(12) UK Patent Application (19) GB (11) 2 263 453 (13) A

(43) Date of A publication 28.07.1993

(21) Application No 9123075.5

(22) Date of filing 31.10.1991

(51) INT CL[5]
B60R 1/08

(52) UK CL (Edition L)
B7J J69

(56) Documents cited
GB 1405188 A GB 1370376 A EP 0085479 A1

(58) Field of search
UK CL (Edition K) B7J
INT CL[5] B60R

(71) Applicant
Optical Perspectives Limited

(Incorporated in the United Kingdom)

25-29 High Street, Leatherhead, Surrey, KT22 8AB, United Kingdom

(72) Inventor
Justin Miles Thomas

(74) Agent and/or Address for Service
Butler & Company
PO Box 117, 73 The Glade, Fetcham, Leatherhead, Surrey, KT22 9LQ, United Kingdom

(54) Rear view systems

(57) A rear view system for a vehicle includes in combination a light transmitting member 2 and a light reflective medium 16 spatially displaced from the member. The member has a first face 4 for light emergence from which in use light rays are directed towards the medium and a second face 6 for light incidence, each face being disposed on a respective side of a median plane 8. The member comprises a plurality of elemental prismatic sections, the prismatic angles of the elemental sections progressively changing along the length of the member whereby rays of refracted light emerging through the first face are in parallelism or substantial parallelism one with the other irrespective of the angles of incidence of the rays. The shape of the light transmitting member is such as to afford a wide angular scope of view to the system thereby to enhance safety.

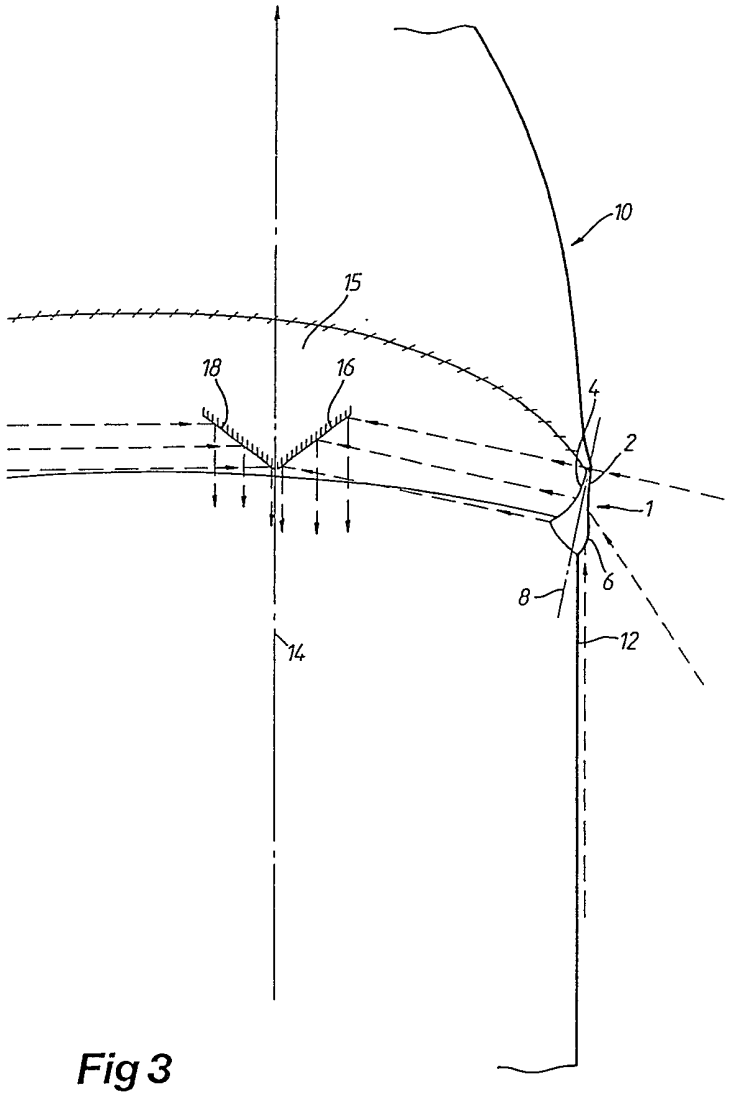

Fig 3

GB 2 263 453 A

TABLE

A / Ref.Ind = 1.3	r	i	Devn. δ	ldg.edge	tr.edge	W	First side x	First side y	Second side x	Second side y
0.0	0.0	0.000	0.000	0.000	0.000	2.000	-1.000	0.000	1.000	0.000
2.0	1.0	1.523	1.046	0.477	1.523	2.035	-1.027	1.000	1.008	1.018
4.0	2.0	3.047	2.094	0.953	3.047	2.107	-1.081	2.018	1.026	2.055
6.0	3.0	4.572	3.144	1.428	4.572	2.214	-1.162	3.036	1.052	3.092
8.0	4.0	6.099	4.197	1.901	6.099	2.358	-1.271	4.054	1.086	4.131
10.0	5.0	7.628	5.256	2.372	7.628	2.539	-1.406	5.073	1.129	5.172
12.0	6.0	9.160	6.321	2.840	9.160	2.756	-1.570	6.093	1.181	6.217
14.0	7.0	10.697	7.393	3.303	10.697	3.010	-1.761	7.115	1.241	7.264
16.0	8.0	12.237	8.475	3.763	12.237	3.302	-1.981	8.138	1.311	8.317
18.0	9.0	13.783	9.567	4.217	13.783	3.633	-2.229	9.163	1.389	9.374
20.0	10.0	15.335	10.670	4.665	15.335	4.003	-2.506	10.190	1.475	10.438
22.0	11.0	16.894	11.788	5.106	16.894	4.413	-2.813	11.220	1.571	11.509
24.0	12.0	18.460	12.921	5.540	18.460	4.864	-3.149	12.254	1.676	12.589
26.0	13.0	20.035	14.071	5.965	20.035	5.357	-3.517	13.290	1.790	13.677
28.0	14.0	21.620	15.240	6.380	21.620	5.894	-3.915	14.332	1.913	14.777
30.0	15.0	23.215	16.430	6.785	23.215	6.476	-4.346	15.377	2.045	15.888
32.0	16.0	24.822	17.643	7.178	24.822	7.105	-4.810	16.429	2.186	17.013
34.0	17.0	26.441	18.883	7.559	26.441	7.783	-5.309	17.486	2.338	18.154
36.0	18.0	28.075	20.151	7.925	28.075	8.511	-5.843	18.551	2.499	19.312
38.0	19.0	29.725	21.450	8.275	29.725	9.293	-6.413	19.623	2.670	20.490
40.0	20.0	31.392	22.785	8.608	31.392	10.132	-7.022	20.704	2.852	21.690
42.0	21.0	33.079	24.158	8.921	33.079	11.030	-7.671	21.794	3.044	22.915
44.0	22.0	34.787	25.574	9.213	34.787	11.992	-8.362	22.896	3.248	24.169
46.0	23.0	36.519	27.037	9.481	36.519	13.021	-9.098	24.011	3.463	25.455
48.0	24.0	38.277	28.553	9.723	38.277	14.125	-9.880	25.140	3.689	26.779
50.0	25.0	40.064	30.129	9.936	40.064	15.307	-10.713	26.285	3.928	28.144
52.0	26.0	41.885	31.770	10.115	41.885	16.575	-11.598	27.449	4.181	29.558
54.0	27.0	43.743	33.486	10.257	43.743	17.938	-12.542	28.633	4.447	31.028
56.0	28.0	45.644	35.287	10.356	45.644	19.406	-13.547	29.841	4.727	32.563
58.0	29.0	47.592	37.185	10.408	47.592	20.990	-14.619	31.077	5.023	34.174
60.0	30.0	49.597	39.193	10.403	49.597	22.705	-15.766	32.344	5.335	35.874
62.0	31.0	51.665	41.331	10.335	51.665	24.568	-16.994	33.647	5.665	37.681
64.0	32.0	53.810	43.621	10.190	53.810	26.602	-18.313	34.992	6.012	39.615
66.0	33.0	56.046	46.092	9.954	56.046	28.836	-19.735	36.387	6.379	41.704
68.0	34.0	58.392	48.783	9.608	58.392	31.305	-21.274	37.842	6.765	43.987
70.0	35.0	60.875	51.749	9.125	60.875	34.060	-22.947	39.367	7.171	46.513
72.0	36.0	63.534	55.067	8.466	63.534	37.169	-24.780	40.979	7.594	49.357
74.0	37.0	66.429	58.858	7.571	66.429	40.733	-26.805	42.700	8.030	52.631
76.0	38.0	69.661	63.322	6.339	69.661	44.914	-29.068	44.563	8.462	56.523
78.0	39.0	73.427	68.853	4.573	73.427	50.000	-31.644	46.621	8.851	61.384
80.0	40.0	78.228	76.455	1.772	78.228	56.636	-34.664	48.970	9.058	68.071
82.0	41.0	87.677	93.353	-5.677	87.677	68.204	-38.432	51.865	7.686	81.875

Key to table of figures:

Col.1 A = angle of prism Col.2 r = angle of refraction (= 0.5 A)

Col.3 i = angle of incidence (i = arcsin(Ref Ind . sinr)) Col.4 devn. = δ = 2i - 2r

Col.5 ldg.edge = 0.5 (A - δ) Col.6 tr.edge = 0.5 (A + δ)

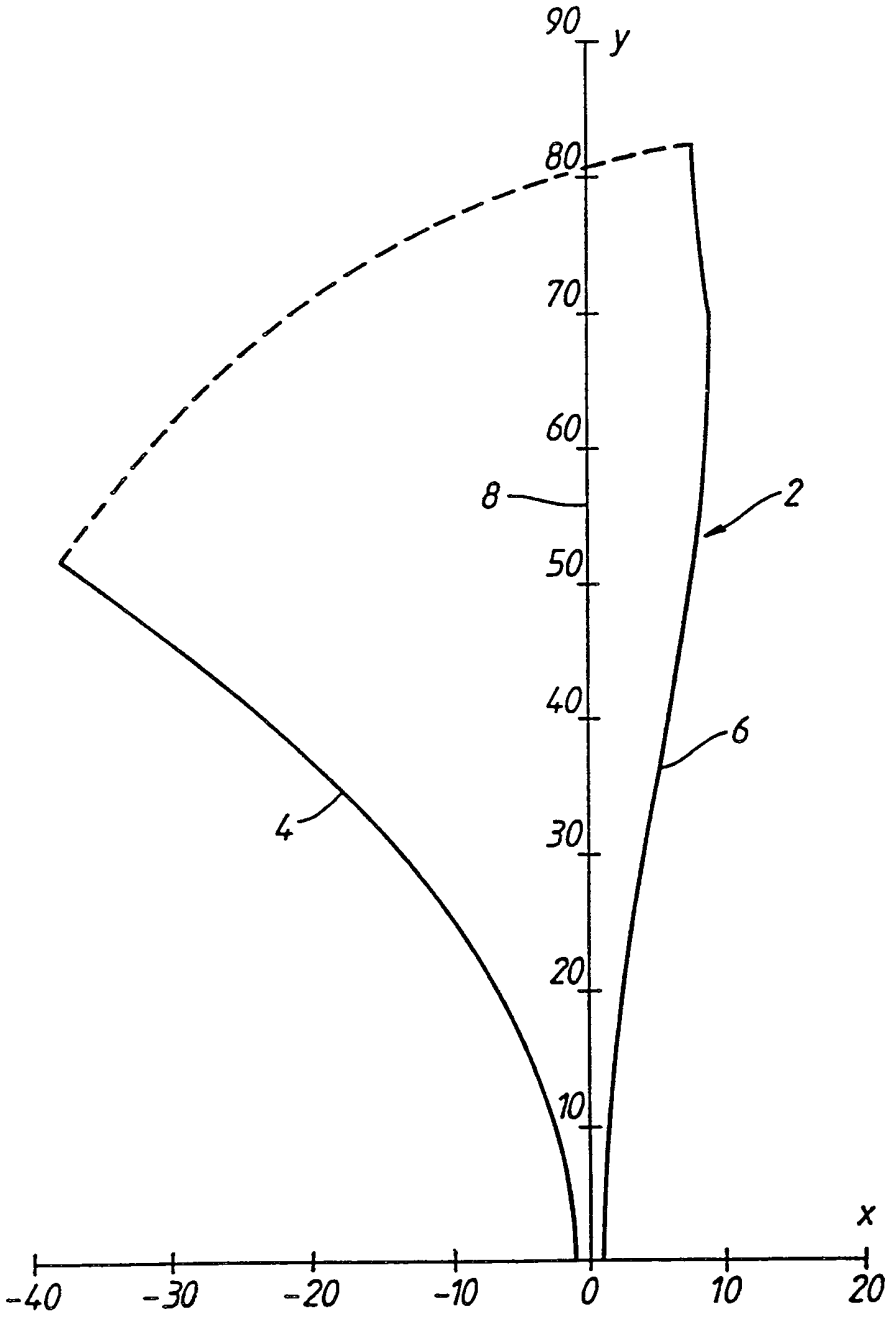

Fig 1

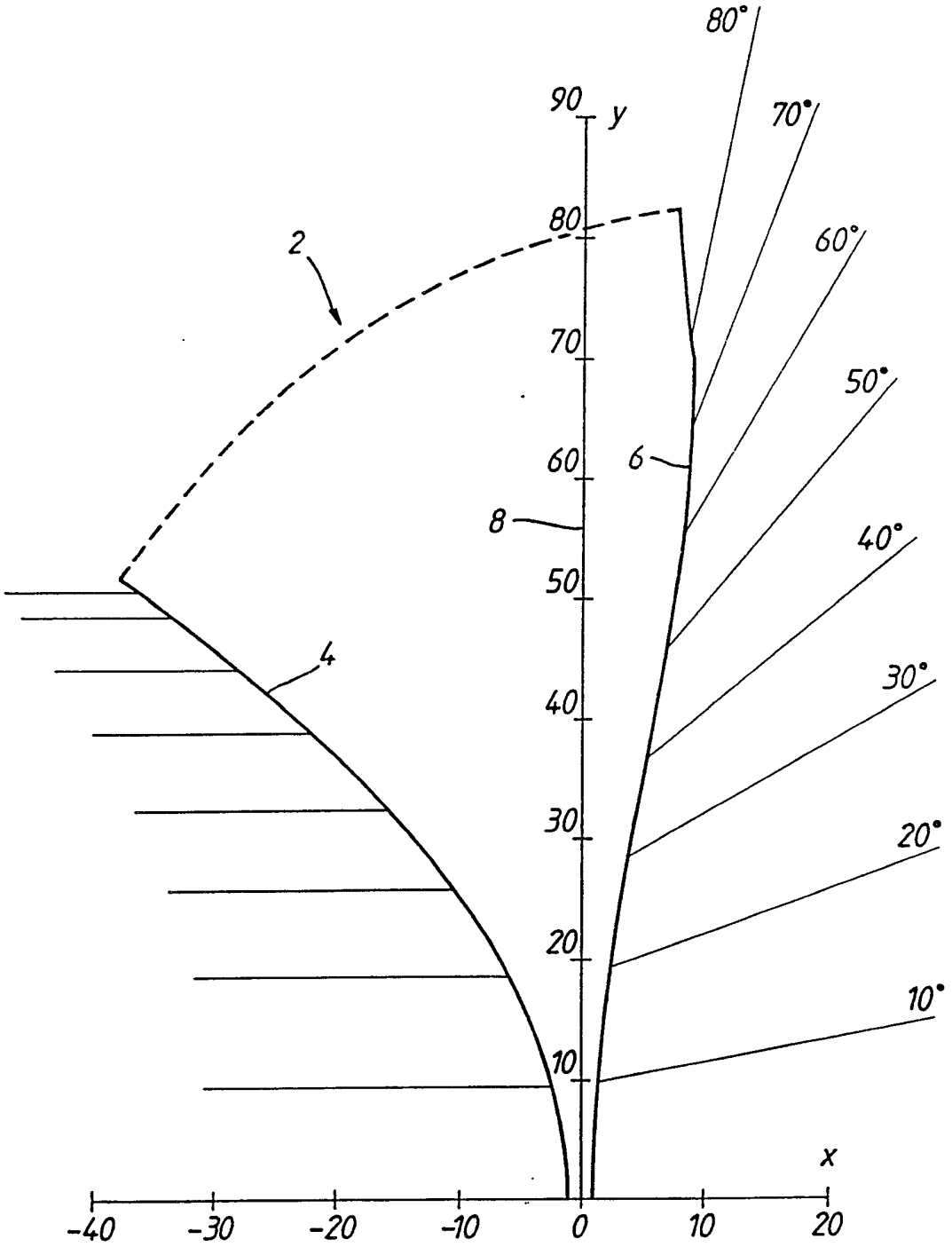
80°
70°
60°
50°
40°
30°
20°
10°
90
y
80
70
60
50
40
30
20
10
2
4
6
8
x
-40
-30
-20
-10
0
10
20

Fig 2

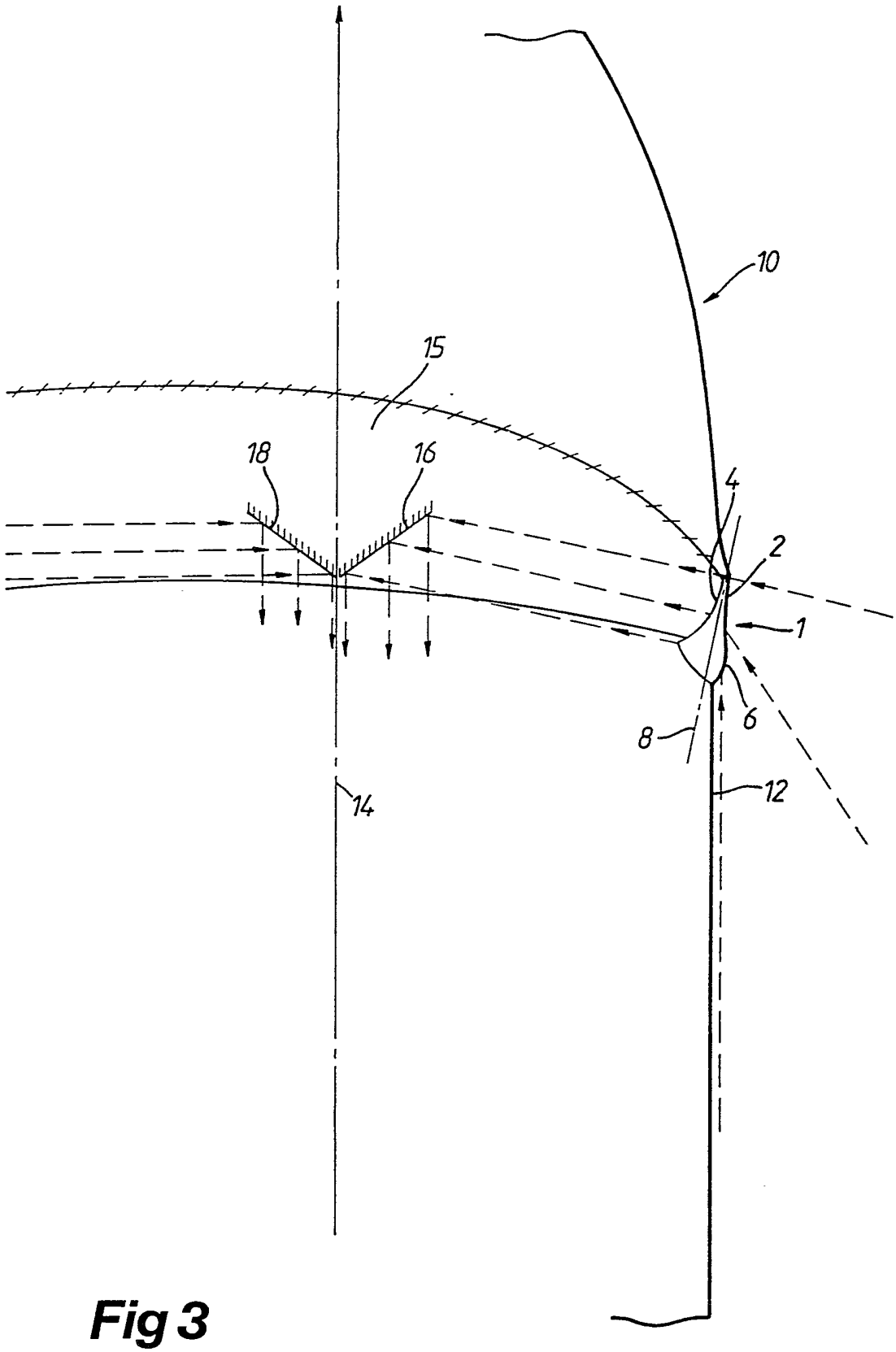

Fig 3

IMPROVEMENTS IN OR RELATING TO REAR VIEW SYSTEMS

This invention concerns improvements in or relating to rear view systems for vehicles and vehicles incorporating such systems.

In particular, although not exclusively, the present invention has reference to such a system suitable for use on motorised road vehicles.

Conventionally, a motorised road vehicle is provided with an internally mounted rear view mirror to give the driver a central vision through the rear window, and either wing or door mounted mirrors to give marginal vision to the rear and, in a narrow path, adjacent the side of the vehicle. For reasons of safety, it is desirable to afford the driver of the vehicle with as comprehensive as possible a view of the prevailing ambient driving conditions. It is known therefore to enhance the vision through the rear window by making the mirror convex to provide a panoramic view, but clearly the degree to which such can be achieved depends upon the vehicle body configuration and invariably the view is impaired by opaque parts of the body structure. Additionally, or in the alternative, it has been proposed to locate a prismatic lens at the rear of a vehicle, more especially a commercial vehicle, such that images of objects immediately to the rear of the vehicle are transmitted to the driver through the agency of a mirror. Similarly, endeavours have been made to improve the vision given by side mirrors, for example by adding a small convex mirror section in one corner in an attempt to give a wider viewing spectrum. However, the image is inevitably small which necessarily militates against the alleged advantage of providing a vision of greater breadth.

It is further known to provide side mirrors combined in close juxtaposition with prismatic arrangements for refracting light

rays from objects to the rear of the vehicle, but the images of the mirrors necessitate diversion of the driver's eyes from the path ahead, and in any event tend not to widen the viewing scope.

It is an object of the present invention to provide a rear view system for a vehicle having the capacity of facilitating inspection of the rear vista and for capturing a wider field of view than possible with conventional or known systems.

It is a further object of the invention to provide a vehicle incorporating such a rear view system.

According to a first aspect of the invention a rear view system for a vehicle includes in combination a light transmitting member and a light reflective medium spatially displaced from the member, the member presenting a first face for light emergence from which in use light rays are directed towards the medium and a second face for light incidence, each face being disposed on a respective side of a median plane, the member comprising a plurality of elemental prismatic sections, the prismatic angles of the elemental sections progressively changing along the length of the member whereby rays of refracted light emerging through the first face are in parallelism or substantial parallelism one with the other irrespective of the angles of incidence of the rays.

Advantageously, the member is so designed to ensure that the incident rays undergo essentially minimum deviation through the prismatic elemental sections.

Conveniently the shape of the first face of the member is generated by a locus of points calculated by the following formulae wherein the 'y' axis is aligned along the median plane and the 'x' axis extends orthogonally thereto:

$$x_n = \sin [(A_n + d_n)/2] \cdot f_n/\cos(A_n/2) + x_{n-1} \qquad (1)$$

$$Y_n = \cos\,[(A_n + d_n)/2] \cdot f_n/\cos(A_n/2) + Y_{n-1} \qquad (2)$$

Similarly the shape of the second face of the member is generated by a locus of points calculated by the following formulae wherein the 'y' axis is aligned along the median plane and the 'x' axis extends orthogonally thereto:

$$x_n = [\sin\{(A_n-d_n)/2\}].[f_n + \sin\{(d_n-d_{n-1})/2\}.W_{n-1}]/\cos(A_n/2)+x_n \qquad (3)$$

$$y_n = [\cos\{(A_n-d_n)/2\}].[f_n + \sin\{(d_n-d_{n-1})/2\}.W_{n-1}]/\cos(A_n/2)+y_n \qquad (4)$$

In the above formulae, the symbols used except where indicated otherwise have the following meanings or values:

A = the prismatic angle $\qquad$ d = deviation

f_n = the correction factor = $(Y_{n-1} - Y_{n-2})$ 2nd side/ $(Y_{n-1} - Y_{n-2})$ 1st side

W_n = width of member = $\tan(A/2).\{2.f_n+W_{n-1}.\sin[(d_n-d_{n-1})/2]\} +W_{n-1}.\cos[(d_n-d_{n-1})/2]$

n = the number of the element

$W_o = 2(\pm x)$ at the narrowest part of the member

In practice the member is of substantially concavo-convex form with the concave surface constituting the first face. The other surface constituting the second face has contiguous concave and convex parts extending in the direction of the median plane. The first and second faces progressively diverge from one another with the increasing prismatic angle of the elemental sections, W_n giving the

varying width of the member. The first face may be angularly disposed in relation to the median plane in order in use to project emergent rays in any desired direction onto the light refelctive medium. The ends of the member may be planar or of any convenient shape.

The length of the member from its smallest width to its largest width is chosen to give the broadest spectrum of image capture, and a particular and unique advantage of the present invention resides in the angular scope which the configuration of the member affords. The angular scope extends from 0° on a line perpendicular to the median plane to approximately 90° thereto.

The depth of the member may be chosen dependent upon the individual requirements.

The light reflective medium may conveniently be a mirror of any suitable profile and shape, for example it may be plane, concave or convex, but the medium may in the alternative be prismatic and suitably orientated to reflect incident light towards a viewer.

According to a second aspect of the invention a vehicle including a driving position and a rear view system according to the first aspect wherein the light transmitting member is located to one side of the direct forward line of sight of the driving position, and the light reflective member is located in or adjacent the direct line of sight of the driving position.

The vehicle is preferable provided with means for positively directing or collimating the rays emerging from the first face of the light transmitting member onto the light reflective member.

The vehicle may be a road vehicle, motorised or manually powered, and more particularly, but not especially, is an automobile, in which case a light transmitting member is located on a respective front door in the manner of a conventional side mirror.

Alternatively, the light transmitting member may be located in a suitable position on the vehicle body. The member may be held within a housing and the housing may be integral with the door or mounted thereon, and may be streamlined. It is to be understood, however, that the light transmitting member is inherently streamlined and thus may be mounted on the vehicle in an appropriate manner without the need for a housing.

The light reflective member may conveniently be disposed on or in the dashboard of an automobile for ease of visibility, but any other suitable position may be selected to give the driver of the vehicle direct and unimpaired vision of the images transmitted by the member without the necessity of moving his head.

When located on a vehicle because of the angular scope of the light transmitting member, the sweep of vision given to the driver is from a point orthogonal to the driving position, which is normally a blind spot with conventional rear view systems, to a point directly to the rear of the vehicle. In this latter respect, the member may conveniently be disposed as to capture part of the vehicle body to provide a reference image for the driver to facilitate the judgement of distances and accordingly the proximity of other vehicles or objects. In view of the wide angular scope afforded by the rear view system, it can be a special feature of the invention that the light transmitting member may be of static form without the facility to change its orientation by the use of electronic components which make conventional mirrors expensive and troublesome to maintain. However, it is within the scope of this invention to provide means for changing the orientation of the member.

The light reflecting medium may be orientable to suit the needs of the individual driver or in the alternative it may be fixed in position.

Whilst the principal field of application of the present invention is for automobiles, it is to be understood that the expression

'vehicle' is not to be limiting and accordingly will embrace any conveyance or mobile structure requiring a rear viewing facility. Thus for example the invention may also be utilised in aircraft or shipping where comprehensive vision of the ambient conditions is desirable, if not essential.

By way of example only, one form of rear view system according to the invention is illustrated in graphical form in the accompanying drawings in which:

Figure 1 is a plan view of the light transmitting member shown against an x,y plot;

Figure 2 is a plan view corresponding to Figure 1 and showing the light transmitting member in plan with the incident and emergent light paths; and

Figure 3 is plan view of a part of a vehicle shown in diagrammatic form with the rear view system mounted thereon.

With reference to Figures 1 and 2 of the drawings, a rear view system 1 includes a light transmitting member 2 having a first face 4 through which refracted light emerges and a second face 6 for light incidence, the faces being disposed either side of a median plane 8. As can be seen from the illustrations, the member is substantially concavo-convex in form and its faces are generated as the loci of points calculated in accordance with the following formulae with the 'y' axis coincident with the median plane. The first face 4 is substantially concave in shape whereas the face 6 presents a combined concave/convex profile in which a part of the face is concave and a contiguous part is convex.

For the first face 4:

$$x_n = \sin [(A_n + d_n)/2] \cdot f_n/\cos(A_n/2) + x_{n-1} \qquad (1)$$

$$y_n = \cos [(A_n + d_n)/2] \cdot f_n/\cos(A_n/2) + y_{n-1} \qquad (2)$$

For the second face 6:

$$x_n = [\sin\{(A_n-d_n)/2\}].[f_n + \sin\{(d_n-d_{n-1})/2\}.W_{n-1}]/\cos(A_n/2)+x_n \quad (3)$$

$$y_n = [\cos\{(A_n-d_n)/2\}].[f_n + \sin\{(d_n-d_{n-1})/2\}.W_{n-1}]/\cos(A_n/2)+y_n \quad (4)$$

In the above formulae, the symbols used except where indicated otherwise have the following meanings of values:

A = the prismatic angle d = deviation

f_n = the correction factor = $(Y_{n-1} - Y_{n-2})$ 2nd side/ $(Y_{n-1} - Y_{n-2})$ 1st side

Wn = width of member = $\tan(A/2).\{2.f_n+W_{n-1}.\sin[(d_n-d_{n-1})/2]\} +W_{n-1}.\cos[(d_n-d_{n-1})/2]$

n = the number of the element

W_o = 2(± x) at the narrowest part of the member

In this example, values for the x,y coordinates for both faces have been calculated over a full range of prismatic angles from 0° to 82° at 2° intervals and the results are shown in the accompanying table for which the key is provided at its foot. Additionally, the material from which the member is formed is crown glass having a refractive index of 1.523.

As will more particularly be seen from Figure 2, the angles of incidence of rays on face 6 vary from 10° to 80° as shown; the rays are refracted by the member undergoing minimum deviation to emerge through face 4 in substantial parallelism to give an image. The emergent rays are directed towards a light reflecting medium (not

shown) which in this example is a plane mirror spatially displaced from face 4 of the member.

Referring now to Figure 3, when the rear view system 1 is employed on an automobile generally depicted at 10, the member 2 is mounted on the door 12 adjacent a driving position 14, and a mirror 16 is located on or in the dashboard 15 directly in front of the driving position as shown. A further member 2 (not shown) is mounted on the passenger door (not shown) and is disposed so as to direct rays emerging from its face 4 to a further mirror 18 located adjacent mirror 16 thereby to provide the driver with a comprehensive view from both sides of the automobile 10 which does not require lateral movement of the head, whilst providing a wider image capture than that hitherto available with conventional side mirrors.

The principal advantage of the present invention is that the driver of a vehicle is provided with a more comprehensive picture of the ambient conditions than is possible with conventional mirrors or known devices, and thus the safety of driving is considerably enhanced, particularly by removing blind spots normally associated with existing systems.

Whilst the present invention has been specifically described in relation to a light transmitting member manufactured from crown glass, it is to be understood that other materials or media may be used therefor and the refractive index will vary accordingly.

It is also to be understood that the invention can be made in kit form for retrofitting to existing vehicles.

JMT/P/1

CLAIMS:

1. A rear view system for a vehicle includes in combination a light transmitting member and a light reflective medium spatially displaced from the member, the member presenting a first face for light emergence from which in use light rays are directed towards the medium and a second face for light incidence, each face being disposed on a respective side of a median plane, the member comprising a plurality of elemental prismatic sections, the prismatic angles of the elemental sections progressively changing along the length of the member whereby rays of refracted light emerging through the first face are in parallelism or substantial parallelism one with the other irrespective of the angles of incidence of the rays.

2. A system according to claim 1 in which the light transmitting member is so designed to ensure that the incident rays undergo essentially minimum deviation through the prismatic elemental sections.

3. A system according to claim 1 or 2 in which the shape of the first face of the member is generated by a locus of points calculated by the following formulae wherein the 'y' axis is aligned along the median plane and the 'x' axis extends orthogonally thereto:

$$x_n = \sin [(A_n + d_n)/2] \cdot f_n/\cos(A_n/2) + x_{n-1}$$

$$y_n = \cos [(A_n + d_n)/2] \cdot f_n/\cos(A_n/2) + y_{n-1}$$

wherein -

A = the prismatic angle d = deviation

f_n = the correction factor = $(y_{n-1} - y_{n-2})$ 2nd side/ $(y_{n-1} - y_{n-2})$ 1st side

W_n = width of member = $\tan(A/2).\{2.f_n+W_{n-1}.\sin[(d_n-d_{n-1})/2]\}$
$+W_{n-1}.\cos[(d_n-d_{n-1})/2]$

n = the number of the element

$W_o = 2(\pm x)$ at the narrowest part of the member

4. A system according to any one of the preceding claims in which the shape of the second face of the member is generated by a locus of points calculated by the following formulae wherein the 'y' axis is aligned along the median plane and the 'x' axis extends orthogonally thereto:

$$x_n = [\sin\{(A_n-d_n)/2\}].[f_n + \sin\{(d_n-d_{n-1})/2\}.W_{n-1}]/\cos(An/2)+x_n$$

$$y_n = [\cos\{(A_n-d_n)/2\}].[f_n + \sin\{(d_n-d_{n-1})/2\}.W_{n-1}]/\cos(A_n/2)+y_n$$

wherein -
A = the prismatic angle d = deviation

f_n = the correction factor = $(Y_{n-1} - Y_{n-2})$ 2nd side/
$(Y_{n-1} - Y_{n-2})$ 1st side

W_n = width of member = $\tan(A/2).\{2.f_n+W_{n-1}.\sin[(d_n-d_{n-1})/2]\}$
$+W_{n-1}.\cos[(d_n-d_{n-1})/2]$

n = the number of the element

$W_o = 2(\pm x)$ at the narrowest part of the member

5. A system according to any one of the preceding claims in which the light reflecting medium is a mirror.

6. A system according to any one of the preceding claims in which the first face is angularly orientated relative to the median plane.

7. A rear view system substantially as hereinbefore described with reference to the accompanying drawings and the Table.

8. A vehicle including a rear view system according to any one of the preceding claims in which the vehicle includes a driving position and the light transmitting member is located to one side of the direct forward line of sight of the driving position, and the light reflective member is located directly in or adjacent the direct line of sight of the driving position.

9. A vehicle according to claim 8 comprising an automobile, in which a light transmitting member is located on a respective door thereof or a part of the vehicle body.

10. A vehicle according to claim 8 or 9 and including means for positively directing or collimating the rays emerging from the first face of the light transmitting member onto the light reflective member.

11. A vehicle according to any one of claims 8 to 10 in which the light refractive member is held within a housing and the housing is integral with the door or mounted thereon.

12. A vehicle according to claim 11 in which the housing is streamlined.

13. A vehicle according to any one of the preceding claims 8 to 12 in which the light reflecting medium is disposed on or in a dashboard of an automobile for ease of visibility.

14. A vehicle according to any one of the preceding claims 8 to 13 in which the light reflecting medium is orientable.

14. A vehicle including a rear view system substantially as hereinbefore described with reference to the accompanying drawings.

Amendments to the claims have been filed as follows

15. A light transmitting member having a first face and a second face each face being disposed on a respective side of a median plane, the member comprising a plurality of elemental prismatic sections, the prismatic angles of the elemental sections progressively changing along the length of the member whereby rays of light incident on the first face refracted through the member are in parallelism or substantial parallelism one with the other irrespective of the angles of incidence of the rays on the second face.

16. A light transmitting member as itemised in claim 15 so formed to ensure that the incident rays undergo essentially minimum deviation through the prismatic elemental sections.

17. A light transmitting member according to claim 15 or 16 in which the shape of the first face of the member is generated by a locus of points calculated by the following formulae wherein the 'y' axis is aligned along the median plane and the 'x' axis extends orthogonally thereto:

$$x_n = \sin [(A_n + d_n)/2] . f_n/\cos(A_n/2) + x_{n-1}$$

$$y_n = \cos [(A_n+d_n)/2]. f_n/\cos(A_n/2) + y_{n-1}$$

wherein -
A = the prismatic angle d = deviation

f_n = the correction factor = $(y_{n-1} - y_{n-2})$ 2nd side/
$(y_{n-1} - y_{n-2})$ 1st side

n = the number of the element

18. A light transmitting member according to claims 15, 16 and 17 in which the second face of the member is generated by a locus of points calculated by the following formulae wherein the 'y' axis is aligned along the median plane and the 'x' axis extends orthogonally thereto:

$$x_n = [\sin\{(A_n-d_n)/2\}].[f_n + \sin\{(d_n-d_{n-1})/2\}.W_{n-1}]/\cos(A_n/2)+x_n$$

$$y_n = [\cos\{(A_n-d_n)/2\}].[f_n + \sin\{(d_n-d_{n-1})/2\}.W_{n-1}]/\cos(A_n/2)+y_n$$

wherein -
A = the prismatic angle d = deviation

f_n = the correction factor = $(y_{n-1} - y_{n-2})$ 2nd side/
$(y_{n-1} - y_{n-2})$ 1st side

$(y_{n-1} - y_{n-2})$ 1st side

W_n = width of member = $\tan(A/2).\{2.f_n+W_{n-1}.\sin[(d_n-d_{n-1})/2]\}$
$+W_{n-1}.\cos[(d_n-d_{n-1})/2]$

n = the number of the element

Wo = $2(\pm x)$ at the narrowest part of the member

19. A light transmitting member according to claims 15, 16, 17 and 18 in which the first face is angularily orientated relative to the median plane.

20. A light transmitting member as hereinbefore described with reference to the accompanying drawings numbered Fig 1 and fig 2

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

9123075.5

Relevant Technical fields

(i) UK Cl (Edition K) B7J

(ii) Int Cl (Edition 5) B60R

Search Examiner

PAT EVERETT

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

30 JANUARY 1992

Documents considered relevant following a search in respect of claims 1-14

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 1405188 (FORD) Figure 1	1 at least
X	GB 1370376 (CORYTON) whole document	1 at least
X	EP 0085479 A1 (DUPEE) whole document	1 at least

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Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

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Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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