Índex

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Sumari de taules

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Taula A-2: Cost per fase de projecte i total.............................................................3
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A. **Pressupost de l’estudi**

En aquest apartat es comptabilitzen els costs relacionats amb les hores invertides en l’elaboració de l’estudi del projecte. El procés seguit ha estat establir un preu per hora segons la categoria professional i avaluar les hores dedicades per cada categoria professional en les diverses fases del projecte. La taula A-1 mostra el desglossament de dites categories professionals i el cost per hora associat a cada una d’elles.

**Taula A-1: Preu per hora segons la categoria professional**

<table>
<thead>
<tr>
<th>Categoria professional</th>
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<tbody>
<tr>
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<tr>
<td>Enginyer tècnic</td>
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<tr>
<td>Administratiu</td>
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</tr>
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</table>

Posteriorment s’han combinat aquestes tarifes amb les hores realitzades en cada fase del projecte per cada una de les categories professionals. La taula A-2 mostra el desglossament d’aquests costs:

**Taula A-2: Cost per fase de projecte i total**

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<tr>
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Al pressupost de l’estudi també s’hi inclou el material informàtic, el lloguer de l’oficina i dietes i possibles viatges. A la taula A-3 es desglossen aquest tipus de costs.

**Taula A-3: Pressupost medis**

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<tr>
<th>Dietes i viatges</th>
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<td>Viatges</td>
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Total [€] 23.350,00

Cost total del projecte: 12.480€ + 23.350€ = 35.830€ (I.V.A. no inclòs)
B. Patents Estudiades


United States Patent

[19] [54] VEHICLE SAFETY CONVEX REARVIEW MIRROR WITH DISTORTION OFFSET MEANS AND METHOD OF USING THE SAME

[16] Inventor: Toby F. Joe, 2578 Daytona Ave., Hacienda Heights, Calif. 91745

[21] Appl. No.: 881,185

[22] Filed: May 11, 1992

[54] Int. Cl. ................. G02B 5/08


[58] Field of Search .......... 359/850, 854, 863, 864, 359/865, 866, 868, 248/479, 481, 483, 484

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Primary Examiner—Loha Ben
Assistant Examiner—Thomas Kobrins
Attorney, Agent, or Firm—Thomas I. Rozsa; Tony D. Chen

ABSTRACT

The present invention is a vehicle safety rearview mirror assembly with distortion offset element and method of using the same. The rearview mirror assembly comprises an elongated convex mirror. The convex mirror is independently supported by a double-ball-joint shank and a mounting base affixed on the windshield of the vehicle. The present invention also provides a method to offset the distortion created by the convex mirror. The method combines a safety reference and a safety locker to tell the driver whether and when it is safe to change lanes or make turns. The safety reference includes two opposite end portions of the rearward visual field respectively prescribed by the side windows of the vehicle, and the safety locker includes the central portion of the extended rearward visual field respectively prescribed by the rear window of the vehicle. When another vehicle appears in the safety reference, it is not safe to change lanes or make turns; when the other vehicle appears in the safety locker, it is safe to change lanes or make turns if the front end of other vehicle is entirely visible in the safety locker because by then the distance between the driver’s vehicle and the other vehicle is farther than the nearest safety distance.

55 Claims, 3 Drawing Sheets
VEHICLE SAFETY CONVEX REARVIEW MIRROR WITH DISTORTION OFFSET MEANS AND METHOD OF USING THE SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the field of vehicle mirror systems which offset the visual distortion created by a convex rearview mirror to the drivers of vehicles. More particularly, the present invention relates to the field of vehicle rearview mirror systems which create a combination of features in order to offset the visual distortion created by a convex rearview mirror and satisfies the federal safety standards, such features including a full-view rearward visual field containing no blind spots for revealing all lanes of uninterrupted roadway traffic, a clarity of image for helping drivers distinguish between one lane and another with vehicles traveling in them, a safety reference to help drivers judge when it is safe to change lanes or make turns.

2. Description of the Prior Art

A rearview mirror system is a necessary safety equipment installed on a vehicle. A quick glance in the rearview mirror while operating a vehicle is something most of the drivers do more than once every minute. This probably makes the rearview mirror system one of the most important safety elements of a vehicle.

An increase in motor vehicle operators brings an unfortunate by-product—increased accidents, and even more severe accidents, that are brought about by increasing vehicle population. The Department of Motor Vehicles figures show the number of registered vehicles exceeds 170 million, and the number of licensed drivers exceeds 170 million. According to the statistics of death, injury and collision loss experience resulted from vehicular accidents composed by the National Highway Traffic Safety Administration (NHTSA), the collision rate exceeds once in every second, the injury rate exceeds three people in every minute, and the death rate is one person in every 11 minutes. Current cars are coming up with more safety developments, which may have better injury experience that corresponding earlier models. However, collision experience can be expected to remain on the rise without solving the drivers' visual problems. If all blind spots surrounding the vehicle can be completely eliminated, the collision rate will be reduced substantially. Unfortunately, the conventional vehicle rearview mirror system continues to have blind spots which leads to vehicular accidents.

Unless one piece of mirror plate which can provide a full-view rearward visual field all in just one picture, revealing all lanes of uninterrupted roadway traffic, it cannot wholly eliminate the blind spots surrounding the vehicle. However, mere one piece of flat mirror plate cannot provide a full view rearward visual field to the driver, and a multiple mirror plates system cannot provide a full-view rearward visual field all in just one picture either. It is an underlying principle that a convex rearview mirror can provide a full-view rearward visual field all in just one picture, but it also creates a highly visual distortion which can cause visual misjudgments to lead to vehicular accidents. However, if the visual distortion created by the convex rearview mirror can be offset, then all blind spots surrounding the vehicle can be completely eliminated, so that the vehicular accidents will be substantially reduced.

Mirrors with curved surfaces were introduced as early as the 13th century, since the wider viewing angle feature created by convex mirror has been common. The convex rearview mirrors were applied to automobiles in many decades ago, since the visual distortion feature created by the convex rearview mirror has been common. Thousands of motorists by convex rearview mirrors that are supposed to assist in eliminating the blind spots because the wider viewing angle feature created by convex mirror. The NHTSA has strict rules that forbid manufacturers or service garages from installing such convex rearview mirrors because the visual distortion also created by convex mirror. On the one hand, the conventional vehicle rearview mirror system continues the have blind spots, which can lead to vehicular accidents. On the other hand, the wider viewing angle convex rearview mirrors continue to have visual distortion, which can also lead to vehicular accidents.

In an attempt to improve upon the conventional vehicle rearview mirror system it has been suggested to use a convex mirror. For example, U.S. Pat. No. 4,895,435 issued to Shoemaker discloses a convex vehicle rearview mirror. The convex mirror is attached to the interior sun visor of the vehicle, in front of the driver's seat. Since the convex mirror creates a wider view angle, the driver is able to see a wider rear view. However, this prior use of an interior convex rearview mirror has some problems. First, the sun visor in front of the driver's seat has been specially designed toward the driver's eye level for blocking off the sun light. Therefore any mirror attached to it would be positioned too low and could cause the blockage of the driver's rear view, because the mirror will reflect all the objects which exist in front of it within its viewing coverage including the driver's and even the passenger's heads, which become new blind spots to the driver. Besides, the sun visor can even block the driver's visual sight from seeing the signals while approaching to intersections. In addition, when a mirror has a convex shape, the reflected objects look farther away than they really are, creating a visual illusion which causes visual misjudgments and leads to vehicular accidents. Drivers cannot use such a convex rearview mirror effectively and safely without knowing how to offset that visual distortion created by the convex rearview mirror.

It would be illegal for a manufacturer or service garage to use any devices "which render inoperative the effectiveness" of a federal standard except the convex rearview mirror on the right side of most vehicles, bear a warning about the visual distortion created by convex mirror. However, without knowing how to offset that visual distortion created by convex mirrors, even bearing the warning about the visual distortion under the federal law, a mere full-view convex rearview mirror alone cannot help drivers judge the closing speed, positions and distances of other vehicles. Therefore, a mere full-view convex rearview mirror alone cannot actually help the drivers operate the convex rearview mirrors safely and effectively.

When a mirror has a convex shape, the smaller the radius of curvature, the wider the viewing angle it creates. However, the convex mirror with smaller radius of
which can actually help the drivers to judge whether and when it is safe to make a lane change or a turn. There remains an additional need for a formula to prove why the method is a safe method for drivers to use to offset the visual distortion created by the convex rearview mirror, to satisfy the federal safety standard.

**SUMMARY OF THE INVENTION**

The present invention is a vehicle safety convex rearview mirror with distortion offset means and method of using the same. It is known that a convex rearview mirror with a small radius of curvature will cause great distortion of the image. An elongated convex rearview mirror with a large radius of curvature is designed to produce a clearer image. However, an elongated convex rearview mirror still creates distortion and increases the difficulty for attachment to the interior of a vehicle. It requires an independent vibration-free supporting device, so that when the elongated convex mirror is mounted inside the vehicle, it is located in a spaced apart relationship from the front windshield of the vehicle, so that it can be swung and adjusted to different angles according to the individual driver's preference, and it is located at a height where the driver's head or the passengers' heads will not block the driver's rear view through the convex rearview mirror.

The present invention satisfies these requirements. The present invention is a vehicle safety convex rearview mirror with distortion offset means and method of using the same. It is a combination of an elongated convex rearview mirror for providing a full rearward vision to a driver of a vehicle and a safety method for allowing the driver to offset the distortion created by the convex rearview mirror. By using the present invention distortion offset method in conjunction with the present invention elongated convex rearview mirror, a vehicle driver can have a full-view rearward vision with a clarity of image and without blind spots. The driver can see all lanes of traffic at a glance and distinguish between one lane and another with vehicles traveling in them. The driver is able to judge the closing speeds, positions and distances of other vehicles for the driver to safely change lanes or make turns. The driver is also able to operate the convex rearview mirror effectively and safely.

The present invention has many unique features. One of the unique features of the present invention is that its convex rearview mirror has a substantially elongated length (as compared to conventional rearview mirrors) and a substantially large radius of curvature (as compared to conventional convex mirrors used in vehicles). Therefore, the convex rearview mirror of the present invention has a substantially small curvature but still enables a driver to have a full rearward vision.

Another unique feature of the present invention is that its elongated convex rearview mirror includes an independent mirror support which can be mounted directly to the interior surface of the front windshield of the vehicle. The independent mirror support has two ball-joints with offset U-shaped notches which maximizes the adjustability of the elongated convex mirror. A further unique feature of the present invention is that it provides a reliable and practical method to effectively offset the distortion created by the convex mirror. The present invention method establishes a "reference" for a driver to judge when it is not safe to make a lane change or a turn. The present invention
Disseny retrovisor interior de camp de visió ampliat. Annexos

United States Patent Office
Patented Nov. 19, 1968

3,411,843

COMPOSITE REARVIEW MIRROR
Bynum W. Moller, P.O. Box 3631,
Victoria, Tex. 77901

Filed Feb. 17, 1966, Ser. No. 228,269
19 Claims. (Cl. 358—283)

The present invention relates to a new and improved composite rearview mirror and particularly to a composite rearview mirror construction to facilitate a vehicle operator's view of the side and rear sectors of a vehicle.

An object of the present invention is to provide a new and improved composite rearview mirror including a segment for viewing the sector directly behind the vehicle as well as a pair of side mirror segments for viewing the rear corners of the vehicle, wherein such side sector mirror segments have enlarged viewing areas for viewing the rear portions of their respective sectors.

The preferred embodiment of this invention will be described hereinafter, together with other features thereof, and additional objects will become evident from such description.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown, and wherein:

FIG. 1 is a plan view of a vehicle schematically illustrating the mirror of the present invention;

FIG. 2 is a sectional view taken along the line 2—2 of FIG. 3 showing details of construction of the composite mirror of this invention;

FIG. 3 is an elevational view of one form of the composite mirror of this invention; and

FIG. 4 is a transverse sectional view taken along the line 4—4 of FIG. 3 illustrating additional details of construction of the mirror of this invention.

Briefly, the composite mirror M of the present invention comprises three substantially flat or plane surface mirror segments including a central mirror segment C for viewing the sector C directly behind the vehicle V as shown in FIG. 1 of the drawings as well as a pair of side sector viewing segments L and R, respectively, for viewing the sectors L' and R' adjacent the rear corners of the vehicle V. With the mirror M of this invention, an operator O of the vehicle V may readily and easily view all of the sectors L', R', and C substantially simultaneously merely by glancing at the segments L, R, and C of the composite mirror M.

Considering now the apparatus of the present invention in more detail, the mirror M shown in FIG. 2 of the drawings includes a support frame or housing 11 which is normally provided with a pivotal mounting means for pivotally mounting mirror M on the dashboard or some other suitable portion of the frame of the vehicle V. In the preferred form of this invention, such pivotal mounting means includes a ball 14 carried in a suitable socket 15 which may be welded or otherwise suitably secured to the frame 16 of the vehicle V. The ball 14 is connected to one end of a rod or stem 17 with the other end of the 17 being secured to the frame 11 at or near its central portion 13. The outer ends 20 and 21, respectively, of such housing 11 are preferably curved or bowed away from such central portion 13 to accommodate the mirror segments C, L, and R, respectively.

As shown in FIG. 2 of the drawings, the central sector viewing mirror C is disposed generally longitudinally relative to the housing or frame R and L, respectively, mounted in the frame 11 at an angle relative to the center mirror segment C. As indicated by the arrows 22 and 23, respectively, the mirror R, which is nearest the driver's side of the vehicle is disposed at a greater angle relative to the center mirror segment C than is the mirror L, which is disposed on the opposite side of the mirror segment C from the driver or vehicle operator O. Thus, whether the vehicle operator O is situated to the right or left of the mirror M, such mirror is mounted so that the side sector mirror R is on the same side of the vehicle V as the operator or is nearer the operator O than is the side sector mirror L.

Also, in the preferred form of this invention, as shown of the drawings, the composite mirror M has a horizontal center axis that extends generally horizontally across the face of the composite mirror M approximately midway between the outer longitudinal edges 29 and 30 of the mirror frame or housing 11 and which also coincides with the innermost or lower edge 27 of the center mirror C. Thus it will be seen that the central viewing segment is normally disposed entirely on one side of the horizontal center line 27. It will be noted that the ends 25 and 26 of the center sector mirror C normally extend beyond the planes of each of the mirrors R and L, respectively. Also, as best seen in FIG. 3 of the drawings, the ends 25 and 26, respectively, are inclined inwardly toward the vertical center portion of the mirror M.

Each of the angularly disposed side sector viewing mirrors R and L, respectively, has a L shape configuration with the short leg of the L forming the side and the long leg of the L extending longitudinally below the rear portion of the central mirror C. The mirror R has a recess portion defined by edges 25 and 27 and mirror L has a similar recess portion defined by edges 26 and 27 into which the center sector mirror C extends. As shown, the central mirror C is disposed within the confines of the two L's formed by the side mirrors R and L, respectively. Such mirrors R and L each have enlarged viewing portions 40 and 41 disposed between the outer ends 25 and 26 of the central mirror C and the outer ends 31 and 32, respectively, of the mirror housing 11. Such enlarged portions 40 and 41 also extend vertically from the outer edge 29 to the opposite, outer edge 30 of the mirror housing 11. Also, each of the side sector viewing mirrors R and L, respectively, have tapered edges 35 and 36, respectively, which correspond generally with the tapered or inclined edges 25 and 26 of the central mirror C. Such edges 35 and 36 extend from the outer edge 29 to the inner edge 27 of the central mirror C and are tapered inwardly toward the vertical center line 27 at substantially the same angle as the corresponding edges 25 and 26 of the central mirror segment C.

Also, as shown, each of the side angle mirrors R and L includes longitudinally extending portions 42 and 43, respectively, which extend inwardly from the enlarged portions 40 and 41, respectively, toward the center of the mirror M. Such longitudinally extending portions 42 and 43 extend laterally from the inner edge 27 of the central mirror C to the outer edge 30 of the housing 11 and have inner edges 45 and 46 which are substantially parallel to each other and which form a step 48 at their juncture due to the difference in the angular disposition of such side sector viewing segments L and R. Consequently, the enlarged portions 40 and 41 enable the operator O to view the side sectors L' and R', respectively, substantially as far as he can view the central sector C and to also enable him to continue viewing the movement of a vehicle as it overtakes the vehicle V on either side.

Thus, it will be seen that each of the side angle mirror segments L and R have diagonal axes or centers of vision
50 and 51, respectively, which extend diagonally across the viewing surface of such mirrors R and I. from approximately the middle of the lower edges 45 and 46 outwardly to approximately the midpoint of the curved ends 31 and 52. As shown, such centers of vision are tilted upwardly at their outer ends and downwardly at their inner ends which converge at approximately the vertical center of the mirror M and behind the plane of the center C.

Due to the relative positions of the mirror M and the driver O, the angles shown by 50 and 51 reflect most efficiently the area normally visible through the automobile window openings extending from rear window to side door glasses in one continuous reflection. That is, such construction provides a view in the mirrors R and L between the lines of window top and bottom while avoiding a view of the inside of the car. Such elimination of bulk or size in a multiple mirror of this kind is important and this wrap-around effect of the mirrors R and L with respect to the mirror C serves this multiple purpose.

In the preferred form of this invention, the side sector viewing mirrors R and L are colored or tinted blue, green, or some other color or shade so that they may be distinguished from the central viewing portion C which is clear. This enables the operator O to instantly differentiate and identify the various areas or sectors of the multiple mirror being viewed.

FIG. 4, which is a transverse sectional view, shows the relationship of the central viewing segment C to the inclined viewing segment R in the preferred embodiment of the composite mirror M of this invention. Thus, in FIGS. 2 and 4 of the drawings, it may be seen that the outer curved end 31 of the inclined viewing segment R and the enlarged viewing portion 40 extends in front of the central viewing surface of the central viewing segment C while the inner ends 45 of such inclined mirror R extends behind the central viewing segment C. Normally, the plane of the central mirror C intersects the plane of the inclined mirror R substantially halfway between its inner end 45 and its outer end 31. Similarly, the centrally disposed mirror C intersects the inclined mirror L substantially halfway between its inner and outer ends 46 and 32, respectively.

Thus, with the arrangement described hereinabove, each of the viewing segments R and L, respectively, has viewing portions numbered 40 and 41, respectively, adjacent to the mirror edge 56 and 36 of the central viewing segment C which extend transversely the full width of the central mirror segment C and thus emphasize and provide a better view of the critical lateral sectors L' and R', respectively, and make it easier for the driver or operator O to observe oncoming cars or other vehicles that may be overtaking or following the vehicle V in front of these critical areas L' and R'. Thus, when compared to my prior invention disclosed in United States Patent No. 3,151-207, it has been found quite unexpectedly that with the apparatus of this invention, the operator O may see substantially as far to the side sectors L' and R' as he can in the central sector C and thereby observe substantially simultaneously the lateral viewing sectors L' and R', respectively, and the central sector C to determine at a glance whether there are other vehicles in these zones. The greater distances shown by the enlarged viewing areas in the mirror M of this invention makes it possible for the operator O to view further in the zones L' and R' flanking his rear and thereby provide more time in which to move or maneuver to the right or left to avoid difficulty.

Also, it will be appreciated that while the mirrors R, L, and C are all shown in the drawings disposed in substantially vertical planes, the mirrors R and L may be tilted or rotated about the longitudinal axis of the mirror M to facilitate viewing, as desired.

In operation, the virtual image of vehicles overtaking the vehicle V directly from the rear in the central sector C' appears in the mirror C and may be viewed in the usual manner. Similarly, the virtual image of vehicles or objects operating or located in lateral zones L' or R' first appear in the large view 41, respectively, of the mirrors L or R and then move laterally toward the inner edges 45 and 46, respectively, as the case may be, as such vehicles overtake the vehicle V.

Thus, with the composite mirror M of this invention, the operator O may quickly and easily determine at a glance the objects and activity occupying the lateral zones L' and R' as well as the rear zone C' substantially simultaneously and thereby determine which zone or sector such activity is occurring in.

The foregoing disclosure and description of the invention is illustrative and not limitative of the invention. Changes in the size, shape, and materials as well as in the details of the illustrated construction may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. A composite rearview mirror for viewing to the rear of a vehicle comprising:
   (a) a housing adapted to be mounted on said vehicle,
   (b) a central mirror segment carried on said housing for viewing the sector directly to the rear of the vehicle,
   (c) a right side sector viewing segment carried in said housing at an angle relative to said central segment for viewing the outside sector of the vehicle at the right rear corner thereof,
   (d) said right side sector viewing segment being set at an angle to the central portion and having a recess portion into which a viewing portion of said rear view segment for viewing the outside sector of the vehicle at the left rear corner thereof,
   (e) said left sector viewing segment being set at an angle to the central segment for viewing the sector directly to the rear of the vehicle,
   (f) said left side sector viewing segment being set at an angle to the central portion and having a recess portion into which a central mirror segment extends,
   (g) the apparatus of claim 1 wherein the angle between the central portion and the side sector viewing segment on the driver's side of the vehicle is greater than the angle between said central mirror and the left sector viewing segment.

2. The apparatus of claim 1 wherein the angle between the central portion and the side sector viewing segment on the driver's side of the vehicle is greater than the angle between said central mirror and the left sector viewing segment.

3. The apparatus of claim 1 wherein the outermost ends of said side sector viewing segments converge behind the plane of the viewing surface of said central mirror segment.

4. The apparatus of claim 1 wherein said central mirror segment has an inner edge and an outer edge and wherein each of said side sector viewing segments has an inner end and an outer end with a longitudinal viewing axis extending therebetween and wherein said viewing axes are inclined relative to the central mirror segment so as to converge below the inner edge of said central mirror segment.

5. The invention of claim 1 wherein said right side sector viewing segment and said left side sector viewing segment...
5. The invention of claim 1 wherein said central sector viewing segment has an inner edge substantially parallel to the longitudinal axis of the composite rearview mirror and the right side sector viewing segment has a viewing axis extending from its outer end toward its inner end and inclined with respect to the longitudinal axis and the left side sector viewing segment has a viewing axis extending from its outer end toward its inner end and inclined at an opposite angle with respect to the viewing axis of said right side sector viewing segment.

6. The invention of claim 1 wherein said right side sector viewing segment and said left side sector viewing segment each is shaded so as to distinguish it from said central sector viewing segment.

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UNITED STATES PATENTS

3,151,207 9/1964 Moller.

DAVID SCHONBERG, Primary Examiner.

M. J. TOKAR, Assistant Examiner.

United States Patent

McCord

[54] REARVIEW MIRROR

[76] Inventor: Robert C. McCord, 6220 Burton, Romulus, Mich. 48174

[21] Appl. No.: 916,598

[22] Filed: Jan. 19, 1978

[51] Int. Cl. .................................................. G02B 5/10

[52] U.S. Cl. .................................................. 350/205; 350/303

[56] Field of Search ............................................. 350/303, 293

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3,003,396 10/1961 Jenkins .................................. 350/293
4,012,123 3/1977 Hart .................................. 350/293

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4,264,144


Primary Examiner—Ion W. Henry
Attorney, Agent, or Firm—Charles W. Chandler

[57] ABSTRACT

A rearview mirror for passenger vehicles has a primary viewing surface that is substantially flat. This surface curves to the rear of the mirror, with a continuously decreasing radius of curvature, toward at least one lateral edge thereof. This provides peripheral vision to the operator of a vehicle in addition to the vision directly to the rear. The peripheral vision introduces a very gradually increasing rate of distortion as the reflected image approaches the edge of vision. This causes the peripherally reflected images to be easily relatable to those reflected from the primary viewing surface.

7 Claims, 10 Drawing Figures
1

REARVIEW MIRROR

BACKGROUND OF THE INVENTION

This invention relates broadly to rearview mirrors for automotive vehicles. More specifically, it relates to such mirrors that are constructed so that they eliminate peripheral blind spots, yet avoid discontinuities and sudden distortions in reflected images.

Rearview mirrors for automotive vehicles have been notoriously inadequate in enabling a driver to determine the traffic situation in rearward, peripheral positions relative to his vehicle. They provide a kind of tunnel vision directly to the rear, leaving blind spots that lead many drivers into the dangerous practice of turning their heads to look to the rear while driving their vehicles forward. Although quite a number of mirror devices have been developed in efforts to solve this problem, it is still considered to be one of the primary safety hazards associated with automotive vehicles.

Perhaps the most common of the devices that attempt to solve this problem of rearward, peripheral blind spots is the spherical-surface mirror. Although such mirrors do eliminate blind spots, they introduce spherical distortions and greatly reduced image sizes, so that both the distance and direction of other vehicles reflected thereby are difficult to determine. This effect is especially acute at night, when only the headlights of rearward vehicles can be seen. Attempts to alleviate spherical distortion and image reduction by using over-sized, spherical mirrors introduce their own disadvantages, such as blocking out excessive areas of the driver's forward vision.

Spherical and planar mirror combinations (e.g., U.S. Pat. Nos. 2,605,676; 2,911,177; and 3,389,952) have also been somewhat unsuccessful, because it is too difficult for the average driver to correlate the images of the two mirrors in the split-second glance he is allowed by ordinary traffic situations.

Similar difficulties have been introduced by mirrors composed of a series of plane mirror segments arranged to form a convex curve (e.g., U.S. Pat. No. 3,972,601). Although there are no image reductions in such a mirror, the degree of a moving object appears to jump through space, as it passes from one mirror segment to another. This makes the object difficult to locate and creates an effect of confusion and psychological stress on the driver. The severity of this effect, together with possible hysteresis between the mirror segments is variable according to the distance of the mirror from the driver's eyes.

Rearview periscopes have been tried and were found to provide little more than would a very large planar mirror, which, at the same time, introduces structural difficulties.

U.S. Pat. No. 2,778,273 to Femleh shows circular mirrors, each having a circular, flat portion surrounded by a spherical or conical mirror surface. U.S. Pat. No. 3,764,201 to Hale shows a rectangular, flat mirror having three edge portions that conform to circular, cylindrical surfaces. U.S. Pat. No. 2,857,810 to Troendle shows a rectangular mirror, the two lateral edge portions of which curve rearwardly in conformity with circular cylinders or cones.

The mirrors of these three patents all have flat surfaces that abruptly conform to cylindrical, conical, or other surfaces based on areas of circles. Hence, a moving image, as of an automobile approaching from the rear, changes from an undistorted image to one that suddenly appears farther away and rather drastically distorted. Hence, it is difficult for the driver to relate images reflected from the flat surface, in space, with those reflected from the adjoining, curved surfaces.

SUMMARY OF THE INVENTION

An object of the present invention, therefore, is to solve this problem of the prior art by providing a rearview mirror that eliminates blind spots when used with automotive vehicles. Another object is to provide such a mirror having a large viewing area, relatively free of distortion, that blends so gradually into a mirror area of increasing curvature that the increasing image distortion is readily relatable to images reflected from the primary viewing surface.

An important feature of the invention is its simplicity and ease of manufacture. It is essentially a rearview mirror of conventional size wherein the primary viewing surface is either flat or the area of least curvature of a curve that has a continuously decreasing radius of curvature toward at least a lateral edge of the mirror; so that the edge curves rearwardly.

Other objects and advantages of the invention will be noted as the following, detailed description is read with reference to the accompanying drawings. Each part number refers to the same part throughout the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:
FIG. 1 is a diagram showing the practical extent of the panoramic view provided a driver of a typical automotive vehicle by the invention;
FIG. 2 is a diagram showing the type of curve on which the invention is based;
FIGS. 3 and 4 are front and top views, respectively, of a mirror wherein the primary viewing surface is flat and the surrounding area conforms to a surface tangent therewith that is based on a cycloidal curve;
FIGS. 5 and 6 are similar to FIGS. 3 and 4, but show a mirror entirely conforming to a modified, cycloidal curve of revolution about the point of least curvature;
FIGS. 7 and 8 are similar to FIGS. 5 and 6, but show a mirror that is asymmetrical about the primary viewing surface; and
FIGS. 9 and 10 show a mirror in which the primary viewing area is flat and curves toward one edge thereof in conformity to a modified, cycloidal curve.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The mirror 10, as shown in FIG. 1, provides a primary viewing surface 11 that produces little or no image reduction or distortion, flanked by two areas 12 that are curved toward the rear of the mirror 10. The curved areas 12 of the mirror 10 are integrally connected to the relatively flat, primary viewing surface 11 to provide peripheral vision in the directions labeled 13.

The essential characteristic of each curved area 12 is that it fairs into the surface of the primary viewing area 11, and is integral therewith, but curves rearwardly with a continuously decreasing radius of curvature. A number of common, mathematical curves, e.g. the trigonometric tangent, the ellipse, the logarithmic curve, as well as the cycloidal curve, have portions that are relatively flat, extending into portions that have continu-
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usually decreasing radii of curvature, so that they could be used for the present invention. This includes empirical curves.

A preferred embodiment of the invention a modified, cycloidal curve 14e (FIG. 2) is used as the basic curve for the area 12. The cycloidal curve is defined as the path of a point on the circumference of a rolling circle. Hence, there is a constant relationship between the height h of a cycloidal curve and the length l of the major axis thereof—the height h being equal to the diameter of the rolling circle c. The major axis 1 1 is equal to the circumference of the same circle, or to its height h multiplied by \( \pi \).

To make the cycloidal curve more useful, the major axis is modified in some proportionate way relative to the height of the curve: The major axis may be lengthened by multiplying it by some constant factor; It may be drawn on a logarithmic scale, which will increase the rate of curvature at the end portions of the curve, etc. One method of modifying the cycloidal curve for this purpose is shown in FIG. 2. In this diagram, the first quarter 15 of a cycloidal curve 14 is projected at right angles to create a new curve 14h wherein the rates of curvature are reversed.

FIGS. 3 and 4 show a rearview mirror 16 wherein the primary viewing surface 17 is flat, surrounded by a peripheral area of revolution 18, about the center thereof, formed according to the curve 14e, illustrated in FIG. 2. The contour lines 19 are included to show the rates of curvature on the mirror 16. The peripheral area 18 may also be formed by the surface of an elliptical torus, wherein the major axis of the ellipse lies in the plane of the torus.

FIGS. 5 and 6 show a second embodiment of the invention, wherein the entire surface 20 of the mirror 21 conforms to a surface of revolution generated by rotating a curve similar to that shown in FIG. 3 about an axis extending perpendicular to the point of least curvature.

FIGS. 7 and 8 show a third embodiment of the invention that is similar to that of FIGS. 5 and 6, except that the curved portion 22 is laterally nonsymmetrical relative to the primary viewing area 23. This embodiment is especially useful when the mirror 24 is to be mounted to the side of a driver's vision, in which case, the larger, curved portion of the mirror is to be oriented toward him.

FIGS. 9 and 10 show a fourth embodiment of the invention wherein the primary viewing surface 25 is flat, and the curved portion 26, conforming to the curve 14 of FIG. 2 is on one side only. This type of mirror 27 is appropriate for external mounting on the side of a vehicle, as is commonly done with mirrors for trucks.

The mirrors of the invention are manufactured according to standard techniques for making curved mirrors.

An invention has been described that provides an advance in the art of rearview mirrors. Although the embodiments have been described specifically with regard to detail, it should be noted that many details may be altered without departing from the scope of the invention, as it is defined in the following claims. The invention is useful with all types of passenger vehicles, including boats, bicycles, motorcycles, etc.

I claim:

1. A mirror having a substantially flat, primary viewing surface, said primary viewing surface having a border merging substantially tangentially into an edge viewing portion which curves away from said primary viewing surface, said edge viewing portion having a cycloidal curvature having a continuously decreasing radius of curvature from the border of said primary viewing surface to the outer edge of said edge viewing portion.

2. A mirror as defined in claim 1, in which said edge viewing portion forms a segment of a surface of revolution developed by revolving said cycloidal curvature about an axis substantially normal to said primary viewing surface.

3. A mirror having a substantially flat, primary viewing surface, said primary viewing surface having a border merging substantially tangentially into an edge viewing portion which curves away from said primary viewing surface, said edge viewing portion having a cycloidal curvature having a continuously decreasing radius of curvature from the border of said primary viewing surface to the outer edge of said edge viewing portion.

4. A mirror as defined in claim 3, in which said edge viewing portion forms a segment of a surface of revolution developed by revolving said cycloidal curvature about an axis substantially normal to said primary viewing surface.

United States Patent

McCord

[54] REARVIEW MIRROR

[76] Inventor: Robert C. McCord, 6220 Burton, Romulus, Mich. 48174

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Related U.S. Application Data


[51] Int. Cl? .................. G02B 5/10

[52] U.S. Cl. .......................... 350/293

[58] Field of Search .... 350/303, 293; D12/187; D28/65

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Primary Examiner—Jon W. Henry

[57] ABSTRACT

Rearview mirrors are disclosed having a convex curvature defined by mathematical and geometrical relationships between the position of the observer, the viewed objects, and the mirror. The mathematical relationships are designed to minimize binocular distortions while producing the desired field of view.

33 Claims, 15 Drawing Figures
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FIGURE 1

FIGURE 2

FIGURE 3
**Figure 5**

- **Center of Radius of Curvature** (Spherical Section Only)

- **Mold Axis of Rotation**

- **Primary Surface Spherical Radius**

- **Compound Curvature**

- **Forward Direction**

- **Controlled Distortion Left Side View**

- **Observer**

- **Limited Distortion Rear-View Vision, Normally with Some Image Reduction**

- **Rearward Direction**

- **Annex 23**
V = \left[ h + \left( \frac{n}{N} \right) (2X - 2h) \right] 

V = X 

V = \left( \frac{n}{N} \right) (2X) 

\text{Factor for constant distortion rate } \gamma = (1 + V) 

\text{Figure 6}
\[ \gamma = (\beta - \alpha) \]
\[ \beta_i = \alpha \]
\[ \gamma_i = 0 \]
MOLD
AXIS OF
ROTATION

Figure 11

(A)

(B)

(C)
**Figure 12**

- **MOLD**
- **AXIS OF ROTATION**
- **SPHERICAL SECTION IS OPTIONAL**
- **SECT. A-A**
- **FOCAL CENTER**
- **OPTIONAL FOCAL CENTERS**

**SEGMENT OF NON-CIRCULAR TORUS SECTION**
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REARVIEW MIRROR

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of my application Ser. No. 916,598 filed June 19, 1978 now U.S. Pat. No. 4,264,144.

BACKGROUND OF THE INVENTION

This invention relates to rearview mirrors of the type employed by automotive vehicles, and more specifically to a family of mirrors formed in accordance with certain structural, geometrical and mathematical relationships to provide a wide field of view of objects in the rear and along side of the vehicle by providing a controlled distortion of the viewed objects, and minimizing the effects of bi-ocular vision of the image of an object in a mirror having a compound curve of variable radius.

Many rearview mirrors in automotive vehicles, as well as the side mirrors, provide a compromise between several conflicting factors. To obtain a relatively large and accurate image of other vehicles moving in the rear, as well as along both sides of the observer's vehicle obviously calls for a relatively large mirror, the larger the mirror, the better the field of view. However, large mirrors interfere with the observer's forward vision through the windshield, as well as oblique vision beyond side view mirrors.

Another problem is that a flat mirror provides only a limited view of vehicles along side the observer's vehicle. One answer is to provide a compound convex mirror having a relatively flat primary viewing surface for viewing objects to the rear of the vehicle, and increasingly curved mirror ends for extending the observer's view of side objects. This approach, however, presents several problems. Since the mirror ends are convex, there usually is considerable image distortion depending upon the curvature of the mirror, and other geometric considerations. Some of the distortion has been reduced in the prior art, but by sacrificing image size, for example U.S. Pat. No. 4,012,125 issued to Philip J. Hart. Other approaches have utilized various conic sections curves and other empirically derived curves in attempts to make an acceptable transition between the primary and edge viewing surfaces. Without exception, results are mirrors having optical distortions because of the observer's bi-ocular vision. In most cases, extremely severe bi-ocular distortions are instantaneously generated at the transition line between different geometric curvatures of the mirror. These basic problems occur in some mirrors having a compound curvature when one eye of the observer is viewing an object through one curvature, and his other eye is viewing the same object through a portion of the mirror having a different curvature. This bi-ocular problem becomes aggravated when the observer is viewing a moving object having an image progressively passing through several curvatures.

My co-pending application, Ser. No. 916,598, utilizing a continuous function modified cycloidal geometry, provides a solution for this type of mirror in which the mirror has a relatively flat central viewing surface for viewing objects to the rear of the observer, and a peripheral curved end portion having a curvature continuously decreasing from the primary mirror portion surface. Such a mirror, with properly selected and proportioned geometric curvature sections, provides a useful balance between a unit image or zero distortion image and a wide field of vision.

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SUMMARY OF THE INVENTION

The broad purpose of the present invention is to provide an improved mirror having a controlled image distortion and a wide field of view while minimizing the distortions caused by the bi-ocular vision of the observer in accordance with defined structural, geometrical and mathematical relationships between the position of the observer, the position of the mirror, the position of the viewed objects, and the field of view. The preferred embodiment of the invention employs a mirror that may or may not have a continuously decreasing radius of curvature from the central or primary viewing portion of the mirror toward the mirror ends. Preferably the primary viewing surface is relatively flat, being either a large spherical radius or a truly non-distorting geometry. On full rearview mirrors, the opposite ends of the mirror are curved downward to provide additional surface area for viewing objects along either side of the vehicle. Side mounted mirrors employ primary and peripheral viewing surfaces, the primary surface lying nearest the observer.

The preferred mirror has a transition between the primary viewing surface and the end curved peripheral surface in which the instantaneous radius of curvature of the primary surface is tangent to the curvature of the peripheral area. In addition, the instantaneous radius of curvature of the two areas at the transition point may be made substantially equal to one another to minimize any distortions caused by the observer's bi-ocular vision, and to generate a smooth image size change through said transition point.

Still other objects and advantages of the invention will become readily apparent to those skilled in the art to which the invention pertains upon reference to the following detailed description.

DESCRIPTION OF THE DRAWINGS

The description refers to the accompanying drawings in which like reference characters refer to like parts throughout the several views, and in which:

FIG. 1 is a schematic plan view of an observer in an automotive vehicle illustrating the field of view of a rearview mirror representing the preferred embodiment of the invention;

FIG. 2 is a view illustrating typical images observed in the preferred mirror;

FIG. 3 is an illustration of the reflective surfaces of the preferred mirror;

FIG. 4 is a diagram illustrating the basic geometric relationships between the observer, the mirror, the direction of observation and reflection, and the field of view developed by the mirror relative to the observer;

FIG. 5 is a diagram illustrating the geometric relationships defining the curvature of the mirror;

FIG. 6 is a chart which illustrates typical modifying factors. Embodiment 1 exclusively employs \( Y = X \) and \( Y = (1 + P) \). Embodiment 2 exclusively employs \( Y = (\sqrt{X} - 2X) \) and \( Y = (1 + P) \). Embodiment 3 employs \( Y = (1 + P) \); and

FIG. 7 compares the curvature of the preferred mirror to a flat plane mirror and to a prior art geometry;
FIG. 8 is another diagram illustrating the geometrical relationships of the curvature of the mirror surface and the geometry of the interior of the vehicle. The mirror surface, as viewed from above, is a concave paraboloid. The curvature of the mirror surface is such that the image of an object placed at any point on the surface will be viewed at the point on the mirror corresponding to that object's position on the surface. The image will be in focus at the point on the mirror corresponding to the object's position on the surface. The image will be in focus at the point on the mirror corresponding to the object's position on the surface.

FIG. 9 shows the same relationship as FIG. 8, but from a different perspective. The mirror surface is viewed from above, and the object is placed on the surface. The image of the object is viewed at the point on the mirror corresponding to the object's position on the surface. The image will be in focus at the point on the mirror corresponding to the object's position on the surface.

FIG. 10 is another diagram illustrating the geometrical relationships of the curvature of the mirror surface and the geometry of the interior of the vehicle. The mirror surface, as viewed from above, is a concave paraboloid. The curvature of the mirror surface is such that the image of an object placed at any point on the surface will be viewed at the point on the mirror corresponding to that object's position on the surface. The image will be in focus at the point on the mirror corresponding to the object's position on the surface.

FIG. 11 shows the same relationship as FIG. 10, but from a different perspective. The mirror surface is viewed from above, and the object is placed on the surface. The image of the object is viewed at the point on the mirror corresponding to the object's position on the surface. The image will be in focus at the point on the mirror corresponding to the object's position on the surface.

FIG. 12 is another diagram illustrating the geometrical relationships of the curvature of the mirror surface and the geometry of the interior of the vehicle. The mirror surface, as viewed from above, is a concave paraboloid. The curvature of the mirror surface is such that the image of an object placed at any point on the surface will be viewed at the point on the mirror corresponding to that object's position on the surface. The image will be in focus at the point on the mirror corresponding to the object's position on the surface.

FIG. 13 shows the same relationship as FIG. 12, but from a different perspective. The mirror surface is viewed from above, and the object is placed on the surface. The image of the object is viewed at the point on the mirror corresponding to the object's position on the surface. The image will be in focus at the point on the mirror corresponding to the object's position on the surface.

FIG. 14 shows a mirror having a built-in eye to aid in determining the curvature of the mirror surface. The mirror surface, as viewed from above, is a concave paraboloid. The curvature of the mirror surface is such that the image of an object placed at any point on the surface will be viewed at the point on the mirror corresponding to that object's position on the surface. The image will be in focus at the point on the mirror corresponding to the object's position on the surface.
of interest \( P_n \), the origin of the respective \( R_n \) values does not lie at point "0" nor at any other point of defined interest. The origin of said instantaneous radii of curvature are of no interest, only the \( \phi_n \) angles and their \( \Delta \phi_n \) increments are of interest. By definition, \( \phi_n \) is constructed perpendicular to a tangent line drawn to the instantaneous radius of curvature of the mirror at point \( P_n \). \( \phi_n \) is the angular displacement of \( R_n \) from the axis of rotation of the mirror \( R_0 \). Also, because perpendicular lines form equal angles with respective elements of other perpendicular lines, \( \phi_n \) is also a measure of the slope angle of instantaneous tangents to the mirror's curve through point \( P_n \) with respect to the \((x-z)\) axis, which slope controls the angle of reflection of light rays incident thereupon; those reaching the observer at point \( E \) being of principle interest in this invention. \( \Delta \phi_n \) is the differential angular change between the \((n-1)\) and \(n\)th angular measurements. \( \gamma_n \) not to be confused with \( \phi_n \) is a measure of the instantaneous slope angle of the chord \( x_2 = (P_{n-1}. P_n) \), with respect to the \((x-z)\) axis.

Finally, all \( \phi \) and \( \Delta \phi \) values are representations and/or measurements of field angle components, which this invention compares to respective constant \( \Delta \phi \) values according to well defined mathematical relationships of said invention. The \( \Delta \phi \) increments are always taken equal to each other, while the \( \Delta \phi \) increments are usually continuously increasing in value based upon said formula(s). The basic relationships between \( \theta \) and \( \delta \) are:

\[
\Delta \phi = (\Delta \phi_n + 2\Delta \phi_n), \quad \text{is the incremental angular relationship;}
\]

\[
\theta = \phi + \Delta \phi = \theta + \Delta \phi = \theta + \Delta \phi = \ldots \quad \text{is another field angle relationship.}
\]

The composition of the preferred embodiment is shown in FIG. 5, and is applicable to both full-rearview and side-view types. For full-rearview types, three distinct viewing areas are distinguished: primary viewing area 20, left peripheral viewing area 22, and right peripheral viewing area 24. For side view types, either the left viewing area 22 or the right viewing area 24 is eliminated for right-side or left-side mirrors, respectively. The primary viewing area consists of a relatively large spherical radius producing little image size reduction. The intent is to limit image reduction. The peripheral areas and curvature interfaces conform to certain mathematical and geometric relationships herein disclosed.

The geometry of the preferred embodiment is defined by the following mathematical relationships which apply to the curvature of the right and left peripheral viewing areas for generating a constant rate of optical distortion from the primary viewing area to the end of the mirror.

The basic principal of all of the following formulas, (1) through (6), is that the ever changing field angle differentials \( \Delta \phi_n \) are always derived in relationship to constant vision angle differentials \( \Delta \theta_1 = \Delta \theta_2 = \Delta \theta_3 \ldots = \Delta \theta_n \).

\[
\Delta \theta = (\Delta \theta_n - 1)(1 + x) \quad \text{FORMULA (1)}
\]

When \((1 + x) = (Y)\), then:

\[
\Delta \theta_n = (\Delta \theta_n - 1)(1 + x) \quad \text{FORMULA (2)}
\]

Formula (2) is the general formula for a "constant rate" of optical distortion for these mirror applications.

This expression states that "\( Y \)" is the constant multiplying factor which develops a constant rate of change for the \( \Delta \theta_n \) value with respect to each respective field angle increment \( (\Delta \theta_n - 1) \) for the field of view \( \theta \), relative to a constantly and uniformly changing field of vision \( \theta \).

"\( X \)" is a constant value and is chosen by trial and error until all physical conditions for a particular application, including total field angle \((360)\times \theta_n\), are satisfied. In FIG. 6, the horizontal line \( Y = (1 + X) \) illustrates this constant multiplying factor.

A second preferred mathematical relationship for defining the curvature of the periphery areas generates a constantly changing rate of optical distortion and is illustrated in the following formula:

\[
\Delta \theta_n = (\Delta \theta_n - 1)(1 + (x/N)(2k)) \quad \text{FORMULA (3)}
\]

combining:

\[
\Delta \theta_n = (\Delta \theta_n - 1)[1 + (x/N)(2k)] \quad \text{FORMULA (4)}
\]

when \((x/N)(2k) = (Y)\) then:

\[
\Delta \theta_n = [\Delta \theta_n - 1][1 + Y] \quad \text{FORMULA (5)}
\]

The "\( X \)" value of this expression is derived the same as that in Formulas 1 and 2 and is derived in the same manner. In this formula, the \((x/N)(2k)\) factor defines and produces a constantly changing rate of change for the \( \Delta \theta_n \) value with respect to each respective field angle increment \( (\Delta \theta_n - 1) \), thus controlling the optical distortion factor, and is illustrated in FIG. 6 as the diagonal straight line function \( Y = (x/N)(2k) \).

Referring again to FIG. 6, a multiplying factor may be generated to vary between those used in formula (1) and in formula (4), as follows:

\[
\Delta \theta_n = (\Delta \theta_n - 1)[1 + (x/N)(2k) - 2d] \quad \text{FORMULA (6)}
\]

Because the formula are based upon the relationship of the observer's eyes to the mirror, the right and left peripheral viewing areas are not symmetrical.

With further reference to FIG. 8, the basic curvature of the left and right hand viewing areas is revolved about an axis 40 passing through the geometric center of the mirror. The result is a compound curvature having a relatively flat midsection, and left and right peripheral viewing areas each having a unique compound convex curvature, usually with a decreasing radius of curvature, from the primary viewing area to the ends of the mirror.

FIG. 13 illustrates a mirror 50 having the same peripheral border as mirror 16, but in which the surface of the peripheral ends are developed independently along a plurality of radial lines 50A, 50B, 50C, etc., which extend completely around the axis of the mirror in equal-spaced angular relationship, being generated per other Formula (1), (2) or (6). The surface of the mirror is smoothly generated from each radial line to its neigh-
boring radial lines. This differs from mirror 16 in which a single curvature is developed for one end of the mirror which is then revolved around the focal axis to generate the surface of that mirror end and a second curvature is developed for the opposite end, which is then also revolved around the focal axis to develop the opposite peripheral viewing surface.

FIG. 8 illustrates another mirror 140 embodying the invention in which there is no primary or central viewing area, the left and right periphery areas being joined along the center of the mirror 140. The mirror is symmetrical about the line of joiner. The curvature of the right peripheral viewing area is defined according to Formula (1), the curvature of the left peripheral viewing area is also defined according to Formula (1), and the values of corresponding points on opposite sides of the central axis are averaged to define a final curve that is revolved about the axis of rotation. This type of mirror having an averaged peripheral area can also be made with a central viewing area.

FIG. 13 illustrates a peripheral curvature developed in which none of the ΔS components are equal. This mirror is an outside mirror having a curvature 60. The eye of the observer is located at 62.

FIG. 10 shows a mirror 64 in which the generated curve is not revolved about a central axis, but has a curvature 66 extended along a linear border 68.

It is to be understood that the inventive mirror may be molded from a prismatic glass blank, thus giving the vehicle observer the option of a silvered second surface providing maximum light reflecting for normal daylight driving conditions, or a plain first surface providing minimum light reflection for a night driving condition. See FIG. 14.

In addition, anti-glare type glass or glass treatments may be applied to any of the mirrors disclosed herein, such as a tinted mirror.

Mirrors developed in accordance with the preferred formula are illustrated in FIGS. 11A, 11B, and 11C. FIG. 11A shows a mirror 70 generated with a curvature 72 along line 74 that is revolved about an axis 76 to develop the reflective surface. Axis 76 is displaced from the edge of the mirror.

FIG. 11B illustrates a mirror 78 developed by generating a curvature along line 90 which is then revolved about an axis 82 that extends through the edge of the mirror.

FIG. 11C illustrates a mirror 84 developed by generating a curvature along line 86 which is then revolved about an axis 88 which extends through the surface of the mirror.

FIG. 12 shows a method for developing a mirror 90 having a curvature 92 developed along line 94. Curvature 92 shows the cross section of the mirror as seen along section line A—A. This mirror has a second curvature along its Y axis, as illustrated at 96. In this case, the reflective surface of the mirror has a decreasing radius of curvature and forms a segment of a non-circular torus section. Radius r is determined by the height "h" of the mirror and by the required total vertical field-of-view of the mirror. This geometric concept is particularly applicable to an eighteen-wheeler commercial trailer and some commercial bus type vehicles, where the mirror is mounted very high above the road surface, which demands a substantially increased vertical field of view. The horizontal curvature selected is rotated about a different horizontal axis, which is displaced from the primary curvature by the dimension of radius "r".

Optional locations of the focal center with respect to the horizontal curvature shown in FIG. 12 agree with the concept shown in FIGS. 11A, 11B, and 11C. A plane, which is tangent to the horizontal curvature at its focal center, is parallel to the axis of rotation and is normal to a radius line therefrom.

FIG. 14 shows a preferred rearview mirror 98 having a thin bull's eye ring 99A affixed preferably to the rear surface of the mirror prior to silvering. Ring 98A aids the user in adjusting the mirror.

FIG. 15 illustrates a side view mirror 99 having the preferred curvature with a pair of eccentric rings 99B and 99C. The larger ring aids the user in judging distance and the relative position of trailing or passing vehicles.

FIG. 7 illustrates the problem of bi-ocular vision with respect to compound mirrors 100 and 101, having a primary viewing surface 102 which extends from point "D" to point "E" and then curved peripheral viewing areas 104 or 105 that extend from point "E" to point "F1" and "F2", respectively. The bi-ocular vision of the observer is the result of the user having two eyes 106 and 108 spaced a distance "d". The γ angles illustrated are a measure of bi-ocular astigmatism. The relationship is: γ = (β - α). Note: These α, β and γ symbols do not relate to FIG. 4. The greatest γ value represents the greatest astigmatic problem, since it is the result of the proportionately smaller instantaneous radius of curvature which in turn produces a more reduced image size that cannot be comfortably compared to the larger image size observed by the left eye at the point "E".

Assuming the cross sections of mirrors 100 and 101 are superimposed on the cross section of a planar mirror 110, if the user views an object through the planar mirror, the line-of-sight 112 of his left eye will be reflected off the reflective surface of the mirror to a continuation of his line-of-sight 114. Since the compound mirrors 100 and 101 are constructed tangent to the planar mirror 110 at point 128, and all three have coincident surfaces between points "D" and "E", the viewer's line-of-sight 112 and 114 for his left eye 106 are identical. Three conditions are then illustrated for the line-of-sight of the observer's right eye 108, as follows:

- For the planar mirror 110 its line-of-sight 110 is reflected to a continuation of his line-of-sight 112 toward the viewed object 130. For the peripheral surface 104 of mirror 100 having a radius of curvature at the point of tangency 128 substantially equal to that of the primary viewing surface 102 and gradually reducing as the curvature proceeds from the point of tangency 128, his line-of-sight 120 is reflected to a continuation of his line-of-sight 122 converging upon viewed object 130. For the peripheral surface 105 of mirror 101, having a radius of curvature at the point of tangency 128 significantly smaller than that of the primary viewing surface 102, his line-of-sight 124 is reflected to a continuation of his line-of-sight 126 toward the object 130.

- In these two cases, γ 1 and γ 2 respectively, represent the three foregoing astigmatic factors for the three conditions just described for right eye 108. For planar mirror 110, no astigmatism exists since γ 1 equals zero. For mirror 101, γ 1 is very large and unacceptable, causing great eye discomfort and blurred images. For mirror 100, which agrees with the preferred embodiments and concept of this invention, γ 2 is small and controlled within acceptable limits of distortion. This condition is affected by
two principal factors of this invention, namely causing the instantaneous radius of curvature of the primary and peripheral viewing surfaces to be substantially equal at their point of tangency 128 and by controlling the reducing radius of curvature of the peripheral viewing surface according to the mathematical relationships of Formulæ (1) through (6).

Summarizing, if the viewer is looking at a compound mirror so that his left eye is looking at the primary viewing surface of the compound mirror, but the right eye is looking at the image through the peripheral viewing area, having a significantly reduced radius of curvature, the sudden change in the curvature of the peripheral viewing area from the primary area produces a reflected line-of-sight that produces an unacceptable astigmatic factor with a great difference in image size observed by the two eyes. On the other hand, by using the preferred mathematical relationships, the astigmatic factor (which is the angle γ₁ illustrated in FIG. 7) is relatively small.

The result is a gradual change in the image size observed by the observer's two eyes so that he can comfortably observe an image crossing the transition between the two curves of the mirror, and crossing the peripheral section itself.

In summary, it is to be understood that I have described a rearview mirror having a controlled image distortion as the observer views an object moving across the mirror such that his eyes can comfortably adjust as the image travels through the transition between the peripheral portion and the primary viewing surface of the mirror, and across the peripheral areas as well.

It is to be further understood that I have described a mirror having a relatively common height, but in which the mirror ends are formed so as to be lower than the midsection of the mirror in order to optimize the viewing area through the rearview window of a conventional vehicle, as well as to provide a line-of-sight through the side windows and thereby provide an effective and wide field of view about the sides and rear of the vehicle.

Having described my invention, I claim:

1. A mirror having a viewing surface with a curvature substantially in accordance with the following mathematical relationship, expressed in incremental field angular relationships:

\[ \Delta \theta_n = \Delta \theta_{n-1} [1 + X] \]

in which (n) defines the point of interest along a substantially horizontal line of the mirror's surface, beginning at the optical design axis at which point the line of sight of an observer located substantially in the normal operator's position with respect to the mirror is reflected straight rearward with respect to the vehicle's forward direction; or beginning at the interface with a primary viewing surface, wherein (n-1) defines the point of interest immediately preceding (n); \( \Delta \theta_n \) defines the incremental field angle between (n) and (n-1); X is the constant factor generating a constant rate of horizontal optical distortion with respect to \( \Delta \theta_{n-1} \), which is chosen to produce a desired total field of view across the variable-radius surface, all other factors remaining unchanged; and \( \Delta \theta_0 \) is the constant vision angle increment to which all \( \Delta \theta_n \) values are related.

2. A mirror having a viewing surface, whose cross-section is generated according to the structural, geometrical and mathematical relationships as defined in claim 1, and which cross-section is revolved about an axis which is located (c) distance from a point on the mirror's surface, which point lies on a plane passing through the center of rotation, said plane being at right angles to any other plane which is tangent to the mirror's surface at its focal point.

3. A mirror having a viewing surface with a curvature substantially in accordance with the following mathematical relationship, expressed in incremental field angular relationships:

\[ \Delta \theta_n = \Delta \theta_{n-1} [1 + \frac{c}{(n+2)X}] \]

in which (n) defines the point of interest along a substantially horizontal line of the mirror's surface, beginning at the optical design axis at which point the line of sight of an observer located substantially in the normal operator's position with respect to the mirror is reflected straight rearward with respect to the vehicle's forward direction; or, beginning at the interface with a primary viewing surface, wherein (n-1) defines the point of interest immediately preceding (n); \( \Delta \theta_n \) defines the accumulated field angle from the optical design axis of the mirror, or from the interface with a primary viewing surface, to the point of interest (n); \( \Delta \theta_{n-1} \) defines the incremental field angle between (n) and (n-1); (c) is a constant factor controlling horizontal optical distortion, which is chosen to produce a desired total field of view across the variable-radius surface, all other factors remaining unchanged; (N) is a value chosen between zero and (X) and becomes the initial value for the multiplying factor at the beginning of the variable-radius curve where (n=1) and in substantial (X) at the final iteration point where (n=N), thus altering
the rate of change characteristics of the constantly changing multiplying factor across the variable-radius surface as well as changing its magnitude at both the beginning and ending points of said variable radius curve; the (u/N) ratio generates a constantly changing rate of change of Δθ with respect to Δθ_{0}, u, and u is the constant visual angle increment to which all Δθ values are related.

5. A mirror having a viewing surface with a final curvature revolved about a central axis of curvature to form a right mirror half and a left mirror half, said final curvature being developed by generating a first curve for the right mirror half and a second curve for the left mirror half and then generating said final curvature as an average of the first and second mirror halves, said first and second curvatures being generated in accordance with the structural, geometrical and mathematical relationships as defined in claim 1, wherein the averaging process is carried out by independently generating the right half and left half (xu, yu) curvature coordinate pairs, wherein the right and left (xu) values are equal to each other, and then for each pair adding the respective (yu) off-set components and dividing them by 2 to produce new (yu) values for each respective (xu) pair, thus completing the averaging process.

6. A mirror having a spherical primary viewing surface with a circular border, the diameter of which is considerably larger than the height of the mirror's central structure, and having right and left edge viewing surfaces generated by a revolved central axis, thus forming a right mirror segment and a left mirror segment, said curvature being developed by generating a first curve for the right mirror segment and a second curve for the left mirror segment, each segment of curvature being rotated 180 degrees about the common central axis, said curvature, said curvature being generated in accordance with the structural, geometrical and mathematical relationships as defined in claim 1.

7. A mirror having a viewing surface with a curvature developed about a central axis having a predetermined angle with respect to a predetermined line of sight of an observer and generated along a plurality of radial lines radiating from the intersection of said lines with said central axis and extending 360 degrees about said axis, the said curve developed along each of said radial lines being in accordance with the structural, geometrical and mathematical relationships defined in claim 1.

8. A mirror as defined in claims 1, 3, 4, 5, 6 or 7, in which the mirror has a primary viewing surface, said primary viewing surface having a border merging substantially tangentially into said first-mentioned viewing surface.

9. A mirror as defined in claim 8, in which the primary viewing surface is flat.

10. A mirror as defined in claim 8, in which the primary viewing surface is spherical.

11. A mirror as defined in claim 8, in which the primary viewing surface is generated by a non-distorting geometry.

12. A mirror as defined in claim 8, in which the primary viewing surface has an instantaneous radius of curvature at said border, and said first-mentioned viewing surface has an instantaneous radius of curvature at said border substantially equal to the instantaneous radius of curvature of the primary viewing surface at their points of tangency, so that the instantaneous slope angles of said surfaces, with respect to common reference axis (x—y), are equal to each other at said point of tangency.

13. A mirror as defined in claim 8, in which the viewing surface of the mirror forms a segment of a surface of revolution developed by revolving said curvature about an axis.

14. A mirror as defined in claim 8, in which the viewing surface of the mirror forms an elongated structure.

15. A mirror as defined in claim 8, in which the viewing surface of the mirror forms an elongated structure.

16. An inside mounted rearview mirror for an automotive vehicle, as defined in claim 8, said mirror having a reflective surface being elongated and having opposite sections curved downward in a common direction parallel to a plane which is normal to the focal axis of the mirror.

17. A mirror as defined in claim 8, in which the first-mentioned viewing surface forms a segment of a surface of revolution developed by revolving said curvature about an axis normal to said primary viewing surface and extending through the center thereof.

18. A mirror as defined in claim 8, in which the mirror is formed by extending the curvature along a linear axis such that the curvature defines the cross section of said mirror.

19. A mirror as defined in claim 14, in which the axis of revolution is spaced from the mirror.

20. A mirror as defined in claim 14, in which the axis of revolution extends through the edge of the viewing surface.

21. A mirror as defined in claim 14, in which the axis extends through the mirror.

22. A mirror as defined in claim 8, in which the mirror is formed of an anti-glare glass material.

23. A mirror as defined in claim 8, in which the mirror has the shape of a prismatic wedge producing maximum light reflection from a silvered second surface and minimum light reflection from an untreated first surface.

24. A mirror as defined in claim 14, and having a silvered surface, upon which a narrow but visible bull's eye ring is permanently affixed to the silvered surface of the mirror, being located such as to essentially define the boundary between the primary viewing surface and edge viewing surface, and to which one or more additional concentric ring(s) may also be affixed, being concentric with said first mentioned ring.

25. A mirror as defined in claim 8, constructed of a transparent plastic material.

26. A mirror having a viewing surface with a final curvature revolved about a central axis of curvature to form a right mirror half and a left mirror half, said final curvature being developed by generating a first curve for the right mirror half and a second curve for the left mirror half and then generating said final curvature as an average of the first and second mirror halves, said first and second curvatures being generated in accordance with the structural, geometrical and mathematical relationships as defined in claim 3, wherein the averaging process is carried out by independently generating the right half and left half (xu, yu) curvature coordinate pairs, wherein the right and left (yu) values are equal to each other, and then for each pair adding the respective right and left (yu) off-set components and dividing them by 2 to produce new (yu) values for each respective (xu) pair, thus completing the averaging process.
27. A mirror having a viewing surface with a final curvature revolved about a central axis of curvature to form a right mirror half and left mirror half, said final curvature being developed by generating a first curve for the right mirror half and a second curve for the left mirror half and then generating said final curvature as an average of the first and second mirror halves, said first and second curvatures being generated in accordance with the structural, geometrical and mathematical relationships as defined in claim 4, wherein the averaging process is carried out by independently generating the right half and left half (x, y) curvature coordinate pairs, wherein the right and left (x, y) values are equal to each other, and then for each pair adding the respective right and left (y) offset components and dividing them by (2) to produce new (y) values for each respective (x) pair, thus completing the averaging process.

28. A mirror having a spherical primary viewing surface with a circular border, the diameter of which is considerably larger than the height of the mirror's central structure, and having right and left edge viewing surfaces with a curvature revolved about a central axis thus forming a right mirror segment and a left mirror segment, said curvature being developed by generating a first curve for the right mirror segment and a second curve for the left mirror segment, each segment of curvature being rotated 180 degrees about the common central axis and tangentially joining the spherical primary surface, said curvature being generated in accordance with the structural, geometrical and mathematical relationships as defined in claim 4.

30. A mirror having a viewing surface with a curvature developed about a central axis having a predetermined angle with respect to a predetermined line of sight of an observer and generated along a plurality of radial lines radiating from the intersection of said lines with said central axis and extending 360° about said axis, the curve developed along each of said radial lines being in accordance with the structural, geometrical and mathematical relationships defined in claim 3.

31. A mirror having a viewing surface with a curvature developed about a central axis having a predetermined angle with respect to a predetermined line of sight of an observer and generated along a plurality of radial lines radiating from the intersection of said lines with said central axis and extending 360° about said axis, the curve developed along each of said radial lines being in accordance with the structural, geometrical and mathematical relationships defined in claim 4.

32. A mirror having a viewing surface, whose cross-section is generated according to the structural, geometrical and mathematical relationships as defined in claim 3, and which cross-section is revolved about an axis which is located (r) distance from a point on the mirror's surface, which point lies on a plane passing through the center of rotation, said plane being at right angles to any other plane which is tangent to the mirror's surface at its focal point.

* * * * *

**United States Patent** [19]

**McGuire**

**[54]** REARVIEW MIRROR FOR VEHICLES

**[76]** Inventor: Arthur M. McGuire, High Spire Apartments, Apartment 100, High Spire, Pa. 17034

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**[52]** U.S. Cl. ✕ ....................... 350/627, 350/612

**[58]** Field of Search .................. 350/615, 627, 281, 278, 350/606, 631; 248/481, 484, 475 R; D12/187

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**Primary Examiner**—John K. Corbin
**Assistant Examiner**—Loha Ben
**Attorney, Agent, or Firm**—John F. A. Earley; John F. A. Earley, III

**[57]** ABSTRACT

Rearview mirror apparatus for automobiles that eliminates the blind spots to the left rear and to the right rear of the automobile comprising a housing holding a mirror having a center mirror portion which is flat so as to reflect images of vehicles located directly behind the driver of the automobile, a left mirror portion which is curved toward the housing so as to reflect images of vehicles located in the left blind spot, and a right mirror portion which is curved so as to reflect images of vehicles located in the right blind spot. The rearview mirror may be mounted on an existing rearview mirror or may replace it.

5 Claims, 8 Drawing Figures
1

REARVIEW MIRROR FOR VEHICLES

TECHNICAL FIELD

This invention relates to rearview mirrors for automotive vehicles that are designed to eliminate the blind spots which exist in conventional rearview mirrors at the left rear and at the right rear of the automobile.

BACKGROUND OF THE PRIOR ART

It is well-known that the driver of an automobile has a blind spot to the right rear and to the left rear, over his left and right shoulders, where he cannot see a vehicle in the next lane approaching from behind. He can see the approaching vehicle in the conventional rearview mirror, but as it draws near it disappears from view in the mirror and cannot be seen. If he then turns into the next lane, he may strike the approaching vehicle and cause an accident.

A number of attempts have been made to solve this problem.

Moller, U.S. Pat. No. 3,411,843, discloses a composite rearview mirror that comprises three substantially flat mirror segments, including a central mirror segment for viewing the area directly behind the vehicle, a left mirror segment for viewing the area to the right rear of the automobile, and a right mirror section for viewing the area to the left rear of the automobile. However, the Moller arrangement is more complex than the present invention; it provides three mirrors instead of one; and it may be somewhat confusing since the right mirror section reflects the left rear and the left mirror section reflects the right rear.

Lenta, U.S. Pat. No. 2,649,028, provides a rearview mirror for use on automobiles and the like which includes three independently adjustable viewing faces. This device is also more complicated than the present invention and provides three separate mirrors instead of one.

BRIEF SUMMARY OF THE INVENTION

It is an object of the present invention to provide a rearview mirror that provides the driver with a view of any vehicles approaching from directly behind the driver, and also provides a view of any vehicles approaching in the next lane from the left rear or from the right rear of his vehicle which would normally be unobserved because they would be located in the blind spots of a conventional rearview mirror.

It is another object to provide such a rearview mirror which is simple in construction and may be adjusted easily to suit each individual driver, and which includes a single mirror, rather than multiple mirrors.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in perspective of a rearview mirror constructed in accordance with the invention;

FIG. 2 is a disassembled view of the rearview mirror of FIG. 1;

FIG. 3A is a view in horizontal section showing the end curvature of one embodiment of the mirror of this invention;

FIG. 3B is a view in horizontal section showing the end curvature of another embodiment of the inventive mirror;

FIG. 4 is a view in side elevation and in section of the rearview mirror apparatus of the invention;

4,575,202

FIG. 5 is a diagrammatic view in top plan of the mirror installed in an automobile with lines indicating sectors of view directly behind, left rear, and right rear;

FIG. 6 is a view in perspective showing another embodiment of the invention from the rear of the mirror; and

FIG. 7 shows the mirror of FIG. 6 in side elevation and partly in section.

DETAILED DESCRIPTION

Turning now to the drawings, there is shown a rearview mirror apparatus 11 that eliminates the blind spots to the left rear and to the right rear of the automobile. The rearview mirror apparatus 11 is adapted to be mounted on or adjacent to the windshield of the automobile at about the center.

Rearview mirror apparatus 11 comprises a housing 13 having a back plate 15 with side panels 15a and 15b, an upper panel 17 curved toward both ends, and a lower panel 19 curved toward both ends in a similar manner. A mirror 21 is mounted in housing 13.

The mirror may be mirror 21a in FIG. 3A which includes a glass or clear synthetic body sheet 23 and reflecting surface sheet 25 silvered onto the back of sheet 23.

In the preferred embodiment of the invention shown in FIG. 3B, mirror 21 comprises a reflecting tape 27 attached to the back of glass or clear synthetic plastic body sheet 23 by an adhesive layer 29. Tape 27 may be a reflecting tape made by the IM Company, St. Paul, Minn.

Mirror 21 has a center portion 31 which is flat so as to reflect images of vehicles located directly behind the driver of the automobile. Mirror 21 also has a left mirror portion 33 which is curved at its left end toward the housing back plate 15 so as to reflect images of vehicles located in the left lane and especially the left blind spot of the driver, and also has a right mirror portion 35 which is curved at its right end toward the housing back plate 15 so as to reflect images of vehicles located in the right lane and especially in the right blind spot of the driver.

The preferable dimensions of mirror 21 are about 3 inches high, the center portion 31 of the mirror being about 3 inches wide, and left and right mirror portions 33, 35 being approximately 24 inches wide and curved about a 9 inch vertical radius.

Mirror 21 is seated in a resilient gasket 37 made of rubber, or other resilient material, that is positioned around the periphery of housing opening 39. A stem 41 extends from a bracket 42 mounted by bolts 42a on the back plate 15 of housing 13, and a ball 43 is mounted on the end of stem 41 and is seated in an end of sleeve 45. A second ball 47 is seated in the other end of sleeve 45 and has a stem 49 extending therefrom which is attached to a mounting plate 51 for mounting on the dashboard or windshield, or other convenient surface, of an automobile. A spring 53 is positioned within sleeve 45 between the balls 43, 47 to exert force against the balls to hold them in an adjustable seated position to, in turn, hold the mirror in an adjustable position that may be changed to suit the individual driver.

The conventional rearview mirror which comes with the automobile may be removed easily and replaced by the inventive rearview mirror.

Turning now to FIGS. 6 and 7 of the drawings, they show rearview mirror apparatus 61 which includes means for attaching mirror housing 13 to an existing
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3. Rearview mirror 63 without having to remove that mirror. Mirror 21 and its housing 13 are easily and removably slipped onto existing mirror 63.

The means for attaching housing 13 onto existing mirror 63 comprises a bracket 85 that includes a horizontal cross bar 67 attached to the back of housing 13 near the top. A positioning tab 69 extends rearwardly from each end of the horizontal cross bar 67 to engage the top edge of existing mirror 63 to horizontally position the mirror housing 13 and to keep the two mirrors 21, 63 parallel to each other.

A first vertically positioned spring 73 has one end 75 fixed to horizontal plane or cross bar 67 and has a free end 77 which is curved rearwardly and which contacts the rear of existing mirror 63 to hold the housing 13 in place. A second vertically positioned spring 79 has one end 81 fixed to the first vertical spring 73 and has a free end 83 which is curved rearwardly and which contacts the rear of existing mirror 63 to assist in holding the housing 13 in place.

Bracket 65 is offset from the center of housing 13 so as to accommodate the mounting bracket 85 of existing mirror 63 to mount the removable mirror 21 evenly on the existing mirror 63 so that the centerlines of the two mirrors are substantially in coincidence. Mounting bracket 85 is shown attached to the interior surface of windshield 87 of the automobile.

With the inventive rearview mirror, the driver can look at both sides of his vehicle with one look; he does not have to look at a center rearview mirror and then turn his head to look at a sideview mirror; and the usual blind spots of the center rearview mirror are eliminated.

I claim:

1. Rearview mirror apparatus for automobiles that eliminates the blind spots to the left rear and to the right rear of the automobile and is adapted to be mounted on or adjacent to the windshield of the automobile at the center, comprising:
   a) a mirror housing having a back plate and upper, lower, and side panels extending therefrom,
   b) a mirror having a body sheet and a reflecting surface sheet,
   c) said mirror having a center portion which is flat so as to reflect images of vehicles located directly behind the driver of the automobile,
   d) said mirror having a left mirror portion which is curved at its left end toward the housing back plate so as to reflect images of vehicles located in the left lane and especially in the left blind spot, and
   e) said mirror having a right mirror portion which is curved at its right end toward the housing back plate so as to reflect images of vehicles located in the right lane and especially in the right blind spot,
   f) and means for attaching the mirror housing to an automobile comprising

2. A bracket mounted on the rear of the mirror housing for easily and removably slipping onto an existing rearview mirror mounted on the automobile, said bracket including:
   a) a horizontal cross bar attached to the back of the housing near the top,
   b) a positioning tab extending rearwardly from each end of the horizontal cross bar to engage the top edge of the existing mirror to horizontally position said mirror housing and keep the two mirrors parallel to each other,
   c) a first vertically positioned spring having one end fixed to the horizontal cross bar and having a free end which contacts the rear of the existing mirror to hold the housing in place,
   d) and a second vertically positioned spring having one end fixed to the first vertical spring and having a free end which contacts the rear of the existing mirror to assist in holding the housing in place.

3. Rearview mirror apparatus for automobiles that eliminates the blind spots to the left rear and to the right rear of the automobile and is adapted to be easily and removably slipped onto an existing rearview mirror mounted in the automobile, comprising:
   a) a mirror housing having a back plate and upper and lower panels extending therefrom,
   b) a mirror having a body sheet and a reflecting surface sheet,
   c) said mirror having a center mirror portion which is flat so as to reflect images of vehicles located directly behind the driver of the automobile,
   d) said mirror having a left mirror portion which is curved at its left end toward the housing back plate so as to reflect images of vehicles located in the left blind spot,
   e) said mirror having a right mirror portion which is curved at its right end toward the housing back plate so as to reflect images of vehicles located in the right blind spot,
   f) and means for attaching the mirror housing to an existing rearview mirror mounted on the automobile comprising

4. A bracket mounted on the rear of the mirror housing for easily and removably slipping onto the existing rearview mirror, said bracket including:
   a) a horizontal cross bar attached to the back of the housing near the top,
   b) a positioning tab extending rearwardly from each end of the horizontal cross bar to engage the top edge of the existing mirror to horizontally position said mirror housing and keep the two mirrors parallel to each other,
   c) a first vertically positioned spring having one end fixed to the horizontal cross bar and having a free end which contacts the rear of the existing mirror to hold the housing in place,
   d) and a second vertically positioned spring having one end fixed to the first vertical spring and having a free end which contacts the rear of the existing mirror to assist in holding the housing in place.

5. The rearview mirror apparatus of claim 3, the reflecting surface sheet of the mirror being a silvered sheet which was silvered onto the back of the mirror body sheet to provide a reflecting surface.

United States

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MOTOR VEHICLE REARVIEW CAMERA SYSTEM AND HITCH COVER WITH DISPLAY

Inventor: David Mendoza, Commerce, CA (US)

Correspondence: Address:
L. Kenneth Rosenthal
2173 Sun Tropex Court
Chino Hills, CA 91709 (US)

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Publication

ABSTRACT

A rearview camera and display system for a motor vehicle which comprises a low light level, wide angle camera mounted securely in a hitch cover which receives power from the hitch power plug, and supplies said power and video signal with blind spot information to a display monitor located in the vicinity of the rear view mirror area near the driver. The secure and locked placement of camera and hitch cover in a substantially flush configuration with the rear of the motor vehicle greatly less the opportunity for damage to the invention due to rear moving accidents and vandalism.
FIG. 1
MOTOR VEHICLE REARVIEW CAMERA SYSTEM AND HITCH COVER WITH DISPLAY

RELATED APPLICATION

[0001] This application claims priority of provisional patent application No. 60/349,858 filed Jan. 17, 2002.

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BACKGROUND OF THE INVENTION

[0003] 1. Field of the Invention

[0004] The invention relates to a rearview camera system and hitch cover assembly for a motor vehicle, and a display system positioned at or near the rear view mirror adjacent to the driver.

[0005] 2. Background of the Invention

[0006] The invention relates to a rearview camera system and display for larger motor vehicles such as SUVs (sports utility vehicles), vans, pick-up trucks, and certain trucks. The rearview camera system allows the driver to view directly behind the vehicle in the blind spot area, said areas which are not viewable with the standard mirror systems and other means provided by the vehicle manufacturer. The invention, which is easily and quickly installed, secure, and vandal and environmentally resistant, is a closed circuit television system specially adopted for said larger motor vehicles whose camera system is adapted for the 2 inch (measured on each of the four sides of the square hitch shape) or the like trailer hitch receiver (or simply motor vehicle tow hitch receiver), and whose display system is adapted for placement near or at the driver’s rear view mirror.

[0007] Drivers often rely on limited views of conventional mirrors, windows, and instinct when moving in reverse. These limited views can be further reduced by taller passengers in the rear seats at night—low light conditions, and other distractions. According the National Highway Traffic Administration data there is a backing accident every 1.6 minutes in the United States, most of said accidents occurring because the driver does not see an obstacle. An average of 116 children are fatally injured in off-road backing crashes annually during the last ten years, and children between the ages of 1 to 4 represent 30 percent of all backing fatalities. Insurance surveys report that 27 percent of all automotive accidents occur in reverse. Other insurance reports indicate that even very slight rear moving accidents can require repair bills of several hundred to several thousand dollars, depending on the motor vehicle model and the nature of the accident.

[0008] Prior art rearview camera systems have several drawbacks. Certain rearview cameras are mechanically fastened under or near the rear bumper, on the inside or outside or the rear window, or by drilling holes in the motor vehicle rear door or key lock and attaching custom bracketry and/or holders which are different which each vehicle class, and are often not essentially flush with the rear vehicle surfaces. These types of installation often require skilled labor, special tools, and the necessity of dismantling interior panels, and may compromise the structure’s mechanical strength. Such systems often comprise the interior and exterior appearance or viewability of the rear parts of the motor vehicle, and are often made inoperable by simple vandalism, very minor accidents, and common environmental factors.

[0009] Recently several auto manufacturers, including Ford, Infinity, and Acura, have announced built in rear view camera systems for selected 2003 models. These systems will work only on these 2003 car and truck models, and cannot be retrofitted to other cars and trucks, and are very expensive, often being viewable with the navigation system screen. Other manufacturers for displays are using the half silvered rearview mirror with LCD TV viewer.

[0010] No rear view camera systems in the prior art can be quickly, easily and securely mounted to the trailer hitch of most new and older motor vehicles equipped with said trailer hitch. No rear view camera systems in the prior art provide a vandal, minor accident, and environmentally resistant enclosure for the rear view camera system, typically without the need for any custom brackets or parts, or skilled labor or detailed knowledge of motor vehicle audio video systems.

SUMMARY OF THE INVENTION

[0011] It is an object of an embodiment of the present invention to provide a closed circuit television system for viewing the blind spot area and other areas in back of the motor vehicle during the reverse movement of the motor vehicle and during other movements and times. The present invention comprises a hitch cover with camera, a color monitor mounted near the rear view mirror next to the driver, a power video cord for connecting the color monitor to the hitch cover with camera which is installed under the interior motor vehicle paneling, and means for providing electrical power to the camera and monitor, preferably through the hitch power receptacle adjacent to the hitch cover. With certain motor vehicle models, the power video cord may be run through the headliner system or partly under the motor vehicle on the outside.

[0012] It is a further object of an embodiment of the present invention to house a television camera in a hitch cover which is securely fitted into the hitch of the motor vehicle. The use of a hitch lock or other means secures the hitch cover and camera to the motor vehicle. It is a further object of an embodiment of the invention that the television and hitch cover are mounted substantially flush with the rear of the motor vehicle as to minimize the damage to the hitch cover and camera during a rear moving accident.

[0013] It is a further object of an embodiment of the invention to allow the installation to be accomplished in 15 to 30 minutes without special tools or extensive training to nearly all motor vehicles which possess a hitch in their rear area.

[0014] Other features and advantages of the invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings which illustrate, by way of example, various features of embodiments of the invention.
BRIEF DESCRIPTION OF THE FIGURES

[0016] A detailed description of embodiments of the invention will be made with reference to the accompanying drawings, wherein like numerals designate corresponding parts in the several figures.

[0017] FIG. 1 is a perspective drawing of an embodiment of the invention, showing the relationship among the main parts of the invention.

[0018] FIG. 2 is an environment drawing of the installation of the invention in a motor vehicle.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] Referring to FIG. 1 hitch cover 1 houses camera 2. Preferably, hitch cover 1 is made from aluminum (6061 grade) and is finished with triple-chrome plate or black matte powder coat for aesthetic and environmental protection purposes. Camera 2 is preferably an approximately 1/2 inch CCD waterproof camera which is a wide angle optical system capable of viewing the large blind spot area behind the motor vehicle which can extend for the larger SUVs 4 to 5 feet or more in height from the ground and up to 20 feet or more back from the rear. Blind spots dimensions do vary depending on the motor vehicle model. Camera 2 also has the ability to operate in low light level conditions. Foam sleeve 10 prevents the rattling of hitch cover 1 with camera 2. Hitch cover 1 and camera 2 are secured firmly in motor vehicle hitch 9, and locked in place by hitch lock pin 10a which is fitted into hitch lock receptacle 10b. In addition other configurations of hitch cover locking systems may be employed using keys, one piece assemblies, or the like. Also, camera 2 may be stationary or controlled by motors (not shown) for changing views for selected motor vehicles.

[0020] Display monitor 6 is for viewing the output of camera 1. Preferably display monitor 6 is a 3.5 inch (screen diagonal measurement) LCD (liquid crystal display) with windshield mounting bracket 7 which may be mounted onto front windshield 20 or video essentially shows view into rear view mirror 30. In the first alternative display monitor 6 could be combined with rear view mirror 30 to form a single combination device for both standard rear view mirror viewing and observation of the output of the camera 2. In the second alternative the output of camera 2 could be fed into the motor vehicle electronics so as to its output could be viewed at the motor vehicle’s navigation or TV screen by the driver and/or passengers in the front and rear seats. These latter two alternatives would require knowledge of the motor vehicle’s audio/video electronic systems, and may only be available on selected models.

[0021] The power cord 4 attached to the hitch power plug 8 also supplies the display monitor 6 with electric power, preferably 12 volts, through the power and video cord 5. In addition, power and video cord 5 which is installed under the motor vehicle interior panels with typically no special equipment or training, supplies the video signal from the camera 2 to the display monitor 6. Also, power and video cord 5 may be equipped with a waterproof disconnect 20 for easy removal of hitch cover 1 and camera 2.

[0022] FIG. 2 depicts an environmental setup of the invention. Camera 2 housed in hitch cover 1 receives electrical power from power cord 4, and transmits said electrical power and camera 2 video signal via power and video cord 5 to display monitor 6 which is connected to motor vehicle 40 at the front windshield 20 via mounting bracket 7. Motor vehicle 40, rear view mirror 30, and front windshield 20 are shown in dotted lines, and form no part of the invention.

[0023] With the use of the invention, the driver is aided in backing and parking and accident prevention by the reduction of the rear blind spot area. Also, the low light level feature of camera 2 provides increased night rear visibility through its automatic low light level feature. In addition other embodiments of the invention could provide electronic power to the display monitor 6 and camera 2 with batteries, and video communication between the display monitor 10 and camera 2 could be accomplished in a wireless manner so as to alleviate the need for hardwire connections of these functions.

[0024] While the description above refers to particular embodiments of the present invention, it will be understood that many modifications may be made without departing from the spirit thereof. The accompanying claims are intended to cover such modifications as would fall within the true scope and spirit of the present invention.

[0025] The presently disclosed embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims, rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed is:

1. A rear view camera system and display for a motor vehicle comprising:

   Camera means housed in a hitch cover which views the area behind a motor vehicle, and

   Display monitor means positioned near the driver for viewing said area behind said motor vehicle while in motion or being stationary.

2. The rearview camera system and display of claim 1 wherein said camera means contains a waterproof wide angle optical system and a 1/2 inch CCD.

3. The rearview camera system and display of claim 1 wherein said camera means views a titlal spot area measuring approximately up to 5 feet in height from the ground and approximately up to 20 feet from the rear of said motor vehicle.
4. The rearview camera system and display of claim 1 wherein said camera means has the capability to operate at low light levels.

5. The rearview camera system and display of claim 1 wherein said camera means and said hitch cover are securely mounted to the hitch of a motor vehicle with a hitch lock and foam sleeve.

6. The rearview camera system and display of claim 5 wherein said hitch cover and said camera are mounted nearly flush with the back of said motor vehicle.

7. The rearview camera system and display of claim 1 wherein said display monitor means is a 3.5 inch screen mounted in the vicinity of the rear view mirror of said motor vehicle.

8. The rearview camera system and display of claim 7 wherein said 3.5 inch screen is mounted on said motor vehicle’s windshield.

9. The rearview camera system of claim 1 wherein said camera means and said display monitor means receive electrical power from the hitch power plug.

10. The rearview camera system of claim 1 wherein said camera means and said display monitor means receive electrical power from the back-up light wiring of said motor vehicle.

11. The rearview camera system and display of claim 9 wherein said camera means supplies a video signal with power and video cord to said display monitor, and said power and video cord is installed under the motor vehicle interior panels.

12. The rearview camera system and display of claim 5 wherein said hitch of the motor vehicle measures approximately 2 inches.

13. The rearview camera system and display of claim 1 wherein said camera means and said display monitor means operate while said motor vehicle is moving forward, in reverse, or in a stationary position.

14. A rearview camera system and display for a motor vehicle comprising:
   A camera mounted in a hitch cover, said hitch cover secured to the hitch of said motor vehicle,
   A display monitor which allows the driver to view the blind spot area and other areas behind said motor vehicle,
   A power cord connected to said camera which receives electrical power from the hitch power plug, and
   A power and video cord installed under the motor vehicle interior panels which connects to said camera and transfers power and video signal to said display monitor.

15. The rearview camera system and display of claim 14 wherein said camera views the blind spot area which measures up to 5 feet in height from the ground and up to 20 feet from the rear of said motor vehicle.

16. The rearview camera system and display of claim 14 wherein said display monitor is a 3.5 inch liquid crystal display with windshield mounting bracket for attachment to front windshield.

17. The rearview camera system and display of claim 14 wherein said camera and said hitch cover are mounted essentially flush with the rear of said motor vehicle.

18. The rearview camera system and display of claim 14 wherein said camera operates in low light level conditions.

19. The rearview camera system and display of claim 14 wherein said camera and said display monitor operate while said motor vehicle is moving forward, in reverse, or in a stationary position.

20. The rearview camera system and display of claim 14 where said hitch of said motor vehicle is approximately 2 inches.

21. The rearview camera system of claim 14 wherein said power and video cord contains a waterproof disconnect for quick removal of said camera and said hitch cover.

* * * * *

A rear viewing apparatus is provided having a convex mirror having a frame backing attached by rotatable hinges to a second frame having straps thereon for mounting onto a conventional truck mirror. The frame backing of the convex mirror is attached by rotatable hinges to the mounting frame having a larger and a smaller hinge providing for an approximate 15 degree angle between the convex mirror and the mounting frame. Thereby, a rear-view viewing angle of approximately 86 degrees is provided.

5 Claims, 1 Drawing Sheet
BROAD ANGLE REAR VIEW MIRROR ASSEMBLY

BACKGROUND OF THE INVENTION

The field of this invention generally relates to the provision of rear view vehicle mirrors. More particularly, the present invention relates to the provision of a rear view mirror suited for large trucks. The present invention generally affords a rear view mirror having very broad angular scope and providing a wide angle of rear vision.

Wide angle rear view mirrors have been found in the prior art. King, in U.S. Pat. No. 3,104,274, described a rear view vehicle mirror to be applied to a presently flat rear view mirror to provide a mirror combination simultaneously affording undistorted rear view vision of limited angular scope and wide angle rear view vision. Budrock, in U.S. Pat. No. 3,424,517, described a twin rear view mirror assembly for providing a wide angle of viewing. Baldwin, in U.S. Pat. No. 3,667,833, described a rear view mirror having a plain and a convex portion for viewing on both sides of the vehicle in addition to the rear thereof. Couch, in U.S. Pat. No. 2,605,676, described a rear view mirror assembly having an objective to increase the visibility zone of the driver. Krone, in U.S. Pat. No. 2,802,394, described an auxiliary reflector securing means to be attached to existing rear view mirrors of motor vehicles.

However, none of the prior art contains the new and unique features of the present invention.

SUMMARY OF THE INVENTION

An objective of the present invention is to provide an apparatus for eliminating blind areas in the rear viewing area for large trucks, e.g., 18 wheel type trucks. It is designed to be attached to a presently flat conventional truck side view mirror. Once the mirror is attached the driver won't be confused as to what he is observing to the rear.

Three of the worst situations that occur with rear view areas are: (1) when one is making a forward right turn the rear end of the trailer cannot be seen after you start your turn; (2) when making a forward left turn into traffic and the rear of the tractor-trailer rig is cocked at an angle more than approximately 10° one cannot see the incoming traffic behind you; and (3) if one needs to back up from the right side with the tractor of the rig turned to the right side of the trailer it is difficult to see to the rear of the rig.

These three difficult viewing areas account for most of the accidents that happen in busy commercial areas. An objective of the present invention is to eliminate these problems. When making a forward right turn the present invention combined with a standard mirror will have approximately 87 degrees of viewing area and one will have the same viewing area when making a forward left turn into traffic or when backing up from the right side.

A unique feature of this mirror is the frame. The manner in which it is structured, with it being built at about a 15 degree horizontal plane angle to its base mount. When it is mounted to the conventional mirror of the viewing area it is where the standard mirror ends so that the standard mirror has approximately 12 degrees of viewing and the present invention has approximately 76 degrees of viewing which gives a total of approximately 87 degrees of viewing.

The mirror consists of a convex mirror approximately 14 inches by 6 inches mounted at about a 15 degree horizontal angle to the existing conventional mirror with a steel strap and screw and nut assembly. The frame is made of plastic. The frame is very simply made with one adjustment which is an up and down vertical angular adjustment. The reason for this adjustment is because drivers being of different heights require this adjustment to correspond with the drivers height. The present mirror when mounted properly automatically provides approximately 87 degrees of viewing area with approximately 26 degrees of vertical viewing area.

The most common mirror currently used today is a round convex mirror which gives a distorted view of its images. Likewise, it has a wide angle so that much is included in the view which is unnecessary, for example, the sky may show in the viewing area which is deceiving to a driver.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows partial elevation view of the present invention shown in operative connection with a conventional truck mirror.

FIG. 2 shows a plan view of the present invention.

FIG. 3 shows a perspective view of the present invention.

FIG. 4 is a perspective photograph of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning now to the drawings, FIG. 1, shows an elevation view of the convex mirror of the present invention, 1, attached to a conventional presently flat truck mirror, 2.

FIG. 2 shows the general features of the present invention. The convex mirror, 1, is shown along with a conventional truck mirror, 2. The mirror base mount, 3, is shown along with the back mounting plate of the frame 4. A steel hold down strap or strap of like material is shown at 5, being interconnection by a bolt, washer and nut assembly. 6, 7, and 8. The vertical angular adjustment of the mirror is provided by a larger rotatable hinge structure, 16, having a wing nut, washer and screw at 9, 10, and 11. A smaller rotatable in assembly is also shown at 16 and 17.

Turning to FIG. 5, the convex mirror is shown at 1, and the mirror base mount is shown at 3. Additionally, the back mounting plate of the frame is shown at 4 and the steel or like material hold down strap is shown at 5. The vertical adjustable larger angular hinge is shown at 14 with its counterpart piece being shown at 16. The smaller rotatable hinge is shown at 15 with its counterpart at 17. Connecting means are shown at 9, 10 and 11 being the nut washer and wing nut for the larger rotatable hinges 14 and 16 and at 12 and 13 for the smaller hinge. Additionally, means for connecting the hold down strap, 5, to the back mounting plate is shown connecting said strap to the back plate at 14.

Turning now to the photograph, the pertinent features of the present invention are shown in perspective view.

1 claim:

A rear viewing apparatus comprising:
(a) a back mounting plate;
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4,824,231

3. (b) a convex mirror being connected to said back mounting plate;
   (c) a first connecting means for connecting said convex mirror to said back mounting plate;
   (d) a second connecting means for attaching said back mounting plate to a presently flat conventional mirror; and
   (e) said first connecting means forming a horizontal plane angle of about 15 degrees between said convex mirror and said back mounting plate.

2. The apparatus of claim 1, further comprising:
   (a) said first connecting means being a first, larger rotatable hinge and a second, smaller rotatable hinge;

4. (b) said first, larger rotatable hinge and said second, smaller rotatable hinge providing a horizontal angle of about 15 degrees between said convex mirror and said back mounting plate, and
   (c) said first, larger rotatable hinge and said second, smaller rotatable hinge further providing a vertical angular adjustment.

3. The apparatus of claim 2, further comprising:
   A. said second connecting means being a strap.

4. The apparatus of claim 3, further comprising:
   A. said strap being of steel material.

5. The apparatus of claim 3, further comprising:
   A. said strap having connecting means for connecting its ends together.

* * * *
UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 4,824,231
DATED : Apr. 25, 1989
INVENTOR(S) : Ross Quintana

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 2, line 47, after "structure," add -- 14 and --.
Column 2, line 49, change "16" to -- 15 --.
Column 2, line 62, delete "at 14".

Signed and Sealed this
Thirteenth Day of February, 1990

Attest:

JEFFREY M. SAMUELS
Attesting Officer
Acting Commissioner of Patents and Trademarks

United States Patent [19]  

[54] VEHICLE MIRROR


[21] Appl. No.: 731,366

[22] Filed: May 7, 1985

[51] Int. Cl. ................................. G02B 5/08

[52] U.S. Cl. ................................. 350/612, 350/611;

[58] Field of Search ....................... 350/600, 604, 605, 606,

[56] References Cited  
U.S. PATENT DOCUMENTS

2,743,187 9/1956 Wisszar ........................................ 350/627 X
2,860,425 1/1959 Keshaw ....................................... 350/627
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Primary Examiner—Donald Watkins  
Attorney, Agent, or Firm—Robert J. Schaap

[57] ABSTRACT

An auxiliary vehicle mirror device having a first attachment mechanism for attachment to a first fixed structure of the vehicle, as for example, the frame of an existing automotive vehicle rear view mirror located in the interior passenger compartment. The auxiliary vehicle mirror comprises a second attachment mechanism capable of being attached to a second portion of a second portion of the automotive vehicle, as for example, a stud or the like secured to the vehicle and which normally retains the existing vehicle mirror. The auxiliary vehicle mirror device comprises a first shell, as for example, an outer shell, and a second shell capable of being attached thereto. The first and second shells each having mating bosses. Moreover, the boss on the outer or first shell includes a spring means which is retained on the boss and forms part of the first attachment mechanism. The second attachment mechanism comprises an internally threaded nut which is secured within the boss on the first shell and is capable of threadedly receiving a threaded end of the stud secured to the windshield or other portion of the automotive vehicle.

26 Claims, 11 Drawing Figures
U.S. Patent  
Jun. 23, 1987  
Sheet 1 of 3  
4,674,849
VEHICLE MIRROR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates in general to certain new and useful improvements in vehicle mirrors, and more particularly, to auxiliary automotive vehicle mirrors which includes a first attachment means for attachment to a first member of an automotive vehicle and a second attachment means for attachment to a second member on an automotive vehicle.

2. Brief Description of the Prior Art

Automotive vehicles are generally always provided with a rear view mirror in the passenger compartment of the vehicle to enable the driver to see traffic conditions rearwardly and to some extent on the sides of the vehicle. Generally, these rear view mirrors may be secured to the upper header which forms part of the roof structure of the vehicle. More often these rear view mirrors are secured to the front window pane or so-called "windshield" of the automotive vehicle. These rear view mirror devices normally found in the automotive vehicles include a mirror frame which holds a mirror. The frame is connected to a mounting bracket on the windshield itself, or on the header portion of the roof structure of the vehicle. When secured to the windshield, a bracket or so-called "button" is secured to the windshield and a threaded end of a stud is threaded secured to the button. The opposite end of the stud is threaded for attachment to the frame.

In each of the aforementioned rear view mirror devices in automotive vehicles, the stud is a threaded rod section which is secured to the bracket or button and the latter is normally adhesively secured to the windshield or otherwise, it may be rigidly affixed to the header section of the roof structure of the vehicle.

It has been recognized that the so-called "wide angled rear view mirror" is an effective safety device for use in automotive vehicles for enabling the driver to obtain a clearer and more accurate image of the traffic conditions on the sides of and to the rear of the vehicle operated by a driver. These wide angled auxiliary mirrors usually include an elongate colored frame adapted to carry two or more side-by-side located mirror sections. However, most commercially available automotive vehicles do not include these wide angled mirrors and they are generally only available in the secondary automotive market or so-called "automotive after market". Thus, it is necessary for the user of these wide angled mirrors to be able to conveniently and easily attach any such wide angled mirror to some existing portion of the vehicle.

In some cases, these auxiliary wide angled mirrors have been provided with attachment devices on the rearward portion thereof for attaching to the interior portion of the automotive vehicle. However, if the commercially available wide angled mirror is not adapted to directly attach to the existing rear view mirror in the passenger compartment of the vehicle, the user must engage in some elaborate attachment system to rigidly secure the auxiliary wide angled mirror. In most cases, there is no universal attachment system which enables a wide angled mirror to be attached to some existing portion of the interior compartment of an automotive vehicle in the same region as the normal rear view mirror is found.

OBJECTS OF THE INVENTION

It is, therefore, a primary object of the present invention to provide an automotive vehicle auxiliary mirror which is capable of being attached to a first structure on an automotive vehicle with a first attachment means or capable of being attached to a second fixed structure of an automotive vehicle with a second attachment means.

It is another object of the present invention to provide an automotive vehicle rear view mirror of the type stated which is provided with a first attachment means for alternative attachment to a rigid structure in the interior passenger compartment of the automotive vehicle and a second attachment means for attachment to a second fixed structure in the interior passenger compartment of an automotive vehicle.

It is another object of the present invention to provide a mirror device of the type stated which includes a first shell and a second shell which are adapted to be connected together and therein one of the shells is provided with a boss for mating attachment with a surface on the other of the shells and which shell also includes a means for mounting a spring mechanism on the boss forming part of a first attachment means and which boss also is adapted to hold a second attachment means.

It is also an object of the present invention to provide a wide angled mirror device capable of being fixedly attached to a portion of an interior passenger compartment of an automotive vehicle and which includes a first clamping attachment means associated with a boss on a shell of the mirror and a second attachment means in the form of a threaded nut capable of receiving a threaded post or stud also associated with the boss on the shell of the mirror device.

It is an additional object of the present invention to provide an auxiliary mirror device of the type stated which can be manufactured at a relatively low cost and which is highly efficient in its operation.

It is another salient object of the present invention to provide a mirror device of the type stated which is adapted for easy and convenient attachment to a wide variety of existing structures in conventional automotive vehicles and thereby lends itself to use in a large number of commercially available automotive vehicles.

With the above and other objects in view, my invention resides in the novel features of form, constructions, arrangement and combination of parts presently described and pointed out in the claims.

SUMMARY OF THE DISCLOSURE

The invention, in a broad aspect, relates to an auxiliary rear view mirror device which has a first mounting means capable of being clamped to a fixed structure of an automotive vehicle and a second mounting means for alternatively being secured to another portion of an automotive vehicle. The auxiliary rear view mirror device more specifically is a wide angled rear view mirror which may include two or more panels of mirrors for enabling wide angled view to the rear and the sides of the vehicle.

The rear view mirror device of the invention is more specifically adapted for attachment to an existing rear view mirror frame in the interior passenger compartment of the automotive vehicle. Alternatively, the existing rear view mirror of the vehicle can be removed and the auxiliary rear view mirror device of the present invention can be threadedly secured to the threaded
3 shaft which is secured to a bracket or so-called "button" on the windshield or other portion of the vehicle and which may also hold the conventional rear view mirror of the automotive vehicle.

The rear view mirror device preferably comprises an outer shell such as a plastic shell and an inner shell which is adapted to be received by a hollow portion of the outer shell. A boss is located on the interior portion of the outer shell and is adapted to engage with a mating surface portion on the inner shell for attachment of the two shells to form a rigid frame. The boss of the outer shell has a surface which engages the mating surface in facewise abutting contact and the two can be effectively heat sealed together in order to form the rigid securement of the two shells. Additional securement means may be provided for purposes of being heat sealed together.

In a more preferred embodiment of the invention, the mating surface on the inner shell also comprises an outwardly projecting boss which is initially spaced apart from the boss on the inner surface of the outer shell when the two shells are separated. Moreover, the two bosses have mating faces which abut one another for purposes of being heat sealed together. The bosses on the inner and outer shells also serve to hold a spring device which operates spring biased expandable clamps located on the outer shell. These clamps are designed to expand for extending over an existing rear view mirror on the vehicle and contract to effectively clamp the auxiliary mirror device of the invention on the existing rear view mirror. The spring device comprises a loop which is disposed about and retained on the boss of the outer shell so that it is effectively carried thereby. In addition, the boss on the outer shell also serves to carry a second attachment means which may be in the form of a fitting. The fitting is comprises of a bosses having internal threads which are sized to receive a threaded section of a stud.

In many automotive vehicles, the rear view mirror of the vehicle is normally secured to the windshield, although in some cases it may be secured to the header of the vehicle as foresaid. When attached to the windshield, a bracket which is often referred to as a "button" is secured, for example, by an adhesive securement to the interior surface of the windshield. This button includes an internally threaded section adapted to threadedly receive a threaded end of a stud. Moreover, the opposite end of that stud is also threaded and adapted for threaded securement to a ball joint on the rear portion of a rearview mirror.

In the present invention, an auxiliary threaded stud assembly may also be provided with the auxiliary rearview mirror. This auxiliary threaded stud assembly may have one end which is threaded for securement to the button on the windshield. Alternately, one end of the auxiliary threaded stud may be provided with a bracket for attachment to an adhesively secured plate on the interior surface of the vehicle windshield. The opposite end may also be threaded for securement to the auxiliary rearview mirror device itself. Moreover, ball joints may be located in the threaded stud assembly in order to enable swingable movement of the auxiliary rearview mirror.

This invention possesses many other advantages and has other purposes which may be made more clearly apparent from a consideration of forms in which it may be embodied. These forms are shown in the drawings accompanying and forming part of the present specification. They will now be described in detail, for the purposes of illustrating the general principles of the invention; but it is to be understood that such detailed descriptions are not to be taken in a limiting sense.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Having thus described the invention in general terms, reference will now be made to the accompanying drawings in which (two sheets):

FIG. 1 is a perspective view of a rear view mirror device constructed in accordance with and embodying the present invention;

FIG. 2 is an end elevation view of the rear view mirror device of the present invention;

FIG. 3 is an end elevation view of the rear view mirror device of the FIGS. 1 and 2;

FIG. 4 is a perspective view of the rear view mirror device, similar to FIG. 3, and showing a clamping means in an expanded position;

FIG. 5 is an end elevation view of the rear view mirror device, similar to FIG. 4, and showing the use of an alternate attachment means of the mirror device of the present invention;

FIG. 6 is a vertical sectional view taken along line 6—6 of FIG. 2;

FIG. 7 is an exploded vertical sectional view, somewhat similar to FIG. 6, and showing the inner shell separated from the outer shell which forms part of the frame of the mirror device of the present invention;

FIG. 8 is a vertical sectional view taken along line 8—8 of FIG. 7 and showing a portion of the inner shell forming part of the mirror device;

FIG. 9 is a vertical sectional view, taken along line 9—9 of FIG. 7 and showing the outer shell forming part of the mirror device of the present invention;

FIG. 10 is an exploded side elevation view, partially in section, and showing an auxiliary threaded stud assembly which may form part of the auxiliary rearview mirror device of the present invention for securement to the windshield of the automotive vehicle;

FIG. 11 is an exploded side elevation view similar to FIG. 10, partially in section, and showing another auxiliary threaded stud assembly which may form part of the auxiliary rearview mirror device of the present invention for securement to the windshield of an automotive vehicle.

**DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT**

Referring now in more detail and by reference characters to the drawings which illustrate a preferred embodiment of the invention, A designates an auxiliary rear view mirror device which is adapted for attachment to a portion of an existing automotive vehicle and particularly in the passenger compartment of an automotive vehicle. The rear view mirror device of the present invention is preferably a wide angled mirror device and is adapted for use in essentially all types of automotive vehicles which includes trucks, passenger vehicles, buses, airplanes, and the like.

The rear view mirror device of the present invention comprises a main frame 10 and which is comprised of an outer frame shell 12 and an inner frame shell 14. The outer frame shell 12 is somewhat rectangulally shaped and includes a vertically disposed back wall 16 and a top wall 18 and bottom wall 20 which are connected by end walls 22. In this way, the outer frame shell 12 forms an enclosing outer section with an interior compartment.
24 which is adapted to receive the inner frame shell 14, in the manner as illustrated in FIG. 6 of the drawings.

The inner frame shell 14 is similarly constructed so as to have a somewhat rectangular shape as illustrated and includes a rear wall 26 facing the rear wall 16 of the outer shell 12. In like manner, the inner shell 14 has an upper wall 28 adapted to engage the interior surface of the wall 18 and a bottom wall 30 adapted to engage the interior surface of the lower wall 20 when the two are fitted together in the manner as illustrated in FIG. 6. The front edge of the inner shell 14 is provided with an expanding flange 32 which is adapted to extend over and curl slightly rearwardly of the outer shell 12 also in the manner as illustrated in FIGS. 3 through 6 of the drawings.

The inner shell 14 is provided with a plurality of longitudinally spaced apart obliquely extending vertically disposed supporting walls 34 which suitably retain rear view mirror plates 36. In this way, each of the mirror plates 36 are effectively parallel to one another although they extend obliquely with respect to the rectangularly shaped walls 30 as is best illustrated in FIG. 1 of the drawings. In this way, by using a plurality of the obliquely extending longitudinally spaced apart mirrors, the user of the rear view mirror device is able to achieve a wide angled view to the rear and the sides of the vehicle. The various rear view mirror plates 36, usually comprise a glass plate with a metalized surface on the rear portion thereof. Moreover, they may be secured to the walls 34 by means of an adhesive or similar mounting means.

The frame 10 and particularly, the shells 12 and 14 can be formed of any suitable material, as for example, plastics and reinforced plastics which are formed by suitable molding techniques. Thus, and in a preferred embodiment, the shells 12 and 14 are formed of a polyvinyl material, although they may be formed of polyethylene, polystyrene, etc. These shells could also be formed of various metals and other structural materials.

The rear view mirror device A of the present invention comprises a unique mounting and securement system which includes a cylindrically shaped boss 38 integrally formed on and projecting rearwardly from the rear wall 16 from the outer frame shell 12. This unique mounting and securement system also comprises a cylindrically shaped rearwardly projecting boss 40 on the exterior surface of the rear wall 26 of the inner shell 14, in the manner as best illustrated in FIGS. 6 through 9 of the drawings.

The boss 38 is provided with a front face 42 and the boss 40 is provided with a rear face 44 which faces are adapted to be engaged in abutting relationship when the two shells are fitted together, in the manner as illustrated in FIG. 6. In this way, the two bosses can be sealed to one another by the application of radio frequency energy, or ultraviolet energy, or the like. In effect, through the application of the energy in the proper frequency, the bosses somewhat melt at the faces 42 and 44, and in effect, flow together and form an integral bond therebetween. In this way, the inner shell 14 is fixedly retained within the outer shell 12. Moreover, inasmuch as the flange 32 has a rearwardly facing section, it could crimp around a bead on the exterior forwardly located portion of the outer shell 12.

The bosses 38 and 40 are also hollow, in the manner as illustrated in the drawings. The first mounting means 48 comprises a clamping means 50, which is more fully illustrated in FIGS. 3 and 4 of the drawings. The clamping means 50 comprises a pair of longitudinally spaced apart ribs 52 which are integrally with the top wall 18 and extend rearwardly beyond the rear wall 16 in the manner as illustrated. These ribs 52 may be covered with a suitable covering material 54, as, for example, a neoprene rubber or other covering material. In addition, the rear wall 16 is provided with a pair of vertically disposed, longitudinally spaced apart channels 56, each of which slidably receive separate vertically disposed legs 58 and which legs 58 are each provided at their lower ends with rearwardly projecting fingers 60. These fingers 60, along with the rearwardly projecting portions of the ribs 52, function as individual clamping mechanisms which operate together and constitute a portion of the first mounting means 48.

The vertically disposed legs 58 will shift downwardly within the channels 56 and thereby enable the fingers 60 and the rib 52 to clamp over an existing device, as for example, an existing conventional rear view mirror device 62 shown as illustrated in FIGS. 4 and 6 of the drawings. In this way, the auxiliary rear view mirror device of the present invention can clamp on an existing rear view mirror in an automotive vehicle, much in the manner as shown in FIG. 4.

The legs 58 are spring biased upwardly, such that the fingers 60 normally are not extended downwardly, in the manner as shown in FIG. 4. Rather, in the relaxed position, the fingers will normally assume the position illustrated in FIG. 3. This biasing action results from a spring 64 which is wound about and retained on the boss 38. The spring 64 also includes a pair of integrally formed outwardly extending arms 66 and each one of which is secured to one of the vertically extending legs 58. These arms 66 forming part of the spring 64 may be secured to the legs 58 by extending through slots formed in the legs 58. Other means for securing the spring arms 66 to the legs 58 may also be provided.

The auxiliary rear view mirror device A of the present invention also comprises a second mounting means 70 which includes a nut 72 pressed into the boss 38, in the manner as illustrated in FIGS. 5 and 6 of the drawings. This nut 72 also includes an internal bore and is provided with an internally threaded portion for rearly threaded onto a bolt or similar member presently existing in the passenger compartment of an automotive vehicle. In the case of the conventional rear view mirror, the frame is often secured to a bracket on the windshield and this bracket includes a bolt with an externally threaded portion when the mirror frame itself is removed. Hence, the auxiliary rear view mirror view device A of the present invention can be secured to the threaded bolt forming part of the bracket of the existing conventional rear view mirror device by merely threading the same using the internally threaded nut 72.

Thus, it can be observed that the present invention provides a dual mounting system for removably mounting a wide angled rear view mirror device in the passenger compartment of a vehicle. This dual mounting means includes a clamping means 50, as aforesaid, as well as the threaded mounting means 70, as aforesaid. Moreover, it can be observed that the clamping means utilizes the bosses 38 and 40 as an integral means to hold the spring 64 in place. In addition, it is a feature of the second and threaded mounting means for retaining the internally threaded nut 72. In like manner, the two
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7. Bosses constitute primary elements in enabling the two shells to be rigidly secured together. Thus, the rear view mirror device of the present invention utilizes a pair of relatively simple bosses which perform at very least three crucial functions and which thereby lend to easy manufacturing and assembly and lower costs.

FIG. 10 illustrates an auxiliary stud assembly 80 which may be used with the auxiliary rearview mirror device of the present invention. In this case, the stud assembly 80 internally includes a pair of elongate stud sections 82 and a centrally located housing 84. The stud sections 82 are integral with ball sections 86 captured in opened ends of the housing 84 and form oppositely disposed conventional ball joints 88. In this case, inasmuch as the ball joints may be conventional, and merely permit the stud sections 82 to be movable relative to one another, these ball joints are neither illustrated nor described in any further detail herein. One of the threaded stud sections 82 is externally threaded at 90 for threaded securement to a button 92 or similar member which is secured to an automotive vehicle windshield 94 by means of an adhesive layer 96. The opposite threaded stud section 82 is similarly provided with a threaded end 98 for securement to the fitting or threaded nut 72. In this way, the auxiliary rearview mirror device can be used with the second attachment means and also can be mounted for limited pivotal movement.

FIG. 11 illustrates another auxiliary stud assembly 100 which may be used with the auxiliary rearview mirror device of the present invention. In this case, the stud assembly 100 internally includes a pair of elongate stud sections 102 and a centrally located housing 104 which are also conventional. One of the stud sections 102 is provided with a bracket 117 having an internal groove 114 which is adapted to slidably engage flanges 116 on a plate 118. By further reference to FIG. 11 it can be seen that the plate 118, which is also referred to as a “button” is secured to an automotive vehicle windshield 94 by means of an adhesive layer 120. The opposite stud section 102 is similarly provided with a threaded end 122 for securement to the fitting or threaded nut 72. In this way, the auxiliary rearview mirror device of FIG. 11 can also be used with the second attachment means and also can be mounted for limited pivotal movement.

Thus, there has been illustrated and described a unique and novel rear view mirror device for automotive vehicles which is provided with a dual mounting system and which is capable of being manufactured and assembled easily and at a relatively low cost. Thus, the present invention fulfills all of the objects and advantages which have been sought. It should be understood that many changes, modifications, variations, and other uses and applications will become apparent to those skilled in the art drawings. Therefore, any and all such changes, modifications, variations, and other uses and applications which do not depart from the spirit and scope of the invention are deemed to be covered by the invention which is limited only by the following claims.

Having thus described my invention, what I desire to claim and secure by Letters Patent is:

1. An auxiliary vehicle mirror device for attachment to a first portion of a vehicle through a first attachment means or to a second portion of the vehicle through a second attachment means, said auxiliary vehicle mirror device comprising:

(a) an outer vehicle mirror device shell,

(b) an inner vehicle mirror device shell capable of being attached to the outer shell,

(c) a boss on the outer shell projecting toward the inner shell,

(d) a mating surface portion on the inner shell for attachment to said boss,

(e) first attachment means incapable with a clamping action comprising a spring biased expandable clamp means on the outer shell,

(f) spring biasing means mounted on and carried by said boss on the outer shell,

(g) second attachment means carried by said boss extending to an exterior portion of said outer shell to engage a second portion on said vehicle, and

(h) at least one mirror carried by one of said shells to enable a view to the rear of the vehicle on which the device is used.

2. The vehicle mirror device of claim 1 further characterized in that the mating surface portion on the inner shell is on another boss on the inner shell which projects toward the boss on the outer shell.

3. The vehicle mirror device of claim 2 further characterized in that the boss on the inner shell has a mating surface adapted for attachment to the boss on the outer shell, and adhesive means enables a permanent attachment of the two bosses in a rigid relationship.

4. The vehicle mirror device of claim 1 further characterized in that the spring biasing means has a section wound about the boss on the outer shell and also has sections extending to the clamp means.

5. The vehicle mirror device of claim 1 further characterized in that said clamp means comprise at least one upper rearwardly extending member and at least one lower rearward extending member and one of which members is vertically movable relative to the other.

6. The vehicle mirror device of claim 1 further characterized in that the at least one mirror is carried by said inner shell.

7. The vehicle mirror device of claim 6 further characterized in that a plurality of spaced apart mirrors are carried by said inner shell.

8. The vehicle mirror device of claim 1 further characterized in that said second attachment means is a fitting which is carried in an interior bore of the boss on said outer shell and is adapted to receive a threaded section of a member on the second portion of the vehicle.

9. The vehicle mirror device of claim 8 further characterized in that the first attachment means comprises the spring biased expandable clamp means and is adapted to be attached to the existing automotive rearview mirror located in the passenger compartment of an automotive vehicle.

10. An auxiliary vehicle mirror device for attachment to a first portion of a vehicle through a first attachment means or to a second portion of the vehicle through a second attachment means, said auxiliary vehicle mirror device comprising:

(a) a mirror frame having a front somewhat vertically disposed wall and a rearwardly spaced apart somewhat vertically disposed wall,

(b) a boss on the rearwardly disposed wall and projecting forwardly toward the front vertically disposed wall,

(c) a second boss on the front vertically disposed wall and projecting rearwardly toward the boss on the rearwardly disposed wall,
(d) a mating surface on each of said first and second bosses adapted to be engaged in mating relationship and sealed to one another,
(e) a first attachment means operable with a clamping action comprising a spring biased expandable clamp means on the outer shell and having a spring biasing means mounted on and carried by the bosses,
(f) a second attachment means carried by at least the boss on the rearwardly presented wall, and
(g) at least one mirror carried by said mirror frame to enable a view to the rear of the vehicle on which the device is used.

11. A vehicle mirror assembly for attachment to a first portion of a vehicle through a first attachment means or to a second portion of the vehicle through a second attachment means, said vehicle mirror assembly comprising:
(a) a mirror housing,
(b) first attachment means operable with a clamping action for clamping to a portion of the vehicle,
(c) a boss forming part of said mirror housing,
(d) second attachment means comprising said boss with an internally threaded portion of said boss on the housing projecting rearwardly thereon,
(e) a stud having at least one threaded end for attachment to said boss and also having a ball joint associated therewith, and
(f) at least one mirror carried by said housing.

12. The vehicle mirror assembly of claim 11 further characterized in that said stud has an opposite threaded end for attachment to a button on the windshield of a vehicle.

13. The vehicle mirror assembly of claim 11 further characterized in that a plurality of spaced apart mirrors are carried by said housing.

14. The vehicle mirror assembly of claim 11 further characterized in that said second attachment means comprises a fitting which is carried in an interior bore of the boss and which fitting forms the internally threaded portion which is adapted to receive a threaded end of said stud.

15. The vehicle mirror assembly of claim 11 further characterized in that the first attachment means comprises a spring biased expandable clamp means and is adapted to be attached to an existing automotive rear-view mirror located in the passenger compartment of an automotive vehicle.

16. The vehicle mirror assembly of claim 12 further characterized in that a pair of ball joints are located intermediate the opposite ends of said stud.

17. The vehicle mirror assembly of claim 11 further characterized in that said one end of said stud is provided with a bracket having a slot receiving a plate secured to an automotive vehicle windshield.

18. An auxiliary vehicle mirror device for attachment to a first portion of a vehicle through a first attachment means or to a second portion of the vehicle through a second attachment means, said auxiliary vehicle mirror device comprising:
(a) an outer vehicle mirror device shell,
(b) an inner vehicle mirror device shell capable of being attached to the outer shell,
(c) means extending between and connecting the outer and inner shells together as a single shell structure,
(d) first attachment means operable with a clamping action comprising a spring biased expandable clamp means on the shell structure,
(e) second attachment means carried by said shell structure and extending to an exterior portion of said shell structure to engage a second portion of said vehicle, and
(f) a mirror carried by said shell structure to enable a view to the rear of the vehicle on which the device is used.

19. The vehicle mirror device of claim 18 further characterized in that said means extending between and connecting comprises:
(a) a boss on one of the shells projecting toward the other of the shells, and
(b) a mating surface portion on the other of the shells for attachment to said boss.

20. The vehicle mirror device of claim 19 further characterized in that the mating surface portion comprises another boss which projects toward the first identified boss.

21. The vehicle mirror device of claim 18 further characterized in that a spring biasing means has a section wound about the boss on the outer shell and also has sections extending to the clamp means.

22. An auxiliary vehicle mirror device for attachment to a structural portion of a vehicle through an attachment means, said auxiliary vehicle mirror device comprising:
(a) an outer vehicle mirror device shell,
(b) an inner vehicle mirror device shell capable of being attached to the outer shell,
(c) means extending between and connecting the outer and inner shells together as a single shell structure,
(d) attachment means operable with a clamping action comprising a spring biased expandable clamp means on the shell structure.

23. A spring biasing means mounted on and carried by said housing and operatively said expandable clamp means, and
(g) a mirror carried by said shell structure to enable a view to the rear of the vehicle in which said device is used.

22. The vehicle mirror device of claim 22 further characterized in that the means extending between and connecting comprises:
(a) a boss on the outer shell projecting toward the inner shell, and
(b) a mating surface portion on the inner shell for attachment to said boss.

24. The vehicle mirror device of claim 22 further characterized in that second attachment means is carried by said shell structure and on an exterior portion of said outer shell which can be engaged by a second portion of said vehicle to mount said mirror device.

25. The vehicle mirror device of claim 22 further characterized in that said clamp means comprises at least one upper rearwardly extending member and at least one lower rearwardly extending member and one of which members is vertically movable relative to the other.

26. The vehicle mirror device of claim 22 further characterized in that a plurality of mirrors are carried by said shell structure.