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GB 2261861 A GB 2157633 A GB 2092534 A
GB 1578116 A US 4580881 A

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(54) Outer rearview mirror assembly for a vehicle

(57) An outer rearview mirror assembly for a vehicle comprises a base (12); a mirror body (10) mounted on the base (12) and having an opening (14); a mirror (20) including a plurality of mirror surface areas comprising a main mirror surface (20a) and supplementary mirror surfaces (20b', 20b'') with different curvatures so as to give a wide field of view in a rearview direction; the mirror opening (14) having edge portions (14a) and at least one of the edge portions (14a'') having a convex curvature. The supplementary mirror surface area (20b) is further from the base than the main mirror surface area. The edge portion (14a) of the mirror opening has a greater curvature in the region of the supplementary mirror surface area (20b) than in the region of the main mirror surface area (20a). The radius of curvature of the mirror opening edge portion (14a'') in the region of the supplementary mirror surface area (20b) is approximately 0.2 to 1 times the radius of curvature of the supplementary mirror surface area (20b).

FIG.1

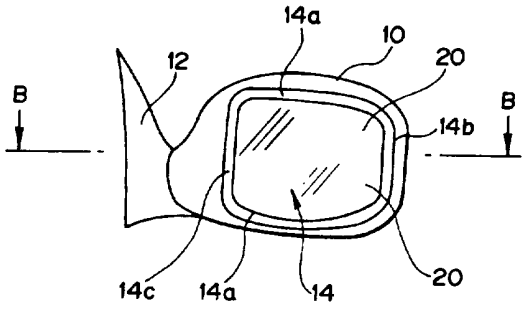

FIG.6

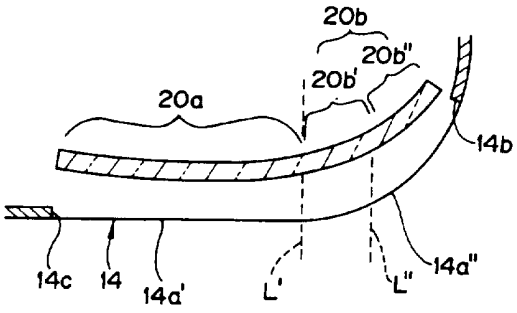

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FIG.1

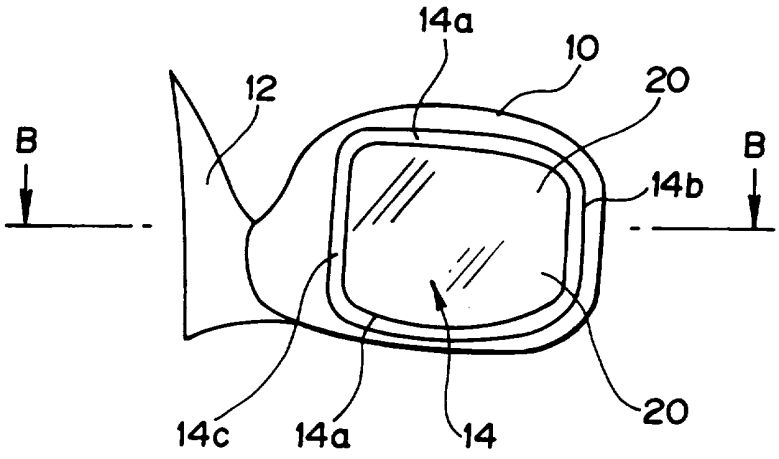


FIG.2

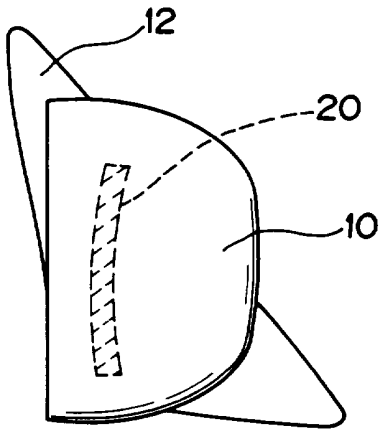


FIG.3

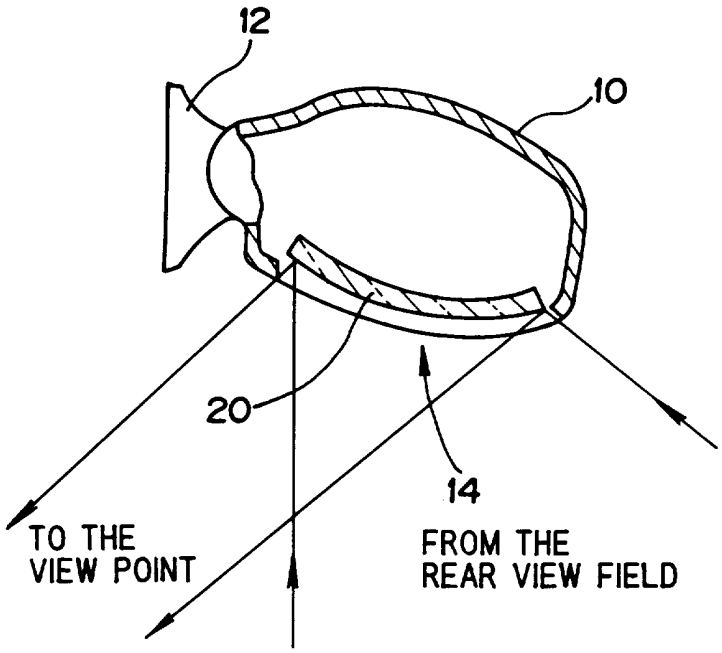

12
10
20
14
TO THE
VIEW POINT
FROM THE
REAR VIEW FIELD

FIG.4

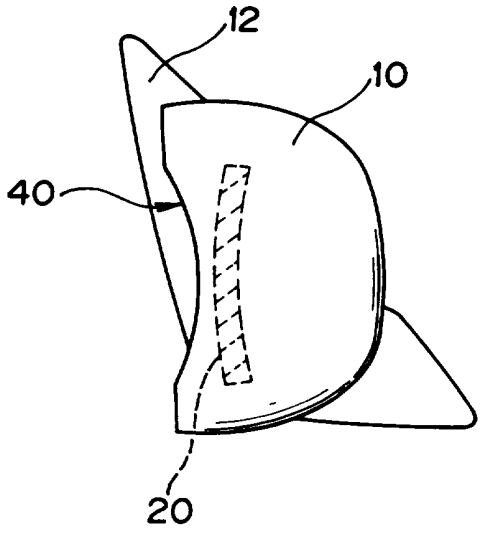

12
10
40
20

FIG.5

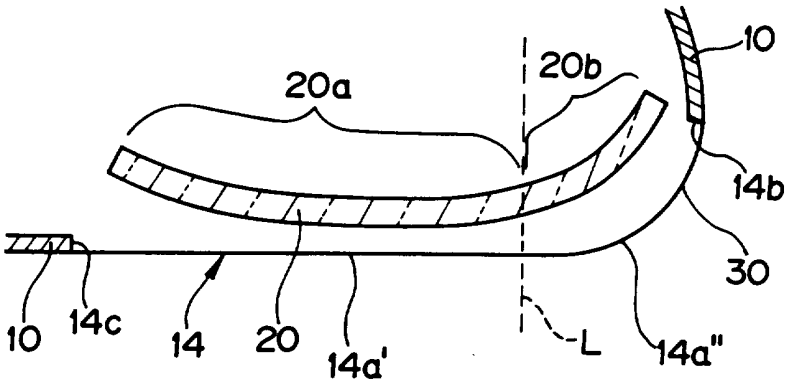

20a
20b
10
14b
30
10
14c
14
20
14a'
L
14a"

FIG.6

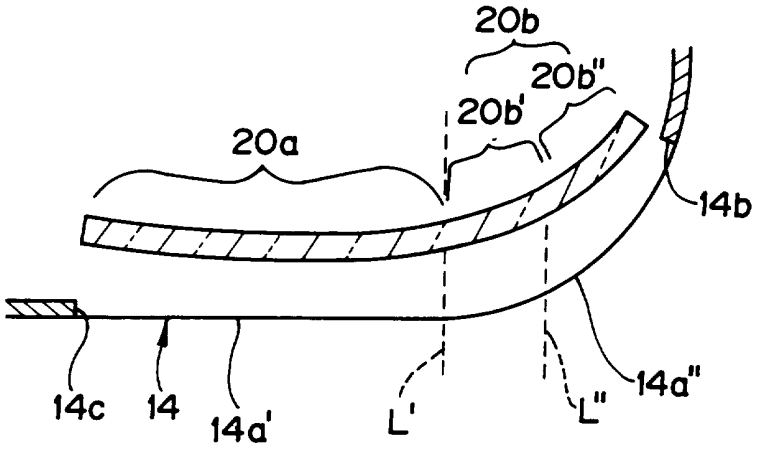

20b
20b"
20b'
20a
14b
14c
14
14a'
L'
L"
14a"

FIG. 7

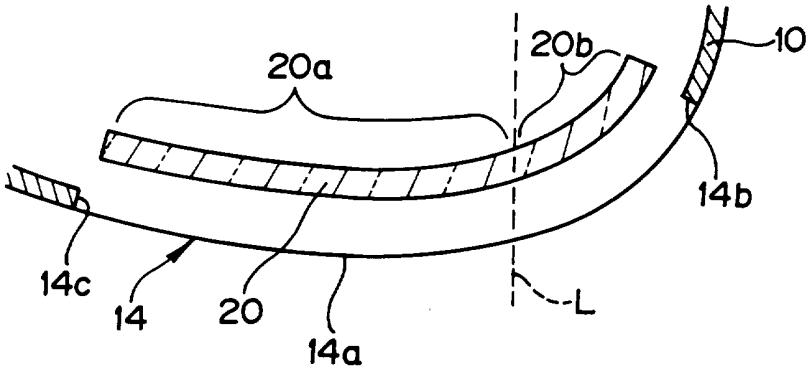
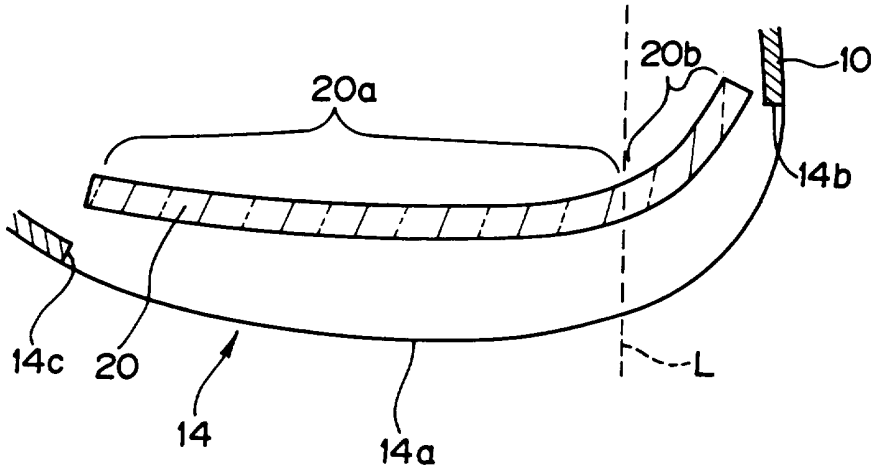


FIG. 8



Outer rearview mirror assembly for a vehicle

The present invention relates to a rearview mirror assembly for a vehicle, especially an outer rearview mirror assembly for an automobile providing a broad rearward field of view which can be seen and checked by a mirror which may have a plurality of mirror surface areas with different curvatures.

Conventionally as one of the means to see and check a rearward field of view, a rearview mirror has been used for an automobile or the like, in which a mirror body is mounted on a base which is fixed on a vehicle body and a mirror is mounted in the mirror body to check the rearward field of view through an opening. For the purpose of eliminating a blind spot, it is necessary to reflect as wide a field of view as possible, and a convex surface mirror having a uniform radius of curvature may be used. When the radius of curvature is very small an image of the vehicle to which the mirror is attached can also be seen reflected in the mirror, and driving is less safe owing to a foreshortening of the image.

To deal with this problem, a rearview mirror combination of a main mirror surface and a supplementary mirror surface having a small radius of curvature has been provided so that a blind spot which was present with conventional mirrors is covered by the supplementary mirror surface. For example as disclosed by United States Patent No. 4,331,382, a mirror can comprise a main mirror surface

area and a supplementary mirror surface area and the radii of curvature in horizontal and vertical planes vary.

Compared with a conventional convex surface mirror, the mirror which is not a spherical surface mirror as described above reflects a broader field of view. However, an inner edge portion of the mirror body opening can be seen in the supplementary mirror surface area, and the full surface of the mirror is not available.

When the mirror is used, the vertical and horizontal angle of the field of view is different for different drivers. For example, for a tall driver who sets his seat further back in the vehicle, the rearview mirror should face a point which is further rearwards and an outer edge portion of the mirror body is consequently seen in the mirror surface. On the other hand, in the case of a short driver, an inner side edge portion of the mirror body can be seen by the driver in the mirror surface.

To overcome these problems, it has been proposed that the mirror is moved in the direction of the opening side of the mirror body to hold the field of view. However, it is not desirable to have the mirror projecting out of the mirror body opening. For example, as disclosed by United States patent No. 4,981,349, in an electrically powered hinged rearview mirror, a mirror body is extended and retracted by an actuation of a motor which is contained in a mirror body. If the mirror in this construction of rearview mirror assembly projects out of the opening, when the rearview mirror body is retracted, a dislocation to the

mirror may occur owing to contact between the mirror and its base. Furthermore, if the mirror projects out of the opening, for example, rain drops may easily fall on the mirror surface.

To overcome the problem caused by contact between the mirror and the mirror base, it is possible to modify the mirror construction. However, it is then necessary to modify the whole design of the rearview mirror assembly including the mirror body.

An aim of the present invention is to provide an outer rearview mirror assembly for checking a broad rearward field of view by a mirror which may have a plurality of mirror surface areas, and furthermore to provide a rearview mirror assembly which is not too different from existing assemblies.

Accordingly, the present invention is directed to an outer rearview mirror assembly for a vehicle, comprising;

a base;

a mirror body mounted on the base and having an opening portion which is opened in a rearward direction, oppositely to the intended direction of travel of the vehicle;

a mirror provided in the mirror body and having at least one main convex mirror surface area; and

the opening having edge portions at least one portion of the edge portions having a curvature which is also convex.

Preferably, the mirror has a supplementary mirror surface area with a curvature which is different from that of the main mirror surface area.

The supplementary mirror surface area may be further from the base than the main surface area, and an edge portion of the opening may have a curvature in the region of the supplementary mirror surface area, or it may have a curvature in both the region of the main surface area and the region of the supplementary surface area, the curvature in the latter region being greater than in the former.

Advantageously, the radius of curvature of the edge portion of the opening in the region of the supplementary mirror surface area is substantially within the range from 0.2 to 1 times the radius of curvature of the supplementary mirror surface area.

The edge portion of the opening may be curved in a longitudinally bisecting plane of the mirror.

In one preferred embodiment a cutout portion is provided at an upright edge portion of the opening on the side thereof which is further from the base of the assembly, the cutout portion having a radius of curvature which is smaller than the radius of curvature of the supplementary mirror surface area in a vertical plane, the edge portion here being concave.

The radius of curvature of the cutout portion may be substantially in the range from 0.2 to 1 times the radius of curvature of the supplementary mirror surface

area in a vertical plane.

The whole of the lateral edge portion of the mirror body opening portion or the outer lateral edge portion of the mirror body may be curved along the mirror. An upright outer edge portion of the mirror body may approach near the mirror edge portion, and the distance between the mirror edge portion and that edge portion may be small, so that the whole surface of the mirror is available and the upright edge of the mirror body cannot be seen without changing the mirror set position.

Preferably, the radius of curvature of a lateral edge portion of the mirror body opening is set to be smaller than that of the supplementary mirror surface area, so that the former radius is for example in the range from 0.2 to 1 times the latter radius. Furthermore the useful available surface of the rearview mirror is increased if the radius of curvature of the lateral edge at the upper and lower sides of the opening side is set to be almost the same as the radius of curvature of the cross section through the centre of the mirror. The upright edge of the outer edge of the opening may have a radius of curvature which is smaller than that of the supplementary mirror surface and may be curved in the reverse sense, so as to be concave, so that no image of this edge will be seen in the mirror, and the mirror may be used more effectively. In the construction thus described, it is preferred that the outer upright edge has a radius of curvature 0.2 to 1 times the radius of curvature of the supplementary mirror

surface.

One way of determining the radius of curvature R' of the upper and lower lateral edges of the mirror opening in the region of the supplementary mirror surface (having a radius of curvature R) will now be described.

As already described, it is desirable to reduce the likelihood of the mirror body edge portion being seen in the mirror, and it is preferable to have R' small. To reduce the likelihood of water droplets landing on or adhering to the mirror, and to reduce the likelihood of interference to retraction of the mirror body, it is preferable to have R' set large. Therefore the setting of R' is determined by selecting the most desirable value thereof. According to one of the preferred embodiments of the present invention, in addition to the condition described above, in consideration of a mirror setting angle, a given height of driver and the desired degree of freedom in the design, R' has been statistically set to be the most appropriate value selected from values of various rearview mirrors. As a result it has been found that it is desirable to set it such that $1/5\ R < R' < R$ and more preferably such that $1/3\ R < R' < 1/2\ R$.

An advantage offered by the present invention is that the mirror projects out from the mirror body opening to the same extent as with a conventional mirror. However, the mirror setting position does not need to be changed since the upper and lower lateral edges are set to have approximately the same radius of curvature as the mirror,

the whole mirror surface becomes available to the field of view. Furthermore the outer upright edge of the mirror opening approaches the mirror edge portion, when the mirror body is merely changed, the full surface of the mirror is utilized so as not to create an image of the edge of the mirror opening therein. The outer upright edge portion of the mirror opening may be provided with a cutout, and the problem of the upright edge of the mirror opening being seen in the mirror is simply and effectively overcome. The radius of curvature of the lateral edge of the mirror opening can be set to be sufficiently smaller closer to the mirror edge, and the useful view field of the mirror can be increased. The radius of curvature of the lateral edge of the mirror opening can be made smaller than the radius of curvature of the mirror in a horizontal plane, so that a roof effect to protect the mirror from rain drops is obtained.

Examples of a mirror assembly made in accordance with the present invention will now be described with reference to the accompanying drawings, in which :-

Figure 1 is a front view of such a mirror assembly;

Figure 2 is a side view of the mirror assembly shown in Figure 1;

Figure 3 is a cross-sectional plan view of the mirror assembly taken along the line B-B of Figure 1;

Figure 4 is a side view of a modified form of

such a mirror assembly;

Figure 5 is a cross-sectional plan view of an edge portion of a further modified form of such a mirror assembly, drawn on a larger scale than that of Figures 1 to 4; and

Figures 6, 7 and 8 are views corresponding to that of Figure 5 of yet further modified forms of such a mirror assembly.

Figures 1 to 3 show a hinged rearview mirror assembly comprising a base 12, a mirror body 10 hinged onto the base 12, and a convex shaped mirror 20 within the body 10.

The mirror body 10 is provided with a generally square-shaped opening 14 for the convex shaped mirror 20. The latter has a substantially uniform radius of curvature in both a horizontal plane and a vertical plane, and is mounted on a vehicle body via the base 12. Through the opening 14, a driver can readily check a rearview field of vision of which an image is created by the mirror 20. Upper and lower lateral edge portions 14a, 14a of the opening 14 are formed to have approximately the same radius of curvature as that of the mirror 20. Vertical edges 14b, 14c of the opening 14 are substantially straight.

As a result, the setting position of the mirror 20 does not need to be changed especially, no images of an edge of the opening is created in the mirror 20, and the

mirror can project out from the opening to the same degree as a conventional rearview mirror. When this construction of mirror is made also as an electrically-powered hinged rearview mirror and the mirror body 10 is rotated into its retracted position, there is substantially no risk of the mirror position being dislocated by contact of the mirror 20 with the base 12. The vertical edge portion 14b of the opening approaches near to the edge portion of the mirror 20. Therefore the mirror body construction is such as to utilize all the available mirror surface whilst not creating an image of the vertical edge 14b of the opening 14 in the mirror.

Thus the vertical edge 14b of the opening 14 is straight. To avoid any image of the mirror body 10 appearing in the edge portion of the mirror 20, the vertical edge 14b approaches near to the edge portion of the mirror 20. The mirror body 10 is not therefore seen in the mirror 20. It is not necessary so far as the mirror function is concerned, and can be eliminated.

In the Figure 4 modification, a cutout 40 is provided on the vertical edge portion 14b. The radius of curvature of the cutout 40 is preferably set to be in the range from 0.2 to 1 times the radius of curvature of the mirror 20 in a vertical plane. With the cutout 40 it is even less likely that an image of the mirror body will appear in the mirror 20.

In the construction shown in Figures 5 and 6, the mirror 20 comprises a main mirror surface portion 20a and

a supplementary mirror surface portion 20b which is that part of the mirror which is outwardly beyond the dotted line L shown in Figure 5. It extends to the mirror edge portion. The radius of curvature from the portion 20a to the portion 20b does not change abruptly : rather it changes smoothly.

Upper and lower lateral edge portions 14a' opposite to the main mirror surface 20a are straight and upper and lower lateral edge portions 14a" opposite to the supplementary mirror surface 20b have a certain radius of curvature. When the radius of curvature of the supplementary mirror surface 20b is R, it is preferable for the radius of curvature R' of the lateral edge portion 14a" to be within the range given by the formula :

$$R/5 < R' < R \qquad \text{[Formula 1]}$$

As shown in Figure 6, the supplementary mirror surface 20b itself can be portioned into a plurality of surfaces such as a first supplementary mirror surface 20b' and a second supplementary mirror surface 20b", and the radius of curvature of the mirror surface may become smaller by degrees in an outward direction towards the mirror end. It is preferable that the relationship between the radius of curvature of each supplementary mirror surface and of the mirror opening 14 satisfies the condition given in formula 1.

As a result, the available field of view of the mirror can be greater, especially broader, than those of the constructions shown in Figures 1 to 4, whilst retaining

the benefits of those constructions. With a plurality of supplementary surfaces of respective radii of curvature, the magnification of an image seen in the mirror can be slowly increased so as to be noticed more easily by the driver, and blind spots are reduced by broadening the angle of the field of view.

In the construction shown in Figures 7 and 8, upper and lower lateral edge portions 14a' are straight. The radius of curvature of the lateral edge portion of the opening adjacent to the supplementary mirror surface should be at the low end of the range expressed by formula 1. In the construction shown in Figures 5 and 6, in respect of the supplementary mirror surface area, the portion of the lateral edge of the opening which functions as a hood to protect the mirror from drops of rain (for example an area designated by numeral 30 in Figure 5) is inadequate, and a retention of rain drops and water drops may not be prevented effectively. In the construction shown in Figures 7 and 8, the straight lateral edge portion is instead given a radius of curvature which is sufficiently smaller than the curvature of the mirror as to perform an adequate hood function, and no image of the opening edge portion is likely to be seen in the mirror.

The Figure 5 construction has the lateral edge portion 14a with a slightly smaller radius of curvature than that of the mirror 20 in a horizontal plane. The Figure 6 construction has a lateral edge portion 14a" in respect of the supplementary mirror surface 20b having a

radius of curvature which is in accordance with the formula 1 (which is set relatively large within the range defined by formula 1). If the lateral edge portion is given a radius of curvature slightly smaller than that of the mirror 20 or to be in accordance with formula 1, it is possible to make the hood portion larger so as to achieve the effect of the present invention as described hereinbefore.

Furthermore, it is possible to combine respective examples described above adequately to obtain a rearview mirror having a plurality of mirror surface areas.

Claims:

1. An outer rearview mirror assembly for a vehicle, comprising;

a base;

a mirror body mounted on the base and having an opening portion which is opened in a rearward direction, oppositely to the intended direction of travel of the vehicle;

a mirror provided in the mirror body and having at least one main convex mirror surface area;

and

the opening having edge portions at least one portion of the edge portions having a curvature which is also convex.

2. An assembly according to claim 1, in which the mirror has a supplementary mirror surface area with a curvature which is different from that of the main mirror surface area.

3. An assembly according to claim 2, in which the supplementary mirror surface area is further from the base than the main surface area, and an edge portion of the opening has a curvature in the region of the supplementary mirror surface area, or has a curvature in both the region of the main surface area and the region of the supplementary surface area, the curvature in the latter region being greater than in the former.

4. An assembly according to claim 3, in which the

radius of curvature of the edge portion of the opening in the region of the supplementary mirror surface area is substantially within the range from 0.2 to 1 times the radius of curvature of the supplementary mirror surface area.

5. An assembly according to any preceding claim, in which the edge portion of the opening is curved in a longitudinally bisecting plane of the mirror.

6. An assembly according to any preceding claim, in which a cutout portion is provided at an upright edge portion of the opening on the side thereof, which is further from the base of the assembly, the cutout portion having a radius of curvature which is smaller than the radius of curvature of the supplementary mirror surface area in a vertical plane, the edge portion here being concave.

7. An assembly according to claim 6, in which the radius of curvature of the cutout portion is substantially in the range from 0.2 to 1 times the radius of curvature of the supplementary mirror surface area in a vertical plane.

8. An outer rearview mirror assembly substantially as described herein with reference to and as illustrated in Figures 1 to 3, or any one of Figures 4 to 8, of the accompanying drawings.

The Patent Office

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Application No: GB 9512843.5
Claims searched: 1 to 8

Examiner: Colin Thompson
Date of search: 4 August 1995

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.N): B7J

Int Cl (Ed.6): B60R 1/08

Other: Online database: EDOC

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2261861 A	(Whittle)	1,2,3
X	GB 2157633 A	(Charlton)	1,2,3
X	GB 2092534 A	(Hagiri)	1,2,3
X	GB 1578116 A	(Jitsumori)	1
X	US 4580881 A	(Kim)	1,2

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.