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(54) **VEHICLE IMAGE ACQUISITION AND
DISPLAY ASSEMBLY**

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1999, now Pat. No. 6,250,766.
- (51) **Int. Cl.**⁷ **G02B 5/08**
- (52) **U.S. Cl.** **359/857; 359/858; 359/838;**
359/362; 348/148
- (58) **Field of Search** 359/857, 858,
359/838, 362; 348/148, 151, 153, 159,
161; 701/200, 213; 396/429, 502

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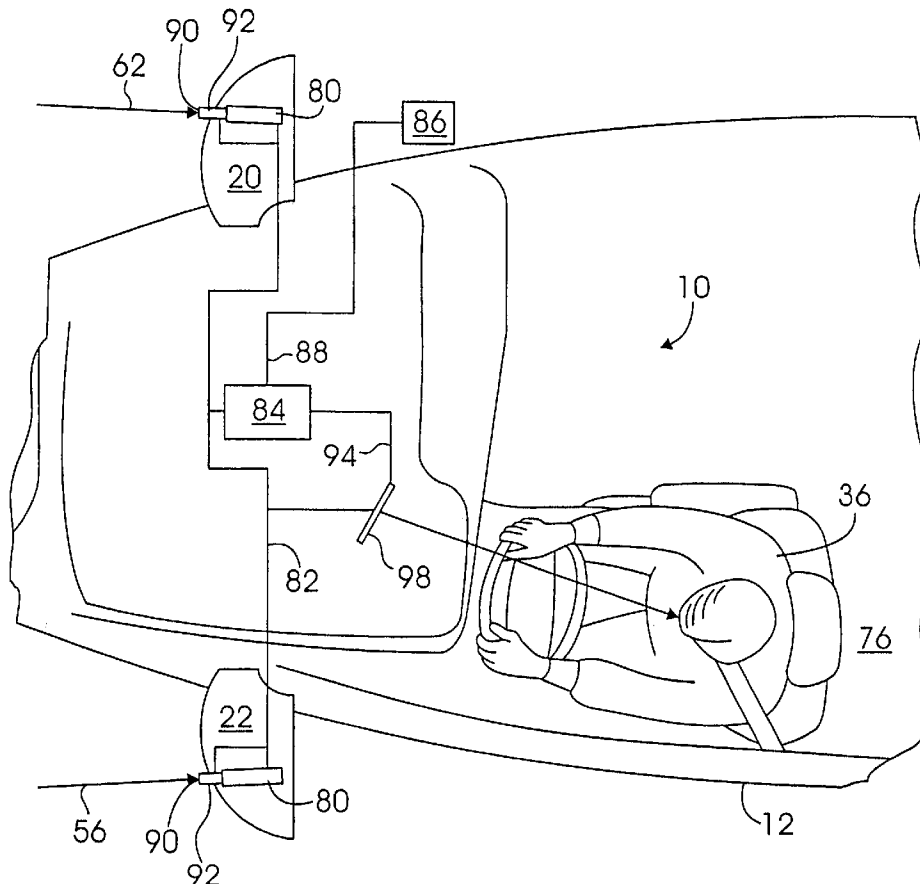
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(57) **ABSTRACT**

A vehicle image acquisition and display assembly **10** which
is deployed within conventional vehicle rear-view mirror
housing or shroud members **20, 22** and which selectively
provides images of areas/regions and/or objects residing
within the front and/or along the side of a vehicle **12**

9 Claims, 6 Drawing Sheets



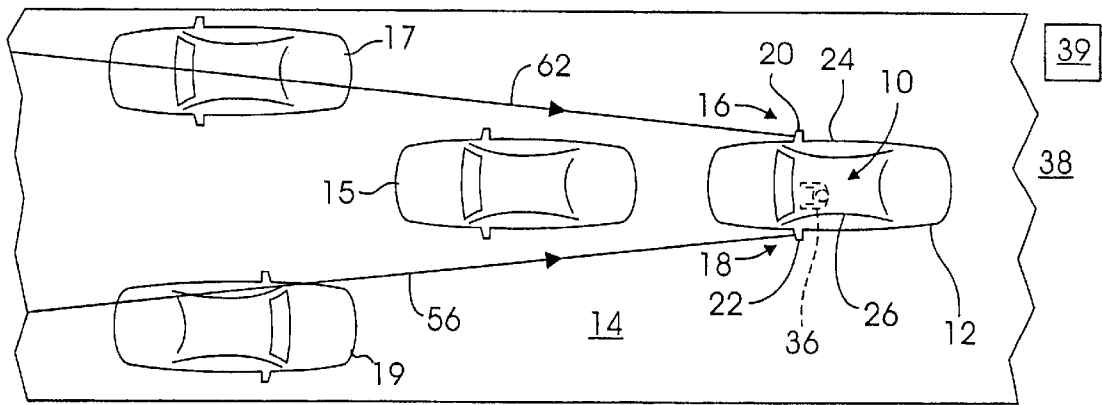


Fig. 1

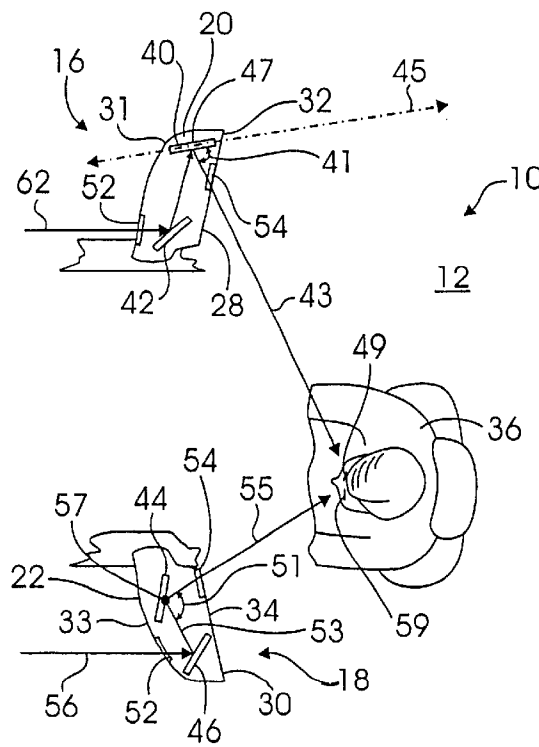


Fig. 2

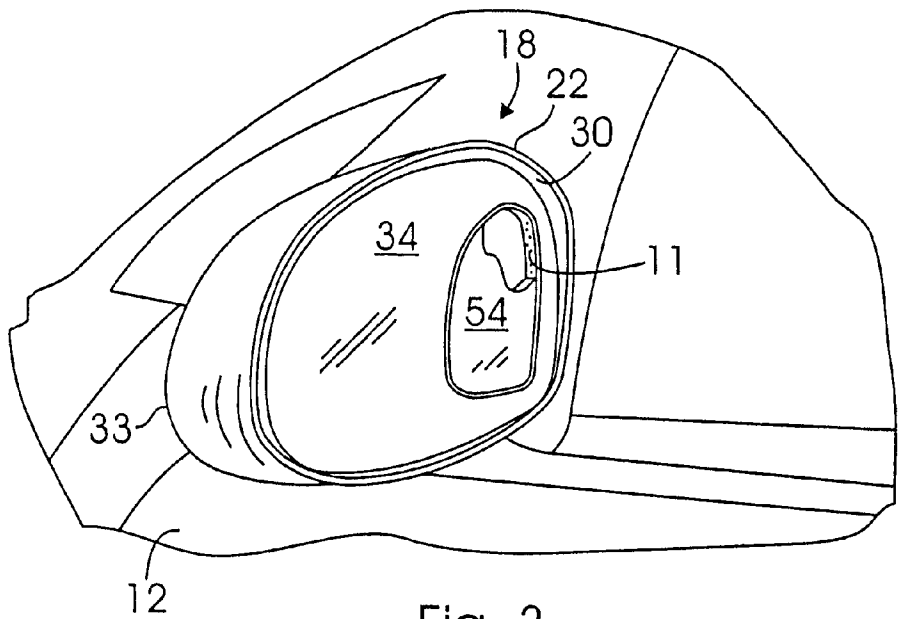


Fig. 3

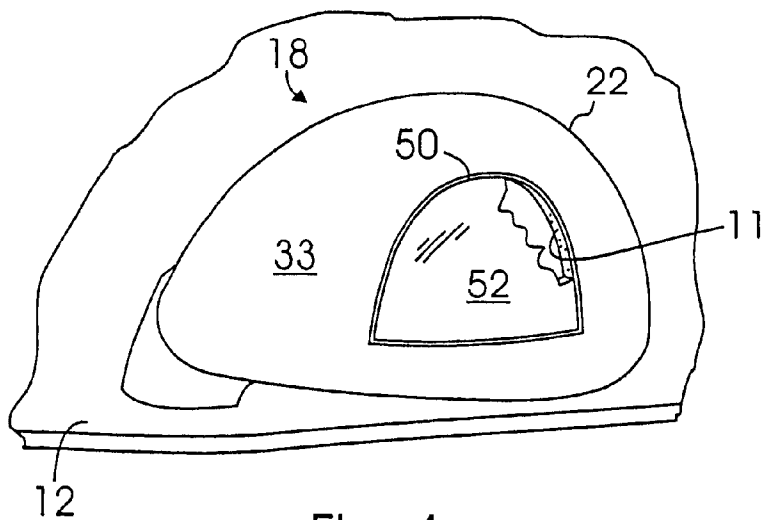


Fig. 4

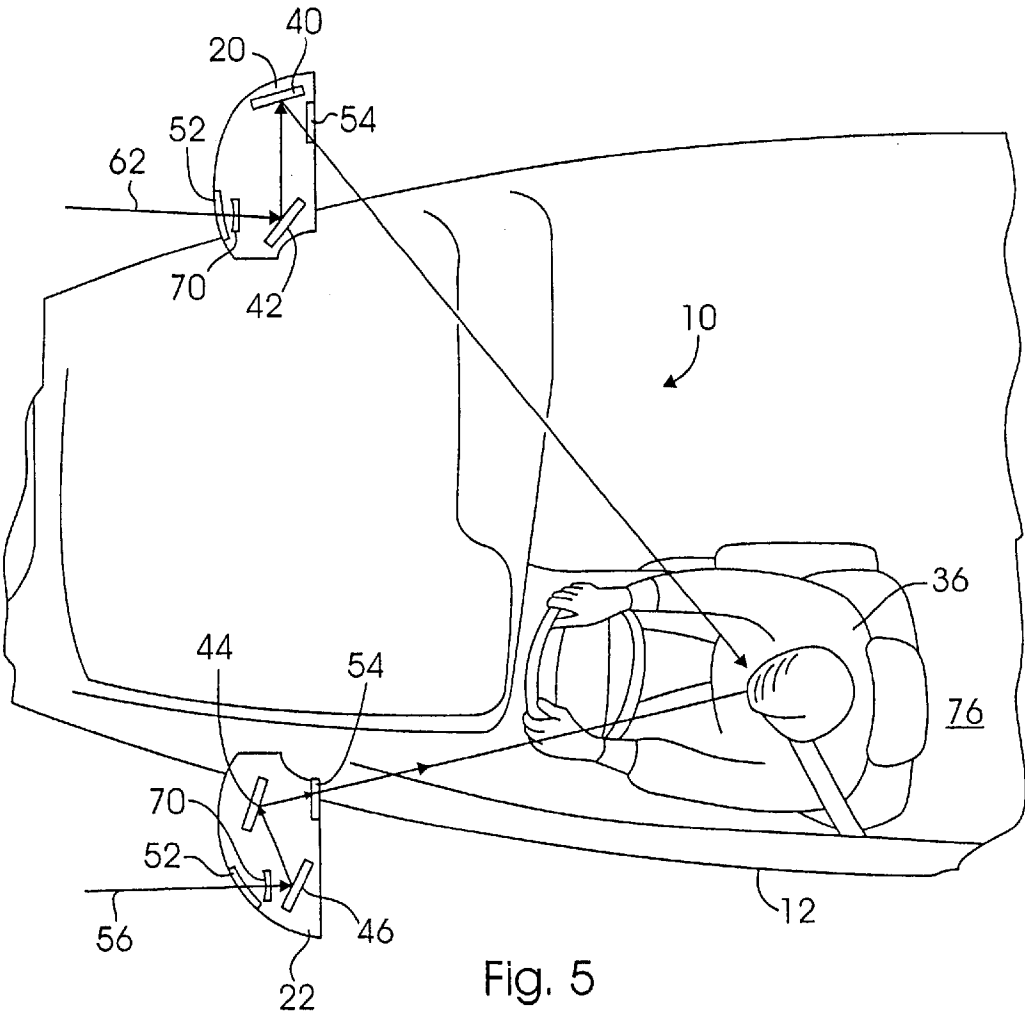
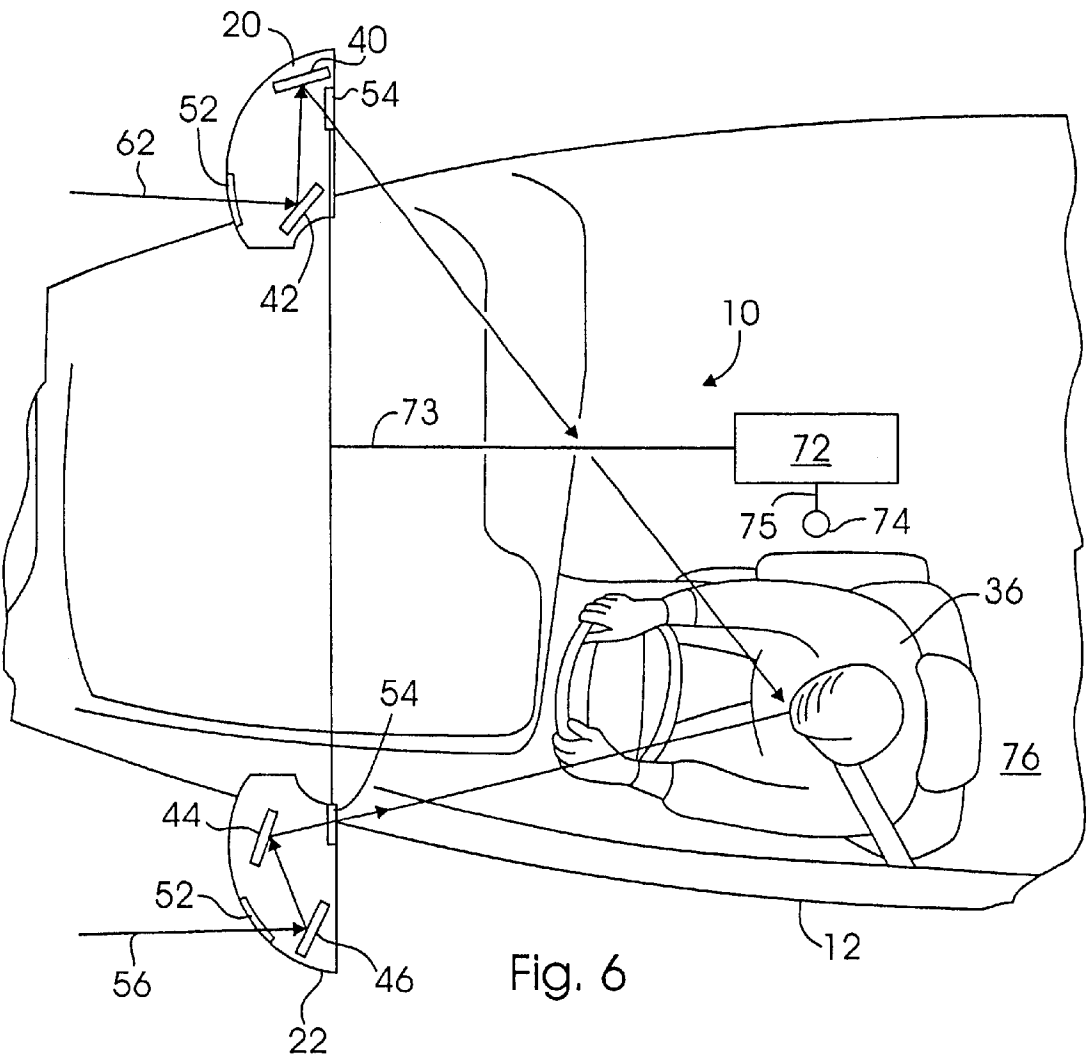


Fig. 5



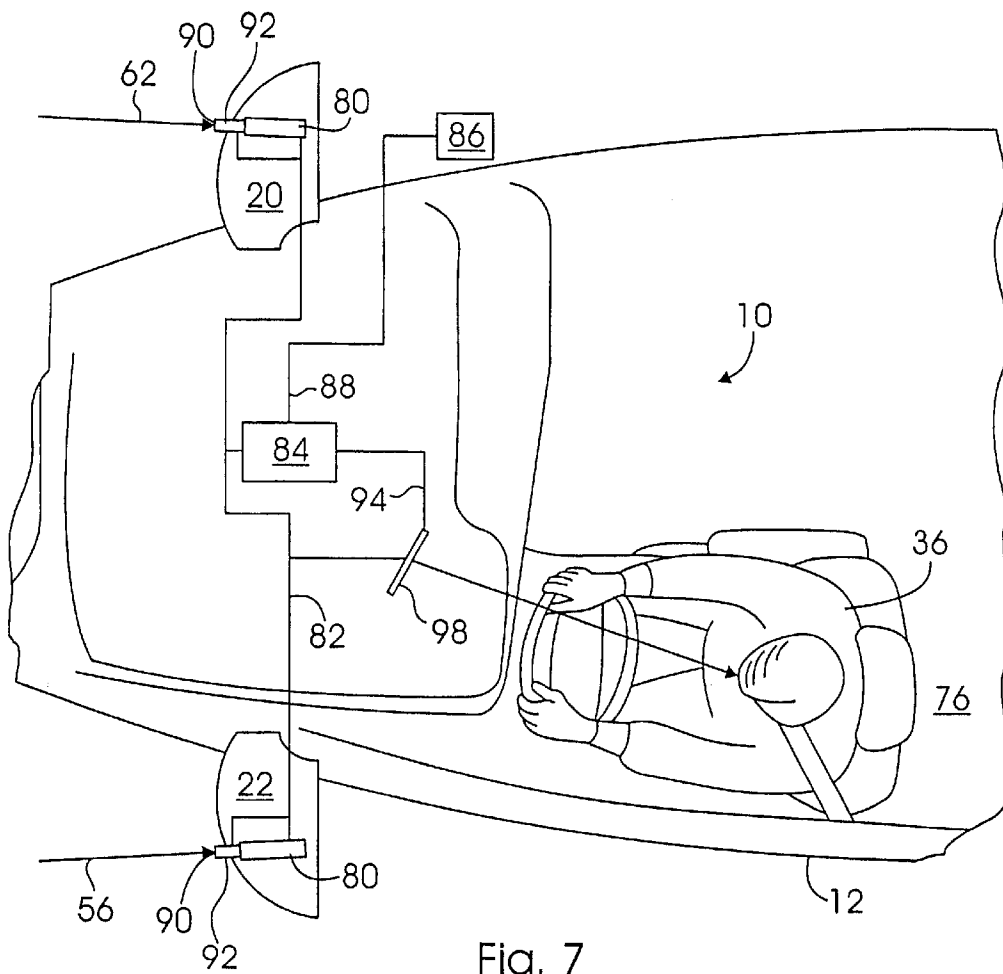


Fig. 7

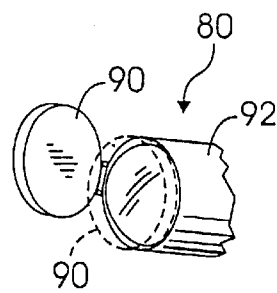


Fig. 8

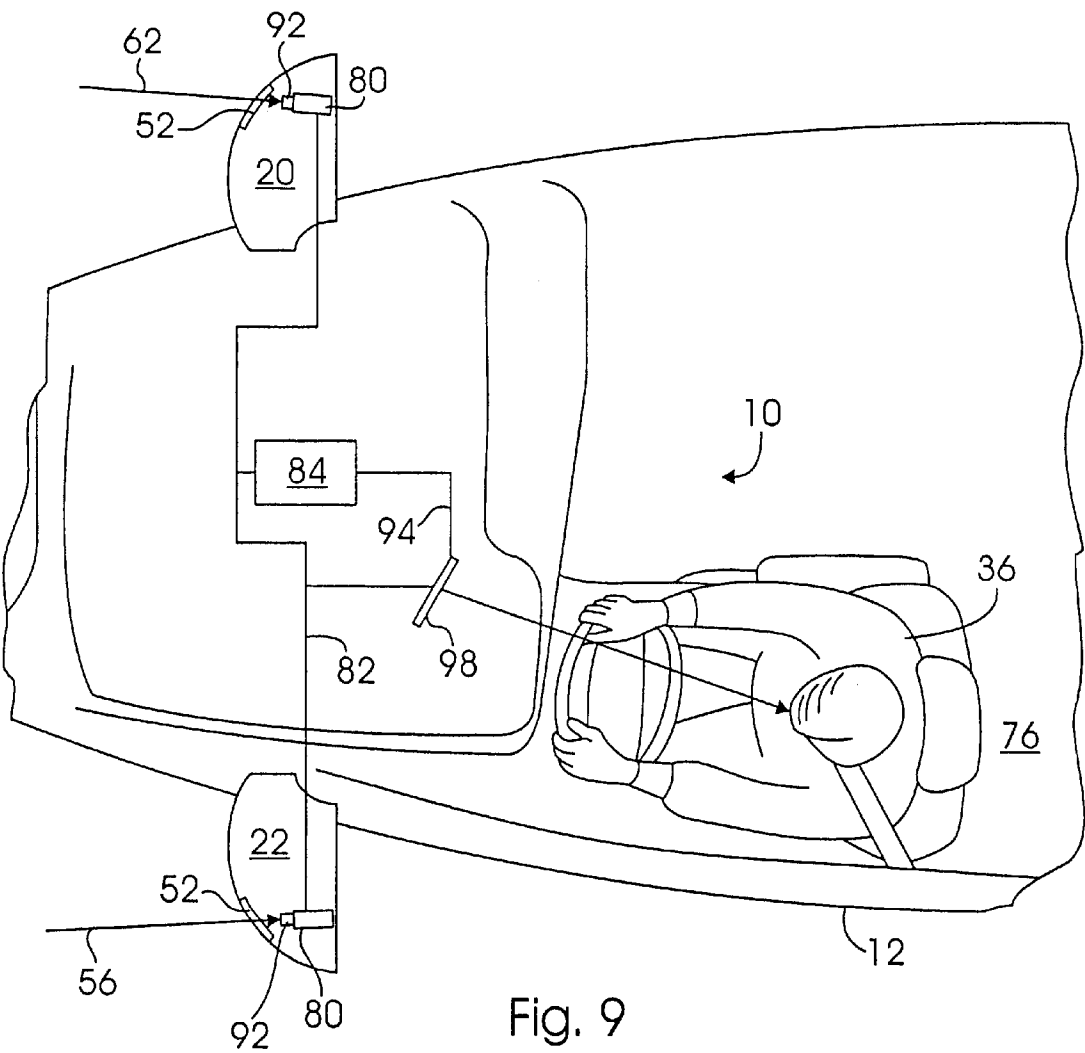


Fig. 9

VEHICLE IMAGE ACQUISITION AND DISPLAY ASSEMBLY

This application is a division of application Ser. No. 09/452,971, filed Dec. 2, 1999 now U.S. Pat. No. 6,250,766. 5

FIELD OF THE INVENTION

This invention relates to a vehicle image acquisition and display assembly and more particularly, to an assembly which captures and provides images of areas and/or objects which are disposed in and/or toward the front and/or the side of a vehicle. 10

BACKGROUND OF THE INVENTION

It may be desirable to allow a user of a vehicle to view certain areas and/or objects which are located or disposed in the front and/or along the side of the vehicle, thereby allowing the user to gain additional images or information over that which is traditionally and/or typically provided by conventional vehicle "rear view" mirrors. This additional information may be useful in the navigation and/or operation of the vehicle. 20

Some attempts have been made to provide images of these frontal and/or side areas and/or objects. Particularly, these attempts include the use of one or more mirrors or image capture devices which are wholly disposed within the passenger compartment of the vehicle, the use of assemblies which are disposed and/or mounted upon the conventional rear-view mirror assemblies or "mirror-containment" members or shrouds, providing an arm or member having several image capture portions or apparatuses and which is selectively extendible from the side of the vehicle, and providing a selectively extendible periscope type assembly which is usually and selectively deployed and/or extended through the roof of the vehicle. While these attempts often provide desired images, they suffer from some drawbacks. 30

For example and without limitation, the assemblies which are wholly deployed within the vehicle and/or within the vehicle passenger compartment are often hidden from view or optically obstructed due to the placement of packages and/or other materials and individuals present in the vehicle. These obstructions substantially prevent these assemblies from properly operating and/or undesirably interfere with their operation. 40

The assemblies which are mounted upon the traditional rear-view mirrors are unaesthetic, frequently and undesirably engage, car wash Components, thereby causing damage to the components and to the vehicle, and present and/or display images having substantially identical display sizes in a "stacked manner" (e.g., the image of the front or side of the vehicle is presented "on top of" or "over" the image of the rear of the vehicle), thereby tending to confuse the driver or the operator of the vehicle and distracting the driver by requiring the driver to tilt his or her head to view the frontal and/or side images and/or requiring the driver to take his or her eyes "off of" the rear images. 50

The selectively extendible assemblies require linkages or members which are selectively extended from the side of the vehicle. These linkages or members require frequent repair or replacement due to the structural degradation that occurs and which is caused by various materials residing within and/or comprising the ambient environment that the vehicle resides within (e.g., road salt). These assemblies, when fully extended, also typically prevent the vehicle from traversing relatively "tight" passages, from traversing in close proximity to pedestrians, bicyclists, and/or other vehicles (e.g., 55

such as when these devices are extended during a left-hand turn maneuver). These assemblies further require that the driver or operator of the vehicle remember to retract these assemblies when travelling in these "tight" passages, near other objects, and/or when making or completing a left-hand turn, or risk incurring substantial damage to the vehicle, causing other structural damage to other objects or vehicles, and/or injuring a pedestrian, bicyclist, or other individual. Further, these extended members undesirably create "drag" which adversely affects the overall performance of the vehicle and which causes the linked members to rotate with respect to each other, thereby potentially destroying the linked connection. 60

Lastly, the periscope approaches were and are of relatively limited use when the vehicle was or is behind a large truck or sports utility vehicle. Due to the proliferation of such relatively large sports utility vehicles, such periscope approaches are becoming even more undesirable. Moreover, such approaches create undesirable "drag" and potentially cause damage if these periscopes are not retracted by the vehicle owner or operator as the vehicle is traversing under a relatively short underpass or traversing a car wash. 65

It may therefore be desirable to provide an image acquisition and display assembly which selectively provides and displays images of areas and/or objects residing within the front and/or within the front and along the side portions of a vehicle and which overcomes the various drawbacks of such prior assemblies.

SUMMARY OF THE INVENTION

It is a first object of the present invention to provide a vehicle image acquisition and display assembly which overcomes some or all of the previously delineated disadvantages of such prior assemblies.

It is a second object of the present invention to provide a vehicle image acquisition and display assembly which overcomes some or all of the previously delineated disadvantages of such prior assemblies and which acquires and displays images of objects and/or regions residing within the front and/or along the side of the vehicle. 40

It is a third object of the present invention to provide a vehicle image acquisition and display assembly which overcomes some or all of the previously delineated disadvantages of such prior assemblies and which acquires and provides a first image of the rear of the vehicle and a second image of the front and/or of the side of the vehicle and which displays the second image substantially alongside the first image. 45

According to a first aspect of the present invention a mirror assembly for use with a vehicle is provided. The mirror assembly includes a generally hollow housing having a first open end portion and a second end portion; a first mirror which is movably disposed within the housing, which substantially covers the open end portion, which is constrained to only move within the housing, and which provides a first image; at least a second mirror which is disposed within the housing; a first member which is disposed within the housing and which is disposed alongside the first mirror; and a second member which is fixedly disposed within the second end portion, which communicates with the mirror assembly and which cooperates with the at least second mirror to provide a second image upon the first member. 50

According to a second aspect of the invention a method is provided for use within a vehicle of the type having a side portion and a rear-view mirror assembly which is disposed upon the side portion and which includes a housing con- 55

taining a mirror. The method is adapted to provide images of an area residing within the front of the vehicle. The method includes the steps of providing an image acquisition assembly; wholly placing the image acquisition assembly within the rear view mirror assembly, effective to capture an image of the portion of the area residing within the front of the vehicle; and providing a display member which is communicatively coupled to the image acquisition assembly, which displays the image, and which abuttingly resides against the mirror, and which is wholly contained within the rear-view mirror assembly.

These and other features, aspects, and advantages of the invention will become apparent from a reading of the following detailed description of the preferred embodiment of the invention and by reference to the following drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top view of a vehicle travelling upon a highway and including the image acquisition and display assembly of the preferred embodiment of the invention;

FIG. 2 is a top view of the driver of the vehicle which is shown in FIG. 1 and the image acquisition and display assembly of the preferred embodiment of the invention;

FIG. 3 is a perspective front view of one portion of the image acquisition and display assembly which is shown in FIGS. 1 and 2;

FIG. 4 is a perspective back view of the portion of the image acquisition and display assembly which is shown in FIG. 3;

FIG. 5 is a top view of an image acquisition and display assembly which is made in accordance with the teachings of a second embodiment of the invention and which is operatively deployed upon and/or within the vehicle shown in FIG. 1;

FIG. 6 is a top view of an image acquisition and display assembly which is made in accordance with the teachings of a third embodiment of the invention and which is operatively deployed upon and/or within the vehicle shown in FIG. 1;

FIG. 7 is a top view of an image acquisition and display assembly which is made in accordance with the teachings of a fourth embodiment of the invention and which is operatively deployed upon and/or within the vehicle of FIG. 1;

FIG. 8 is a perspective side view of the lens of the camera which is shown in FIG. 7; and

FIG. 9 is a top view of an image acquisition and display assembly which is made in accordance with the teachings of a fifth embodiment of the invention and which is operatively deployed upon and/or within the vehicle of FIG. 1.

DETAILED DESCRIPTION OF THE
PREFERRED EMBODIMENT OF THE
INVENTION

Referring now to FIGS. 1-4, there is shown an image acquisition and display assembly 10 which is made in accordance with the teachings of the preferred embodiment of the invention and which is operatively deployed upon and/or within a typical and conventional vehicle 12. As shown, vehicle 12 may selectively traverse or travel upon a convention highway or road 14 which contains other vehicles 15, 17, and 19. The image acquisition and display assembly, referred to as "the assembly" 10, includes first and second image capture/acquisition and display portions 16, 18 which are adapted to be housed and operatively contained within respective and typical or conventional vehicle rear-view mirror shrouds or containment members 20, 22.

Particularly, each shroud or containment member 20, 22 is generally and substantially hollow and is coupled or attached to respective side portions or a door 24, 26 of the vehicle 12. Further, each member 20, 22 has a respective and generally open end portion 28, 30 and a respective and opposed closed end portion and/or contoured opaque surface 31, 33. Each open end portion 28, 30 respectively receives a generally planar mirror 32, 34 which is used by the driver or operator 36 of vehicle 12 to view the area 38 and/or objects 39 which are located to the rear of or behind vehicle 12.

It should be appreciated that although mirrors 32, 34 are movably disposed within respective housings or shroud members 20, 22, they are constrained to only move within such respective housings or members 20, 22. Further, it should be appreciated that the shapes and the sizes of housings or shroud members 20, 22 and mirrors 32, 34 may vary from those shapes and sizes which are shown in the attached figures and that, in one non-limiting embodiment, mirrors 32, 34 comprise typical "rear-view" vehicle mirrors.

In this non-limiting embodiment, portion 16 includes first and second substantially identical, generally planar, and communicating mirrors 40, 42 which are wholly disposed within shroud member 20. Portion 18 similarly includes substantially identical, generally planar, and communicating mirrors 44, 46 which are wholly disposed within shroud member 22. It should be appreciated that mirrors 40, 42, 44, and 46 are substantially identical and may be contained within respective housing/shroud members 20, 22 by the use of conventional fasteners and/or adhesives. Further, in another embodiment of the invention, mirrors 40, 42 are physically connected to the conventional motor (not shown) which selectively moves mirror 32, while mirrors 44, 46 are physically connected to the motor (not shown) which selectively moves mirror 34. In this manner, mirrors 32, 40, 42 are selectively moveable within shroud member 20 but maintain their respective positions, as shown in FIG. 2, and mirrors 34, 44, and 46 are selectively movable within shroud member 22 but maintain their respective positions, as shown in FIG. 2.

In one non-limiting embodiment, an angle 41 exists between axis 43 and axis 45. Particularly, axis 43 lies between the center point 47 of mirror 40 and the right eye 49 of the user or driver 36 of the vehicle 12, when the driver or user 36 is in a seated and upright position and is about six feet tall. Axis 45 is the longitudinal axis of symmetry of mirror 40. In one non-limiting embodiment, the angle 41 has a value of about 70°. Similarly, an angle 51 is formed between axis 53 and axis 55. Particularly, axis 55 lies between the center point 57 of the mirror 44 and the left eye 59 of the user 36 when the user is in a seated and upright position and is about six feet tall. Axis 55 emanates from center point 57 of mirror 44 and forms an angle of about 45° with respect to the longitudinal axis of symmetry of the mirror 44. In one non-limiting embodiment, the angle 51 has a value of about 90°.

As shown best in FIGS. 3 and 4, closed end portion or contoured surface 33 includes or has an aperture 50 over and/or into which a substantially transparent member 52 is removably fixed while maintaining the relatively smooth texture and continuous surface of closed end portion 33. Further, portion 18 includes a substantially transparent member 54 which may be formed within the mirror 34 or disposed and/or placed within shroud member 22 in an abutting, coplanar, or "side by side" relationship to the mirror 34 (e.g., a portion of the mirror 34 is removed and portion 54 is made to substantially and wholly replace the removed portion).

The sizes and shapes of members **52**, **54** may change from those shown in the figures but, in the most preferred embodiment of the invention, the shape of member **54** is dissimilar to the shape of mirror **34** and member **54** is coplanar to the mirror **34**. Hence, the image provided by mirror **34** has a substantially different shape and size than does the image provided by member **54**. In one non-limiting embodiment, members **52** and **54** are each respectively attached to shroud **22** and mirror **34** by use of a conventional and commercially available "glue" or another type of adhesive material **11** which also substantially prevents water or other ambient contaminants from entering the interior portions of members **20**, **22**. It should be realized that portion **16** is substantially similar to portion **18** (e.g., member **20** includes substantially identical members or portions **52**, **54** which have been delineated above).

In operation, light rays **56**, representing images from the left front or left side of the vehicle **12** (e.g., from the front or side of the driver **36**), impinge upon member **52** of portion **18**, are communicated to mirror **46**, are thereafter reflectively communicated to mirror **44**, and then are communicated to the user/operator **36** by use of and/or through member **54**. In this manner, the user/operator **36** of vehicle **12** gains images or information associated with regions/areas and/or objects residing within the front and/or along-side the traveling vehicle **12**. Light rays **62**, representing images from the right front or right side of the vehicle **12** (e.g., from the front or side of the passenger of vehicle **12**), impinge upon member **52** of portion **16** and are communicated to mirrors **42**, **40**, and then are communicated to the user/operator **36** by use of and/or through member **54** of portion **16**. In this manner, the driver/operator **36** gains image information associated with or representing objects residing within and/or alongside the right side of the vehicle **12** (e.g., residing within the front or along the side of the "front seat" passenger position).

In the previously delineated manner, the driver/operator **36** gains information concerning the front and/or the frontal side portions of the vehicle **12** and the information is presented in a "side by side" or coplanar format relative to the information provided by the rear-view mirrors **32**, **34**, thereby allowing the user/operator/driver **36** to quickly obtain all of the information which is desired to be viewed, without requiring the driver **36** to tilt or move his or her head or eyes or to otherwise be undesirably distracted (e.g., the frontal/side and rear images may be concomitantly viewed by the driver **36**). Further, the use of dissimilar shapes and sizes of the displayed substantially coplanar images (e.g., the "rear views" images are substantially longer and of a different shape than the frontal/side view images) also reduces operator or driver confusion.

In an alternative embodiment of the invention, as best shown in FIG. **5**, a concave lens **70** is placed in each of the shroud members **20**, **22**. Particularly, each of the concave lenses **70** are adapted to receive a unique one of the light rays **56**, **62** and to respectively communicate the captured image data to a unique one of the mirrors **42**, **46**. The use of such concave lenses **70** allows the provided frontal and/or side images to be relatively well-defined and substantially undistorted. The concave lenses **70** may, in yet another non-limiting embodiment of the invention, be alternatively adapted to each receive image data emanating from a unique one of the mirrors **42**, **44** and to communicate the received image data to the user or operator **36** through a unique one of the members or portions **54**. Each lens **70** may also be coupled to a unique one of the motors which respectively allow the mirrors **32**, **40**, **42** and the mirrors **34**, **44**, **46** to

move, thereby substantially ensuring the maintenance of the relative and respective positions of each of the lenses **70** with respect to the mirrors **32**, **40**, **42** and to the mirrors **34**, **44**, and **46**. Further, it should be appreciated that shroud members **20**, **22** may include other types of image acquisition and display assemblies other than those which have been described.

In yet another non-limiting embodiment of the invention which is best shown in the FIG. **6**, portions **54** each comprise and/or are formed from an electrochromic material. In this non-limiting embodiment, assembly **10** includes a controller **72** which is operable under stored program control and which is electrically and physically coupled to portions **54** by bus **73**. A switch **74** is selectively placed within the passenger compartment **76** of the vehicle **12** and is physically and electrically coupled to the controller **72** by bus **75**. In this manner, the user/operator **36**, by a depression or activation of switch **74**, causes the controller **72** to generate an electrical signal, upon bus **73**, which selectively causes each of the portions **54** to become opaque or to provide frontal and/or side type images in the previously delineated manner. In this manner, the user/operator **36** may select the type of images which are desired to be viewed and, more particularly, may manually prevent frontal and/or side type image data from being presented upon each of the portions **54** during times when such images are not needed.

Yet another alternate embodiment of the invention is shown in FIGS. **7** and **8**. In this alternate embodiment, assembly **10** includes a camera **80** which is placed within each of the shroud members **20**, **22** and which is directed to the front of the vehicle. The cameras **80**, by use of bus **82**, are physically and electrically coupled to a controller **84** which operates under stored program control and which resides within vehicle **12**. Moreover, assembly **10**, in this alternate embodiment of the invention, includes one or more sensors **86**, such as a temperature or precipitation type sensor, which are physically and electrically coupled to the controller **84** by use of bus **88**. Further, as shown best in FIG. **8**, each camera **80** includes a selectively movable member **90** and a motor (not shown) which allows member **90** to be movable, in response to a signal emanating from controller **84** and placed on bus **82**. Particularly, member **90** is selectively movable from a first position in which the member **90** protectably overlays the camera lens **92** (shown in phantom in FIG. **8**), to a second remote position in which the camera lens **92** is uncovered and operable.

In this manner, controller **84** may protect lens **92** by causing member **90** to overlay lens **92** when sensor(s) **86** detects precipitation, weather, and/or other ambient conditions and/or materials which may damage the lens **92**. This arrangement also allows the lens **92** to be protected when camera **80** is not in use. Assembly **10** also includes a display assembly **98** (such as a conventional "heads up" display) which is disposed within the passenger compartment **76** of the vehicle **12** and which is communicatively and physically coupled to the cameras **80** and to the controller **84** by respective busses **82** and **94**. In this manner, cameras **80** cooperatively provide frontal and/or side images to the display **92** unless the controller **84** deactivates the cameras **80**. In another alternate embodiment, each camera **80** may be wholly disposed within a unique one of the shroud members **20**, **22**, as shown best by FIG. **9**, and each respective lens **92** is operatively deployed behind a unique one of the members **52**.

It is understood that the invention is not to be limited to the exact construction and method which has been previously described, but that various changes may be made without departing from the spirit and the scope of the invention.

Moreover, it should be appreciated that by placement of the image acquisition and display portions 16, 18 within conventional rear-view mirror shrouds 20, 22, an overall aesthetically pleasing appearance and protection from degradation caused by the ambient environment is provided. Further, assembly 10 obviates the need for the vehicle operator/user 36 to remember to retract the assembly 10 when the vehicle 12 enters a car wash, low overpass, or a “tight” passage, and substantially prevents the formation of undesirable drag. Further, assembly 10 provides images of the rear and the front/side of the vehicle in a substantially co-planar, abutting, “side by side” format and further provides for each of the displayed images to be of a different size, thereby further reducing operator confusion. The placement of the image acquisition and display portions 16, 18 within members 20, 22 also substantially prevent interference with the operation of assembly 10 by packages and/or individuals residing within vehicle 12. Hence, assembly 10 provides many advantages over prior vehicle image acquisition and display assemblies.

What is claimed is:

1. A viewing assembly for use with a vehicle, said viewing assembly comprising:

- a housing having a rear portion, a front portion opposite to said rear portion, and a reflective member disposed upon the front portion of the housing, said reflective member being positioned to present an image of an object located behind said vehicle;
- a camera which is contained within said housing, which has an image capturing portion which protrudes from said rear portion of said housing, said image capturing portion being effective to capture a certain image of a second object located in front of and alongside said vehicle and to provide said captured image and wherein said second object is not viewable by a driver of said vehicle when said captured image of said second object is initially captured by said camera; and
- a display which is disposed within said vehicle, which receives said captured image, and which displays said captured image within said vehicle.

2. The viewing assembly of claim 1 further comprising a member which is movably coupled to said camera.

3. The viewing assembly of claim 2 further comprising a controller which is coupled to said member and which causes said member to selectively move from an open to a closed position in which said member overlays said image capturing portion.

4. The viewing assembly of claim 3 wherein said controller senses the presence of precipitation and, upon said sensed presence of precipitation, causes said member to move to said closed position.

5. A viewing assembly for use with a vehicle, said viewing assembly comprising:

a housing having a rear portion and a front portion opposite to said rear portion and further having a reflective member which is disposed upon the front portion, said reflective member being positioned to present an image of an object located behind said vehicle, said housing further having a transparent member positioned upon said rear portion;

- a camera which is wholly contained within said housing and which has an image capturing portion which communicates with said transparent member, said image capturing portion being effective to capture a certain image of a second object located in front of and alongside said vehicle and to provide said captured image and wherein said second object is not viewable by a driver of said vehicle when said image of said second object is initially captured by said camera; and
- a display which is disposed within said vehicle, which receives said captured image, and which displays said captured image within said vehicle.

6. A viewing assembly for use with a vehicle, said viewing assembly comprising:

- a housing having a rear portion and a front portion opposite to said rear portion and further having a reflective member which is disposed upon said front portion, said reflective member being positioned to present an image of an object located behind said vehicle, said housing further having an opening within said rear portion;
- a camera which is wholly contained within said housing and which has an image capturing portion which is effective to capture and provide a certain image of a second object located in front of and alongside said vehicle by use of said opening, wherein said second object is not viewable by a driver of said vehicle when said image of said second object is initially captured by said camera; and
- a display which is disposed within said vehicle, which receives said captured image, and which displays said captured image within said vehicle.

7. The viewing assembly of claim 6 further comprising a member which is movably coupled to said camera.

8. The viewing assembly of claim 7 further comprising a controller which is coupled to said member and which causes said member to selectively move from an open to a closed position in which said member overlays said image capturing portion.

9. The viewing assembly of claim 8 wherein said controller senses the presence of precipitation and, upon said sensed presence of precipitation, causes said member to move to said closed position.

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