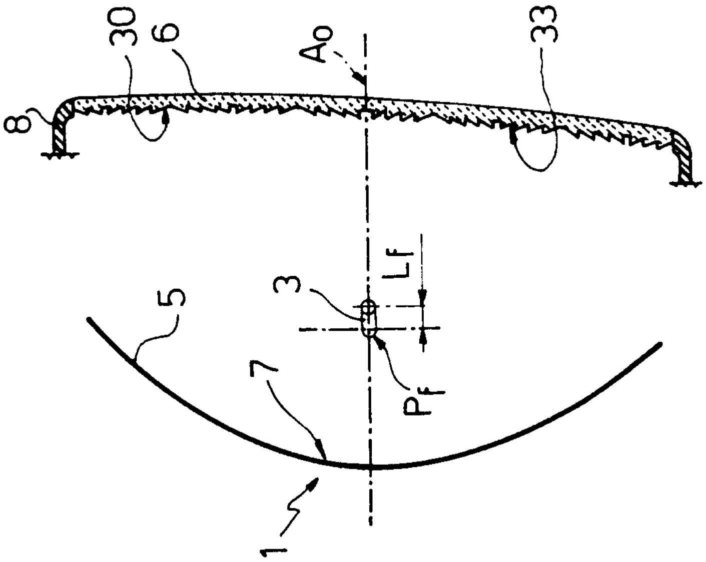


Fig.3

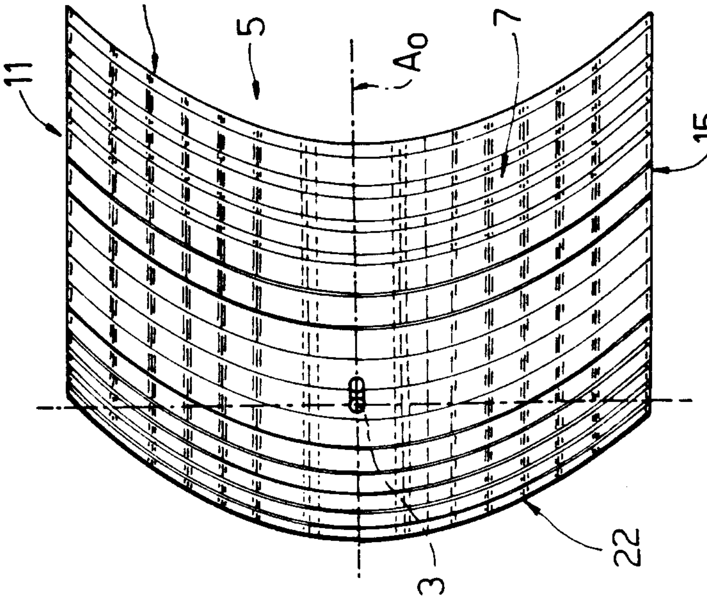


Fig.1

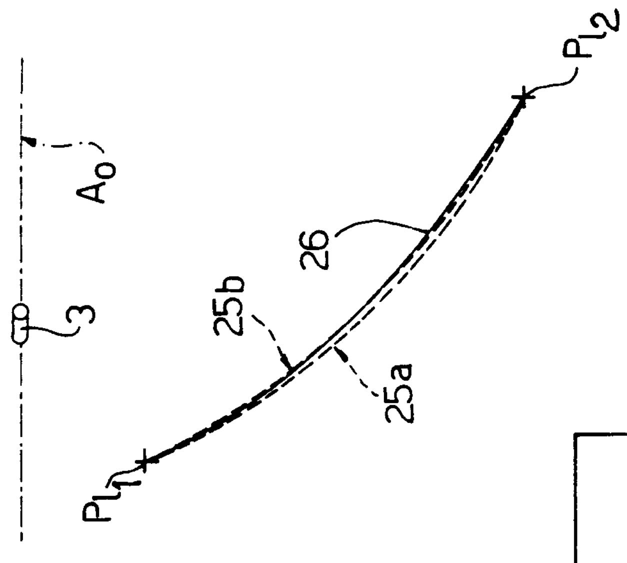


Fig.5

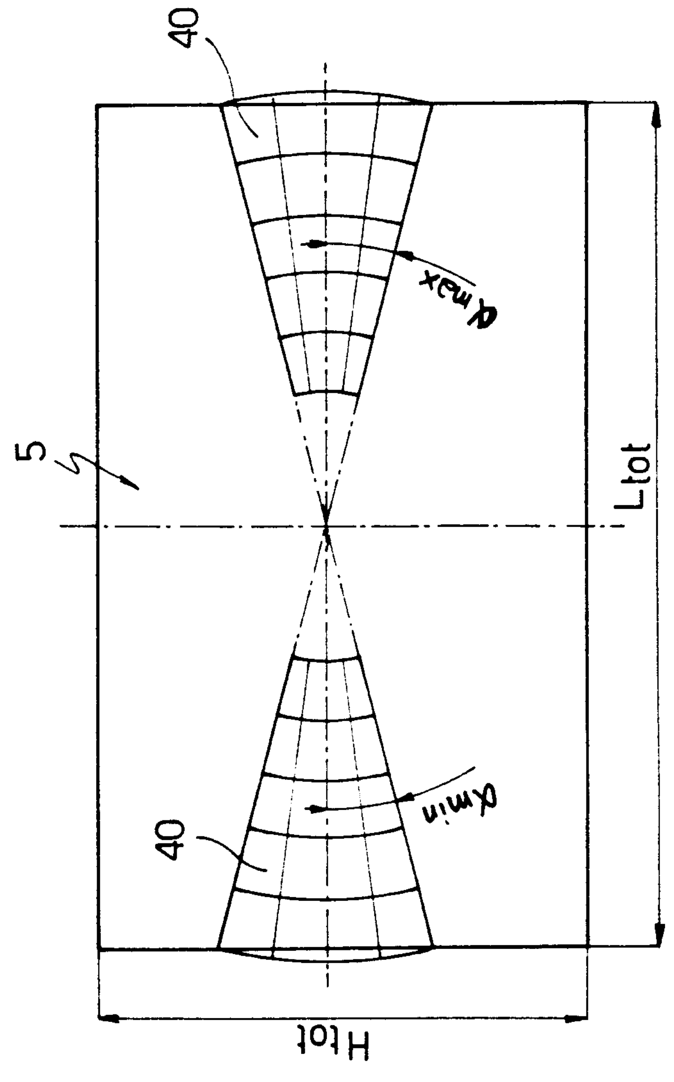


Fig.6

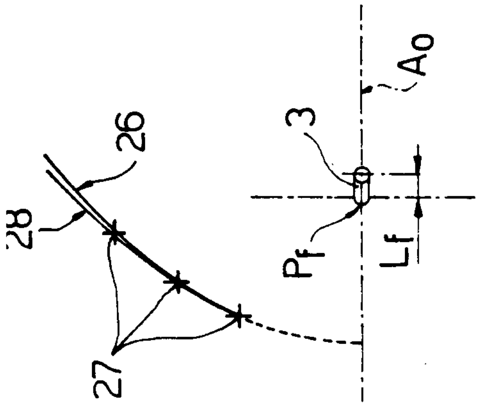
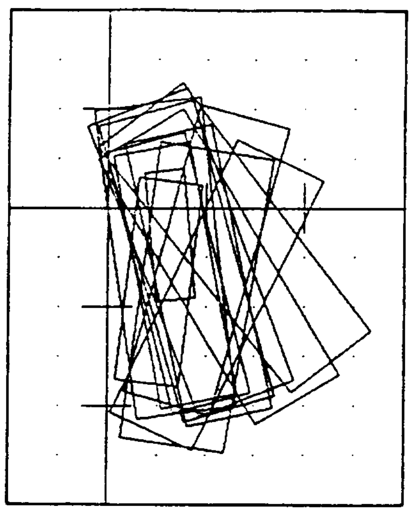


Fig.4

Fig.8



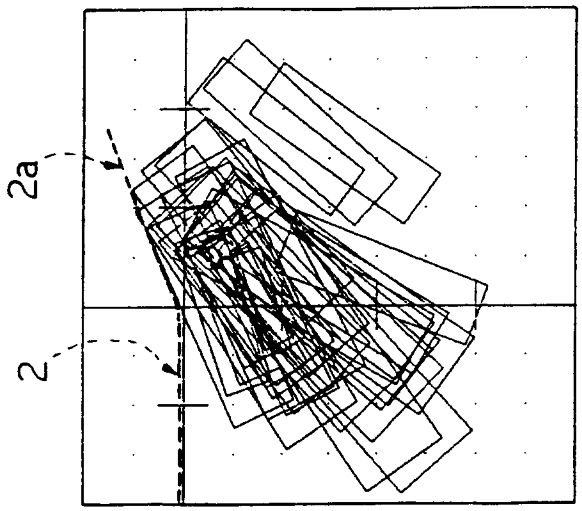


Fig.10

Fig.7

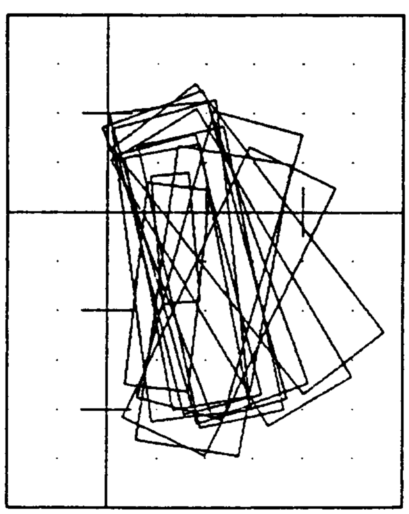
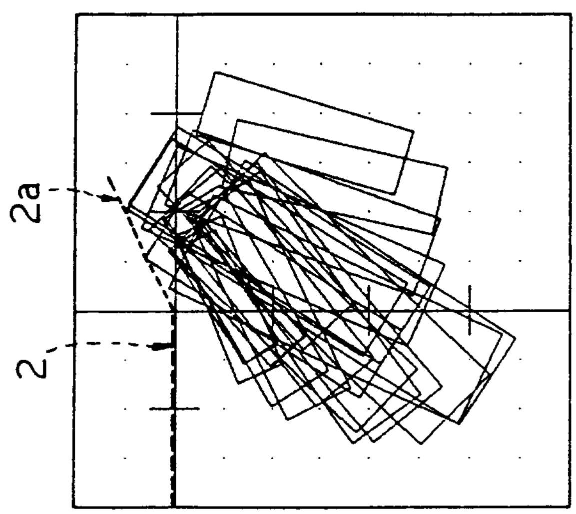


Fig.9



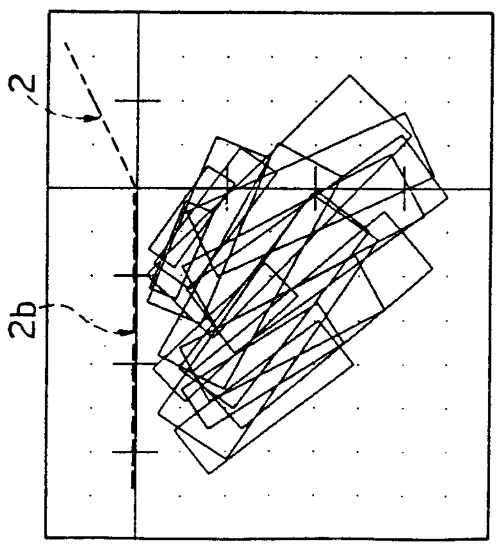


Fig.11

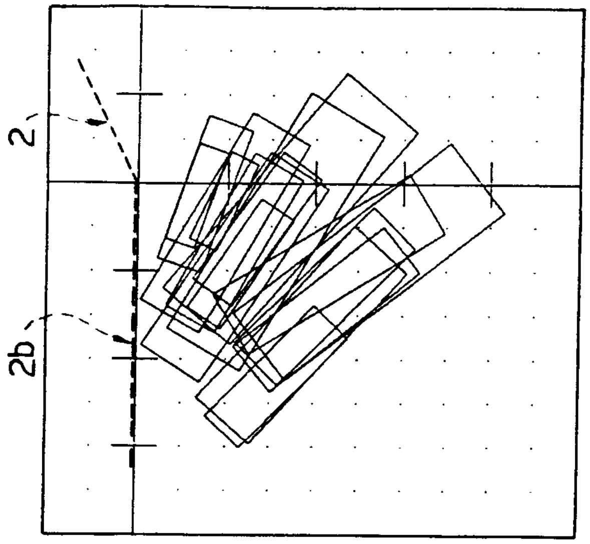


Fig.12

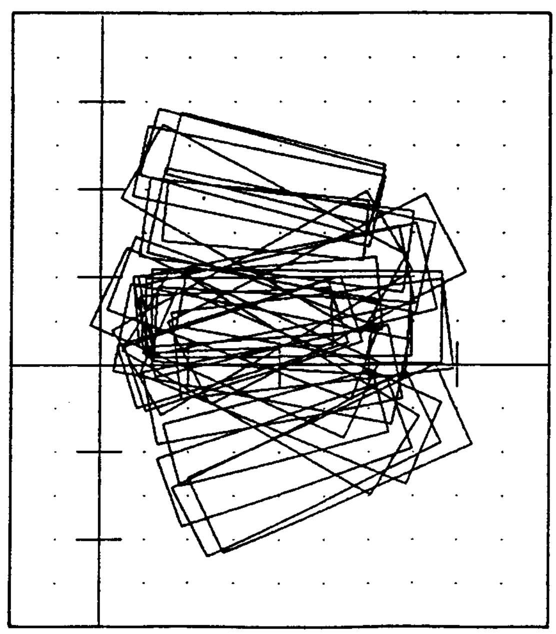


Fig.13

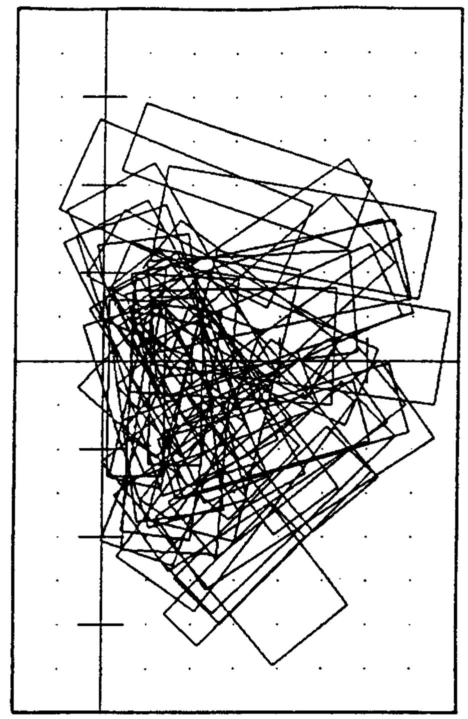


Fig. 14

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 11 4817

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)
Y,D	US-A-4 530 042 (CIBIE ET AL.) * column 4, line 5 - line 18 * * column 5, line 48 - line 62 * * abstract; figures 1-5 * & FR-A-2 536 502 ---	1,7-9	F21M3/08
Y	EP-A-0 084 934 (LUCAS INDUSTRIES) * page 4, line 29 - page 5, line 4 * * page 7, line 17 - page 9, line 7 * * page 10, line 1 - line 32 * * page 12, line 13 - line 22; figures 1,2,4,9 * ---	1,7-9	
A	US-A-1 732 884 (FOSTER) * page 1, line 1 - line 53 * * page 2, line 80 - line 86; figures 1-8 * -----	1	

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	28 November 1995	Martin, C

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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