(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 084 934**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **83300102.7**

(22) Date of filing: **10.01.83**

(51) Int. Cl.³: **F 21 M 3/08**

(30) Priority: **16.01.82 GB 8201207**

(43) Date of publication of application: **03.08.83 Bulletin 83/31**

(84) Designated Contracting States: **DE FR GB IT**

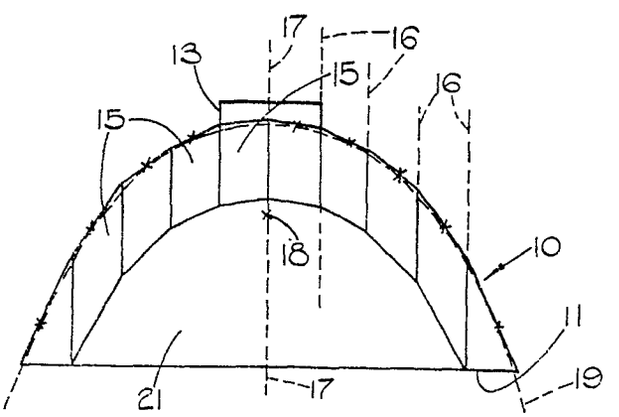
(71) Applicant: **LUCAS INDUSTRIES public limited company, Great King Street, Birmingham, B19 2XF (GB)**

(72) Inventor: **Jones, Kenneth James, 11 Aragon Drive, Sutton Coldfield West Midlands (GB)**

(74) Representative: **Pearce, Anthony Richmond et al, Marks & Clerk Alpha Tower Suffolk Street Queensway, Birmingham B1 1TT (GB)**

(54) **Lamp reflector.**

(57) To provide an increase horizontal spread of light compared with a paraboloidal reflector, the lamp reflector comprises a dished body (10) having an internal reflective surface defined at least partly by a series of troughs (15) whose surfaces are generated by movement of a parabola so that the tangent at the apex thereof moves parallel to itself along a polygonal line whose sides are tangents to a parabola which has the same focal length as that of the first-mentioned parabola and which is perpendicular to the latter. In an alternative embodiment, only one such trough is provided between a pair of paraboloidal reflective portions each of which has its focus coincident with the second-mentioned parabola.



EP 0 084 934 A1

This invention relates to a lamp reflector and is particularly, but not exclusively concerned with a headlamp reflector for a motor vehicle.

In headlamp reflectors for dipped or passing beam purposes, it is necessary for the light beam pattern projected by the headlamp to have a substantial horizontal spread. It is known in headlamp reflectors to provide a paraboloidal reflective surface and to modify the light beam pattern provided by the paraboloidal surface with the use of a transparent glass cover which closes the front of the lamp reflector. The cover has lensing therein which is chosen so as to increase the otherwise limited horizontal spread of the beam pattern projected by the paraboloidal reflector. However, recent vehicle styling trends dictate headlamp constructions where the cover is well forward of the reflector. With such constructions, the portion of the lensing on the cover near the centre thereof acts on light rays coming from different areas of the reflector which need different treatment by the lensing. This means that it is difficult to obtain the required beam pattern. Furthermore, vehicle styling trends also dictate the use of a cover that is sloped relative to the reflector so that the top of the cover is nearer to the reflector than the bottom. The use of lensing on such a sloping cover to effect a wide horizontal spread of light results in a vertical deviation of the wide spread rays so that the beam pattern becomes increasingly displaced downwardly from the centre of the beam to the lateral extremities thereof. Since a generally horizontal beam spread is required, the required illumination pattern cannot be obtained.

Moreover, such transparent glass covers with lensing thereon require expensive tooling and absorb and/or scatter more light than a smooth transparent cover.

It is disclosed in GB-PS 435946 to transfer vertical corrugations or grooves on the glass cover to the reflector by defining the corrugations on the reflector by the curves of intersection of the reflector with planes passing through the corrugations of the glass cover. It is further disclosed in GB-PS 435946 to provide such corrugations on the reflector by first tracing the parabolas delimiting the corrugations on a die that serves to make the reflectors by stamping, and then removing matter by means of files between these parabolas along a trace othogonal or perpendicular to the said parabolas to obtain corrugations having a curvature equal to zero perpendicularly to the parabolas that delimit them. It is clear from the manner that the die is produced that the resultant reflector is made up of a number of parabolic trough reflectors each of which is chordal in the horizontal plane with respect to the paraboloidal surface of the die in which they are formed. Whilst such a construction produce an advantageous divergence of horizontal light rays emanating from a light source placed at the focus of the paraboloidal surface, it also produces a divergence of light rays from said source in the vertical plane, which is highly undesirable.

It is an object of the present invention to obviate or mitigate the above disadvantages.

According to one aspect of the present invention, there is provided a lamp reflector comprising a dished body having an internal reflective surface, said internal reflective surface including at least one portion formed of a plurality of side-by-side troughs formed by respective trough-like surfaces as hereinafter defined.

The shape and arrangement of the trough-like surfaces is best understood by reference to a constructional (or imaginary) paraboloidal surface i.e. a surface produced upon rotation of a parabola about its focal axis. The constructional paraboloidal surface is divided into a plurality of surface portions which are defined between vertical sections (which may be equi-spaced) parallel to a vertical plane in which the focal axis lies. In eachof said surface portions, take a line on the surface portion which is at a fixed distance from one of the side edges of the surface portion (the line may be midway between the side edges of the surface portion). Horizontal tangents to the constructional paraboloidal surface at the line define each trough-like surface which has a parabolic curvature in the vertical plane and zero curvature in the horizontal plane. The reflective surface is defined by a plurality of troughs each having the shape of a respective one of the trough-like surfaces. The joint line between each adjacent trough lies in a respective one of said vertial sections.

In other words, the reflective surface can be considered to have the form of a surface generated by movement of a parabola so that the tangent at the apex thereof moves parallel to itself along a polygonal line whose sides are tangents to a parabola which has the same focal length as that of the first-mentioned parabola and which is perpendicular to the latter.

With such an arrangement, whilst there is an advantageous horizontal spread of light reflected by the reflective surface portion from a light source at the focus of the paraboloid, there is no disadvantageous vertical spread, compared with a conventional simple paraboloidal reflector. Thus in a

headlamp fitted with a reflector according to the present invention, the lensing on the transparent cover can be materially simplified thereby mitigating the above discussed disadvantages.

The horizontal width of the troughs is chosen to suit the desire degree of horizontal spread. The smaller the width, the smaller the degree of horizontal spread.

In one embodiment, substantially the whole of the relfective surface of the reflector is defined by said troughs.

In another embodiment, the reflective surface includes more than one of the internal reflective surface portions. In a preferred example of said another embodiment, the reflector includes a first and a second of said internal reflective surface portions, the first internal reflective surface portion being disposed above the second and displaced therefrom so that the focus of the second internal reflective surface portion is spaced forwardly of the focus of the first internal reflective surface portion.

In a further embodiment, the reflective surface includes at leat one paraboloidal surface portion having its focus coincident with that of the paraboloid to which the troughs are horizontally tangential.

According to another aspect of the present invention, there is provided a lamp reflector comprising a dished body having an internal reflective surface, said reflective surface including a pair of paraboloidal portions separated by a

trough, the trough being defined by a trough-like surface having the form as described above, each paraboloidal portion having its focus coincident with that of the paraboloidal portion with which the trough-like surface is associated.

Such an arrangement also produces an advantageous horizontal spread of light without a disadvantageous vertical spread light in comparison with a conventional simple paraboloidal reflector.

In an embodiment of this aspect of the present invention, the lamp reflector has upper and lower sets of said paraboloidal portions and trough, the sets being displaced so that the focus of the paraboloidal portions of the lower set is disposed forwardly of that of the paraboloidal portions of the upper set.

Embodiments of the present invention will now be described by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a front elevation of a first embodiment of lamp reflector according to the present invention,

Figure 2 is a schematic horizontal section through the lamp reflector of Figure 1,

Figure 3 is a longitudinal section through a vehicle headlamp assembly incorporating the lamp reflector of Figure 1,

Figure 4 is a front view of a second embodiment of lamp reflector according to the present invention,

Figure 5 is a front view of a third embodiment of lamp

reflector according to the present invention,

Figure 6 is a schematic front view of a fourth embodiment of lamp reflector according to the present invention,

Figure 7 is a front view of a fifth embodiment of lamp reflector according to the present invention, and

Figure 8 is a horizontal section through the lamp reflector of Figure 7, and

Figure 9 is a schematic plan view illustrating the shape of a typical trough.

Referring now to Figs 1 to 3, the lamp reflector illustrated therein comprises a dished body 10 having a front opening 11 of generally rectangular form, and a central rear opening 12 surrounded by a bulbholder sleeve 13. A continuous flange 14 is provided around the front opening 11. The interior of the body 10 is aluminised so as to provide a reflective surface.

The whole of the reflective surface is defined by a multiplicity of side-by-side troughs 15. Each trough 15 is as defined hereinabove and a typical trough 15 is illustrated in Fig. 9 to which reference is now drawn. This trough 15 is defined by horizontal tangents to a constructional (or imaginary) paraboloidal surface defined by rotation of a parabola 19 focussed at 18 about its focal axis 17. These horizontal tangents are those which touch the constructional paraboloidal surface at a vertically disposed parabolic line (part of which is illustrated by dotted line EF) lying in a plane parallel to vertical planes 16 which are themselves parallel to a vertical plane in which the focal axis 17 lies. Examples of the tangents are illustrated by lines AC, GH and IJ, the

and being shown in full line as it defines the rear, ie apex, of the trough 15. The parabolic line shown partly by line EF is disposed at a fixed distance from the respective planes and, in this embodiment, is approximately midway between them. The side edges of the trough 15 are defined by vertically disposed parabolic lines lying in the respective planes 16. Those parts of the side edges which are illustrated in Fig. 9 are indicated by lines AB and CD respectively. The two front edges of the trough lie in respective vertical planes perpendicular to that in which focal axis 17 lies. The upper front edge of the trough 15 is indicated by line BD in Fig. 9. Thus, the typical trough 15 has a zero curvature in the horizontal plane and a parabolic curvature in the vertical plane.

Alternatively, the surface of the troughs 15 can be considered to be generated by movement of a vertically disposed parabola having the same focal length as that of the horizontally disposed parabola 19 so that the tangent at the apex of the verticallydisposed parabola moves parallel to itself along a polygonal line whose sides are tangents to a horizontally disposed parabola having the same focal length as that of the first-mentioned parabola.

As is usual with lamp reflectors having a rectangular front opening 11, the body 10 includes upper and lower mutually parallel planar portions 20 and 21 which are not designed to take part in reflection of light in use. As can be seen from Fig 3, these portions 20 and 21 are of different depths so that the top edge of the flange 14 lies nearer to the rear of the lamp reflector body 10 than does the bottom edge of the flange 14. This construction is provided for vehicle styling purposes where it is necessary for a transparent glass cover (indicated at 22 in Fig. 2) to be inclined so as to complement the vehicle styling at the front of the

car. The cover 22 is provided with a peripheral flange 23 which is sealingly secured to the flange 14 in the completed headlamp. A bulb 24 is mounted in the bulb holder sleeve 13 and, because it is intended for a main (long range or driving) beam, is provided with a filament 25 which is disposed on the axis 17 with its centre at the focus 18 in the conventional manner.

In use, light emanating from the filament 25 which is incident upon the median lines of the troughs 15 is reflected in the same manner as would be the case if the light were incident upon a plain paraboloidal reflector generated by rotation of parabola 19 about axis 17. Light which is incident upon other parts of the troughs 15 will be horizontally spread upon reflection compared to reflection off the plain paraboloidal reflector generated by parabola 19. The spacing between the planes 16 and therefore the number of troughs 15 provided in a reflector of given horizontal width, is chosen to provide the required degree of beam spread in the horizontal direction. The smaller the spacing and the greater the number of troughs, the more the overall reflector shape approaches that of the plain paraboloidal reflector and the smaller the degree of horizontal beam spread. However, it is a feature of the above described reflector that there is no such beam spread in the vertical direction. In other words, in the vertical direction, the reflected light beam is as compact as that from the plain paraboloidal reflector generated by parabola 19. This is because of the above described tangential disposition of the troughs 15 in the horizontal plane relative to the paraboloidal surface generated by rotation of parabola 19 about axis 17. The bulb 24 will be provided in the usual way with a shield which is positioned in front of the filament 25 to prevent light passing directly, ie without reflection, through the front opening 11 of the reflector.

Referring now to Fig. 4, the embodiment of lamp reflector illustrated therein is intended for dipped beam purposes only and is split in a manner known per se into upper and lower reflective regions which are both use under dipped beam conditions. Basically, the lamp reflector comprises a dished body 110 having a front opening 111 of generally rectangular outline and a central rear opening 112. The upper and lower reflective regions (indicated by arrows 113 and 114 respectively) are separated by a step 115 composed of downwardly directed step portions 116 and 117, the lower reflective region 114 being stepped back rearwardly of the upper reflective region 113. The step portions 116 and 117 extend respectively from the rear opening 112 to the front opening 111 and, in use, define the upper cut off to the dipped beam projected by the headlamp in a manner known per se without the requirement to provide a filament shield for cutting off the top of the beam.

Each of the upper and lower reflective regions 113 and 114 includes respective troughs 118 and 119. The troughs 118 are mutually disposed in the same way as the troughs 15 described hereinabove with reference to Figs. 1 to 3. This applies also to the mutual arrangement of the troughs 119. However, the focal length of the paraboloid on which the median parabolae of the troughs 118 lie is less than that of the paraboloid on which the median parabolae of the troughs 119 lie. Further, although the focal axes of these two paraboloids lie on the longitudinal axis 120 of the body 110 the focus of the paraboloid associated with the lower region 114 is spaced directly forwardly of the focus of the paraboloid associated with the upper region 113. In use, a lamp filament (not shown) is disposed between the two foci.

The step portion 116 is horizontal whilst the step portion 117 is downwardly inclined away from the rear opening 112.

The downwardly inclined step portion 117 is disposed at an angle a to the horizontal which, in this embodiment, is 15-20°.

An area 122 of the upper reflective region 113 immediately above the horizontal step portion 116 is made up of troughs 123 which have half the horizontal width of the troughs 118 as viewed in Fig. 4. The vertical height of the area 122 is substantially equal to the radius of the rear opening 112. The area 122 extends widthwise of the reflector from the opening 112 to the periphery of the region 113. The troughs 123 are in the same mutual arrangement as the troughs 118 and are arranged in a similar manner to the troughs 118 so that the median lines thereof lie on the same paraboloid as those of the troughs 118. However, instead of being associated woth the same paraboloid as that with which the troughs 118 are associated, the troughs 123 may be associated with a paraboloid of longer focal length but which nevertheless has a focus coincident with that of the first-mentioned paraboloid. Such an arrangement produces an acceptable step from region 113 to area 122. The same may apply to area 124 described below.

An area 124 of the upper reflective region 113 immediately above the inclined step portion 117 is also made up of troughs 125 which have half the width of the troughs 118 and which are mutually disposed in a like manner to the troughs 118. However, the troughs 125 extend perpendicularly with respect to the inclined step portion 117. The troughs 125 are so mutually arranged that their median parabolas lie on a paraboloid having its focal axis inclined with respect to the paraboloid(s) associated with the troughs 118 and 123. In this embodiment, the paraboloid associated with the troughs 125 has its focus coincident that of the paraboloid(s) associated with the troughs 118 and 123. The area 124 extends from the inclined step

portion 117 to a line 126 upwardly inclined at an angle b with respect to the horizontal which, in this embodiment, is 5-10°.

In use, light from the dipped or passing beam filament described above is reflected from both of the upper and lower regions 113 and 114 to produce an assymmetric dipped or passing beam whose upper cut-off is defined by the step portions 116 and 117 in a manner known per se. The provision of the troughs 118 and 119 gives a greater degree of horizontal spread of images than would be the case if the respective reflective areas occupied thereby were purely paraboloidal.

However, the presence of the narrower troughs 123, 124 and 125 gives a reduced spread and therefore a greater beam intensity in the critical region of the passing or dipped beam just below the upper cut-off. It is within the scope of the present invention to provide narrower troughs similar to troughs 123 and 125 at corresponding locations in the reflector of Figs. 1 to 3 (in a case where such reflector is used in conjunction with a twin filament bulb), and in the reflectors of the embodiments to be described hereinafter. Referring now to Fig. 5, the reflector illustrated therein is similar to the split reflector of Fig. 4 and similar parts are accorded corresponding reference numerals in the 200 series. The upper reflection region 213 is made up three troughs 218a, 218b and 218c and a pair of outer paraboloidal portions 230. Similarly, the lower reflective region is made up of three troughs 219a, 219b and 219c and a pair of outer paraboloidal portions 231. The troughs 218a, 218b and 218c are mutually arranged in the same way as that described above for the troughs 118. The same also applies to the troughs 219a, 219b and 219c in relation to the troughs 119. The paraboloidal portions 230 lie on the surface of the

same paraboloid which has its focus at 220 and its focal line coincident with the longitudinal axis of body 210. However, to ensure a smooth joint line 232 and 233 with the respective troughs 218c and 218b, the joint lines 232 and 233 are of hyperbolic form and the paraboloid on which the portions 230 lie has a longer focal length than that to which the troughs 218a are tangent although the paraboloids have a common focus at 220. Likewise, the troughs 219a to c and the paraboloidal portions 231 have the same mutual disposition to produce smooth joint lines 234 and 235 between the troughs 219c, 219b and the respective portions 231. However, the paraboloids associated with the troughs 219a to c and the portions 231 have longer focal lengths than those associated with the troughs 218a to c and the portions 230 so that downwardly directed step 215 consisting of portions 216 and 217 is defined between upper and lower reflective regions 213 and 214. To effect an advantageous distribution of light along the cut-off line in a direction inclined to the horizontal, the small area 250 may either be paraboloidal or be similar to area 124 described above with reference to Fig. 4.

In use, the above-described horizontal beam spreading effect is produced solely by reflection off the troughs 218a to c and 219a to c since the portions 230 and 231 are paraboloidal. In this embodiment, the troughs 218a and 219a have their horizontal directions of extent lying perpendicular to the longitudinal axis of the body 210.

Referring now to Fig. 6, the lamp reflector is similar to that of Fig. 5 and similar parts are accorded corresponding reference numerals in the 300 series. However, in this embodiment, the reflector is not of the split type and there is no trough corresponding to trough 218a so that troughs 318b and c and paraboloidal portions 330 together define the whole of the internal reflective surface of the

body. The troughs 318b and c are joined along a line extending in a vertical plane in which the longitudinal axis of the body 310 lies.

The above-described horizontal spreading of the light beam takes place solely by reflection off the troughs 318b and c.

Referring now to Figs. 7 and 8, the lamp reflector is similar to that of Fig. 6 and similar parts are accorded corresponding reference numerals in the 400 series. However, in this embodiment, only one trough 418 is provided and, like troughs 218a and 219a, is arranged with its horizontal direction of extent (indicated by dotted line 440 in Fig. 8) perpendicular to the longitudinal axis 417 of the reflector body 410. The trough 418 is horizontally tangential to the apex of a paraboloid having its focus at 420 and its focal axis coincident with axis 417 but is chordal in a horizontal plane with respect to a paraboloid upon which the portions 430 lie and which is defined by rotation of a parabola (indicated by dotted line 441 in Fig. 8) focussed on point 420 about axis 417. It will be apparent that the paraboloid upon which the portions 430 lie has a longer focal length than the paraboloid to which the trough 418 is a tangent, even though the foci thereof are coincident.

In all of the illustrated embodiments described hereinabove, the lamp reflector is of a form having a substantially rectangular front opening. However, the invention is applicable mutatis mutandis to lamp reflectors having a circular, square trapezoidal or other form of front opening.

CLAIMS

1. A lamp reflector comprising a dished body (10, 110, 210, 310) having an internal reflective surface, said internal reflective surface including at least one surface portion formed of a plurality of side-by-side troughs (15, 118 or 119, 218 or 219, 318) characterized in that the surfaces of said troughs (15, 118 or 119, 218 or 219, 318) are generated by movement of a parabola so that the tangent at the apex thereof moves parallel to itself along a polygonal line whose sides are tangents to a parabola which has the same focal length as that of the first-mentioned parabola and which is perpendicular to the latter.

2. A lamp relfector as claimed in claim 1, wherein substantially the whole of the reflective surface of the reflector is defined by one of said at least one surface portion.

3. A lamp reflector as claimed in claim 1, wherein more than one of said surface portions is provided.

4. A lamp reflector as claimed in claim 3, including a first and second of said surface portions being disposed above the second and being displaced therefrom so that the focus of the second surface portion is spaced forwardly of the focus of the first internal reflective surface portion.

5. A lamp reflector as claimed in any preceding claim, including at least one paraboloidal surface portion having its focus coincident with that of the second-mentioned parabola.

6. A lamp reflector comprising a dished body (410) having an internal reflective surface, said reflective surface including a pair of paraboloidal portions (430), characterised in that the paraboloidal portions (430) are separated by a trough (418), the trough being defined by a surface generated by movement of a parabola so that the tangent at the apex thereof moves parallel to itself along a line which is a tangent to a parabola which has the same focal length as that of the first-mentioned parabola and which is perpendicular to the latter each paraboloidal portion (430) having its focus coincident with the second-mentioned parabola.

7. A lamp reflector as claimed in claim 6, having upper and lower sets of said paraboloidal portions and trough, the sets being displaced so that the focus of the paraboloidal portions of the lower set is disposed forwardly of that of the paraboloidal portions of the upper set.

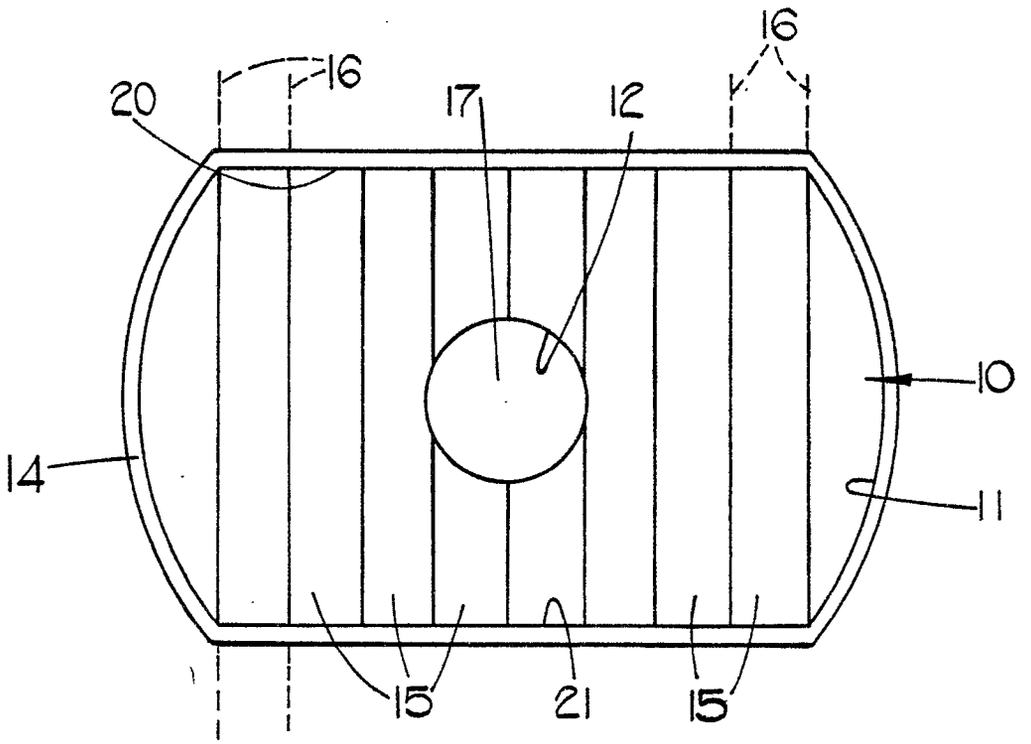


FIG. 1.

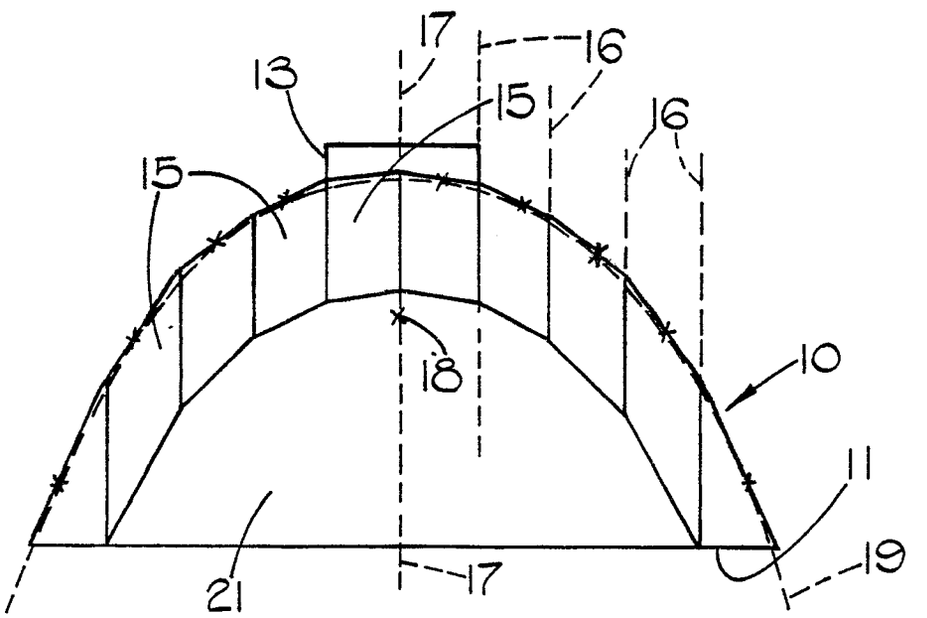


FIG. 2.

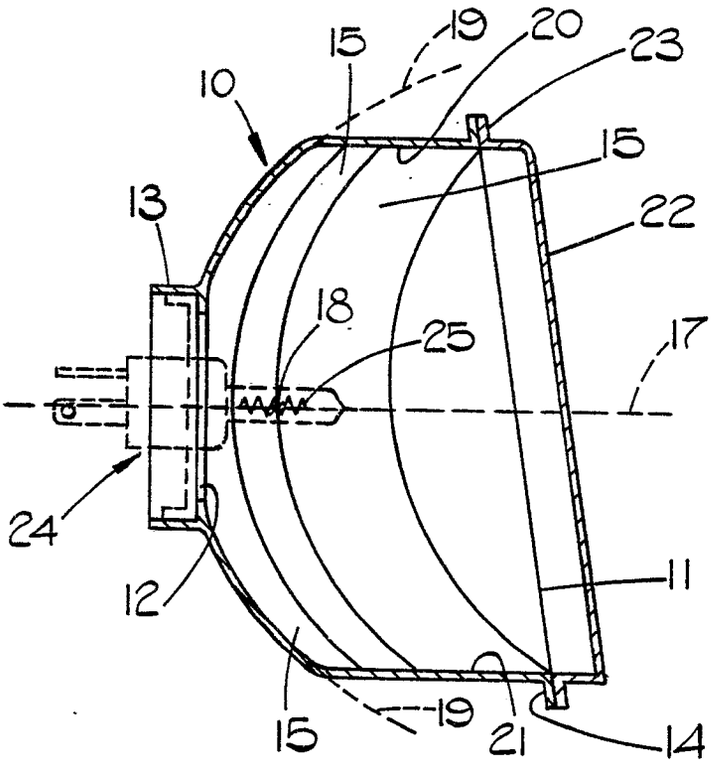

10
15
19
20
23
15
13
22
18
25
17
24
12
11
15
19
21
14

FIG.3.

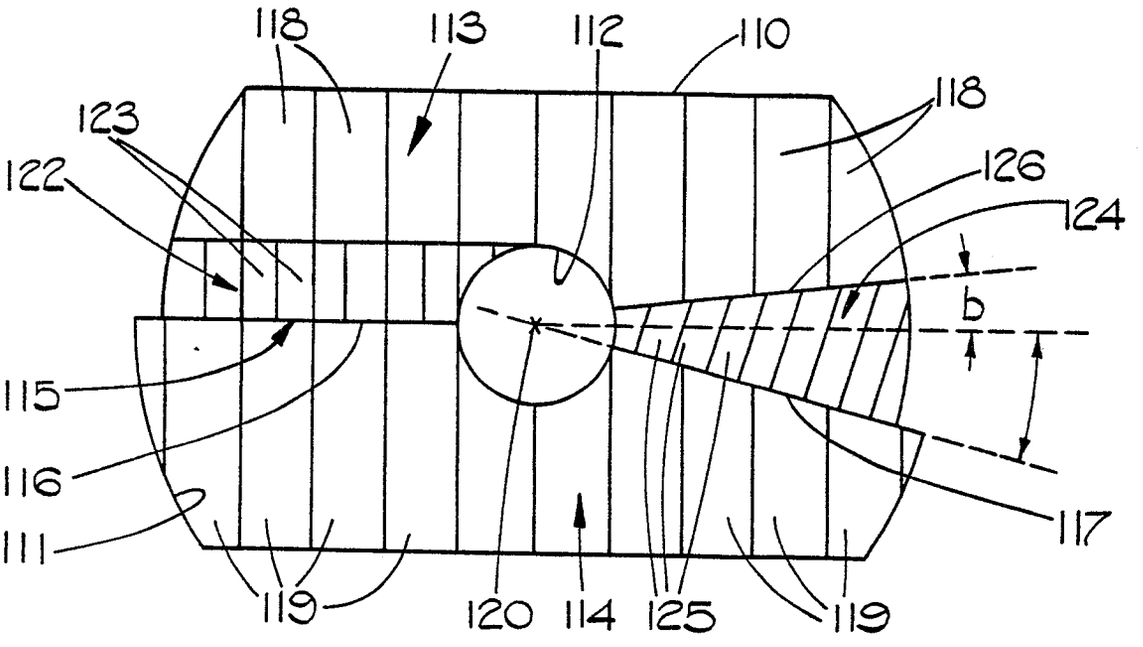

118
113
112
110
118
123
122
126
124
b
115
116
111
117
119
120
114
125
119

FIG.4.

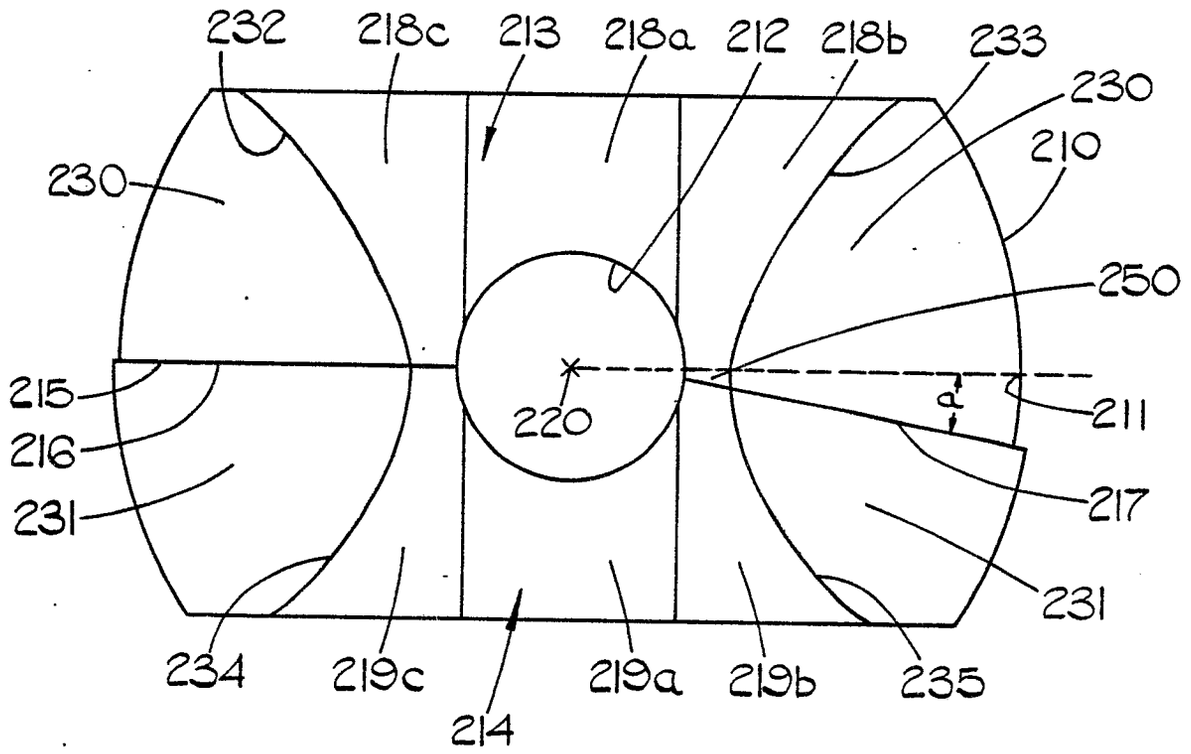

232
218c
213
218a
212
218b
233
230
210
230
250
215
216
231
220
a
211
217
231
234
219c
214
219a
219b
235

FIG.5.

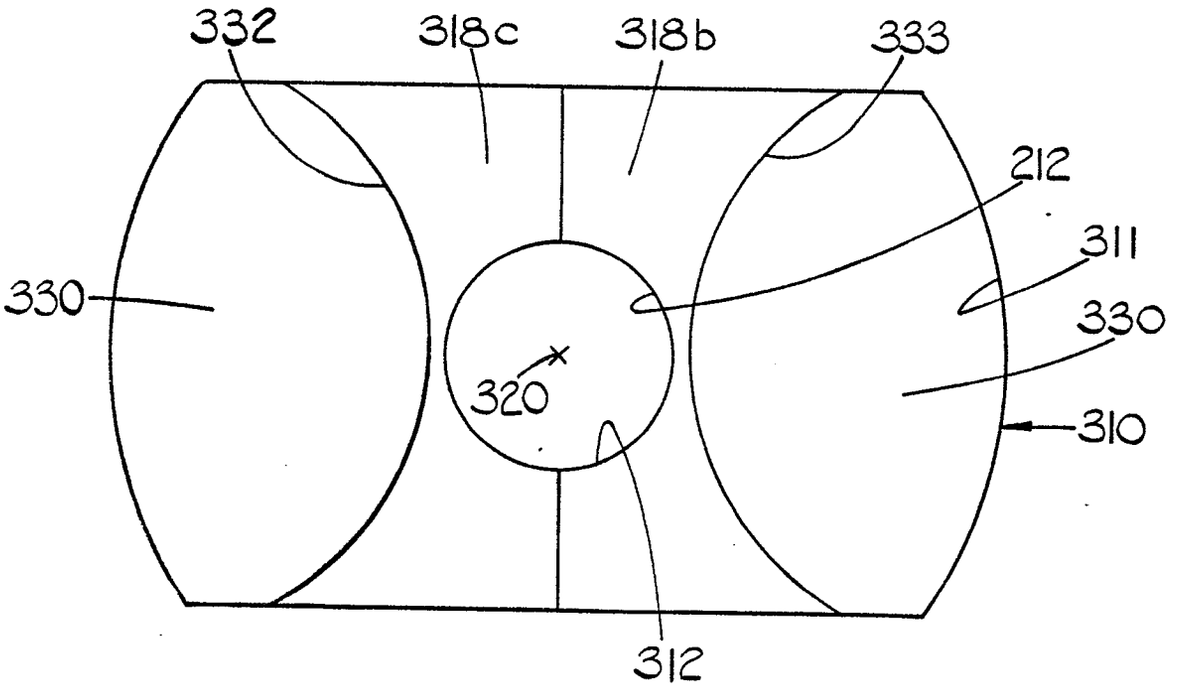

332
318c
318b
333
212
311
330
330
320
310
312

FIG.6.

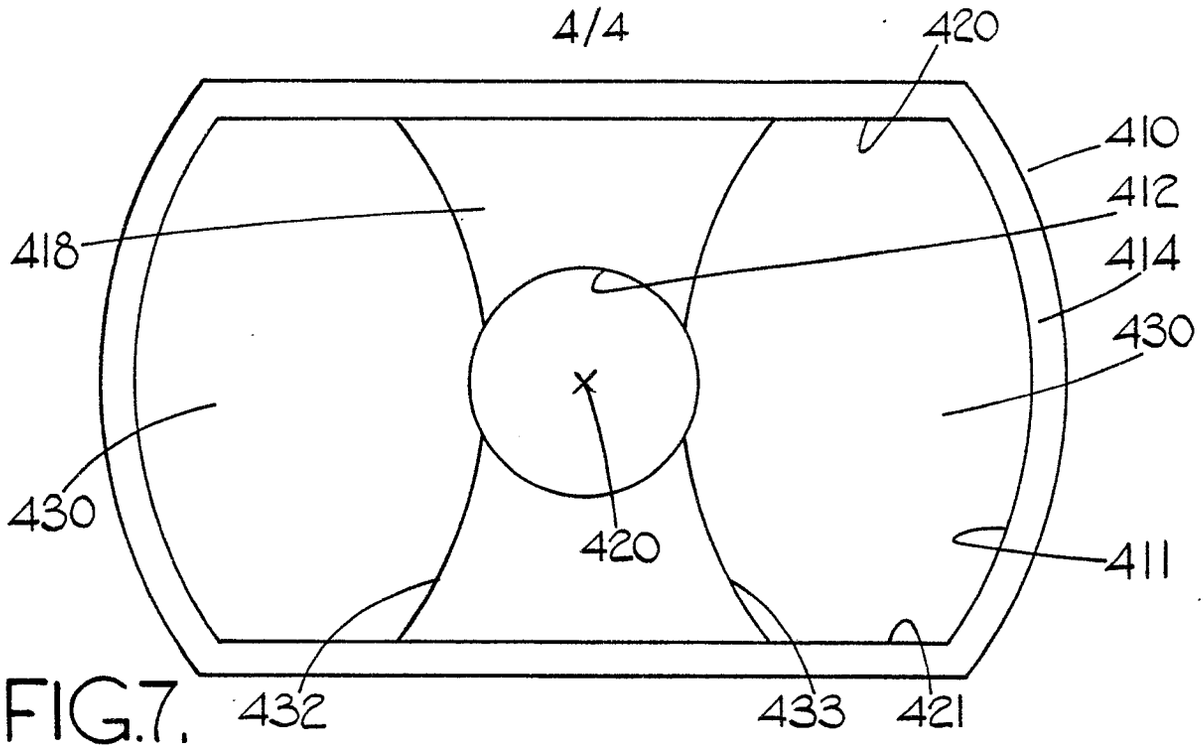


FIG.7.

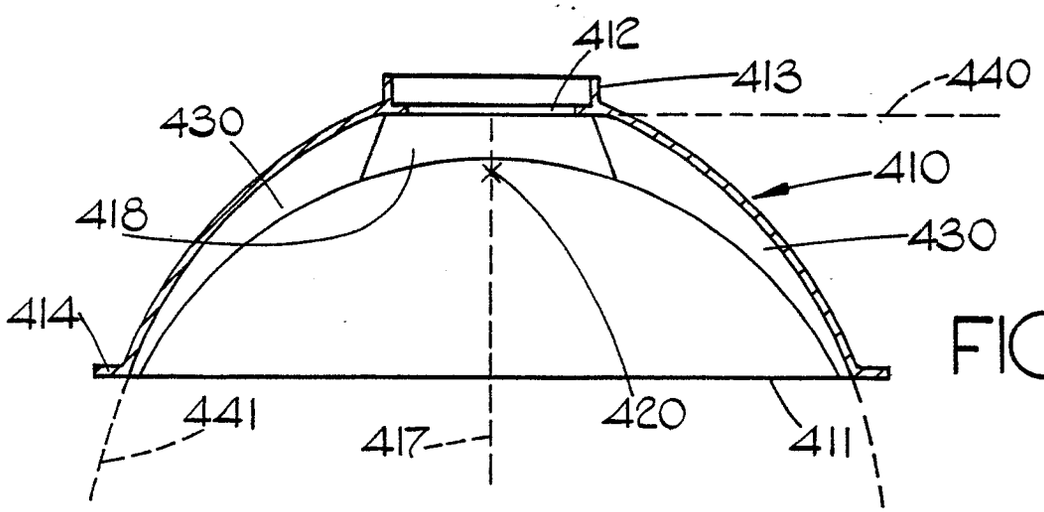


FIG.8.

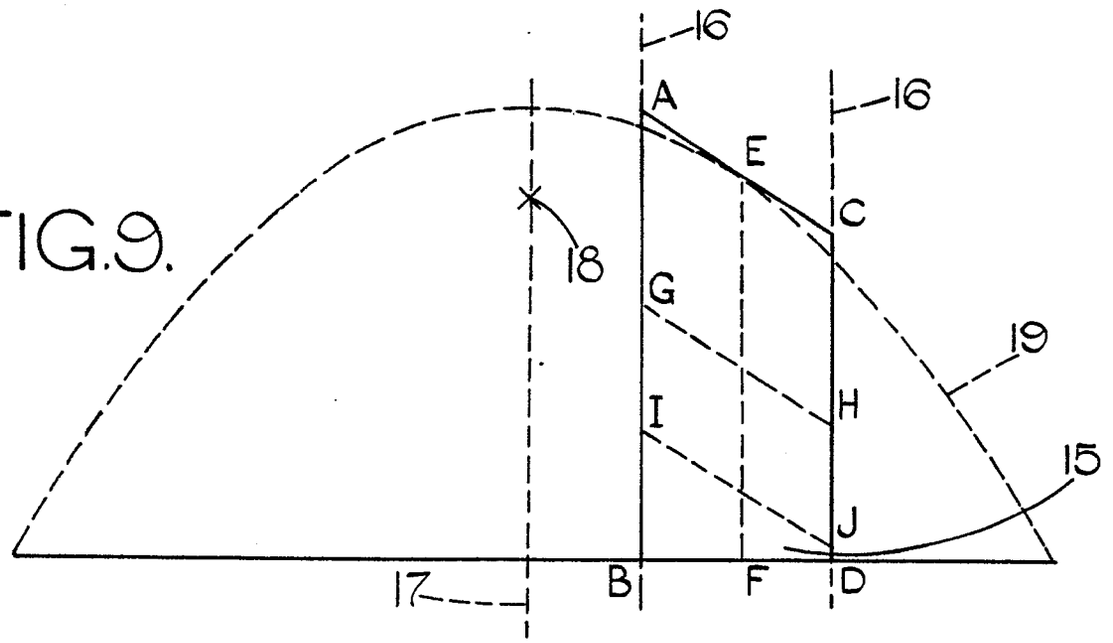


FIG.9.

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 83 30 0102

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. ³)
X	US-A-1 540 813 (SOLOSABAL) * Page 2, lines 50-59 *	1,3	F 21 M 3/08
A	US-A-1 558 270 (MORRISSON) * Page 2, lines 73-119 *	1,2,3, 6,7	
A	GB-A-2 054 815 (CIBIE) * Page 3, lines 62-65 *	4,7	
A	US-A-1 691 131 (RYDER) * Page 2, lines 31-34 *	5	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

F 21 M
F 21 V

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15-04-1983	FOUCRAY R.B.F.

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