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(12) **United States Patent**
Schofield et al.

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(45) **Date of Patent: May 19, 2009**

(54) **VEHICLE ACCESSORY MODULE**

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(73) Assignee: **Donnelly Corp.**, Holland, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/716,834**

(22) Filed: **Mar. 12, 2007**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Continuation of application No. 10/958,087, filed on Oct. 4, 2004, now Pat. No. 7,188,963, which is a division of application No. 10/355,454, filed on Jan. 31, 2003, now Pat. No. 6,824,281.

(60) Provisional application No. 60/420,560, filed on Oct. 23, 2002, provisional application No. 60/398,346, filed on Jul. 24, 2002, provisional application No. 60/381,314, filed on May 17, 2002, provisional application No. 60/374,724, filed on Apr. 23, 2002, provisional application No. 60/364,008, filed on Mar. 14, 2002, provisional application No. 60/350,965, filed on Jan. 31, 2002.

(51) **Int. Cl.**

G02B 7/18	(2006.01)
G02B 7/182	(2006.01)
H04N 7/00	(2006.01)
H04N 7/18	(2006.01)

(52) **U.S. Cl.** **359/844**; 359/872; 348/118

(58) **Field of Classification Search** 359/844, 359/871, 872; 348/118
See application file for complete search history.

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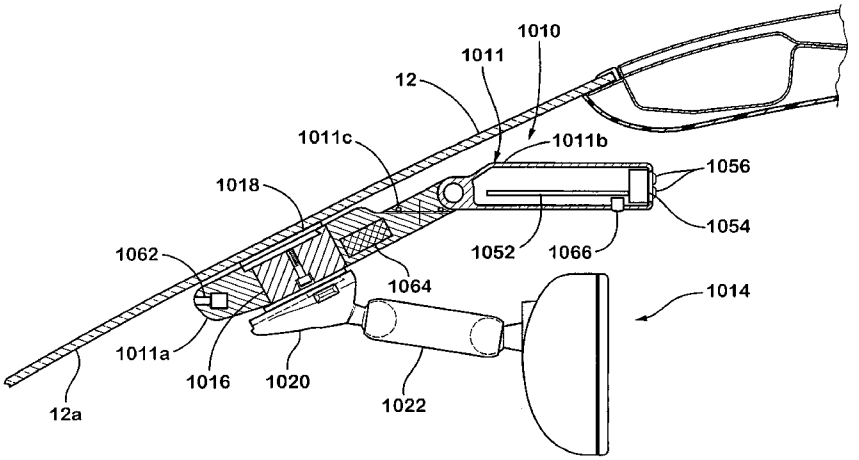
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(57) **ABSTRACT**

An accessory system for a vehicle includes an accessory module, at least one accessory and an attachment member at an interior surface of a vehicle windshield. The at least one accessory comprises a camera having a lens, with the camera being disposed in the accessory module, and the accessory module comprising structure to angle the camera with respect to a windshield facing portion of the accessory module. The camera has a forward field of view through the vehicle windshield when the accessory module is mounted to the attachment member. The accessory system may include a resilient element disposed between the windshield facing portion and the interior surface of the vehicle windshield to cushion and/or seal the accessory module relative to the interior surface when the accessory module is mounted to the attachment member at the interior surface of the vehicle windshield.

10 Claims, 63 Drawing Sheets



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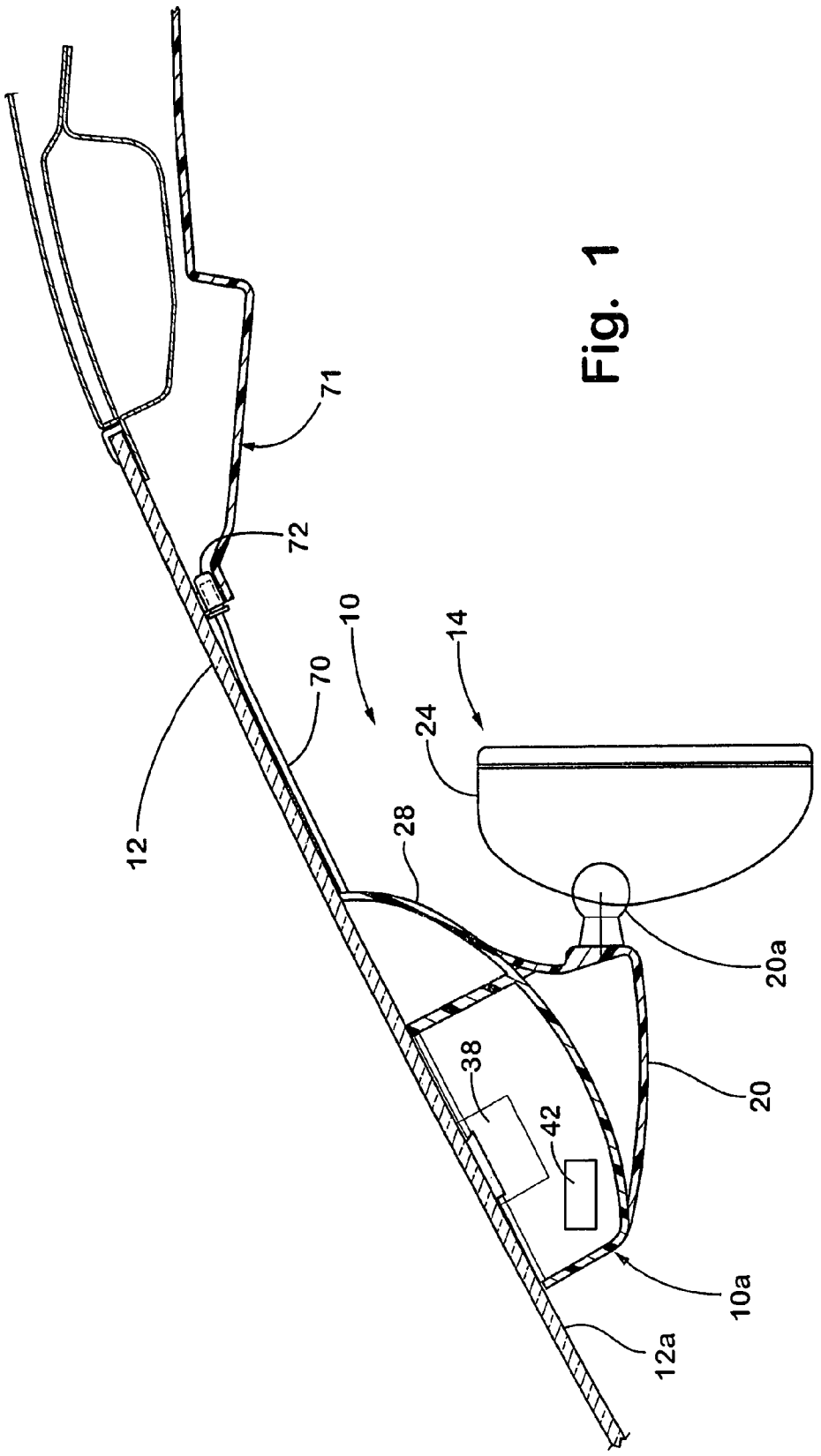


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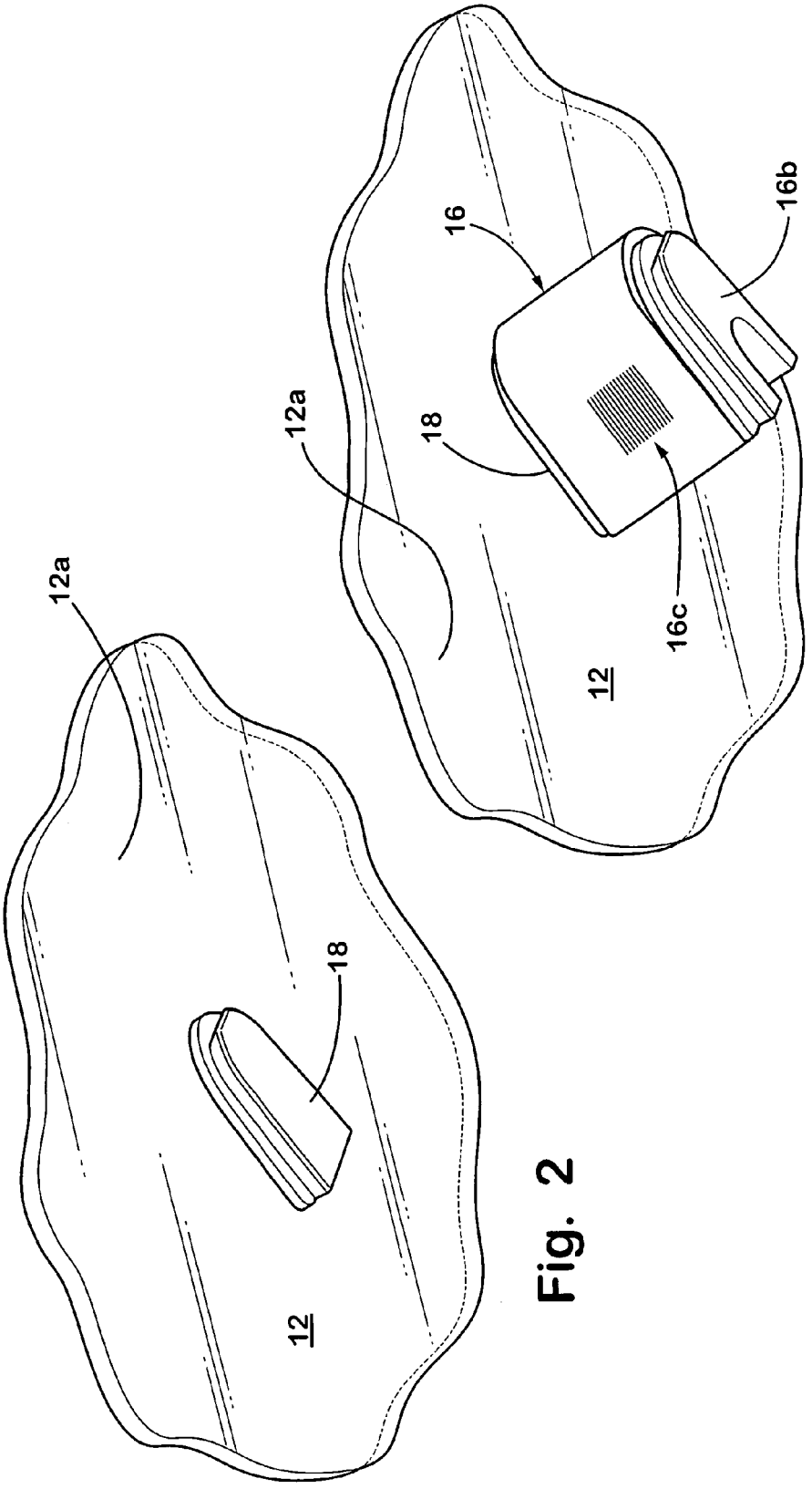


Fig. 2

Fig. 3

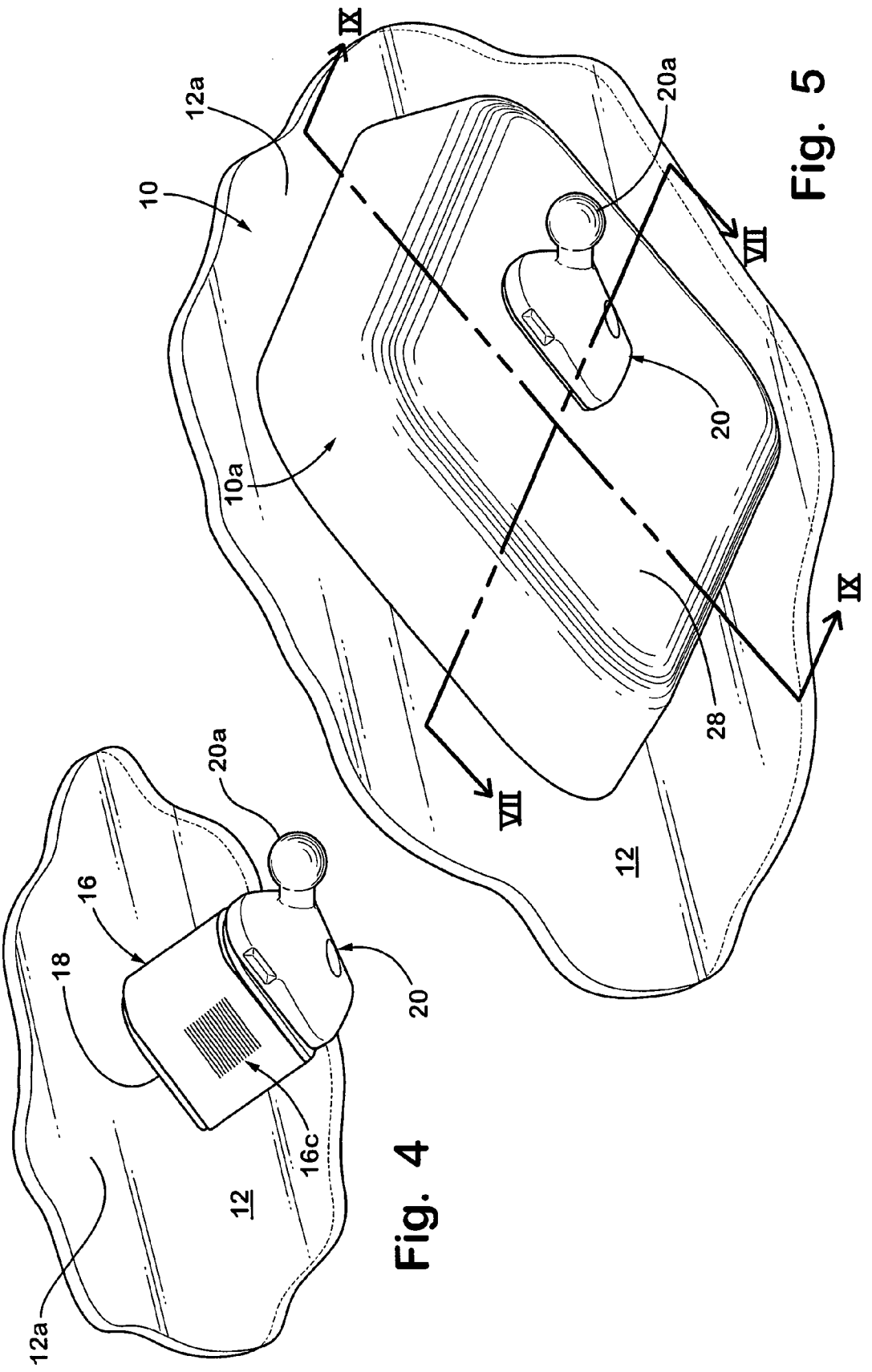


Fig. 5

Fig. 4

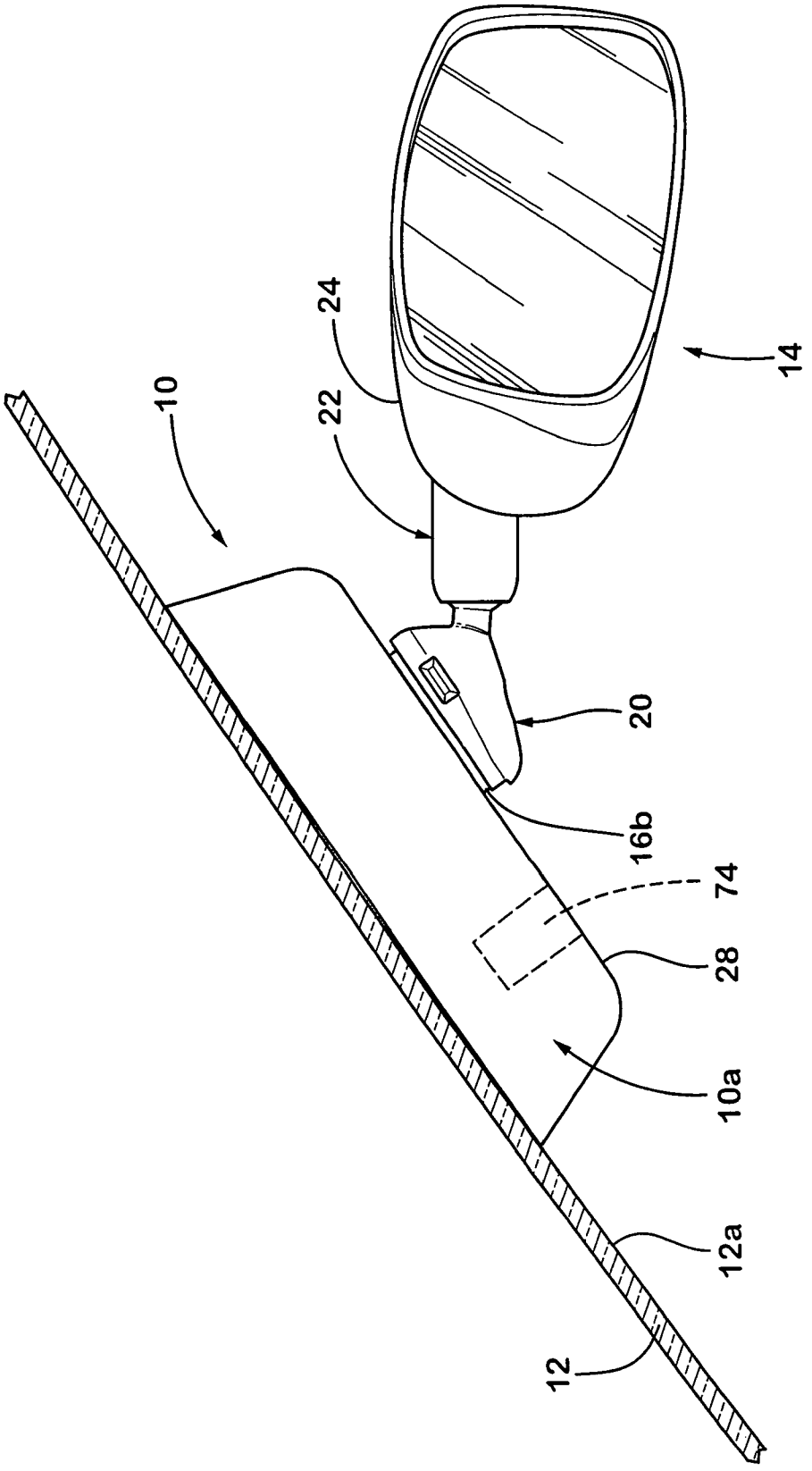


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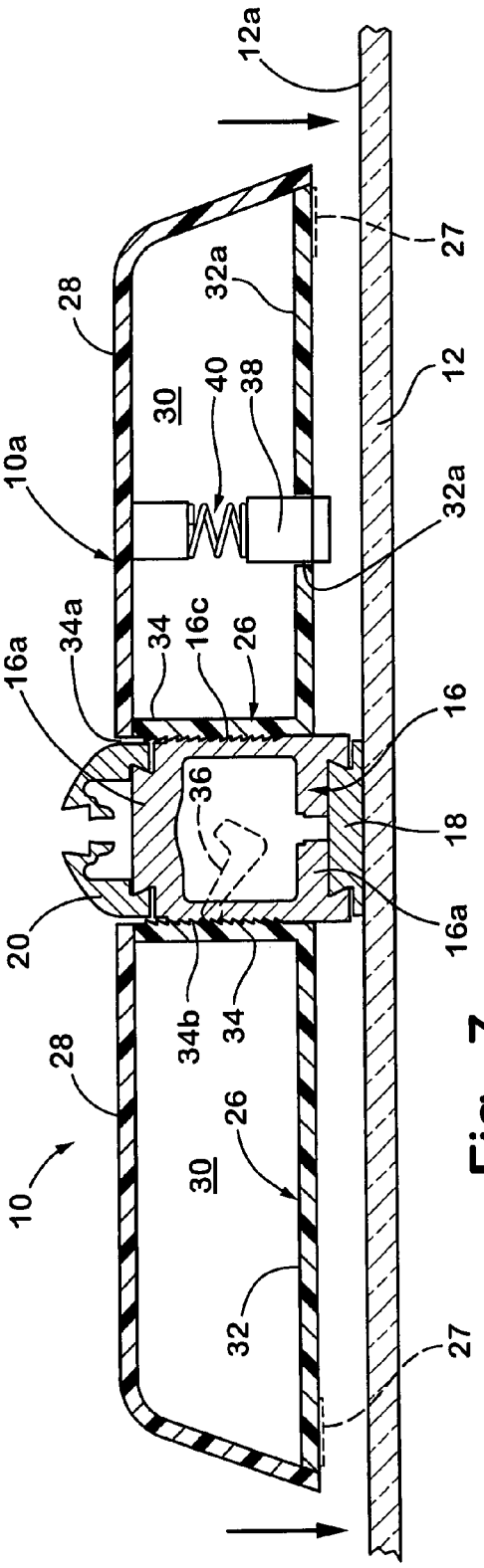

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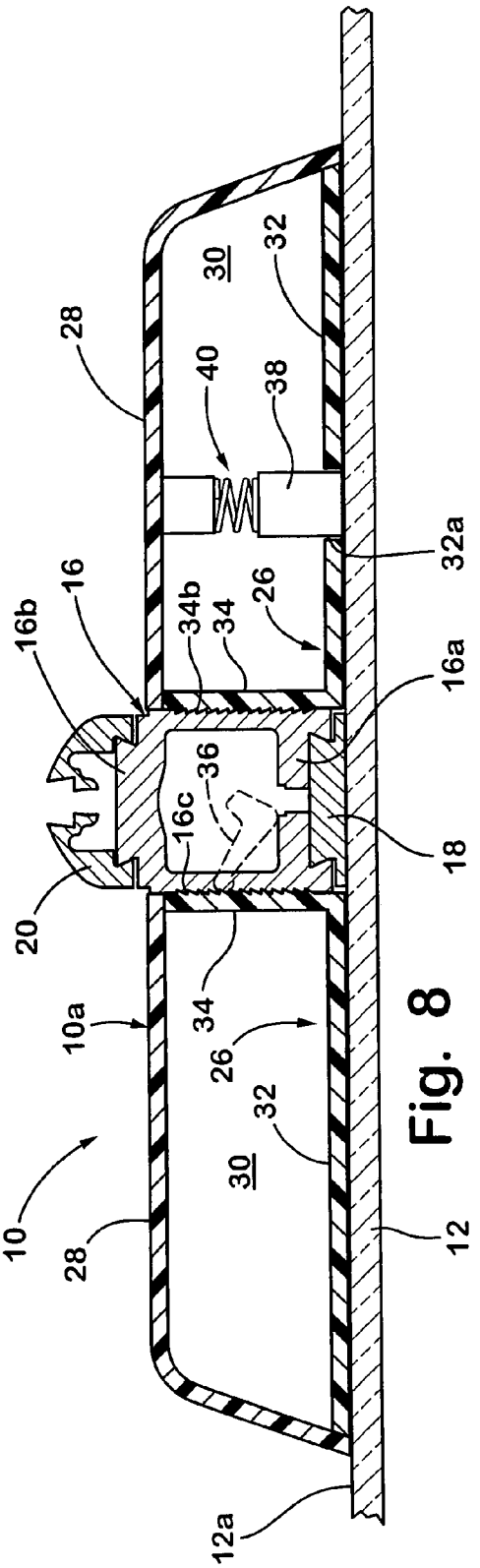

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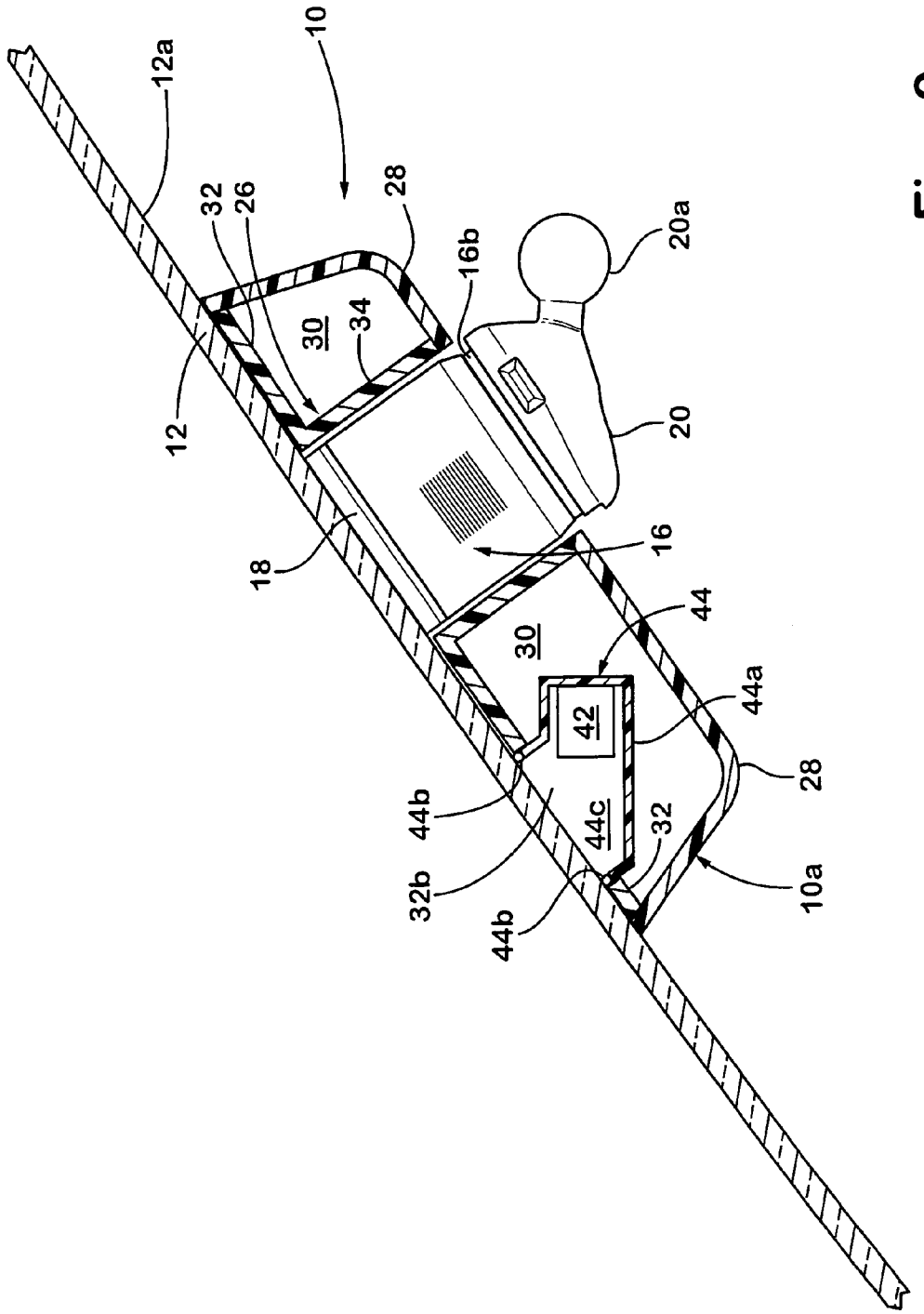

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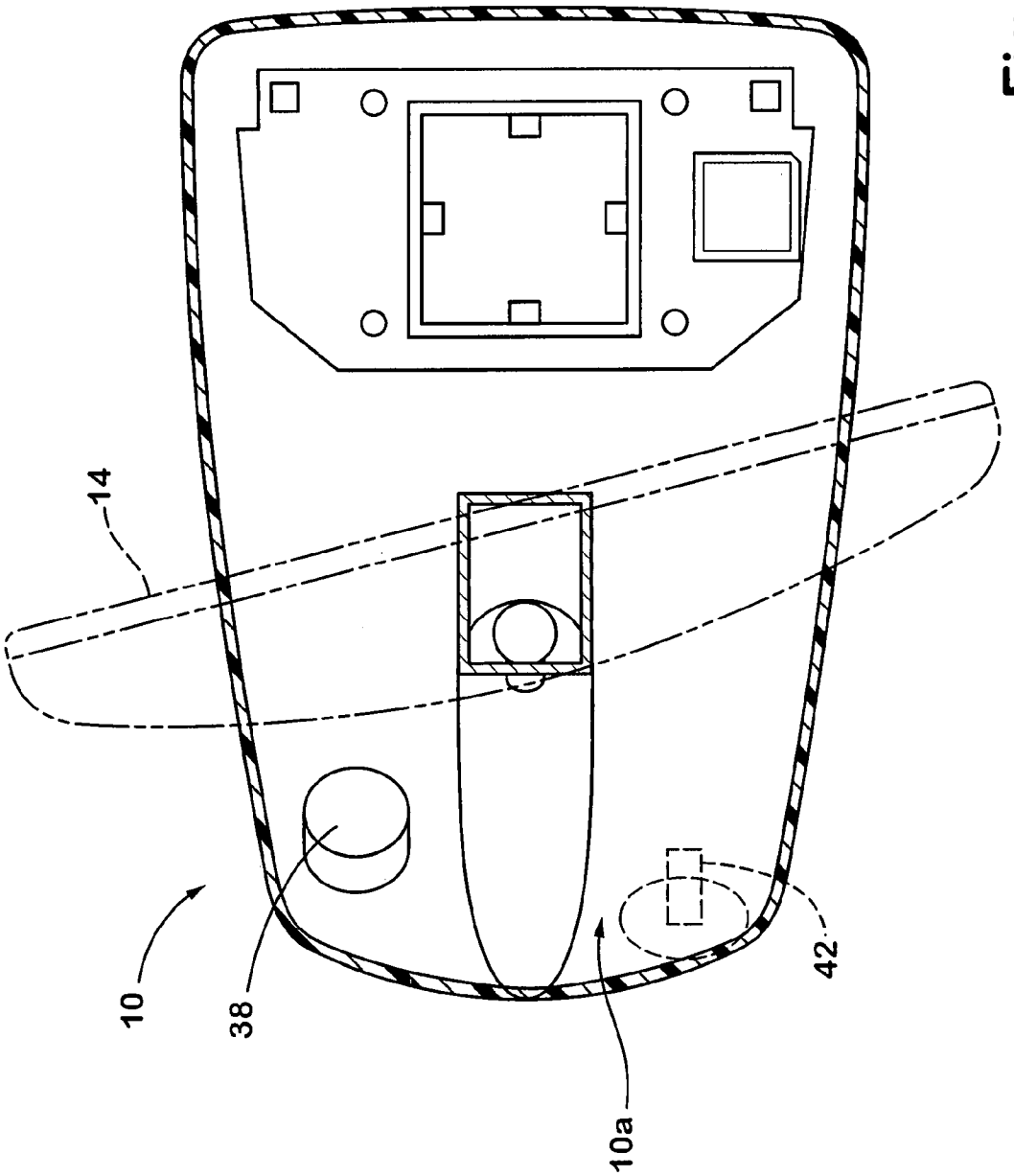


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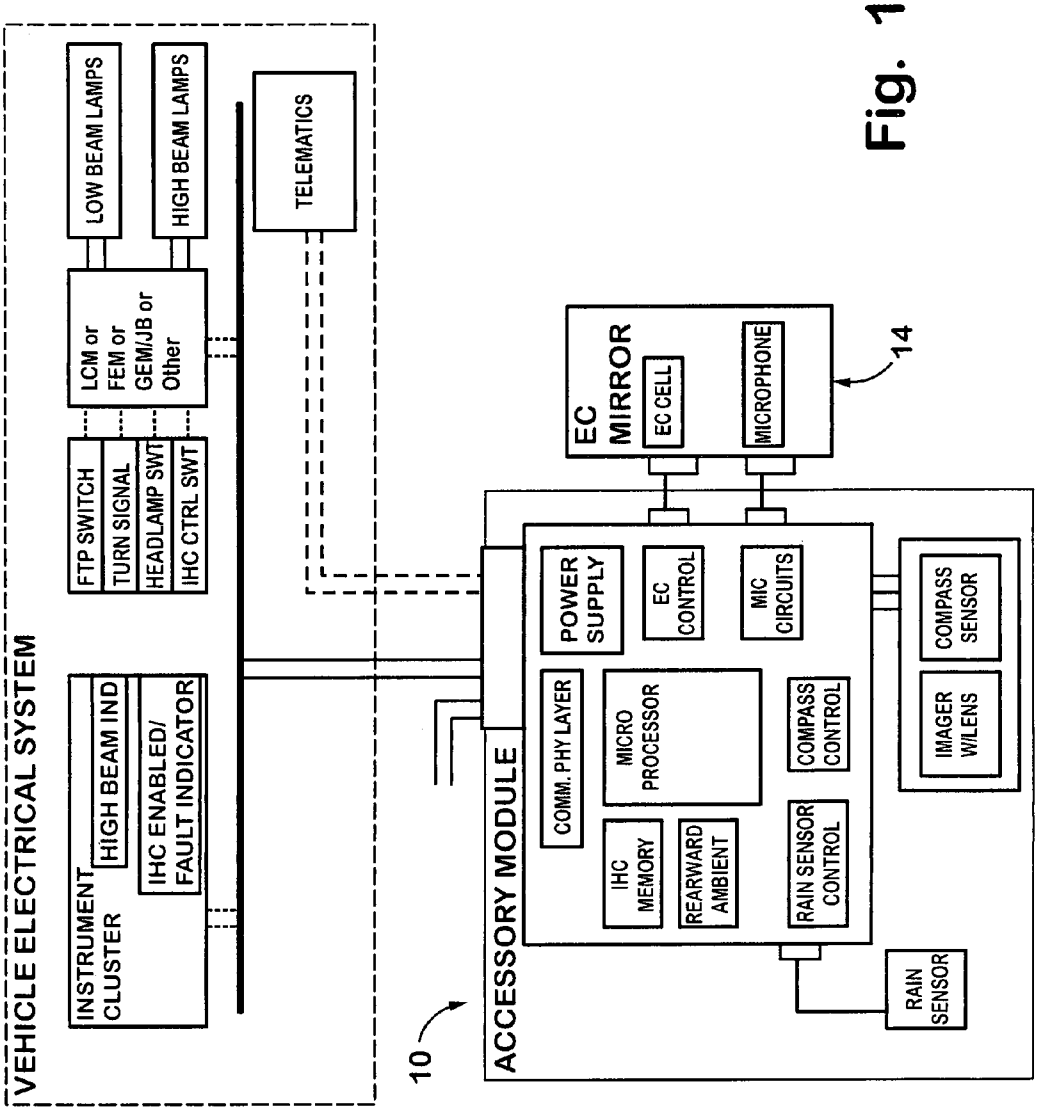

VEHICLE ELECTRICAL SYSTEM
INSTRUMENT CLUSTER
HIGH BEAM IND
IHC ENABLED/ FAULT INDICATOR
FTP SWITCH
TURN SIGNAL
HEADLAMP SWT
IHC CTRL SWT
LCM or FEM or GEM/JB or Other
LOW BEAM LAMPS
HIGH BEAM LAMPS
TELEMATICS
10
ACCESSORY MODULE
POWER SUPPLY
EC CONTROL
MIC CIRCUITS
COMM. PHY LAYER
MICRO PROCESSOR
IHC MEMORY
REARWARD AMBIENT
COMPASS CONTROL
RAIN SENSOR CONTROL
COMPASS SENSOR
IMAGER WILENS
RAIN SENSOR
EC MIRROR
EC CELL
MICROPHONE
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Fig. 11

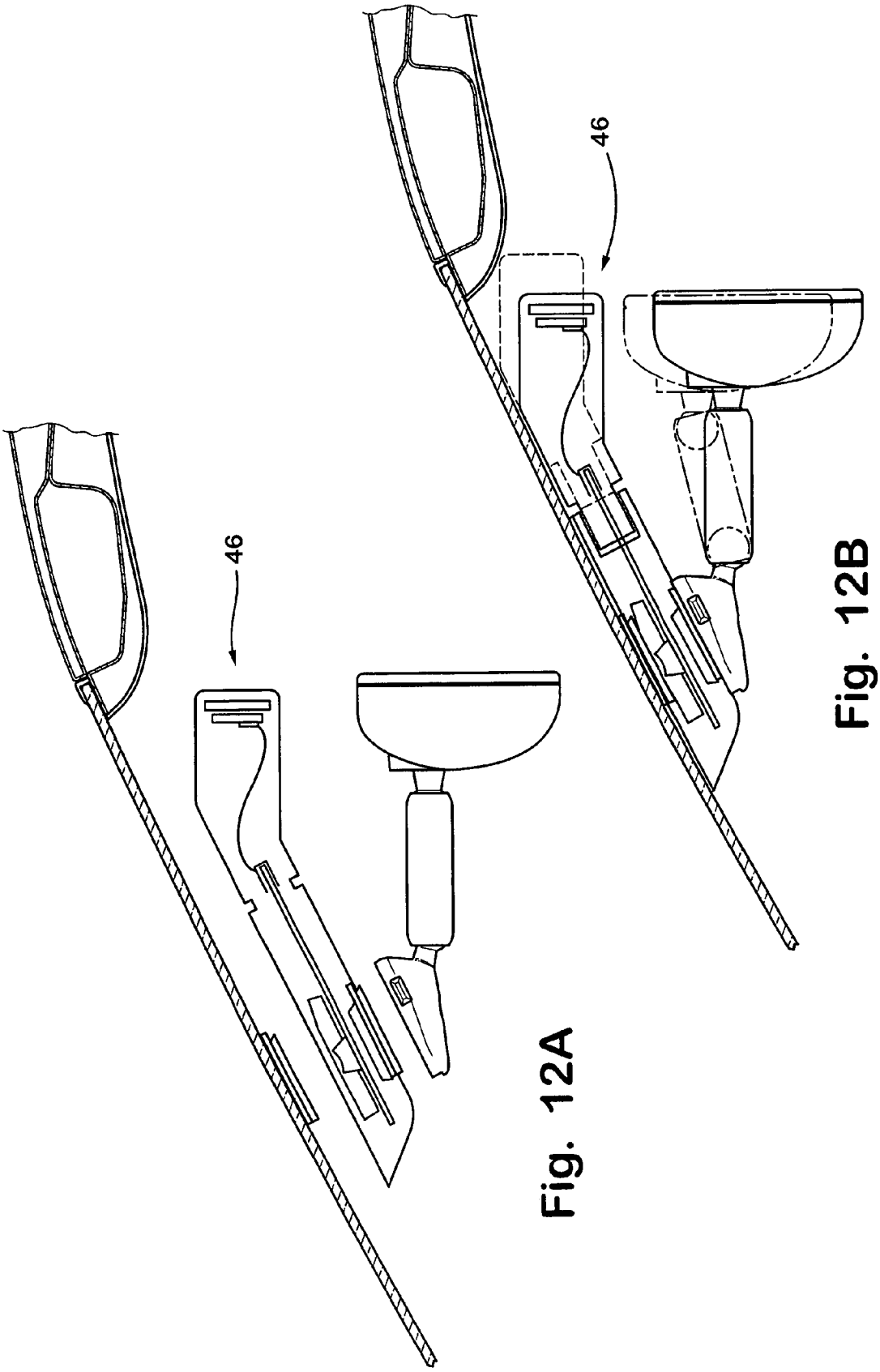


Fig. 12A

Fig. 12B

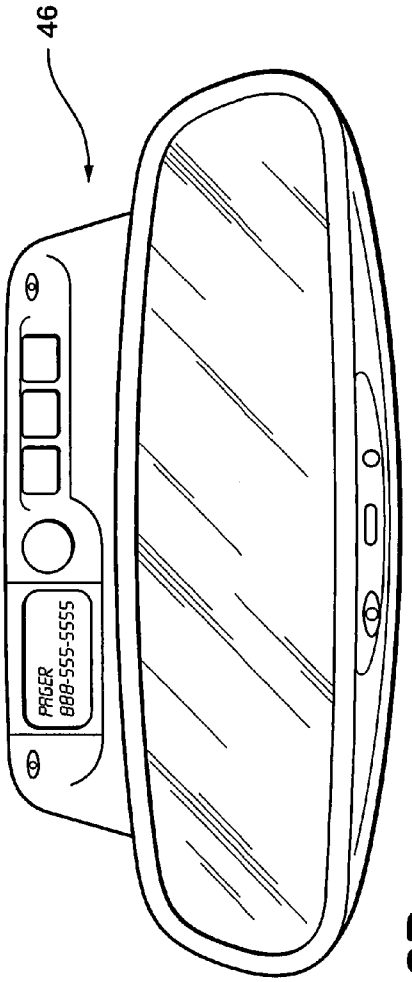


Fig. 12D

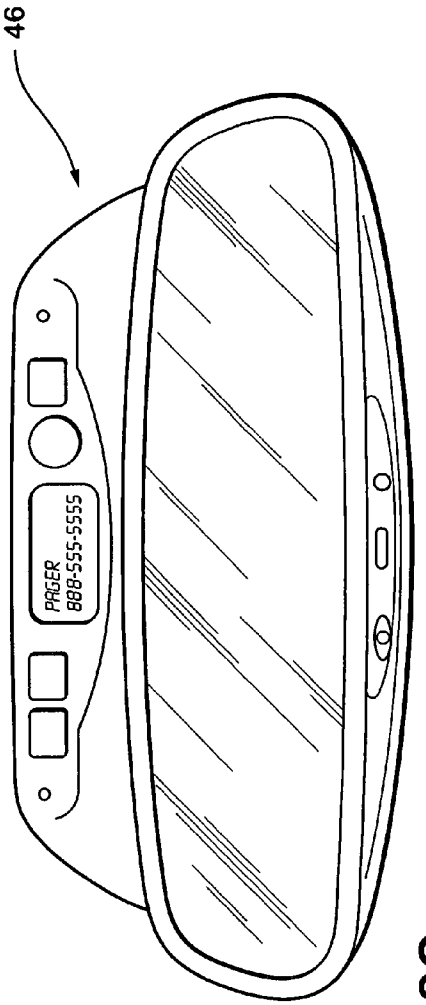


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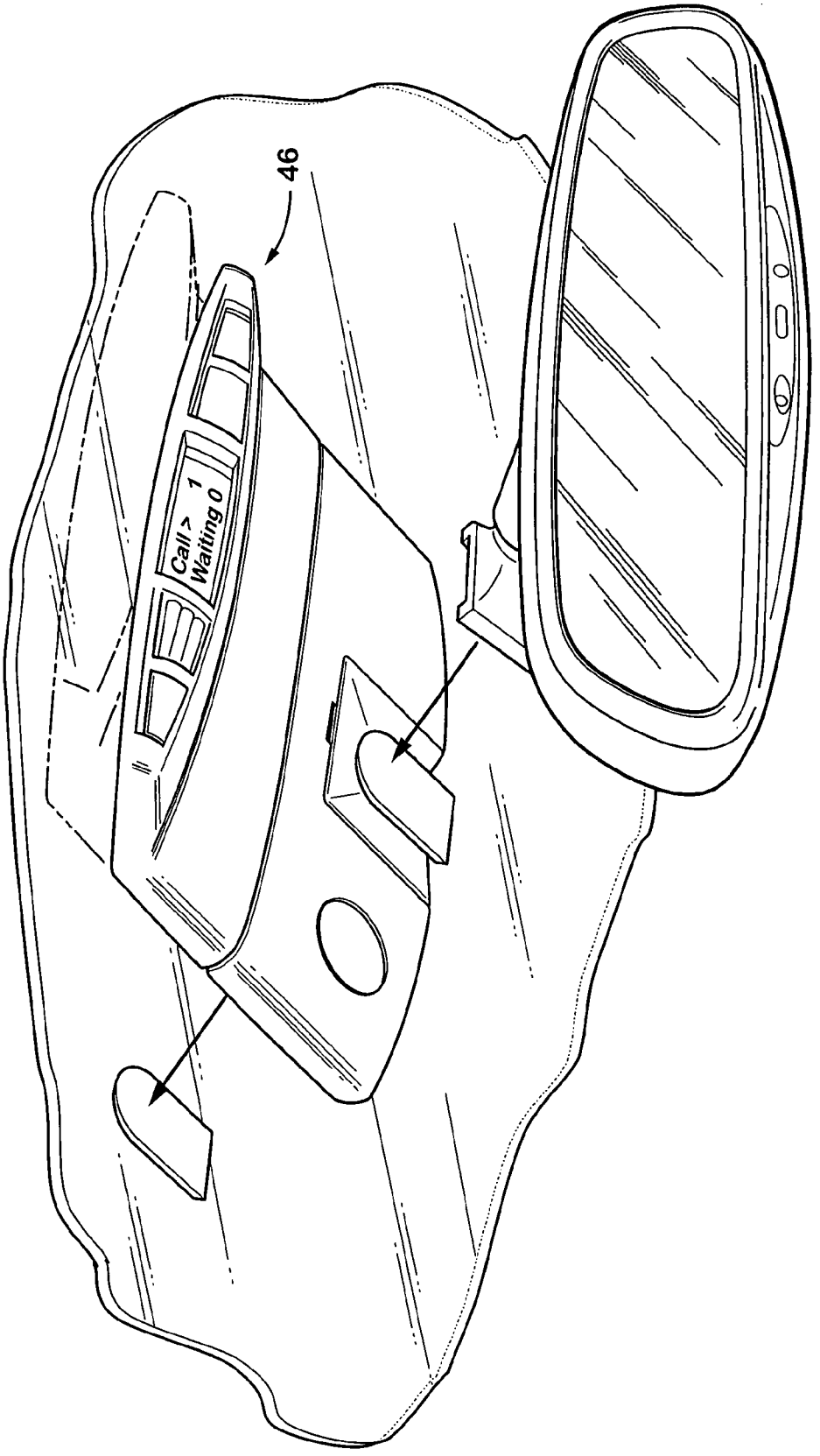


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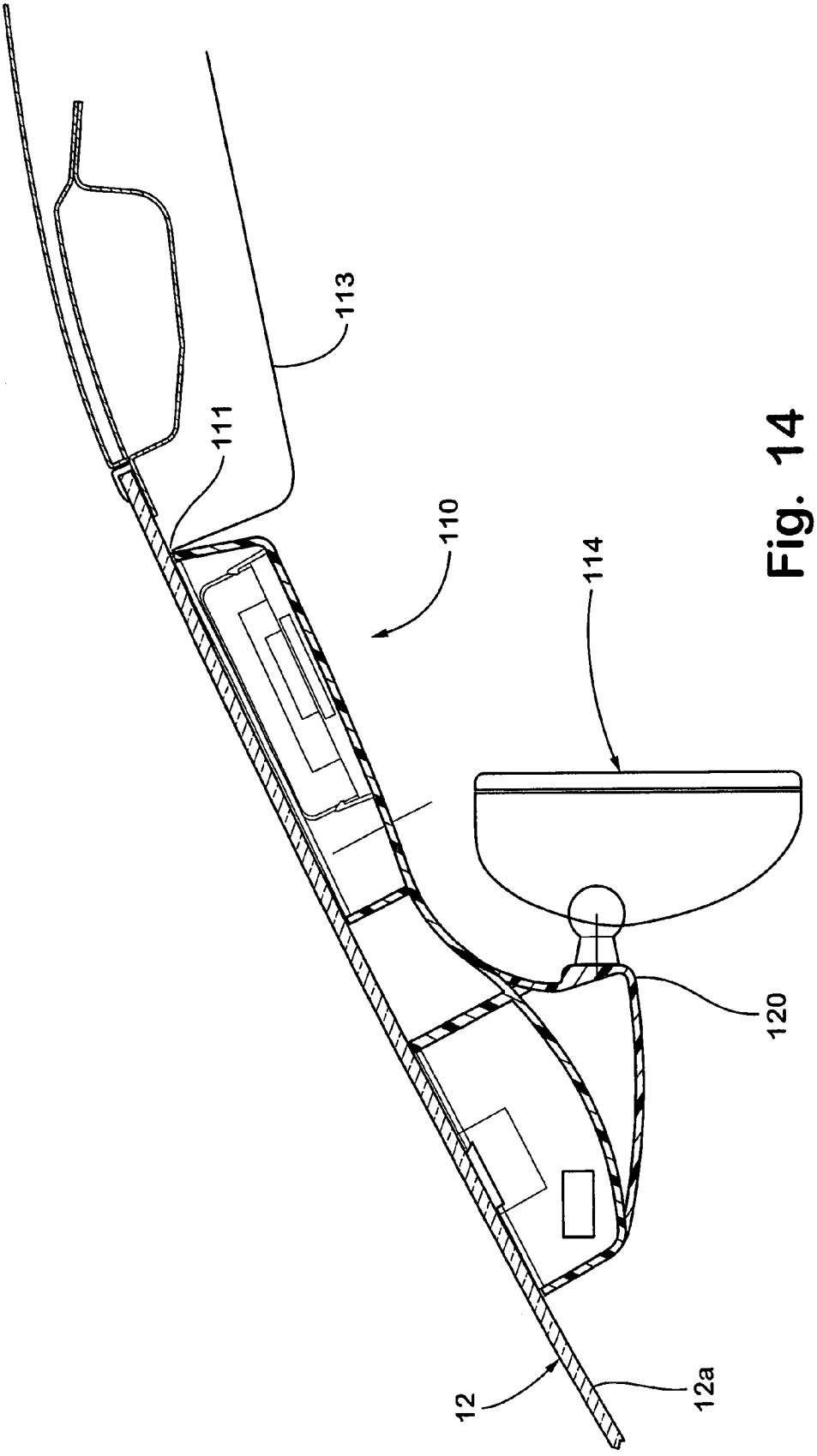


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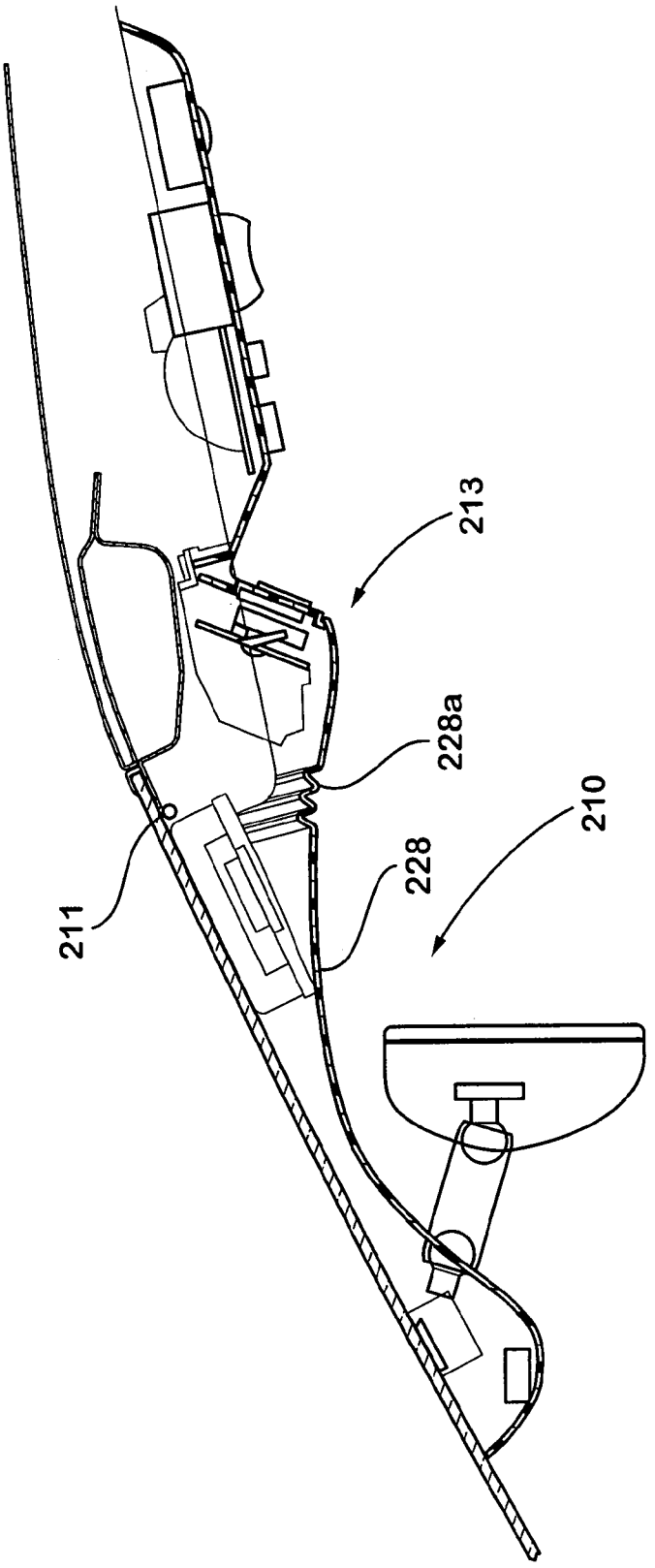


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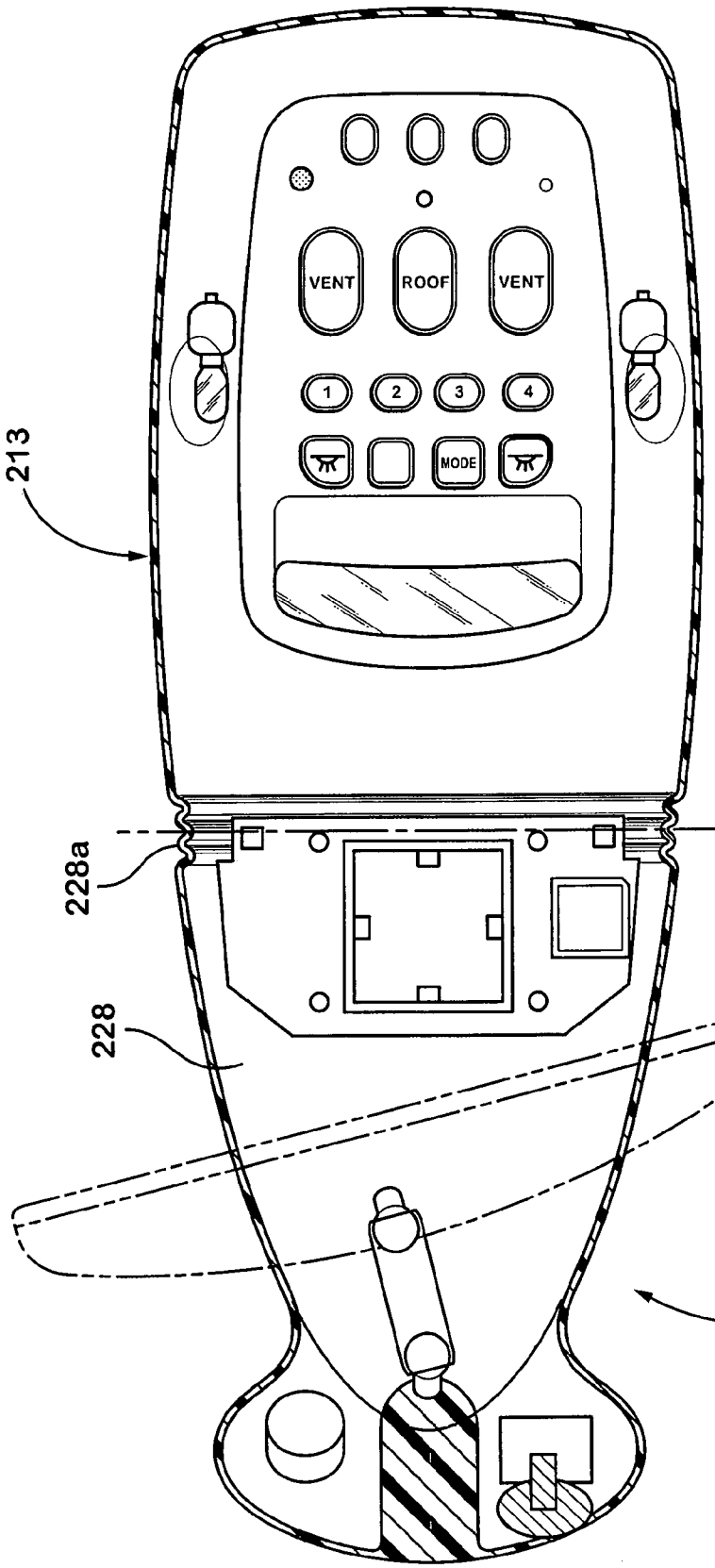


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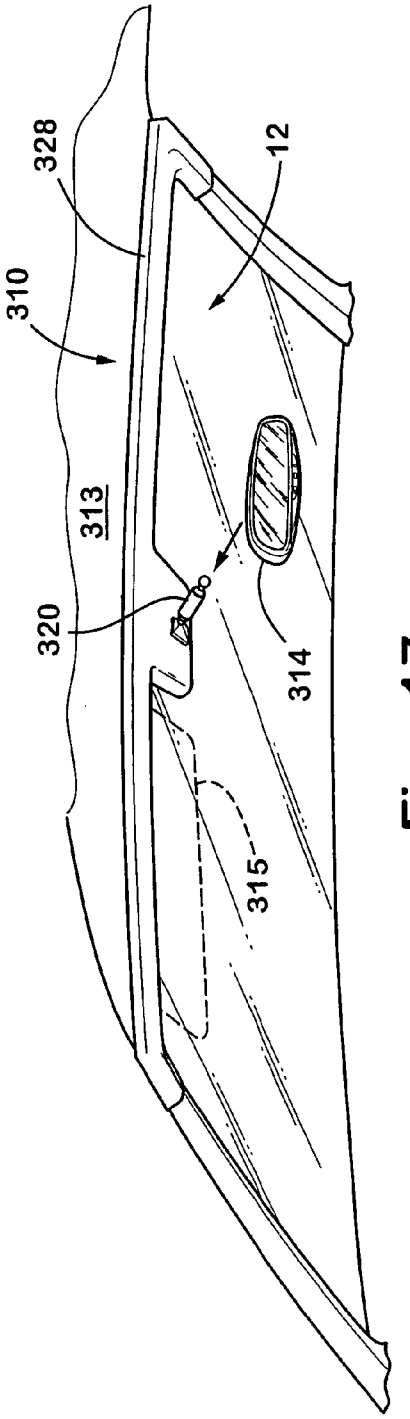


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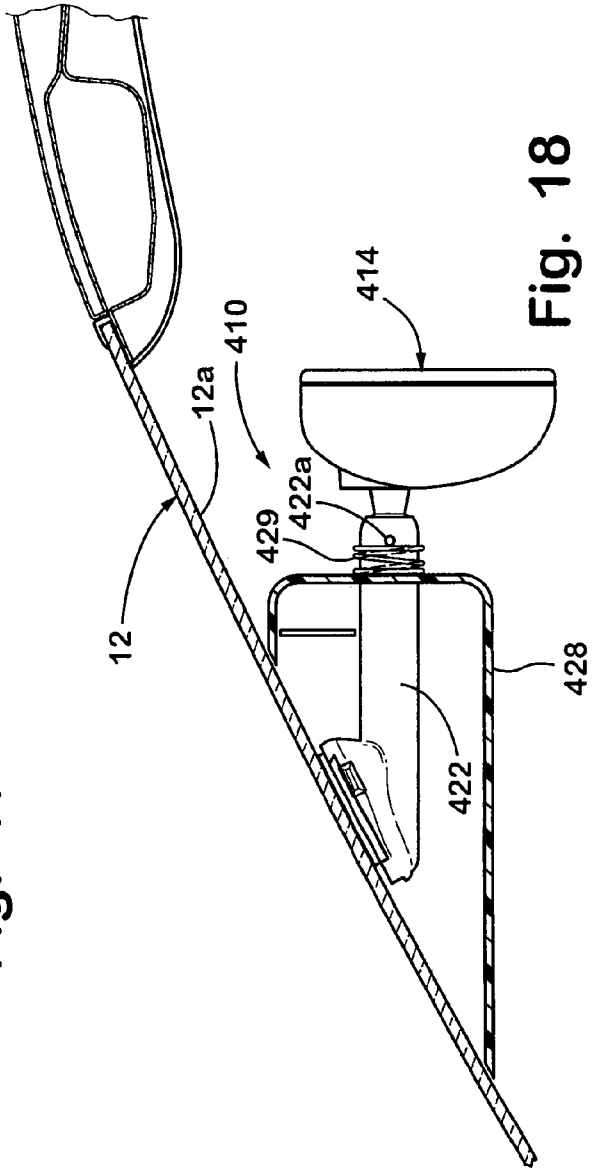


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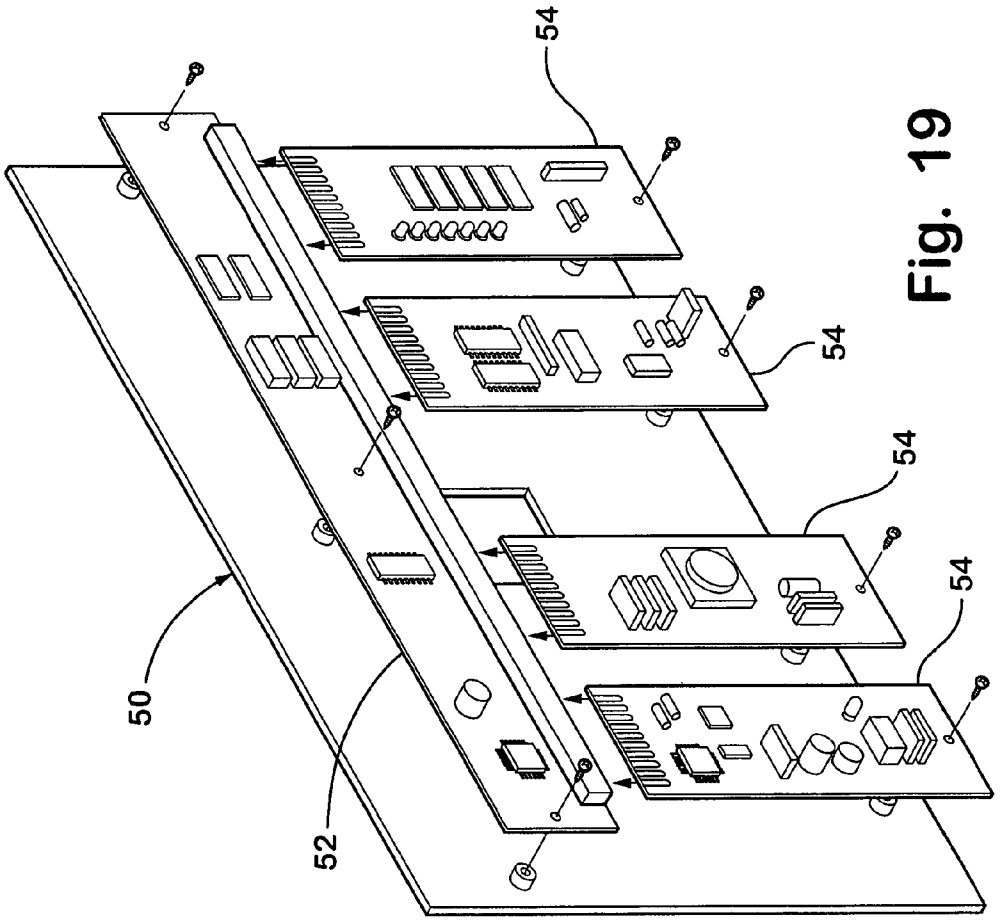


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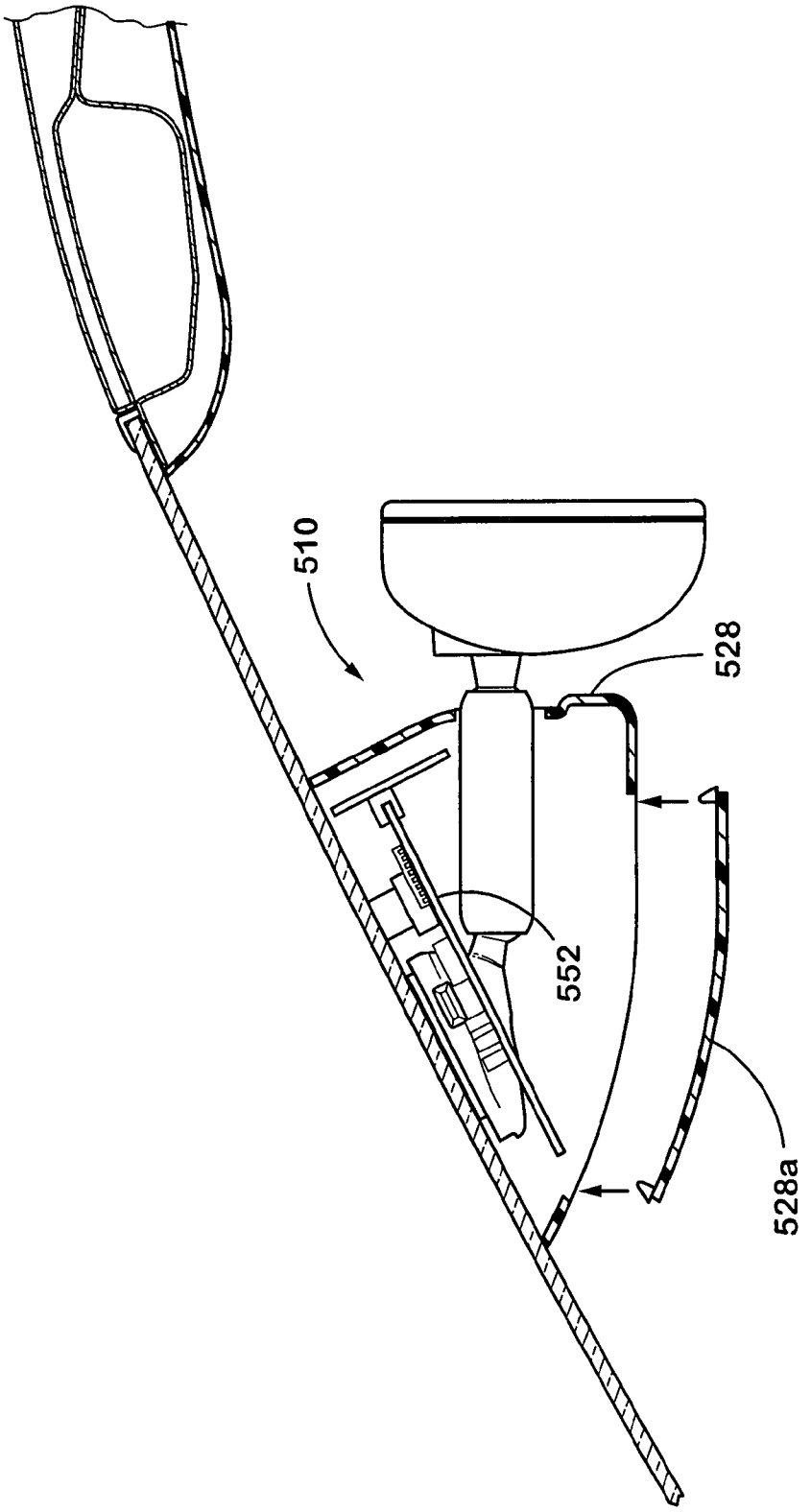


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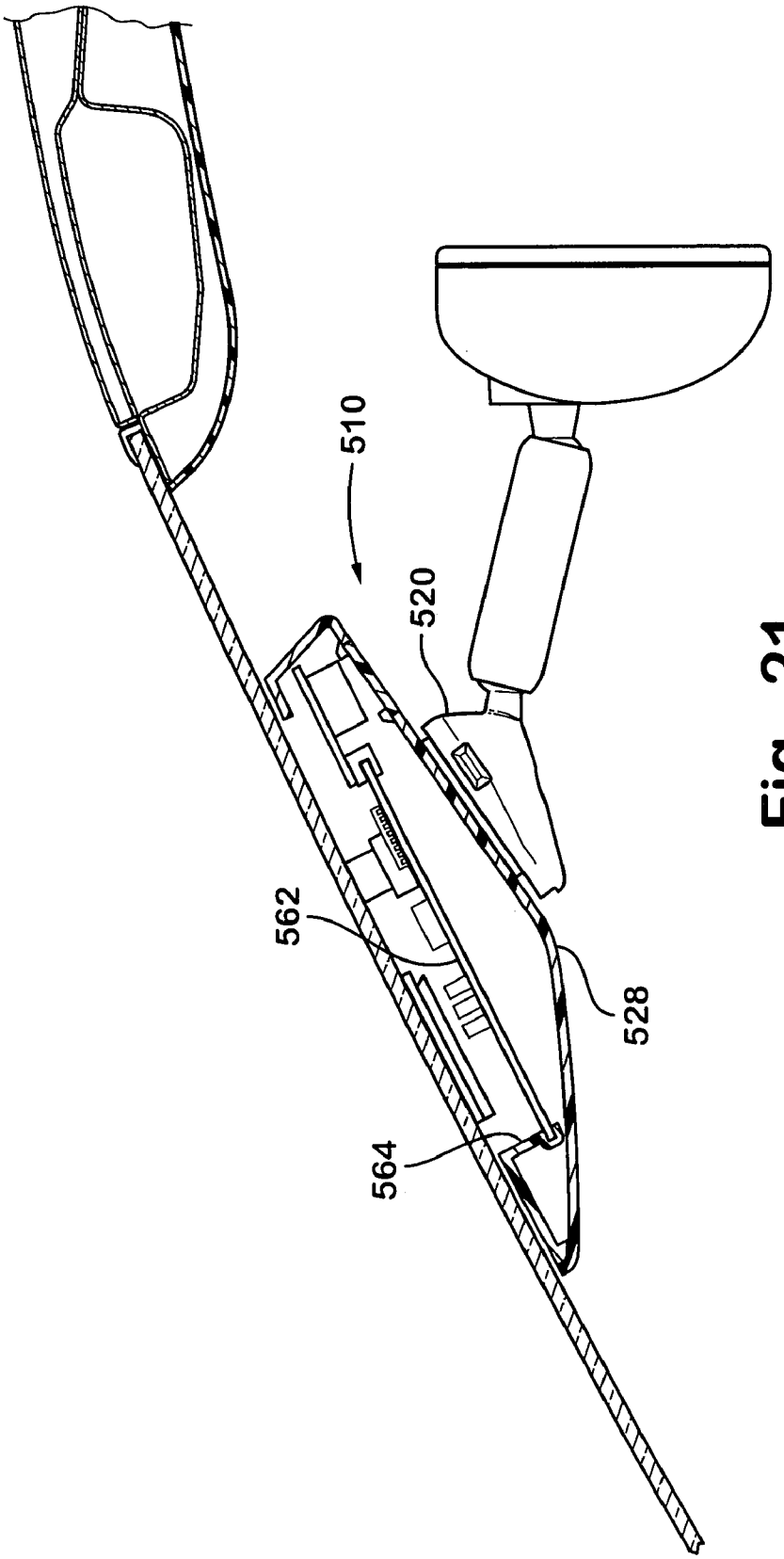


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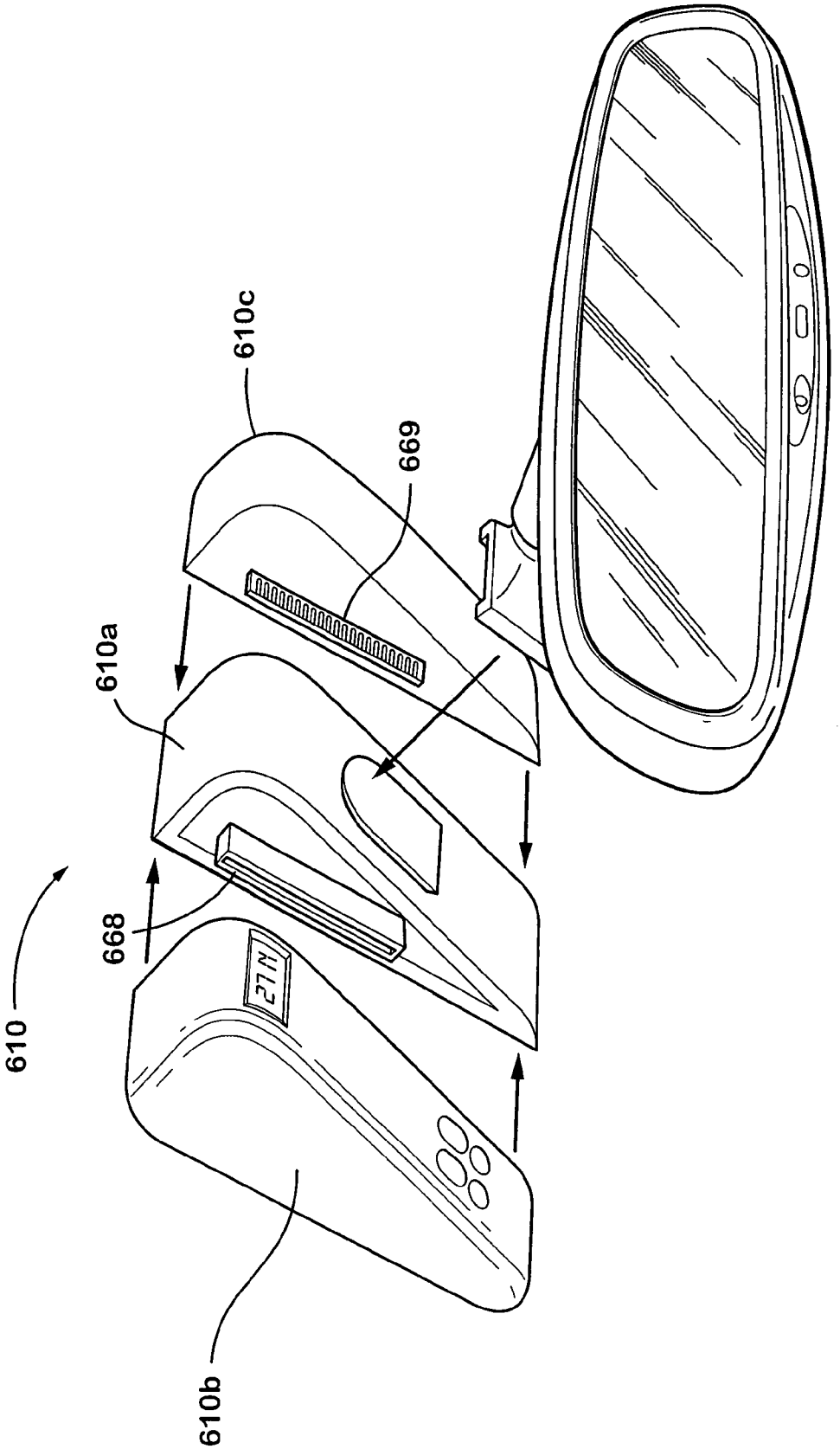


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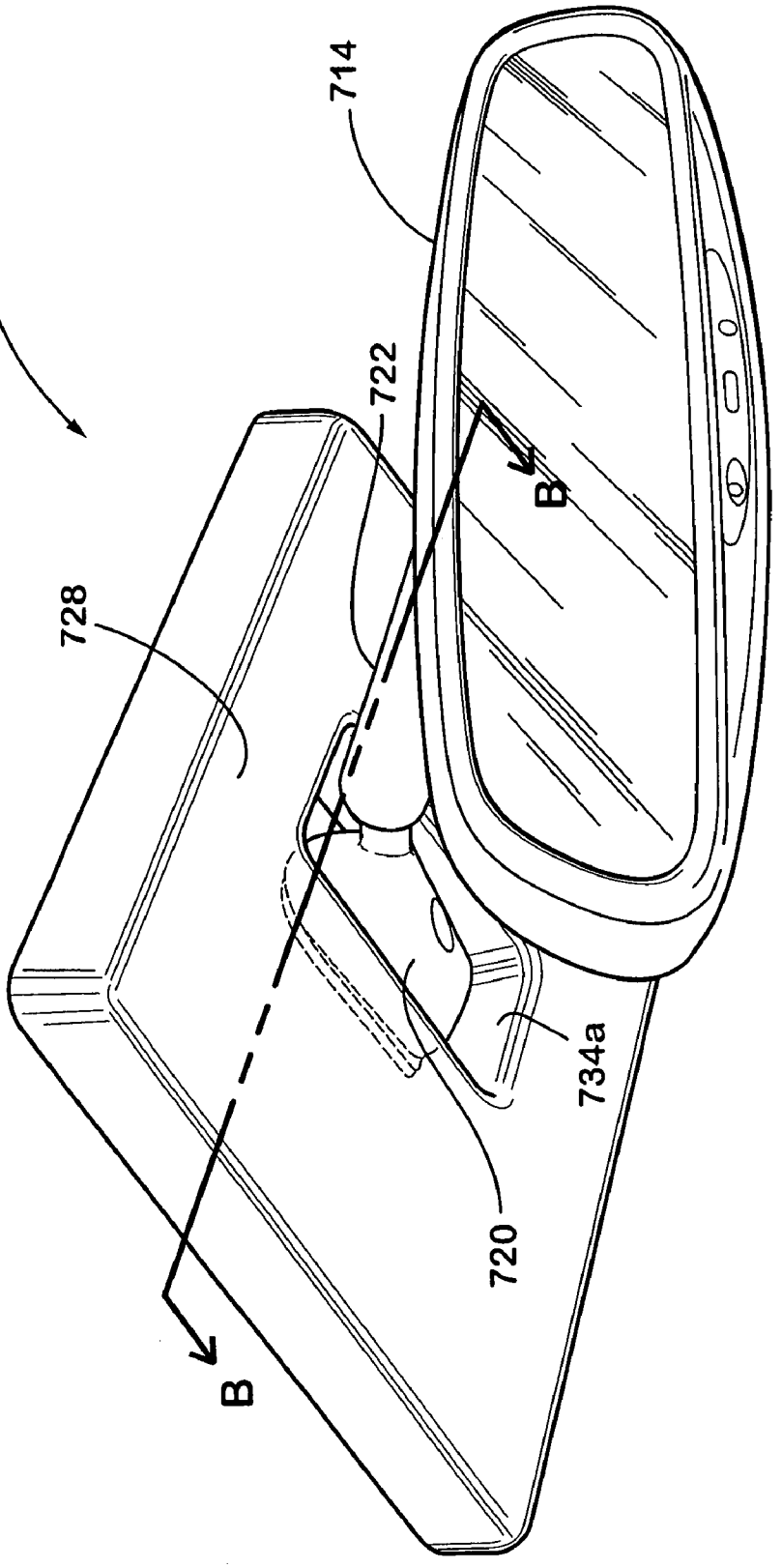


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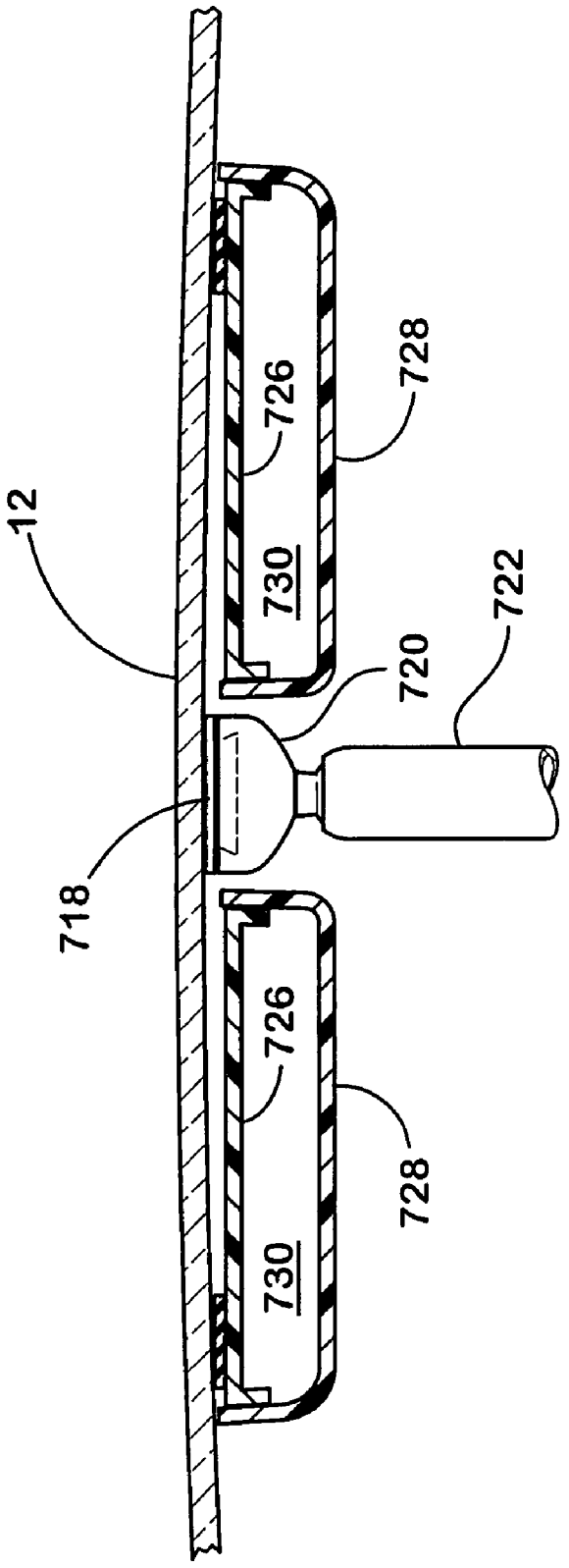


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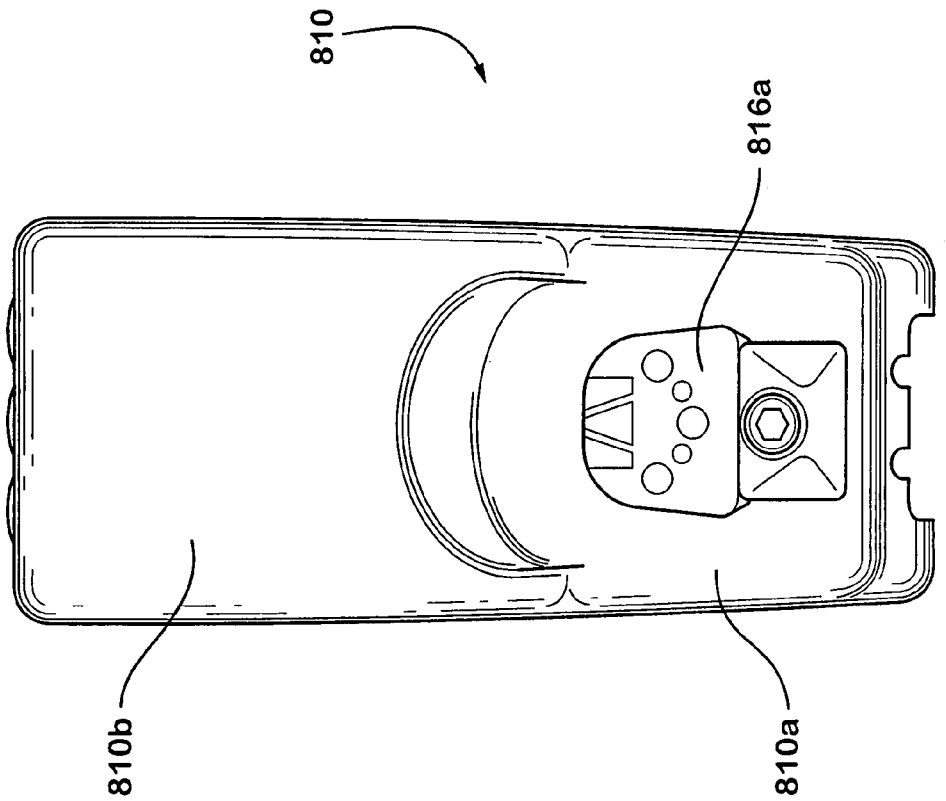


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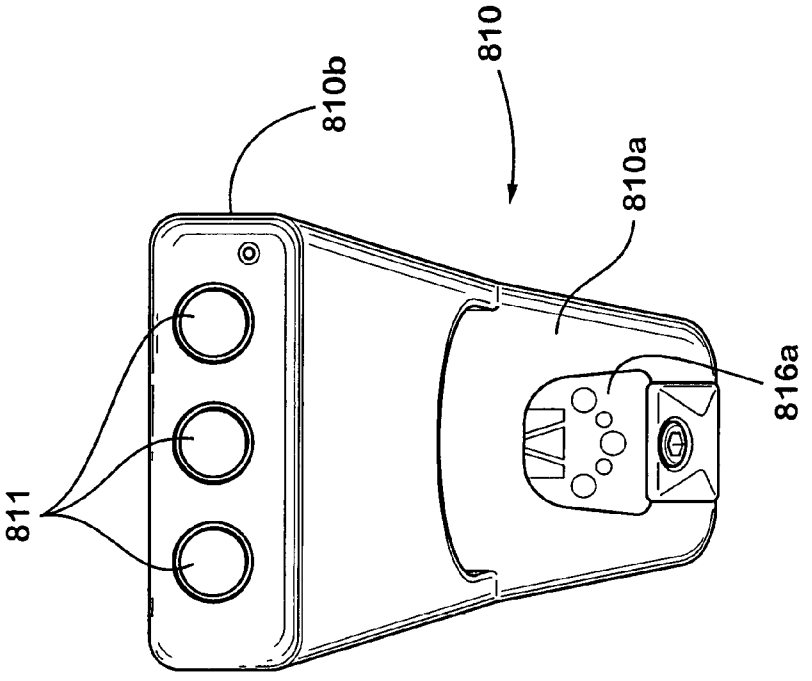


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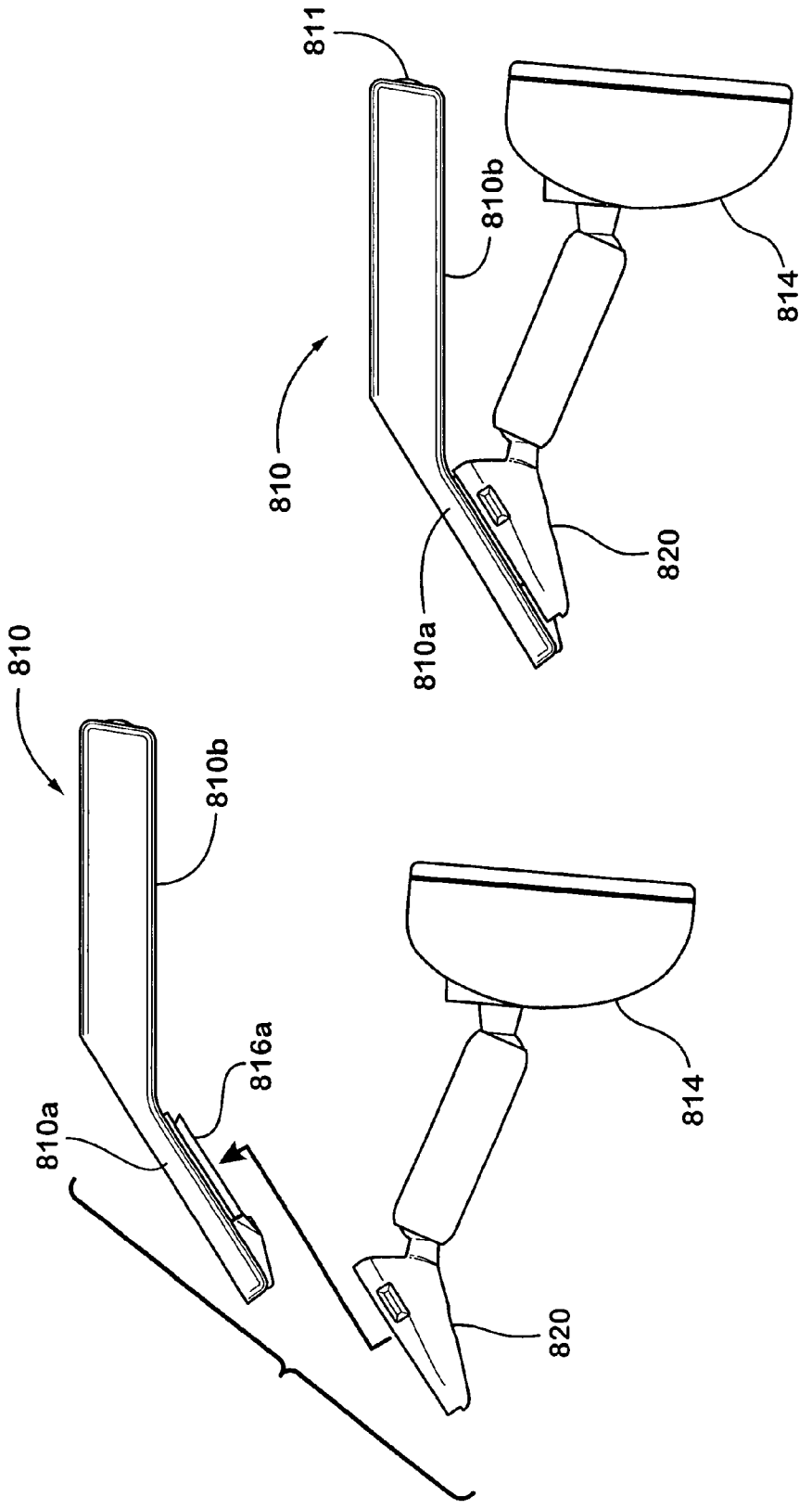


Fig. 25B

Fig. 25A

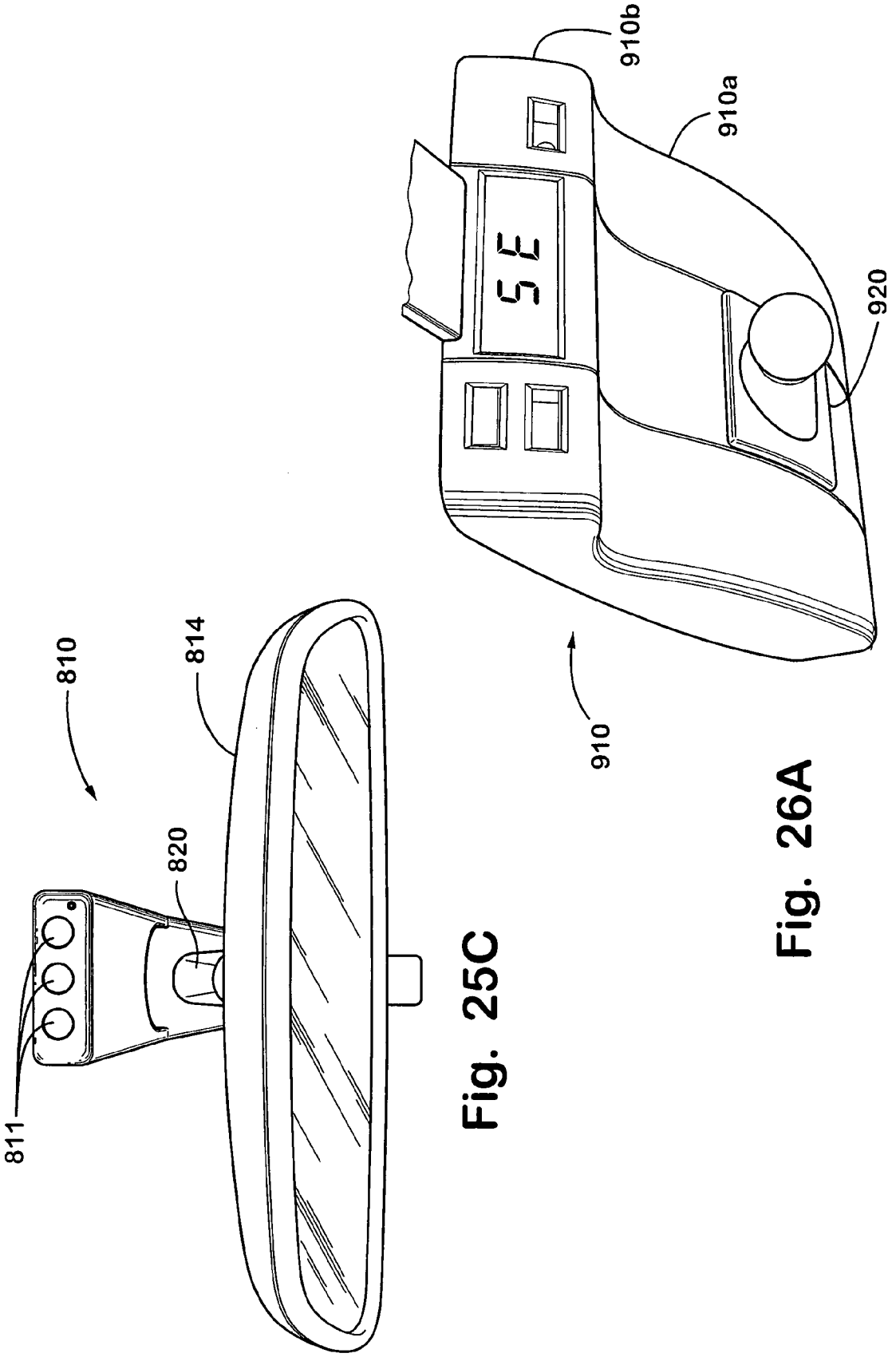


Fig. 25C

Fig. 26A

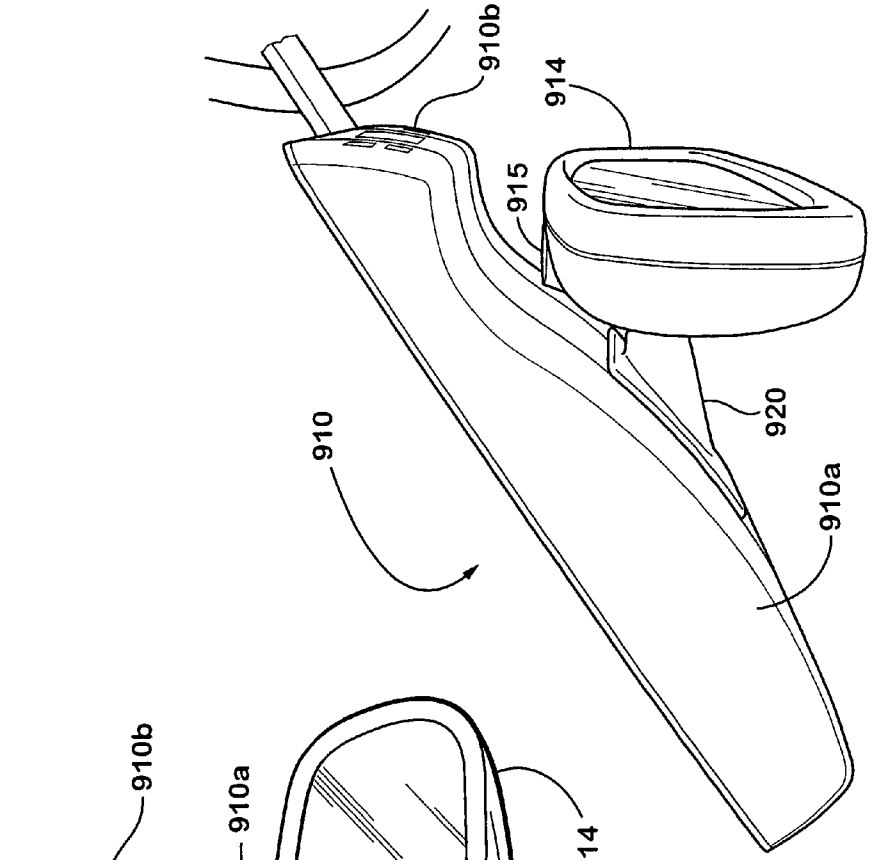


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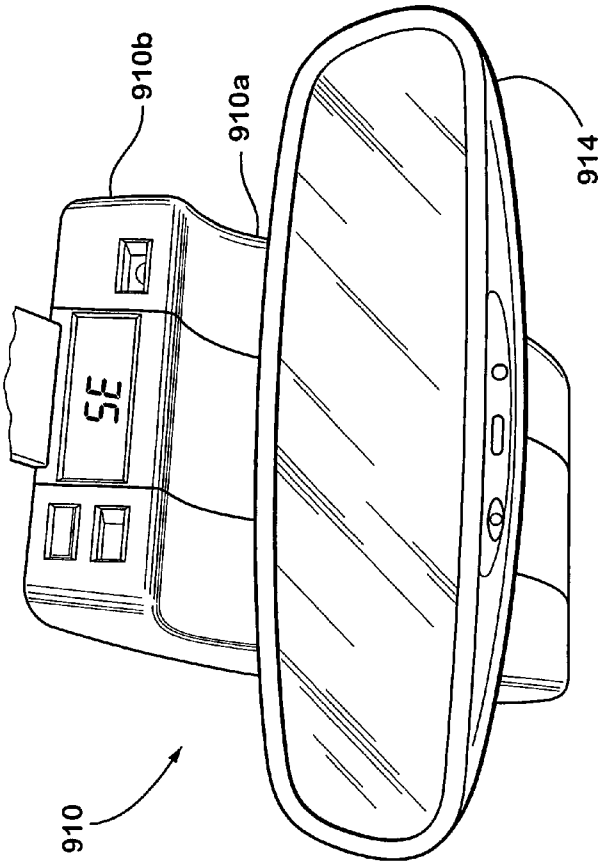


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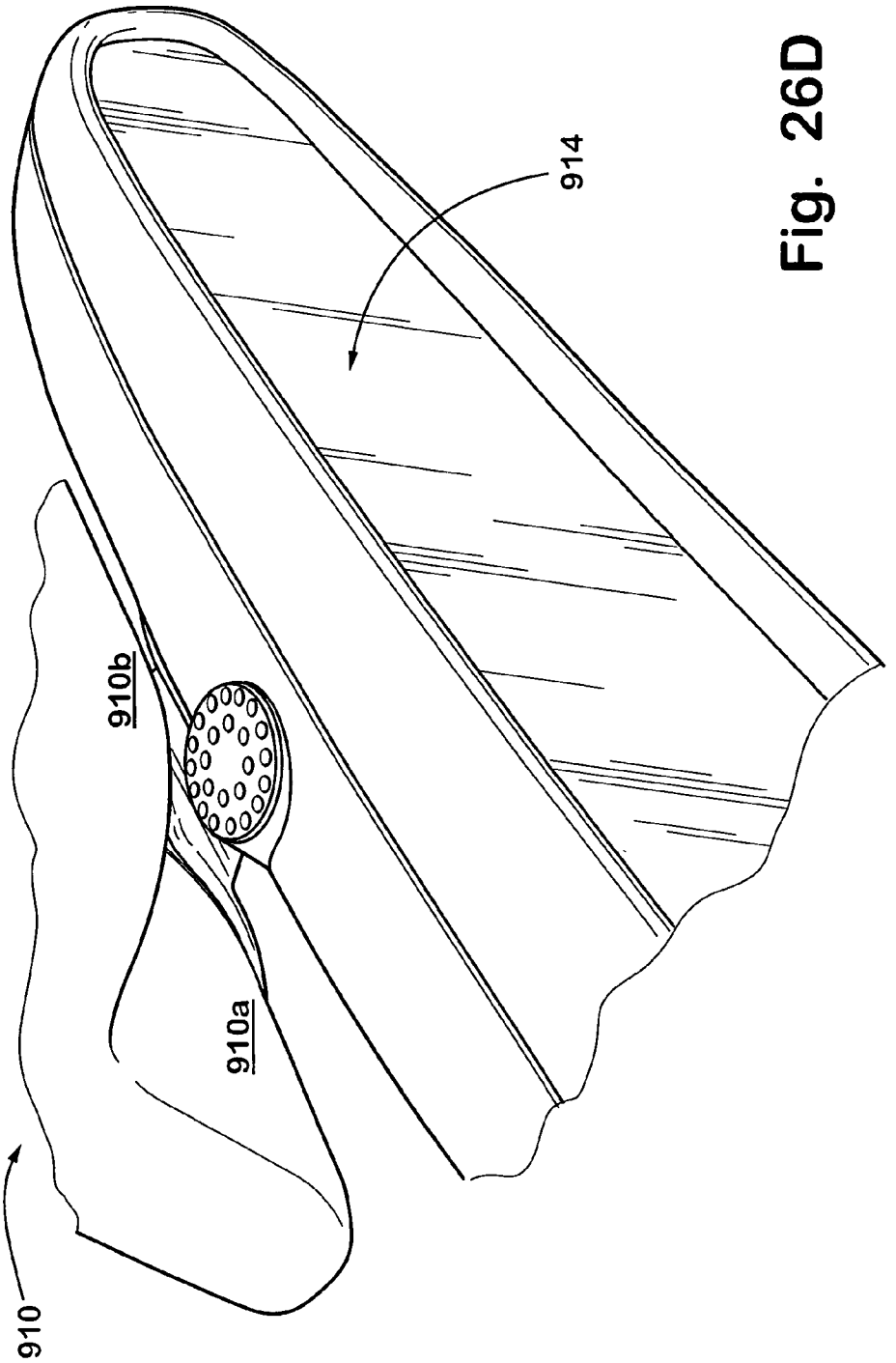


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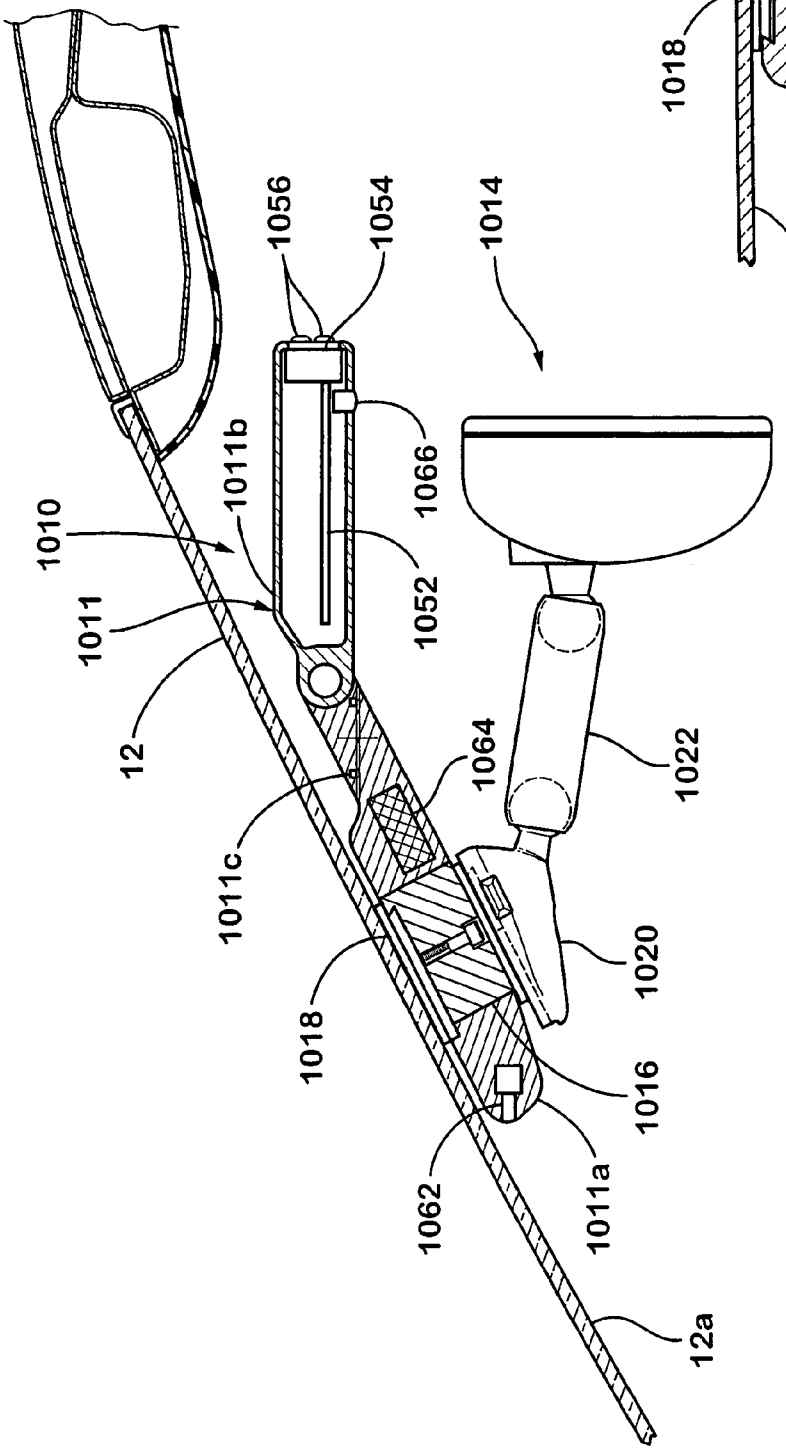

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Fig. 27

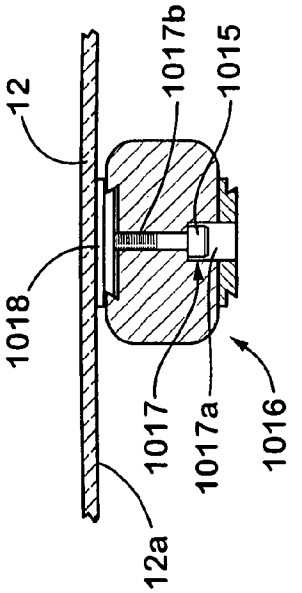

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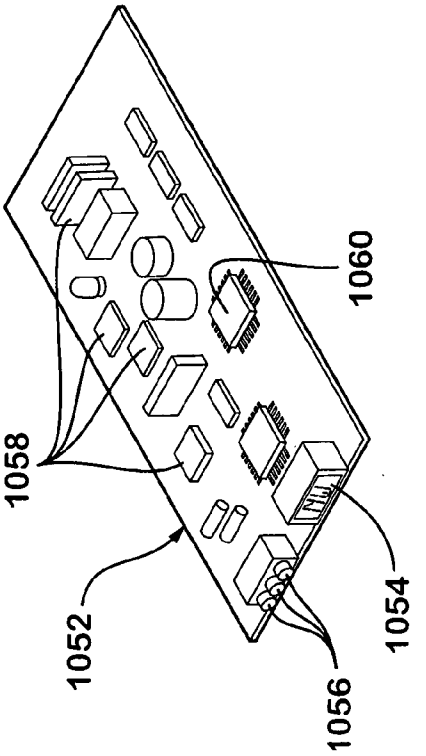


Fig. 30

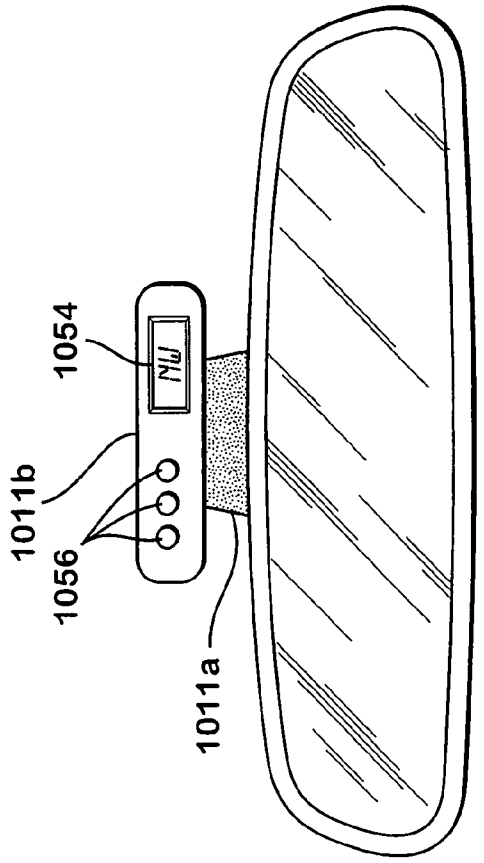


Fig. 29

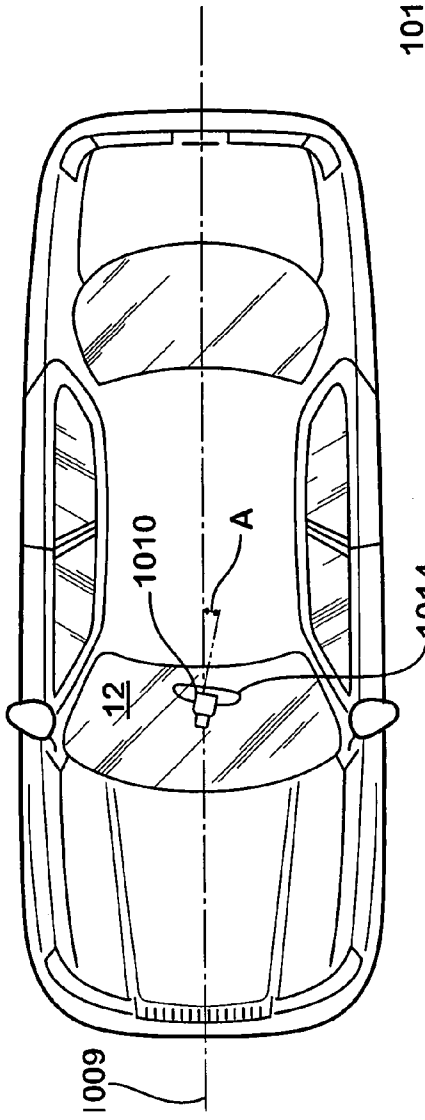


Fig. 31

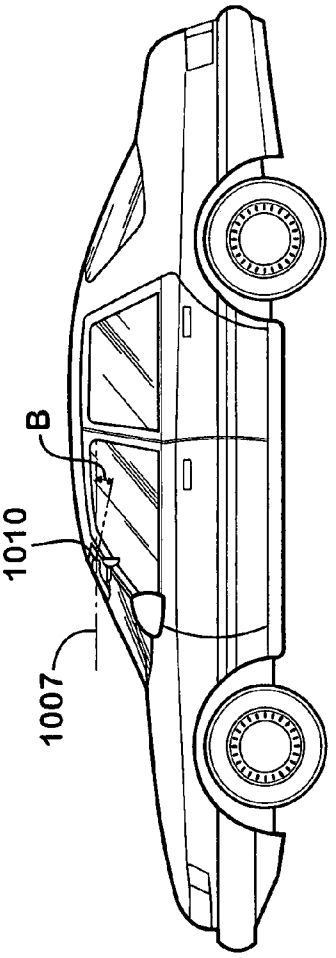


Fig. 32

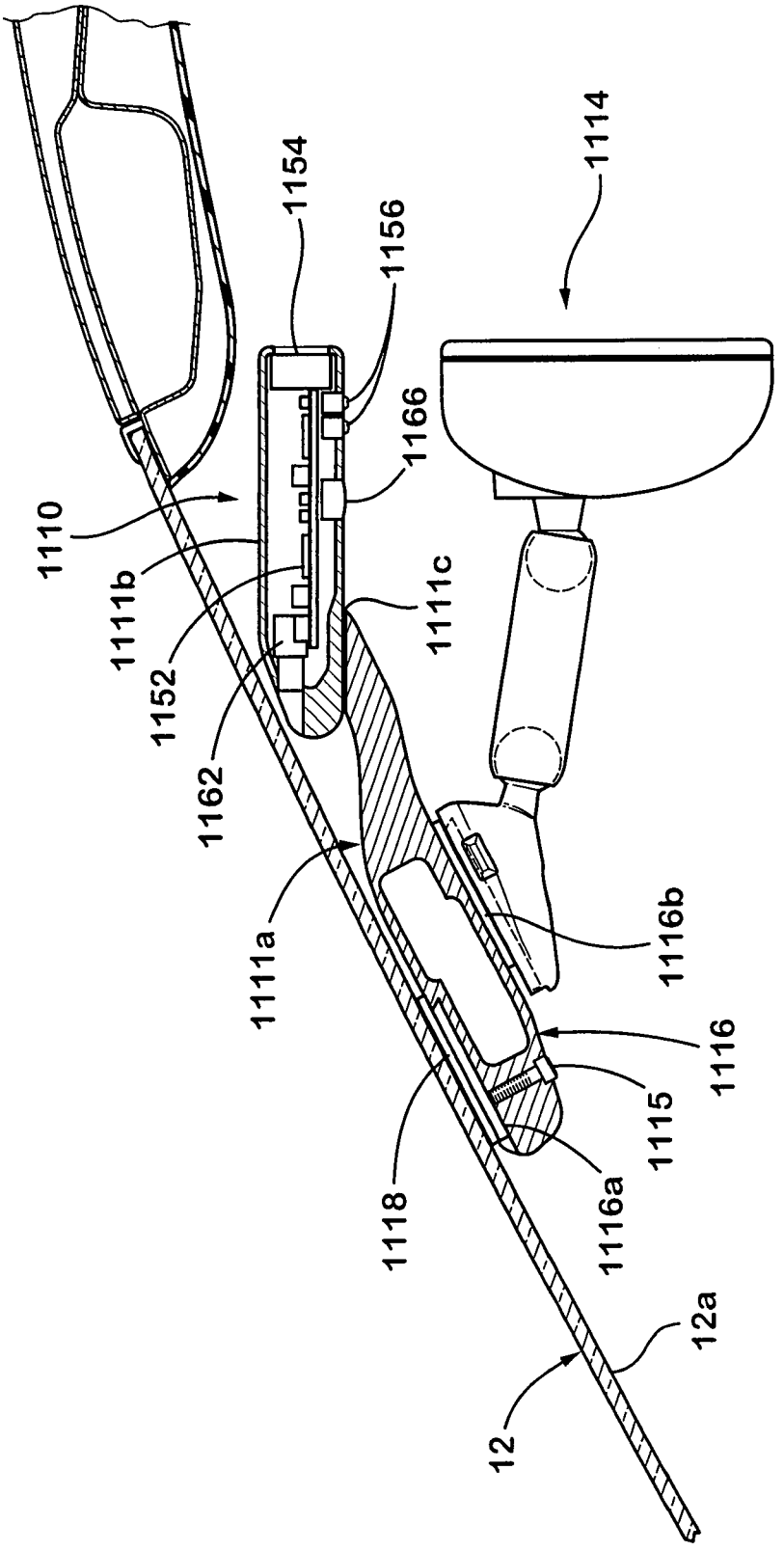

1154
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1166
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1162
1111a
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1116
1115
1118
1116a
12a
12

Fig. 33

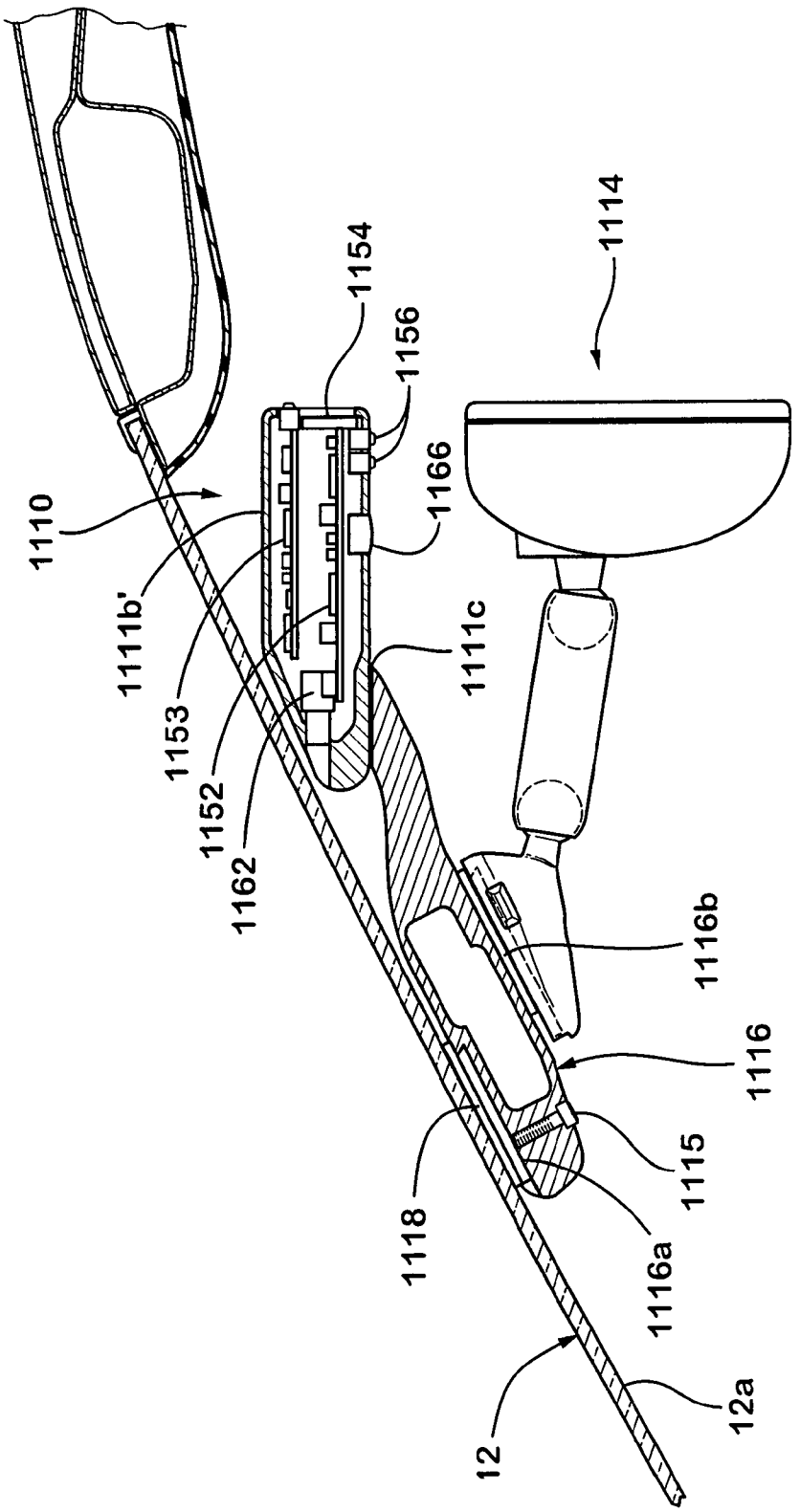

1110
1111b'
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1111c
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1116
1115
1118
1116a
12
12a

Fig. 34

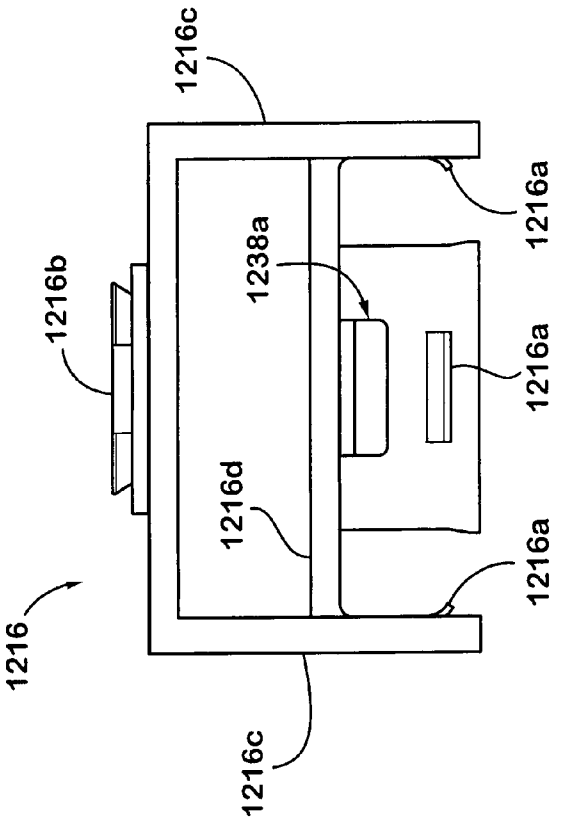


Fig. 36

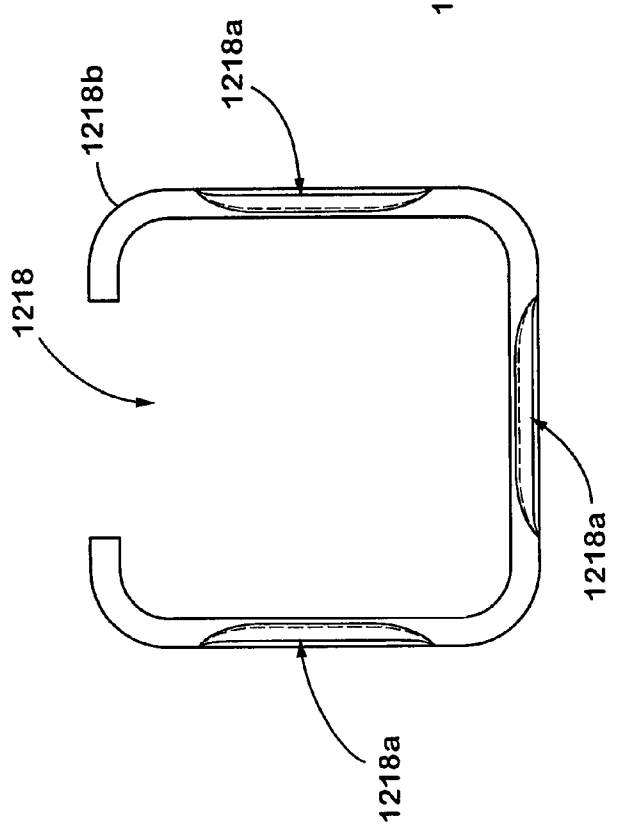


Fig. 35A

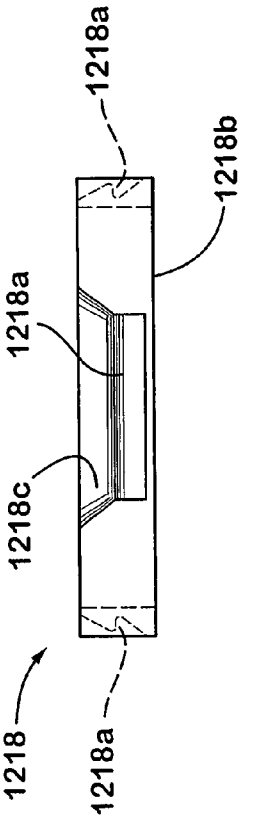


Fig. 35B

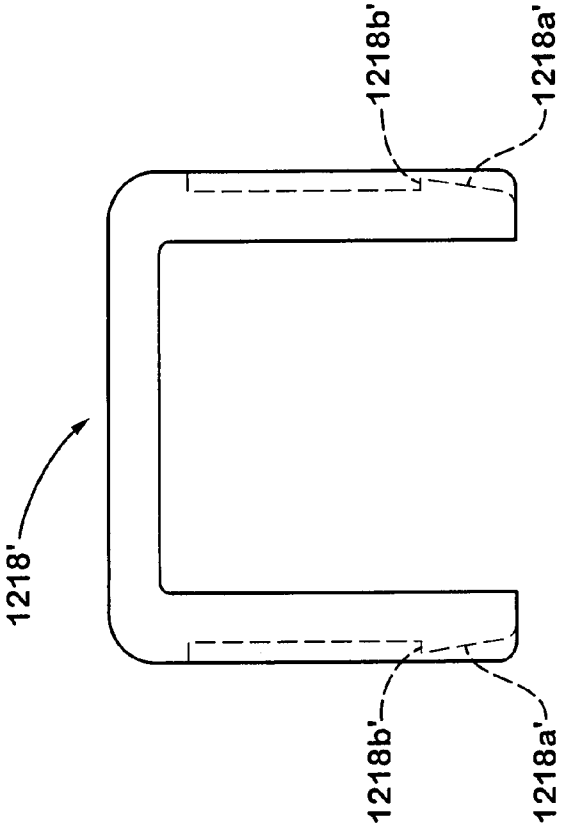


Fig. 37B

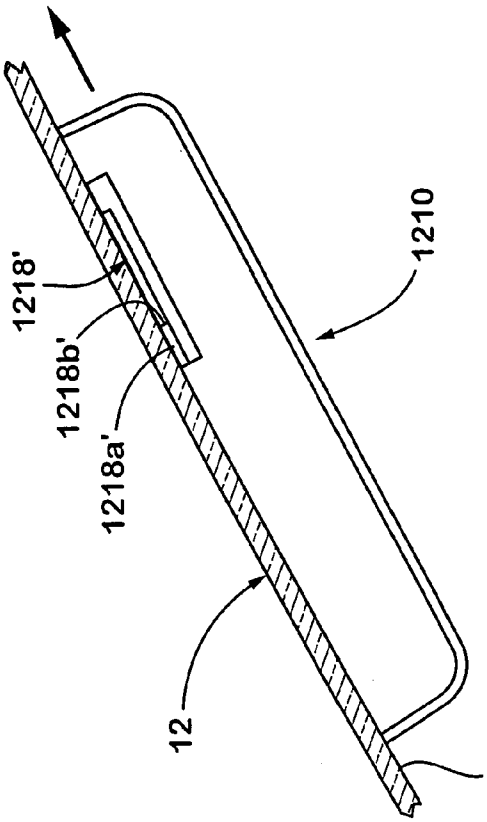


Fig. 37A

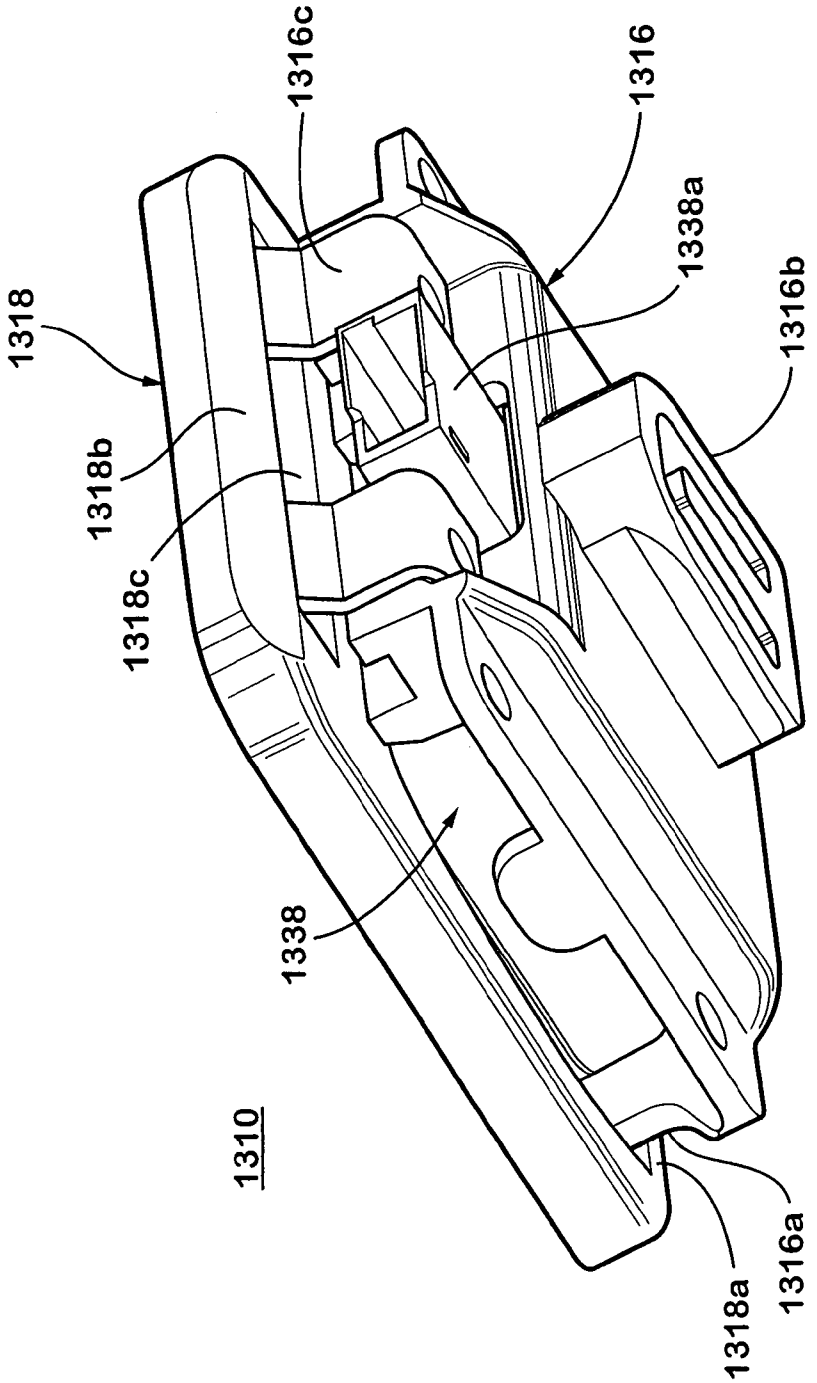

1316c
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1338a
1316b
1318
1318b
1318c
1338
1310
1318a
1316a

Fig. 38A

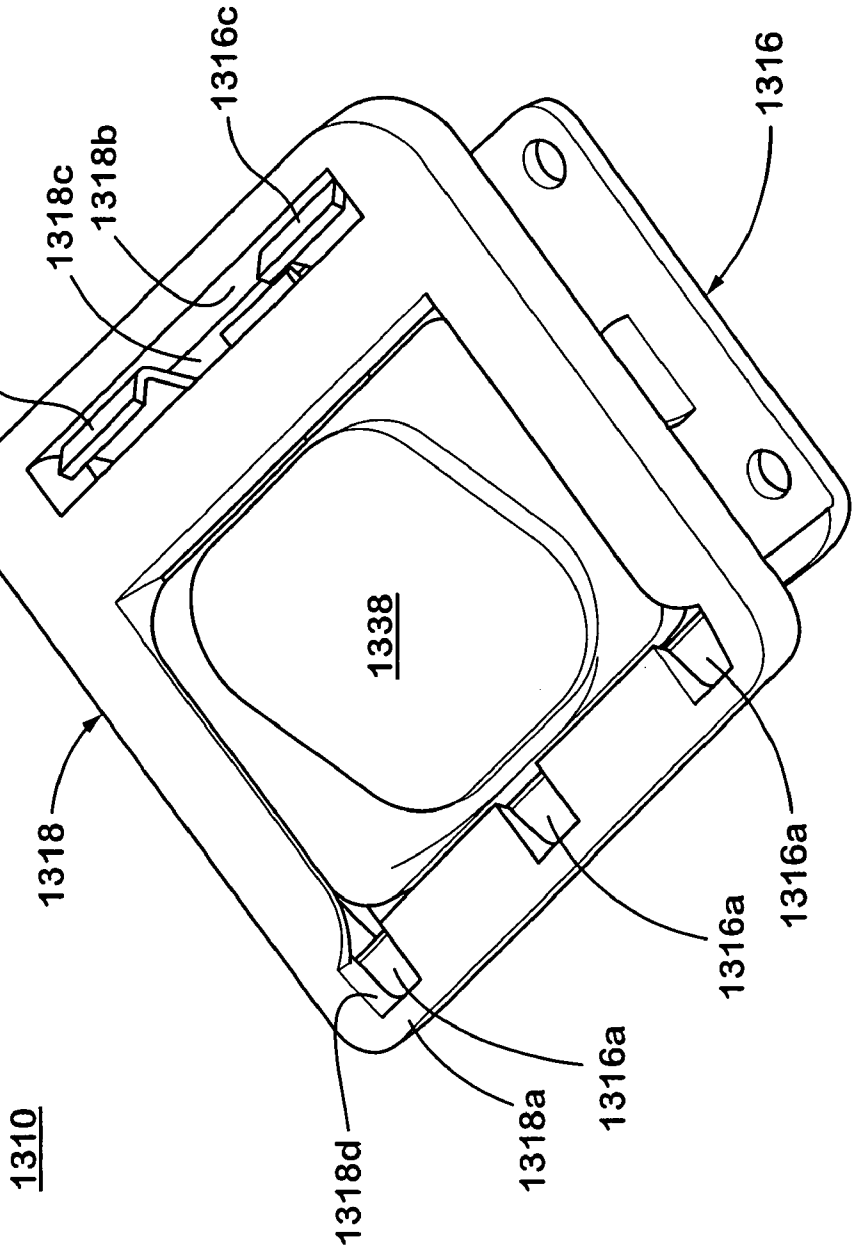

1316c
1318c
1318b
1316c
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1318
1316a
1316a
1316a
1318a
1318d
1310

Fig. 38B

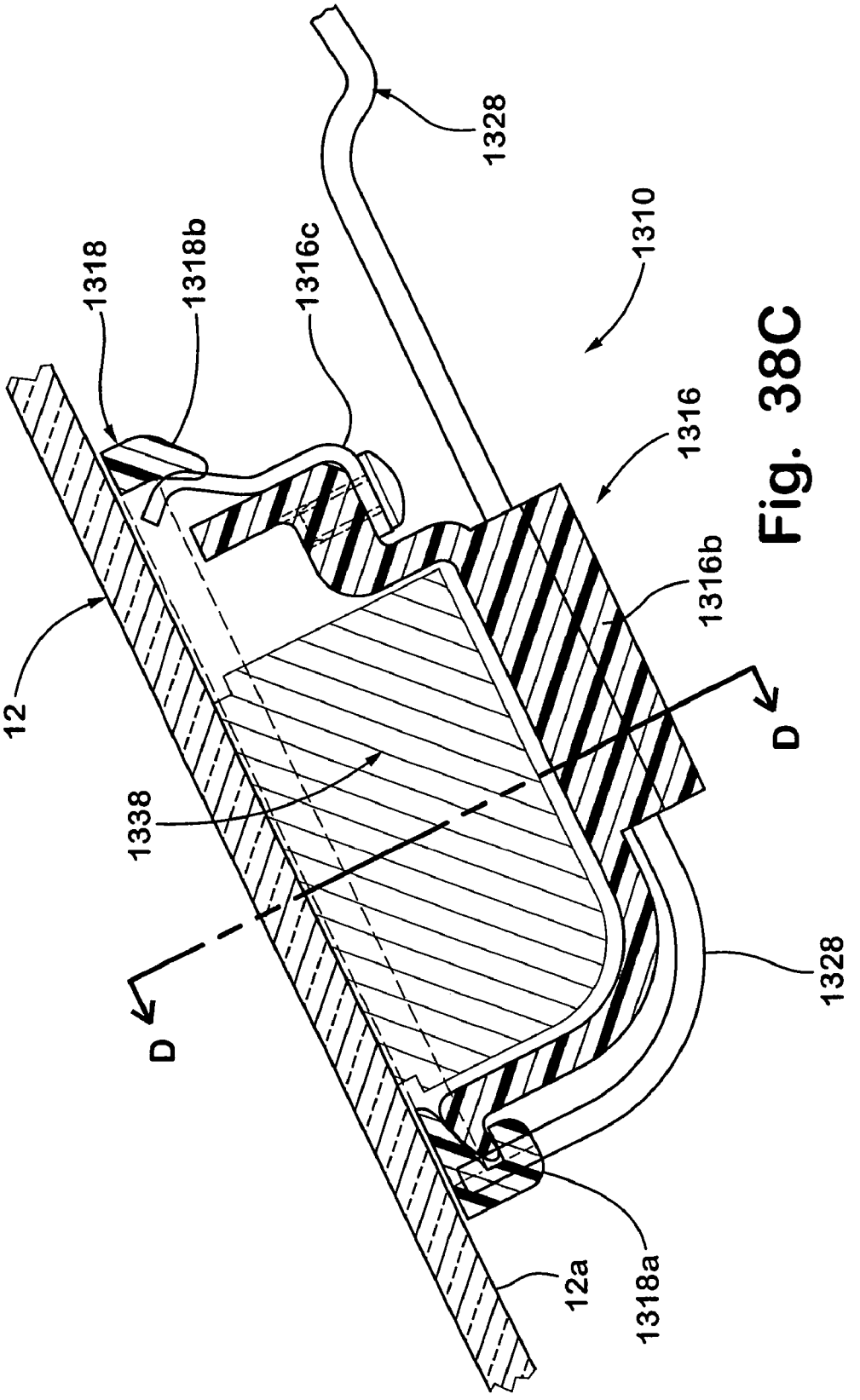

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1318b
1316c
1316
1316b
12
1338
D
D
1328
12a
1318a

Fig. 38C

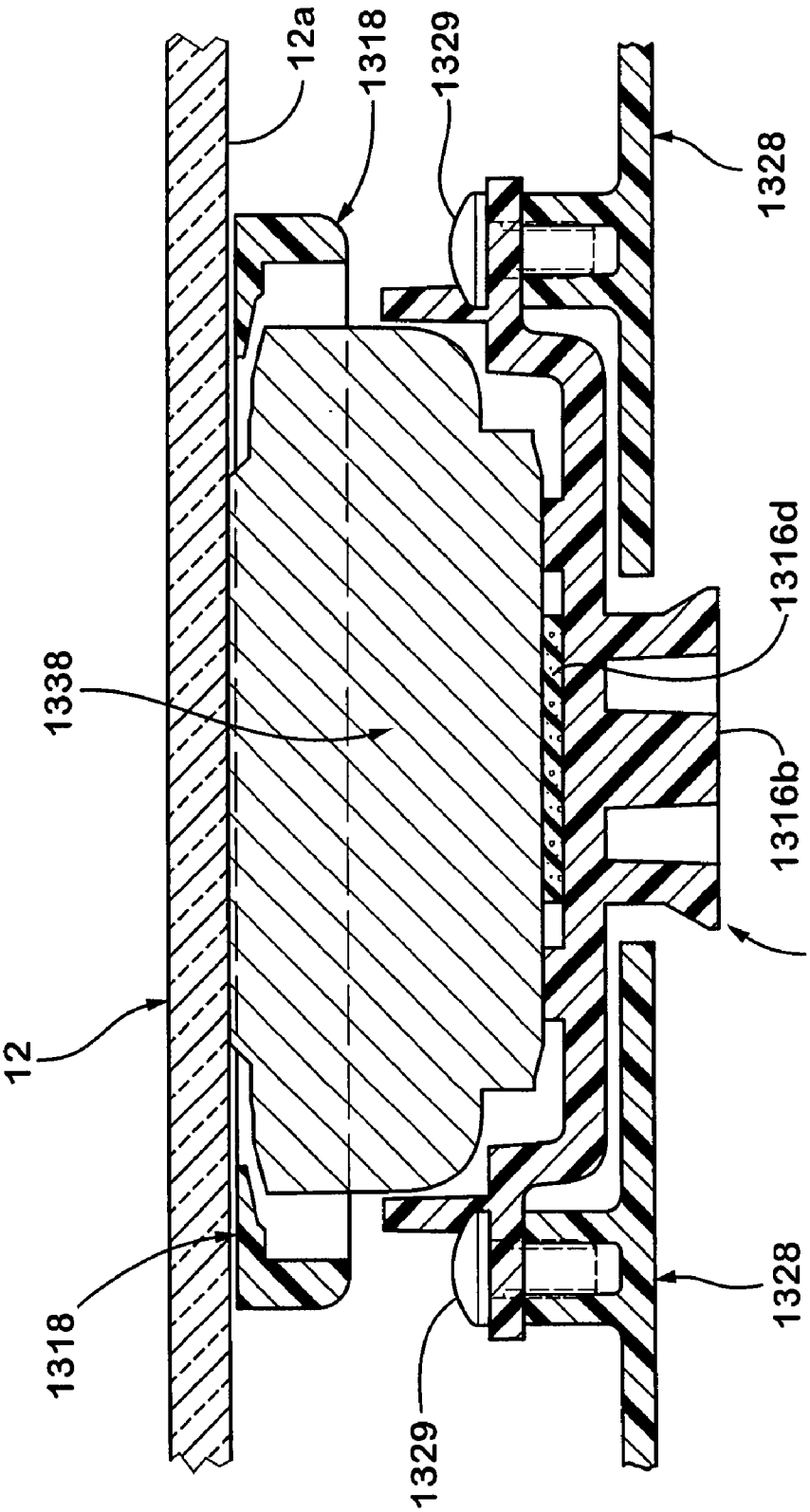

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1316b
1316
12
1318
1328
1329

Fig. 38D

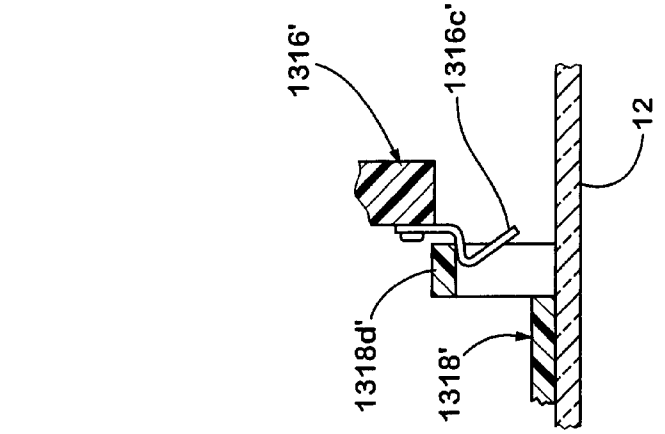


Fig. 41

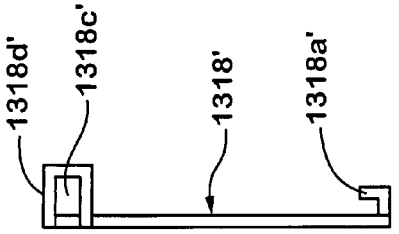


Fig. 39B

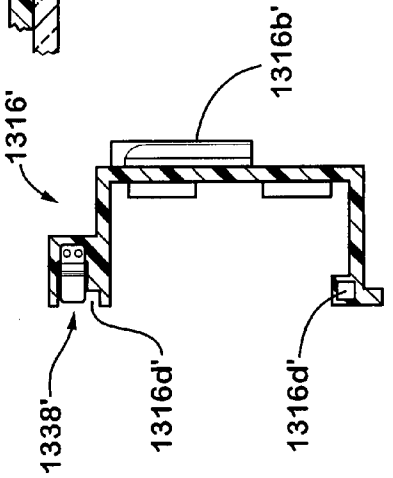


Fig. 40B

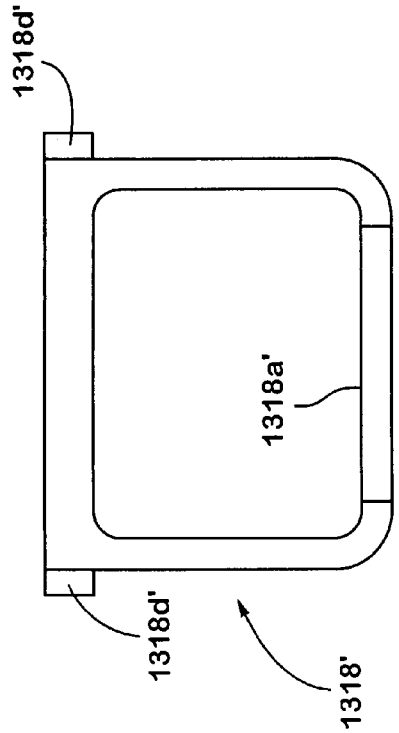


Fig. 39A

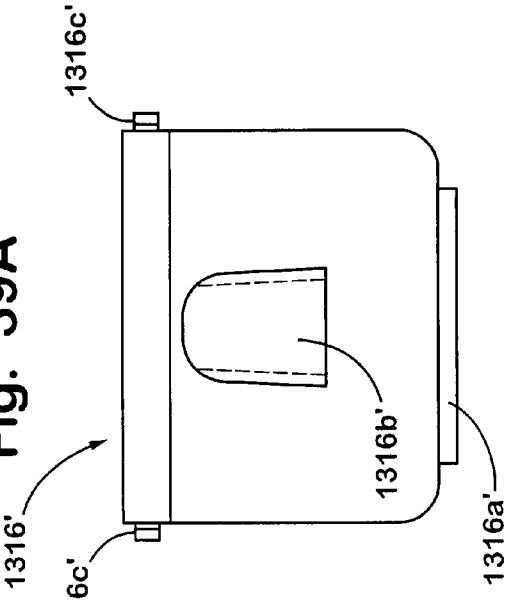


Fig. 40A

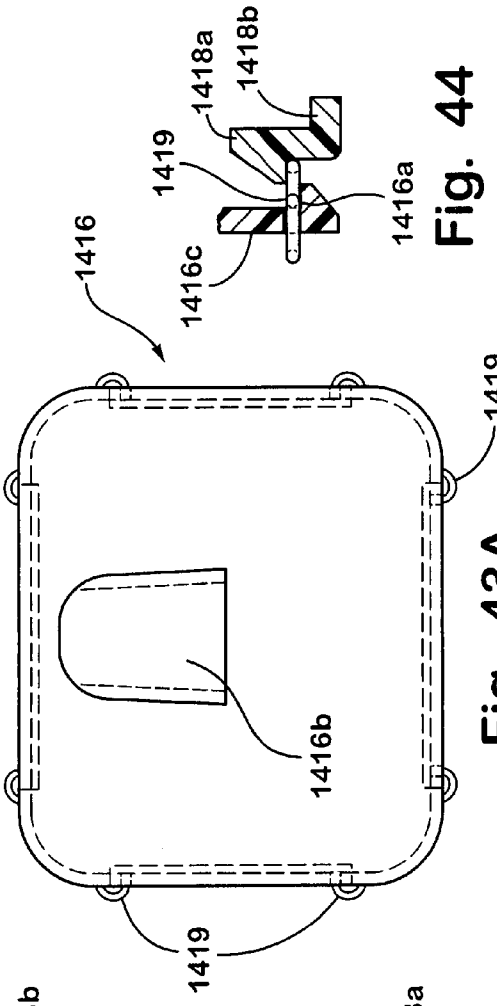


Fig. 42A

Fig. 42B

Fig. 43A

Fig. 43B

Fig. 43C

Fig. 44

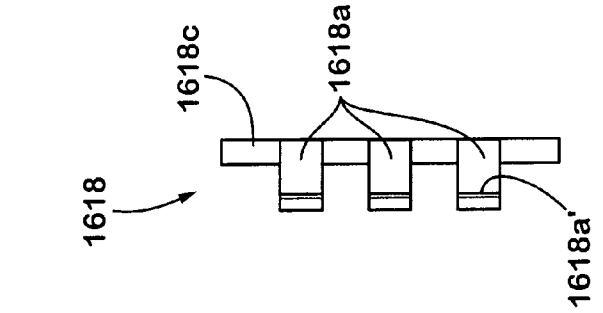


Fig. 46B

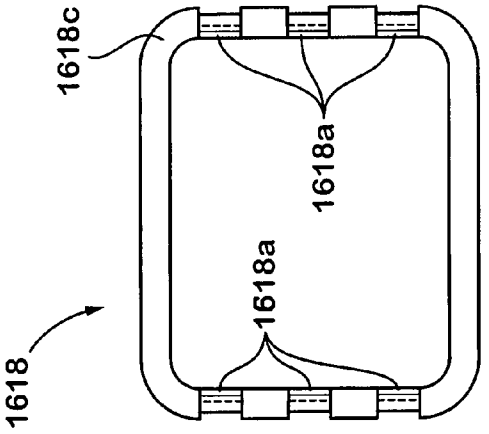


Fig. 46A

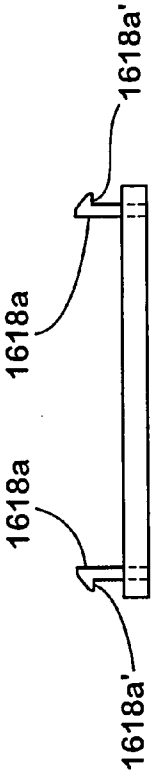


Fig. 46C

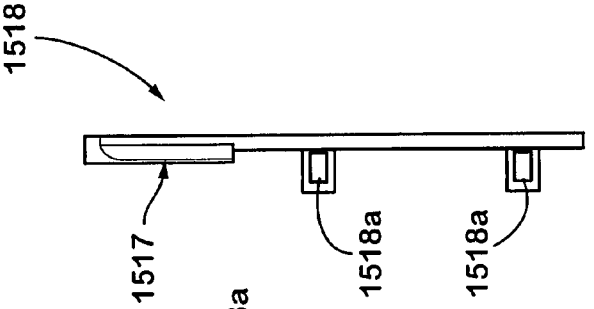


Fig. 45B

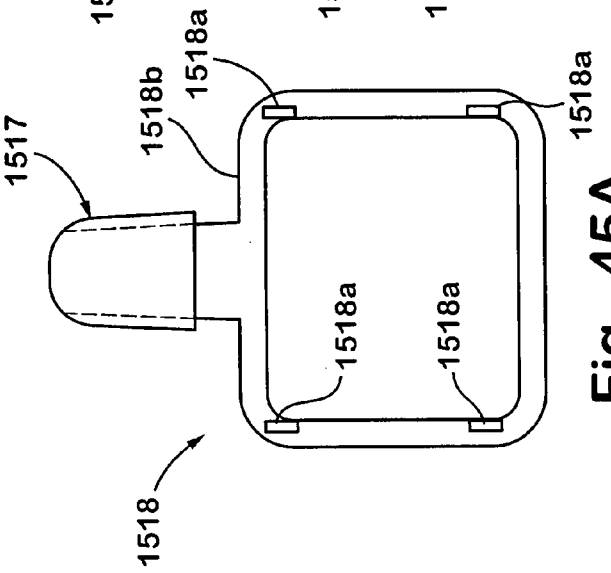


Fig. 45A

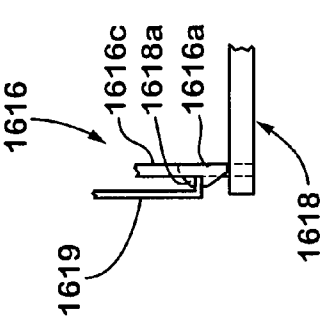


Fig. 48

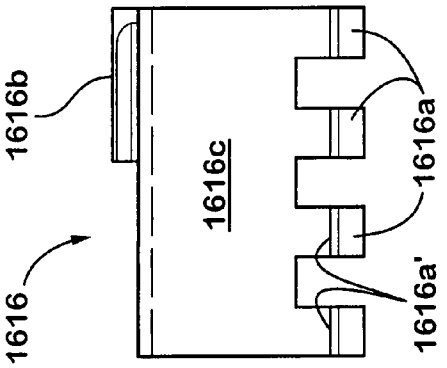


Fig. 47B

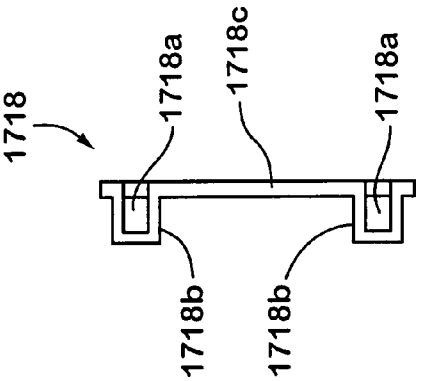


Fig. 49B

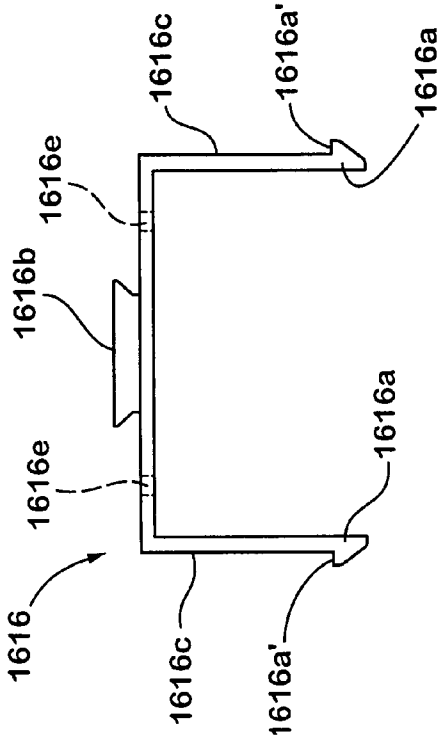


Fig. 47A

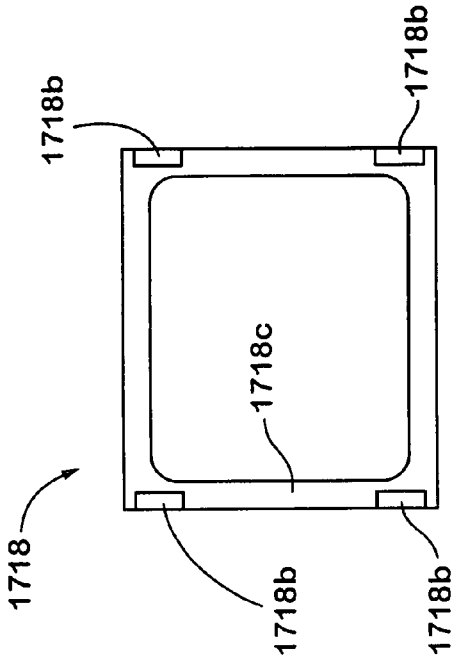


Fig. 49A

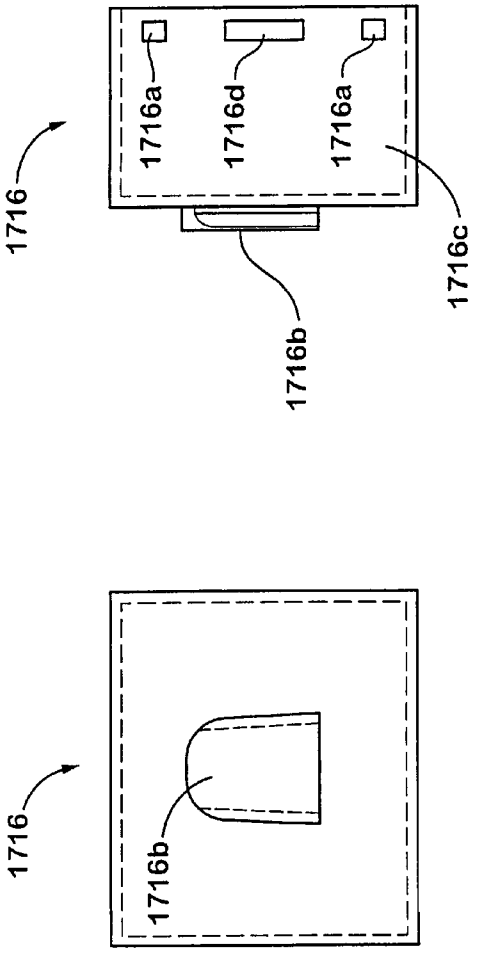


Fig. 50B

Fig. 50A

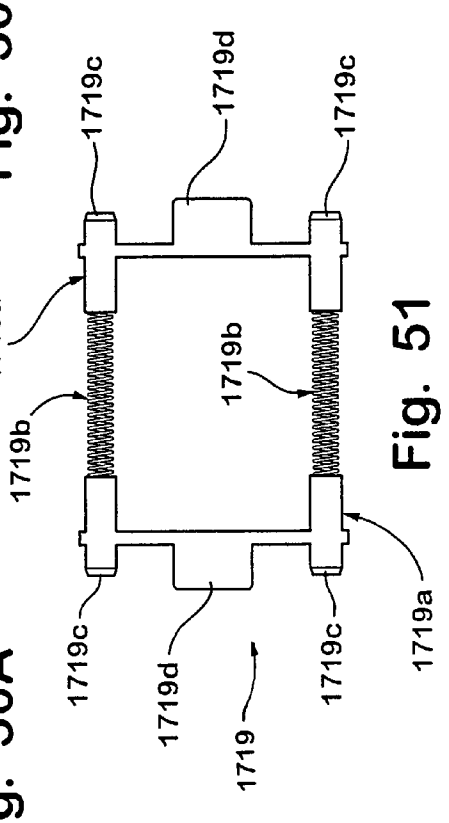


Fig. 51

Fig. 52A

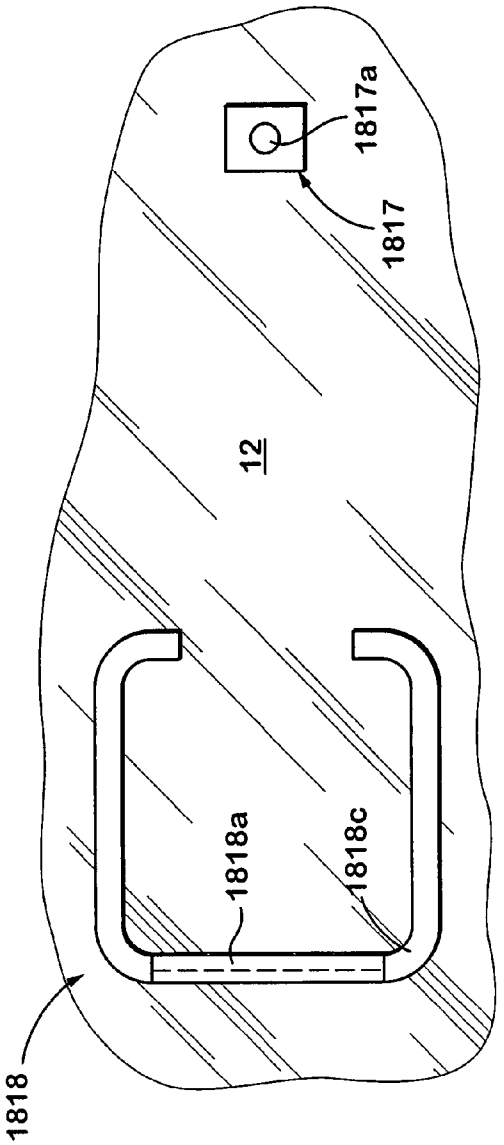


Fig. 52B

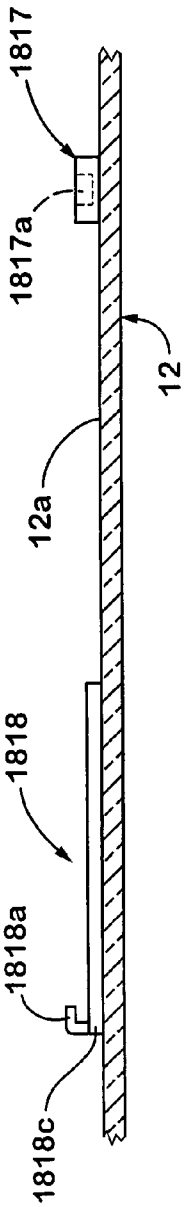


Fig. 53

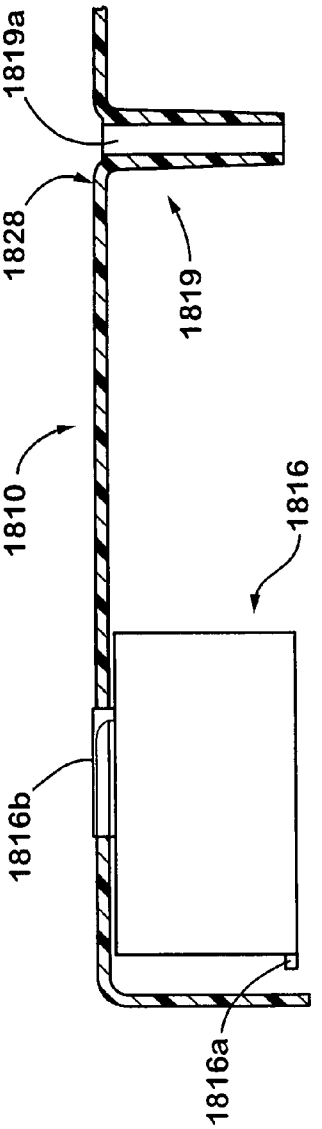


Fig. 54A

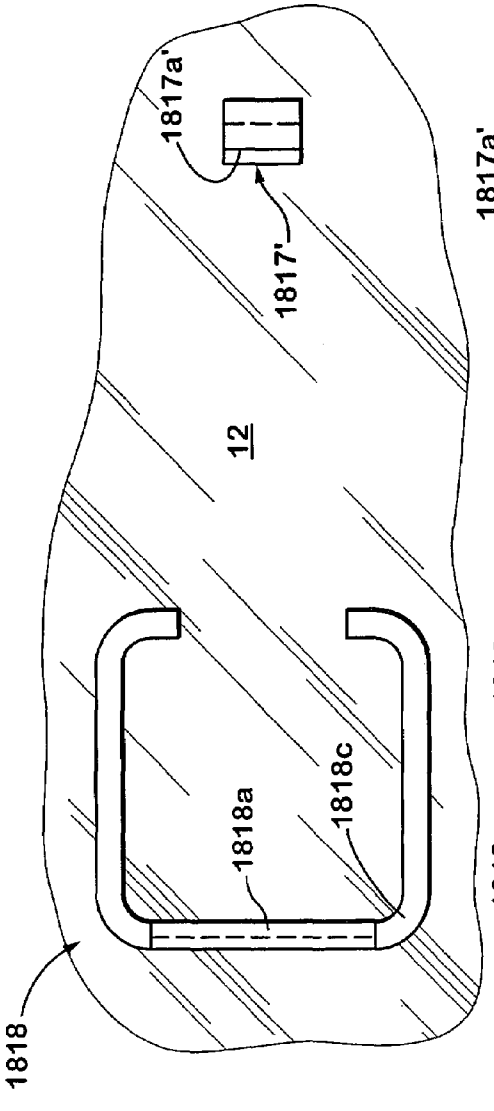


Fig. 54B

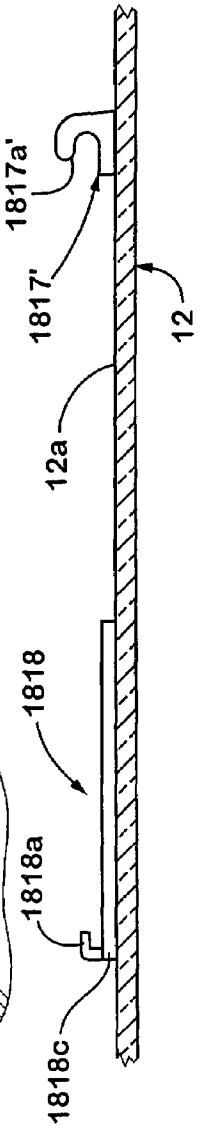
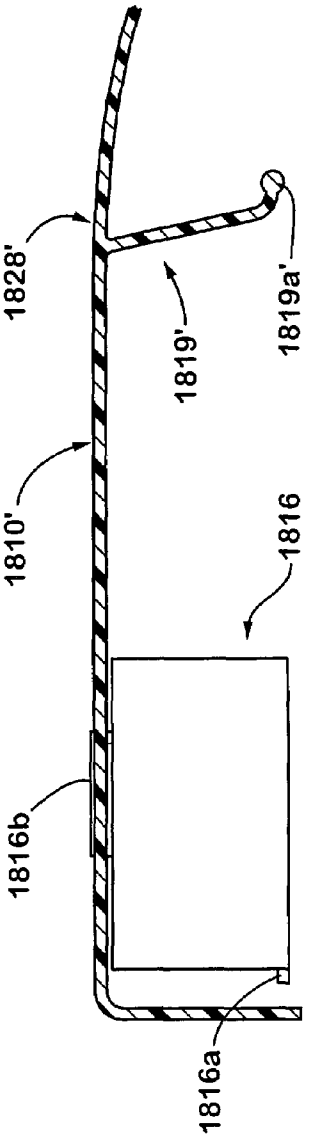


Fig. 55



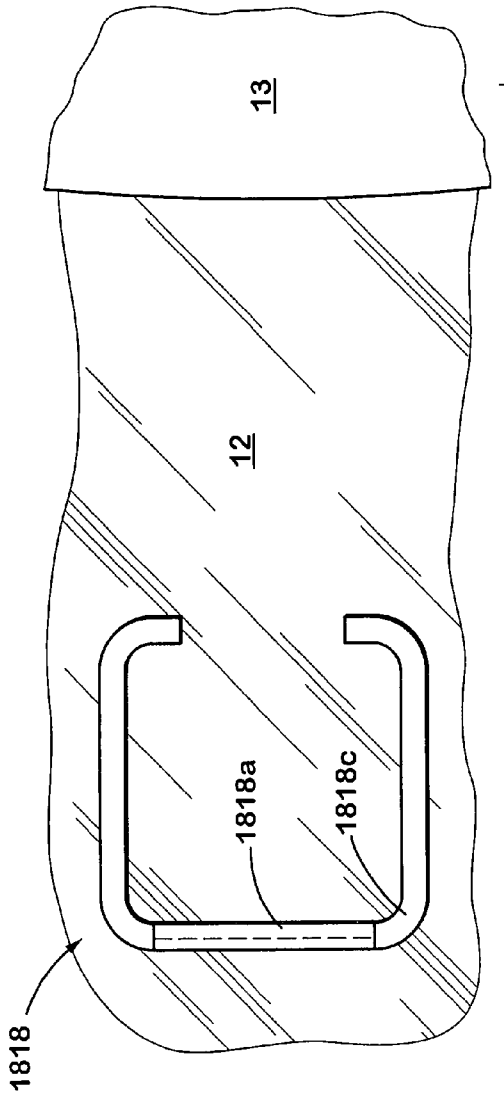


Fig. 56A

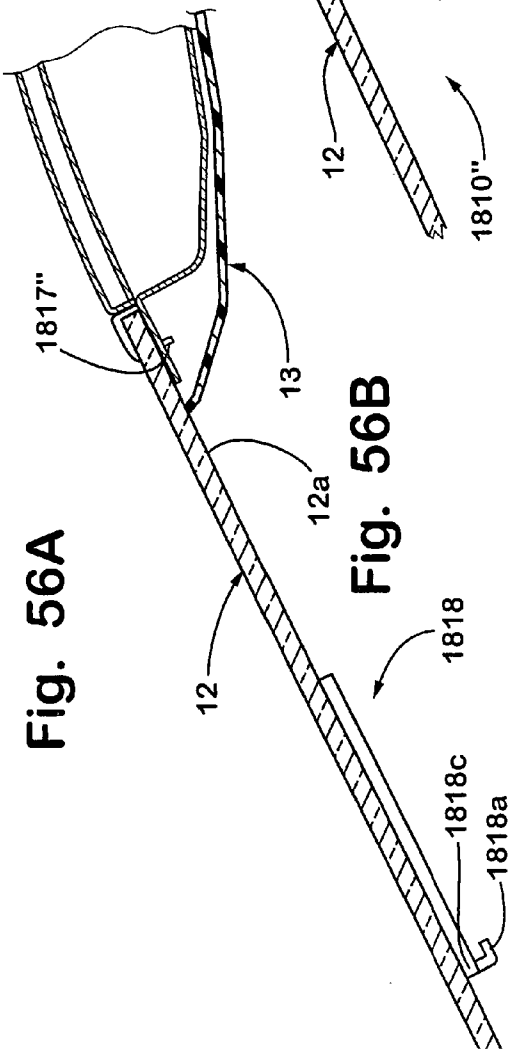


Fig. 56B

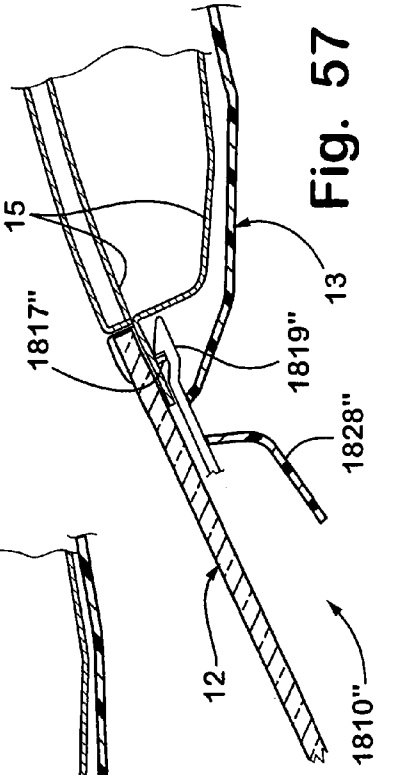


Fig. 57

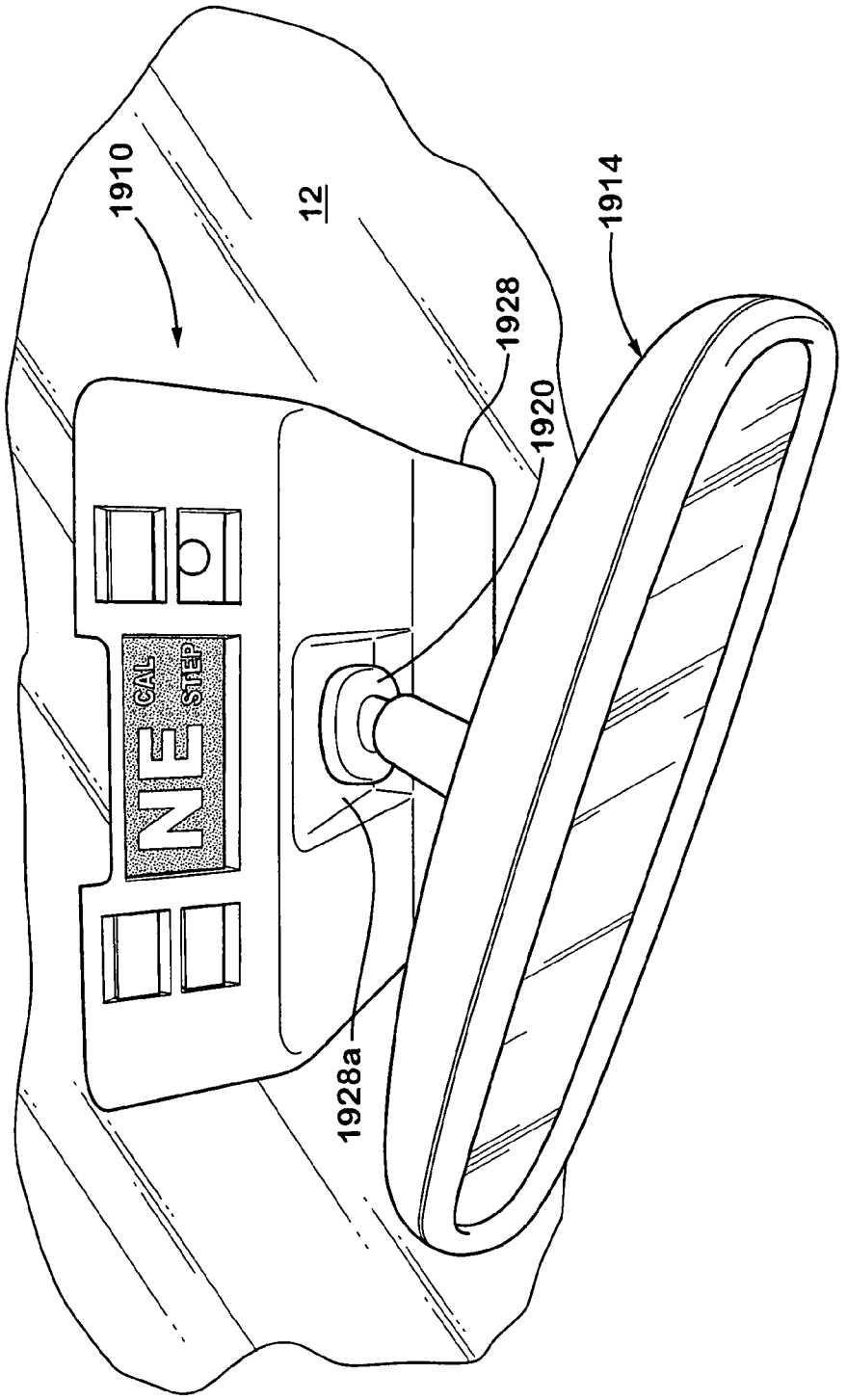


Fig. 58A

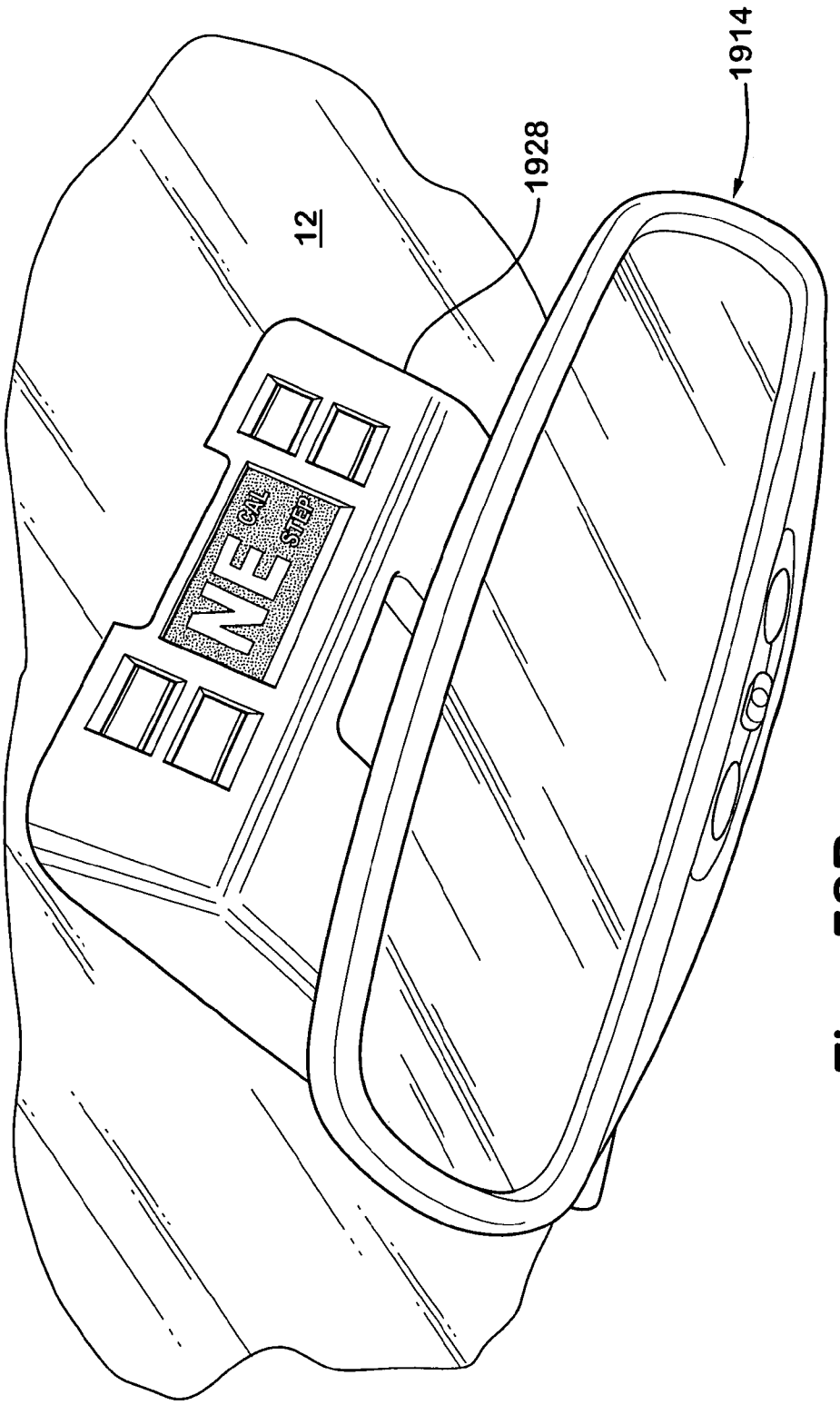


Fig. 58B

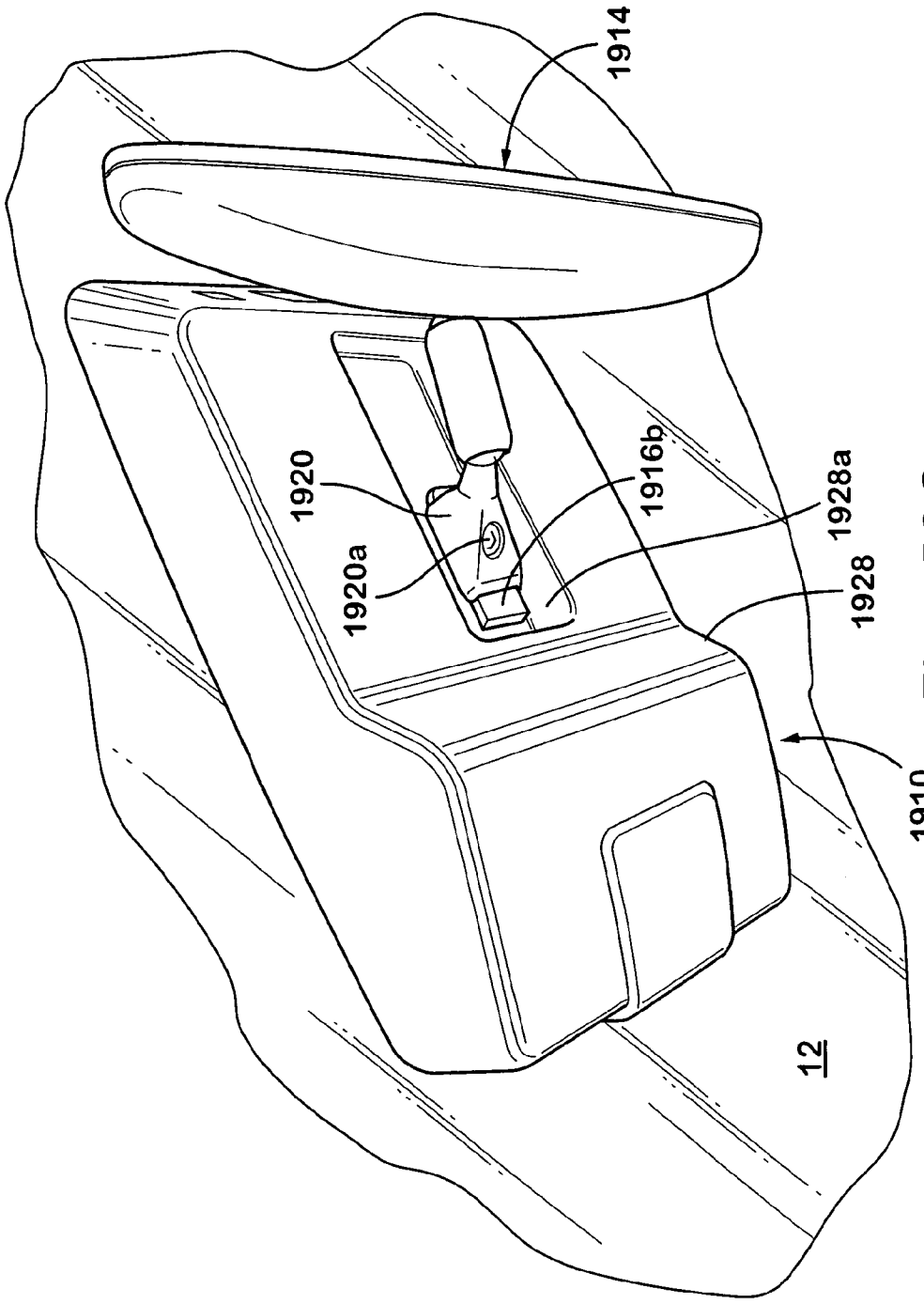


Fig. 58C

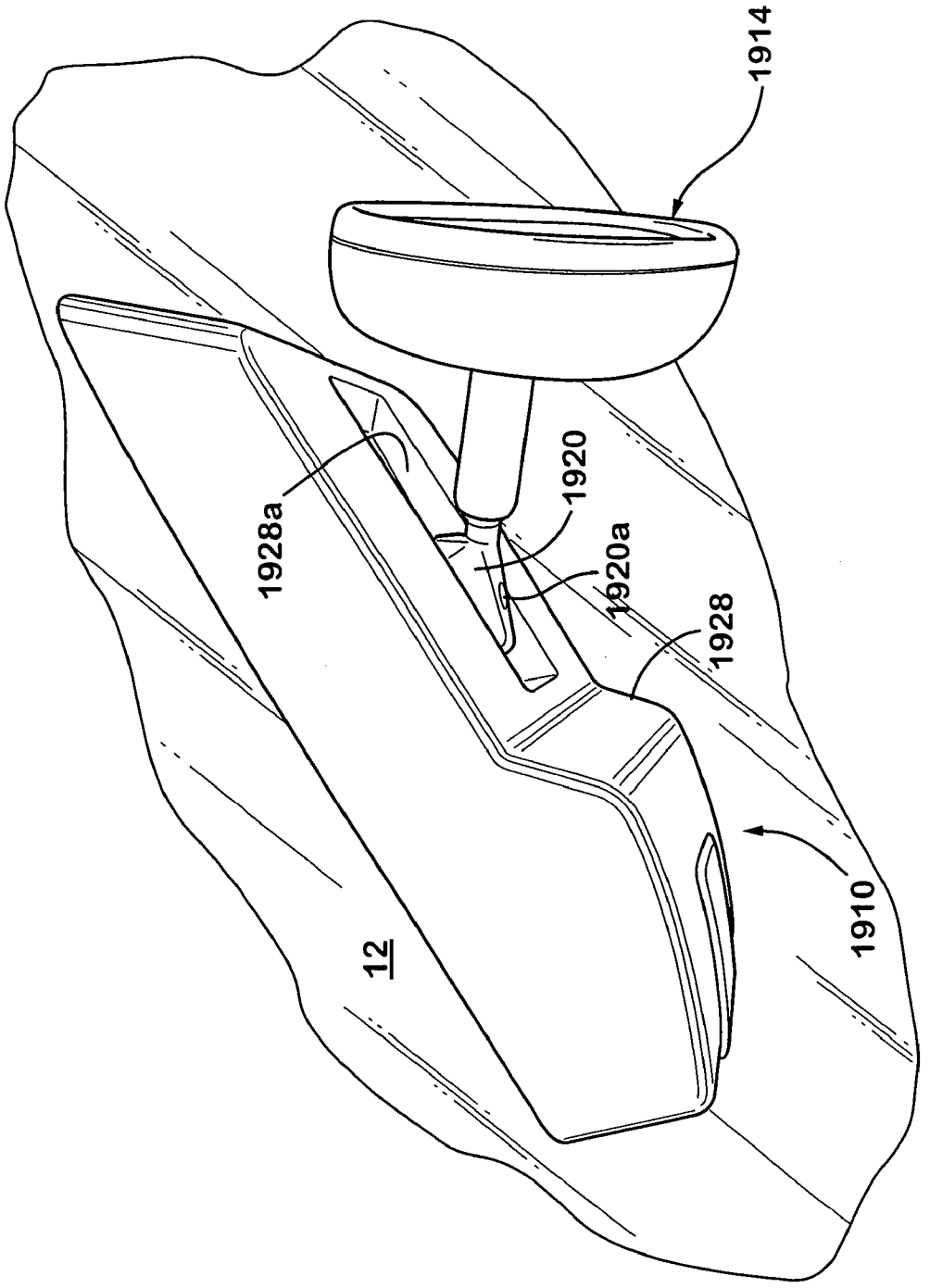


Fig. 58D

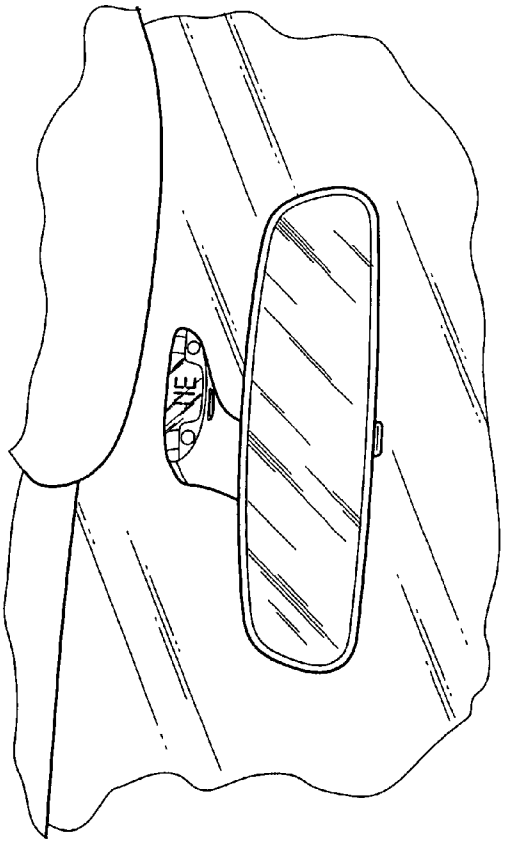


Fig. 60

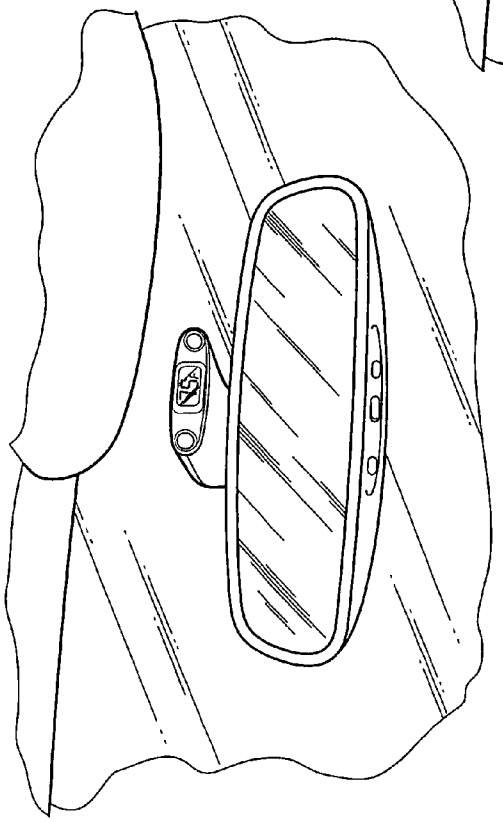


Fig. 59

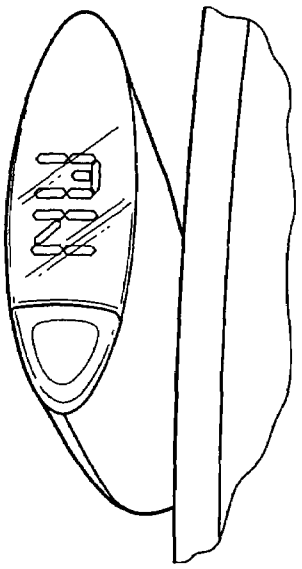


Fig. 61B

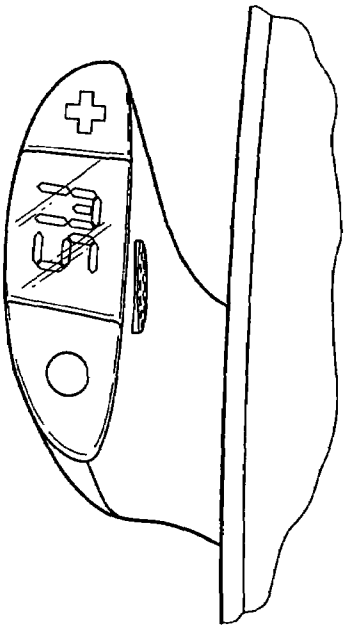


Fig. 61D

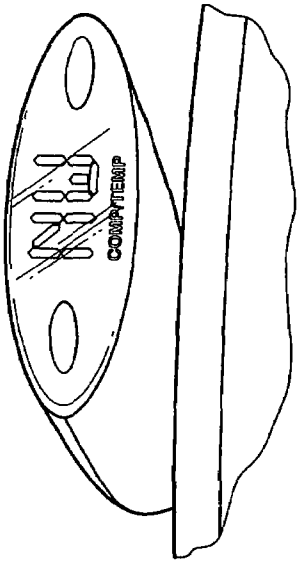


Fig. 61A

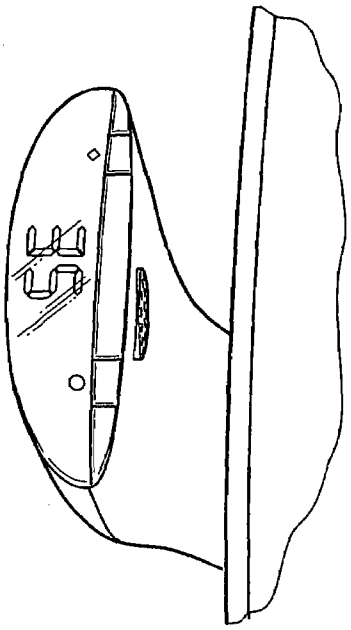


Fig. 61C

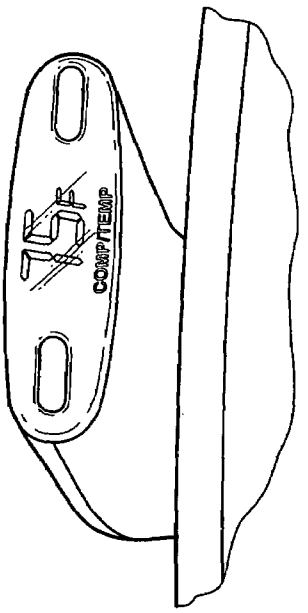


Fig. 61G

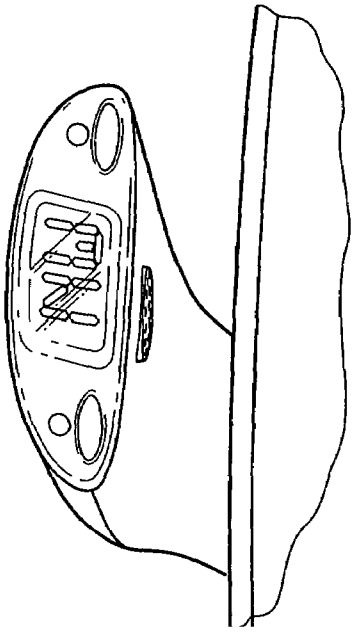


Fig. 61E

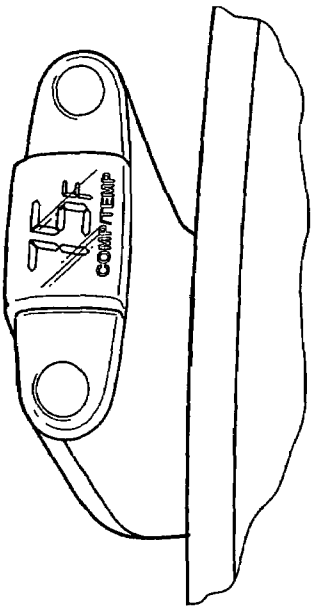


Fig. 61F

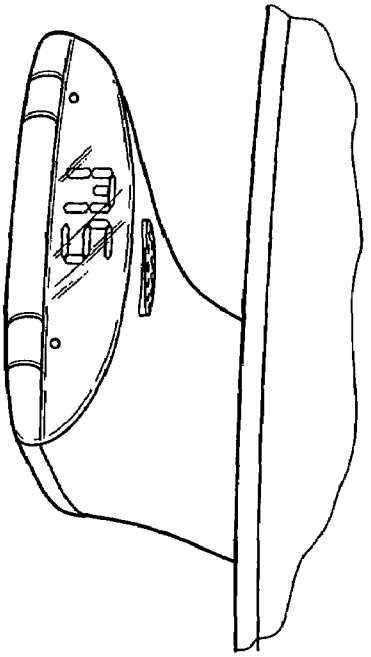


Fig. 61I

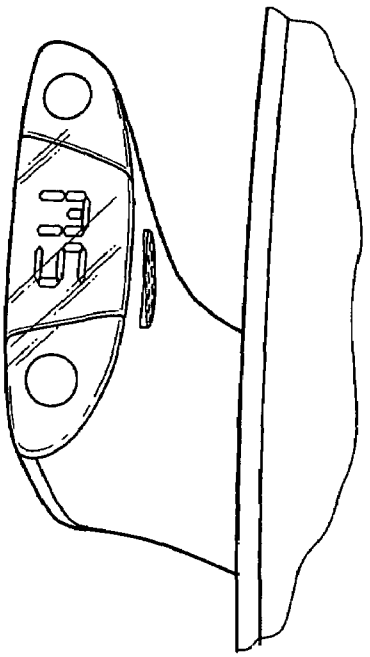


Fig. 61H

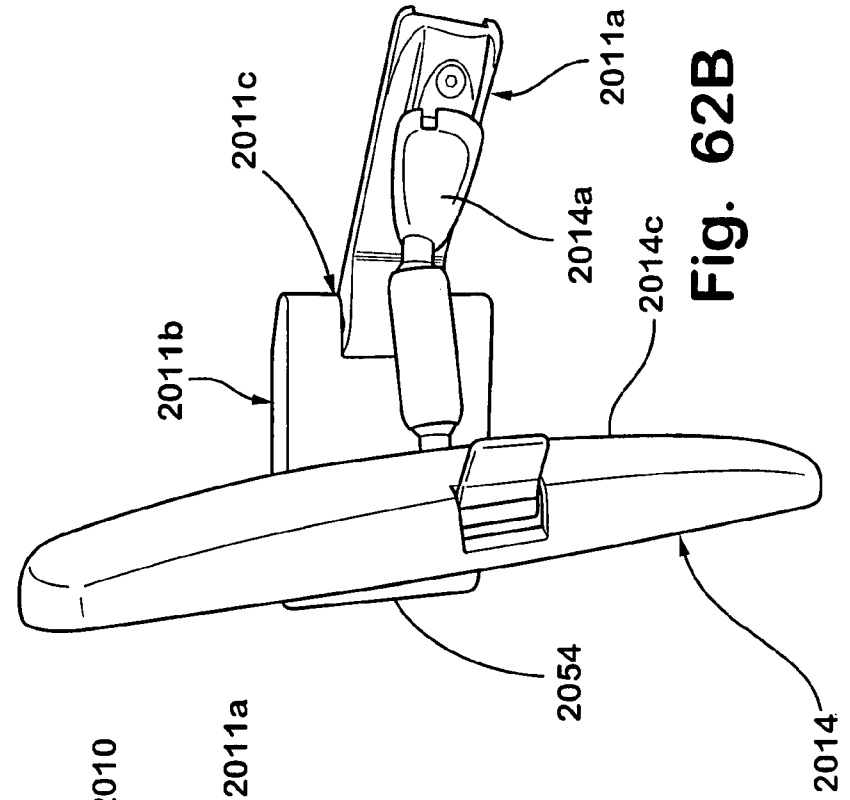


Fig. 62B

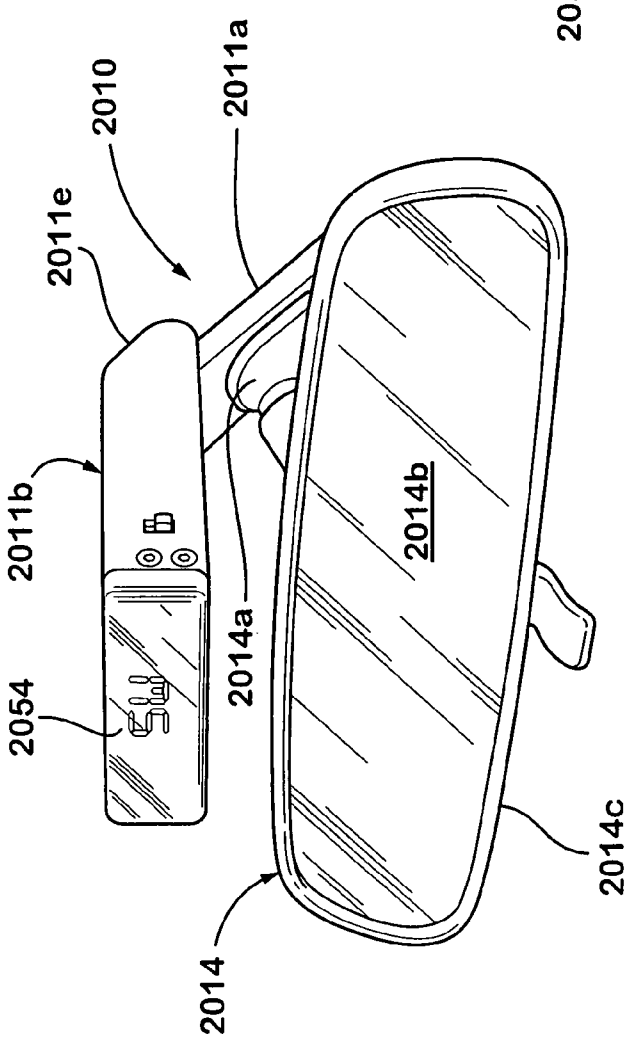


Fig. 62A

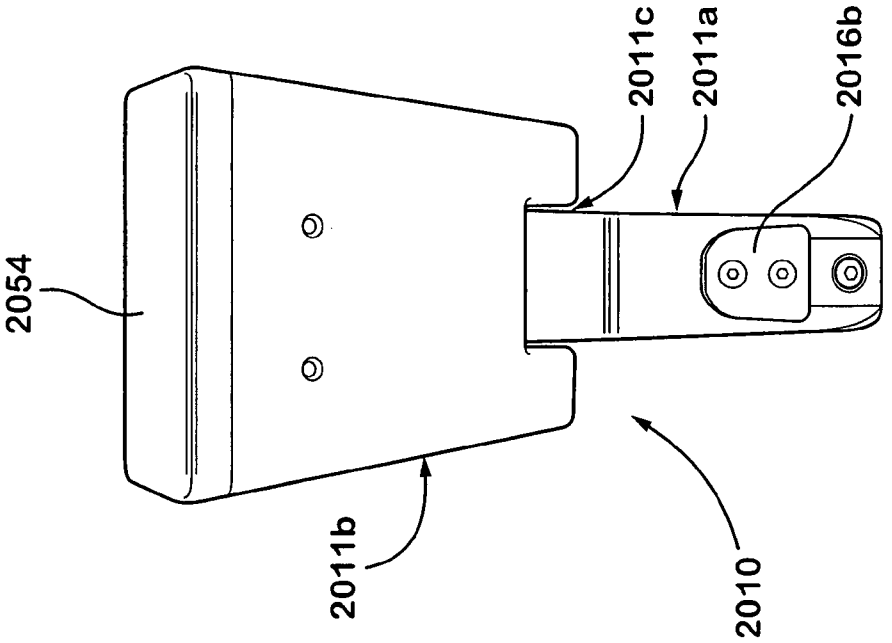


Fig. 63B

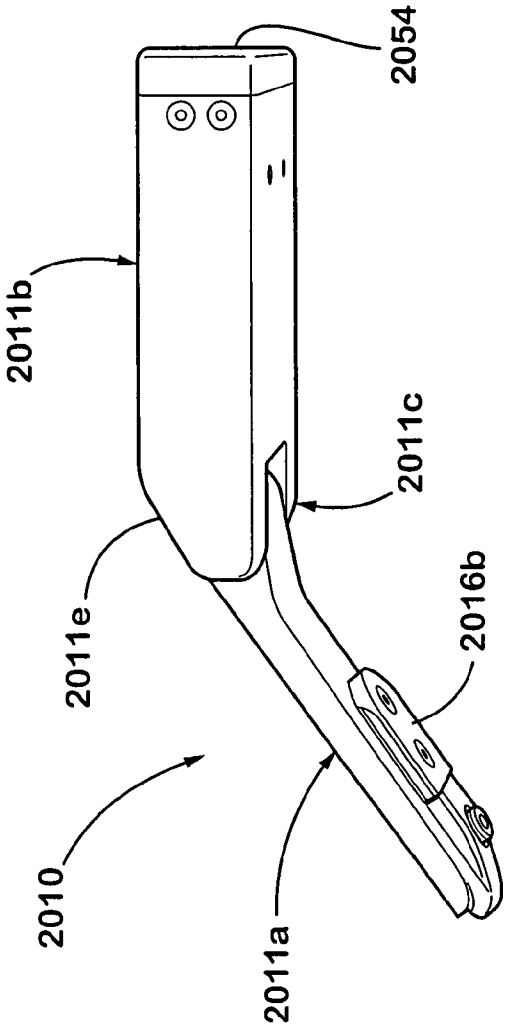


Fig. 63A

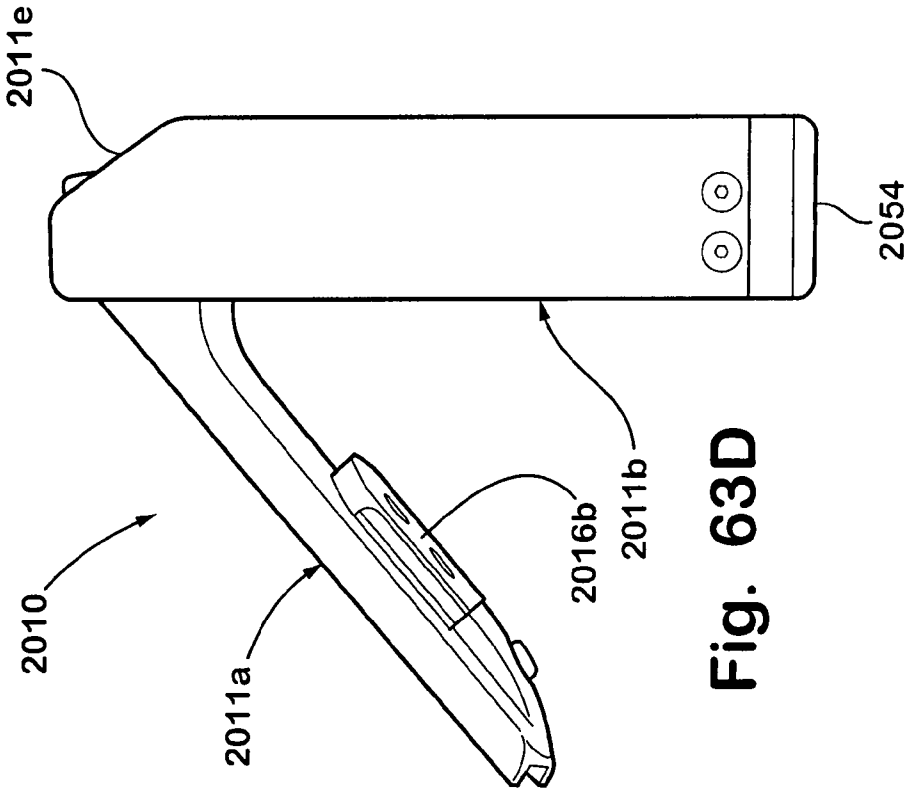


Fig. 63D

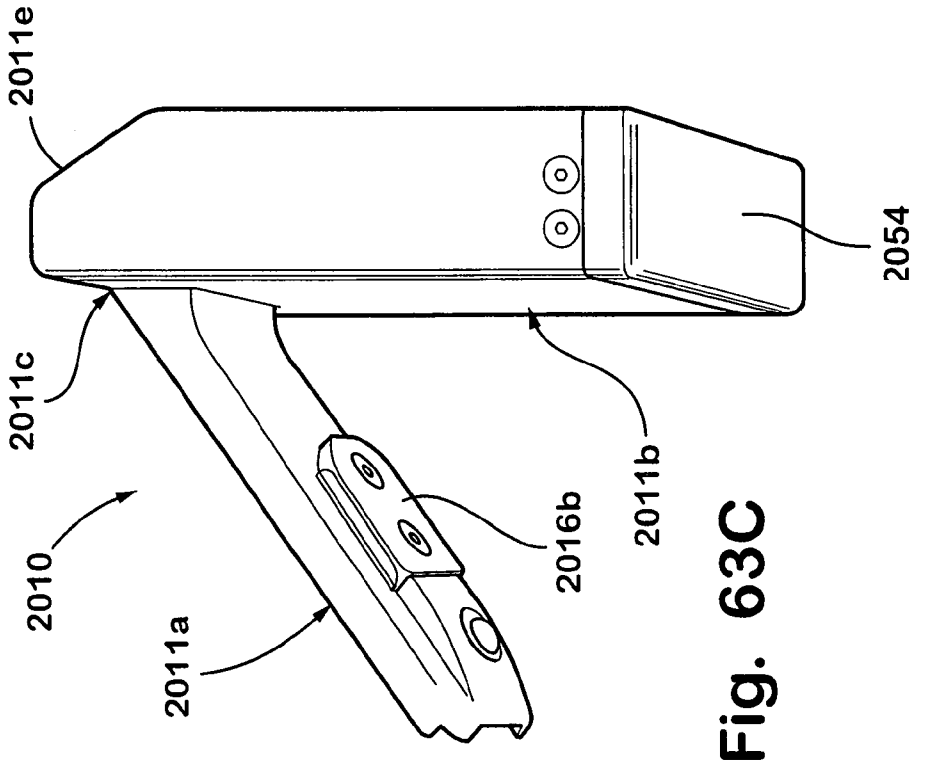


Fig. 63C

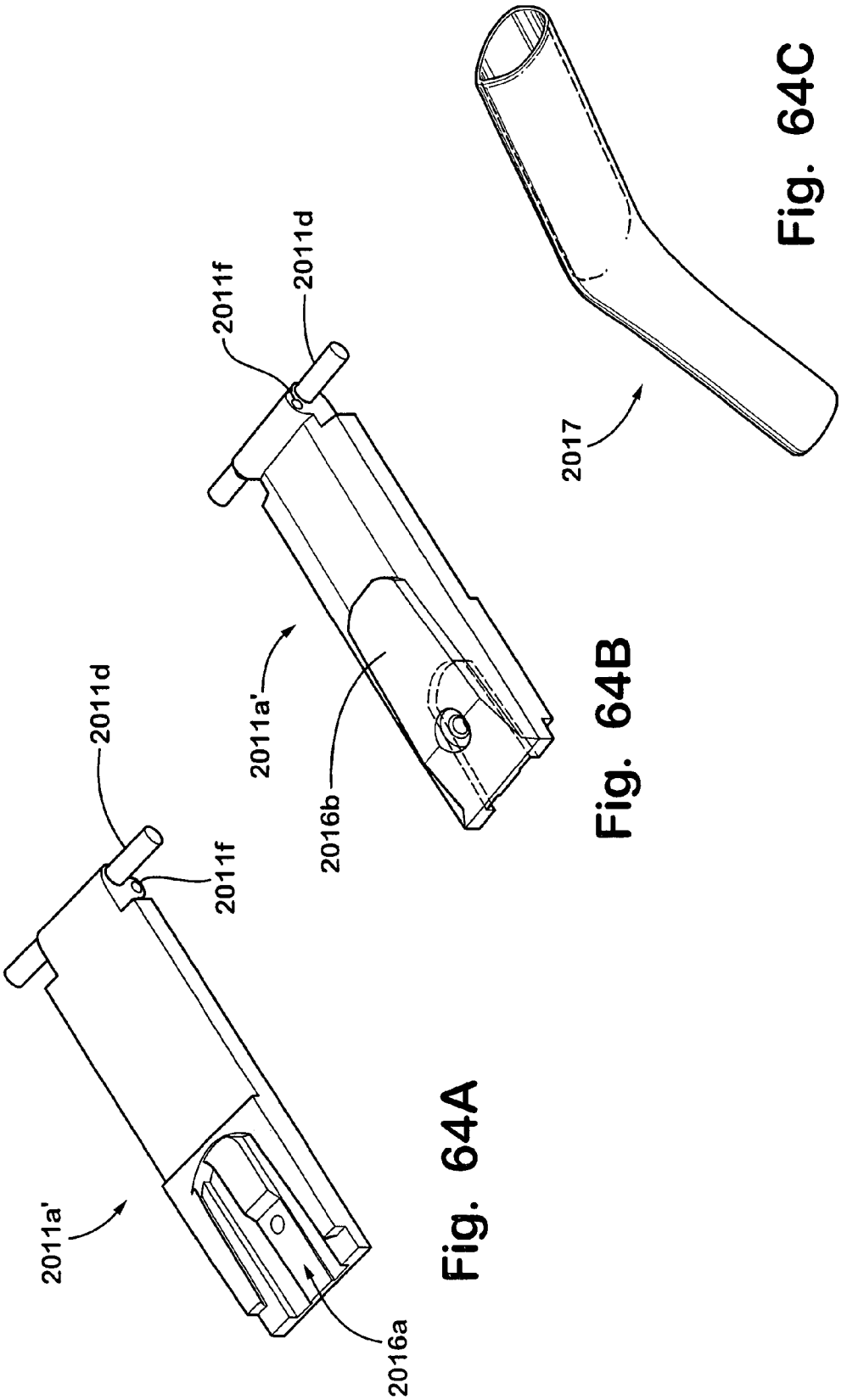


Fig. 64A

Fig. 64B

Fig. 64C

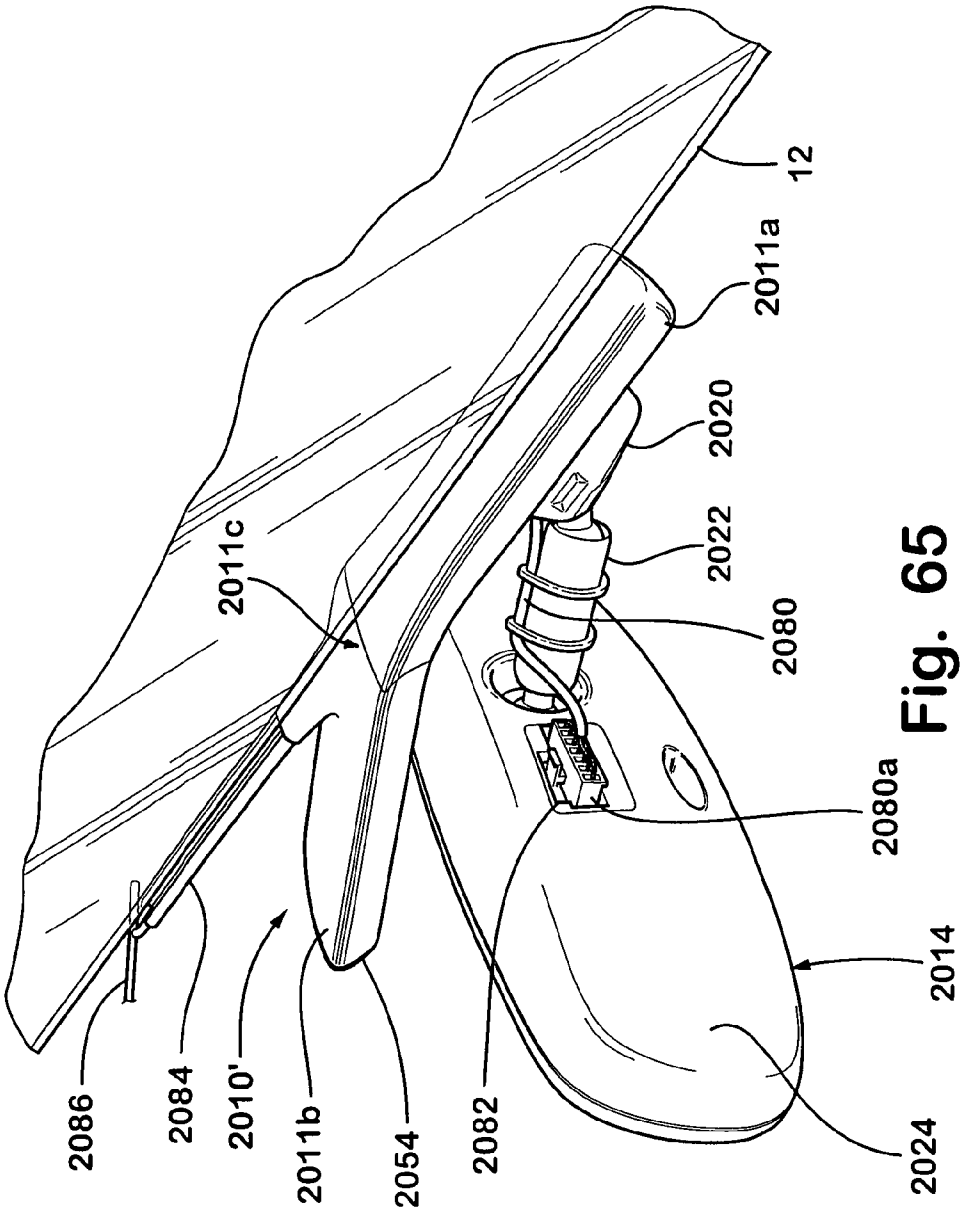

12
2011a
2020
2022
2080
2011c
2080a
2014
2024
2086
2084
2010'
2011b
2054
2082

Fig. 65

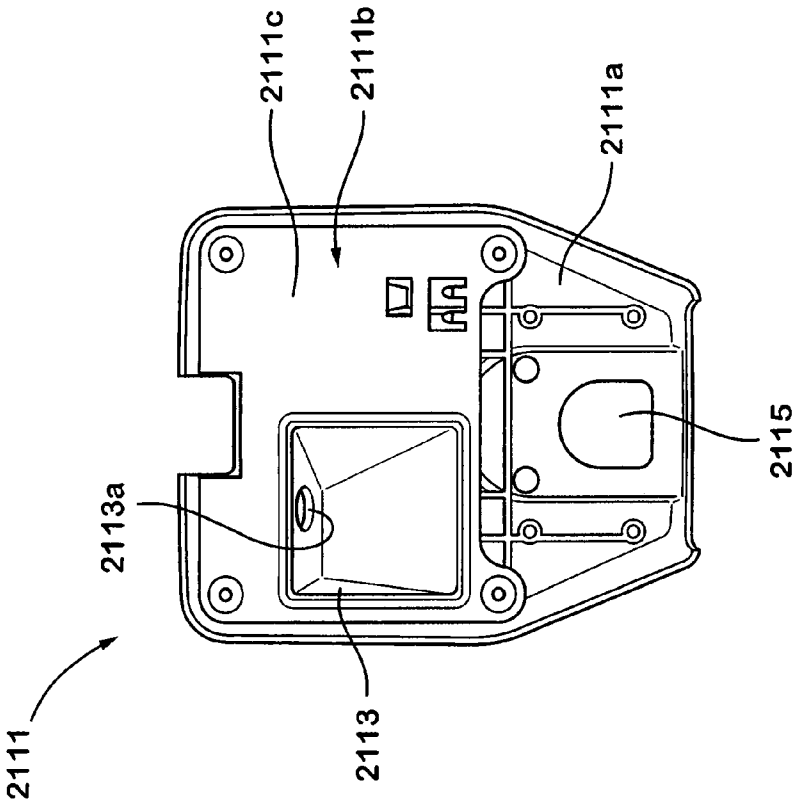


Fig. 66B

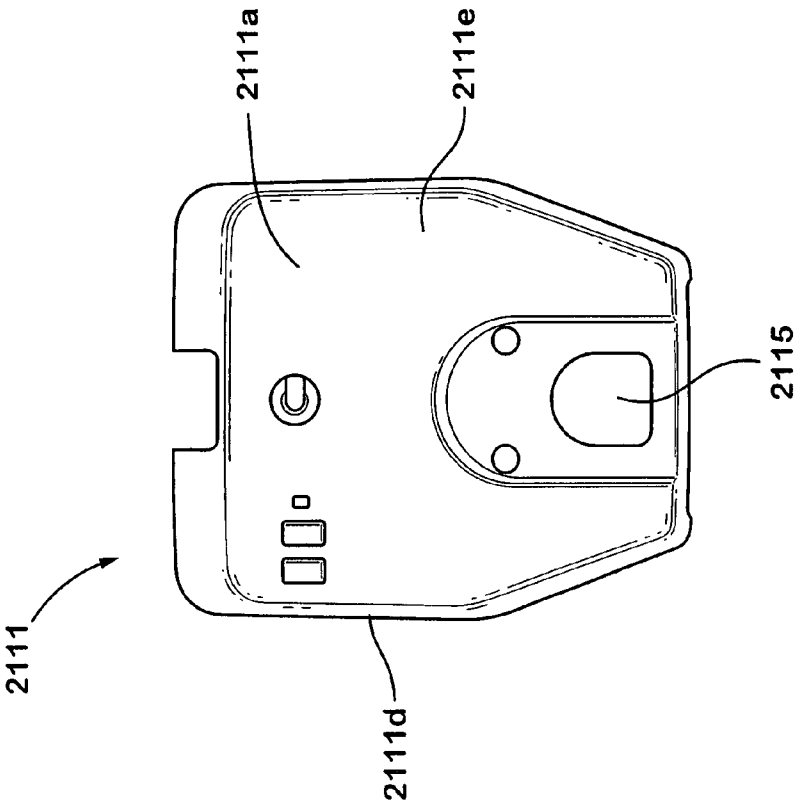


Fig. 66A

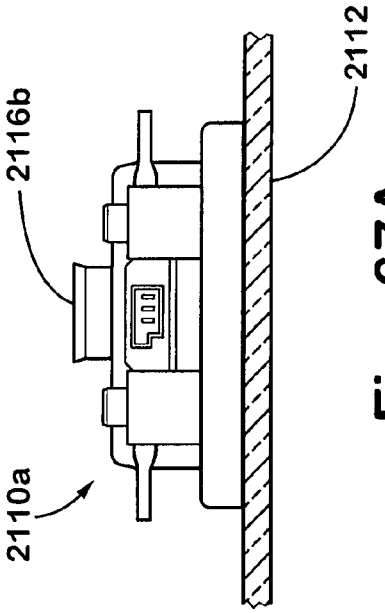


Fig. 67A

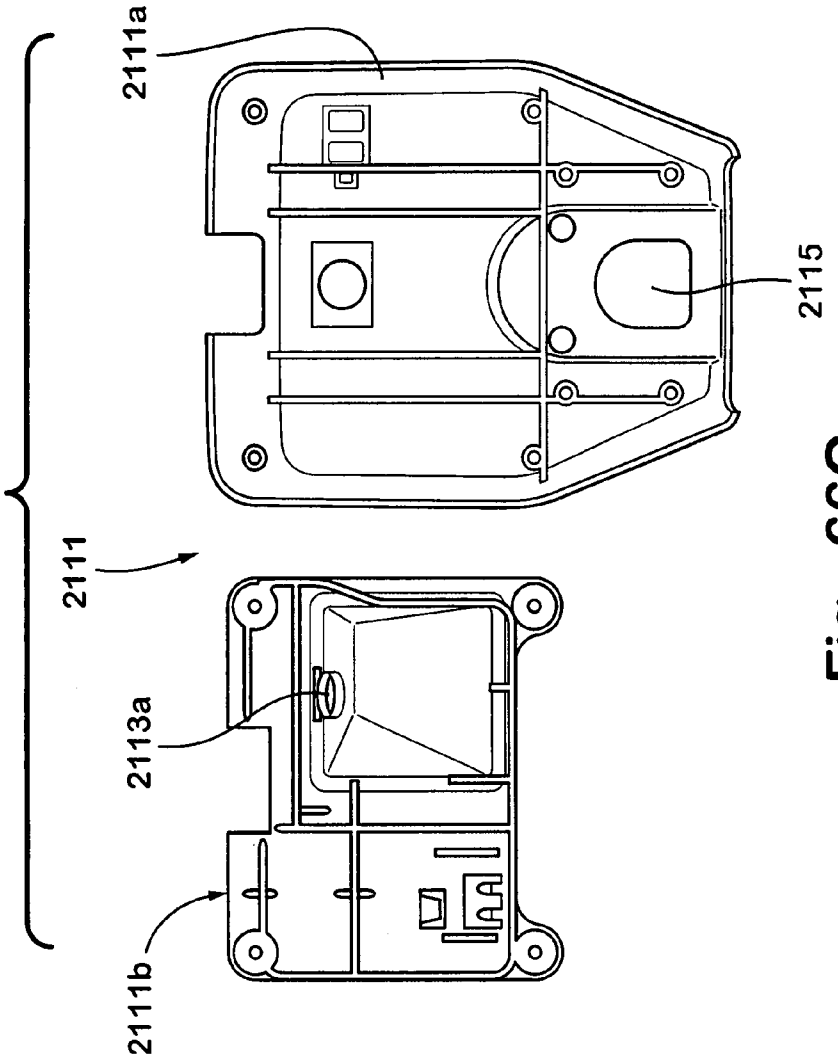


Fig. 66C

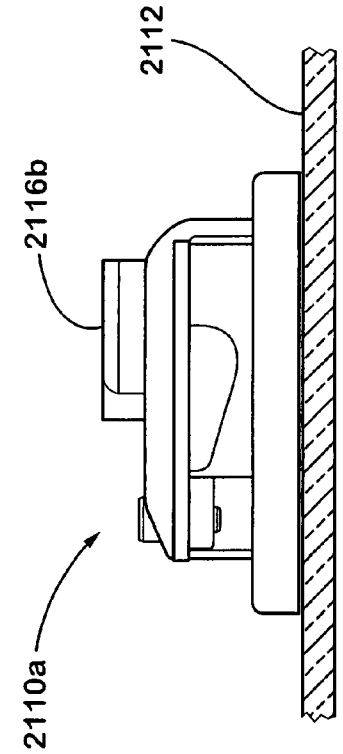


Fig. 67C

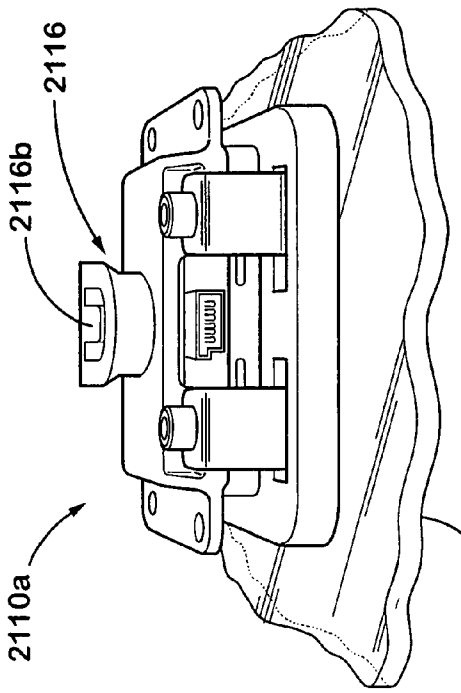


Fig. 67B

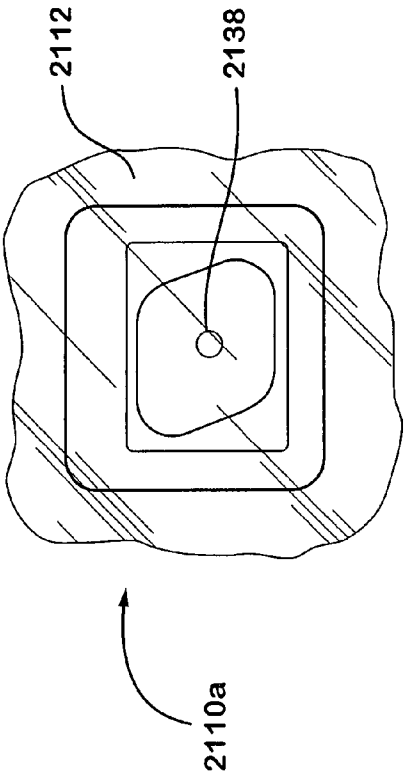


Fig. 67D

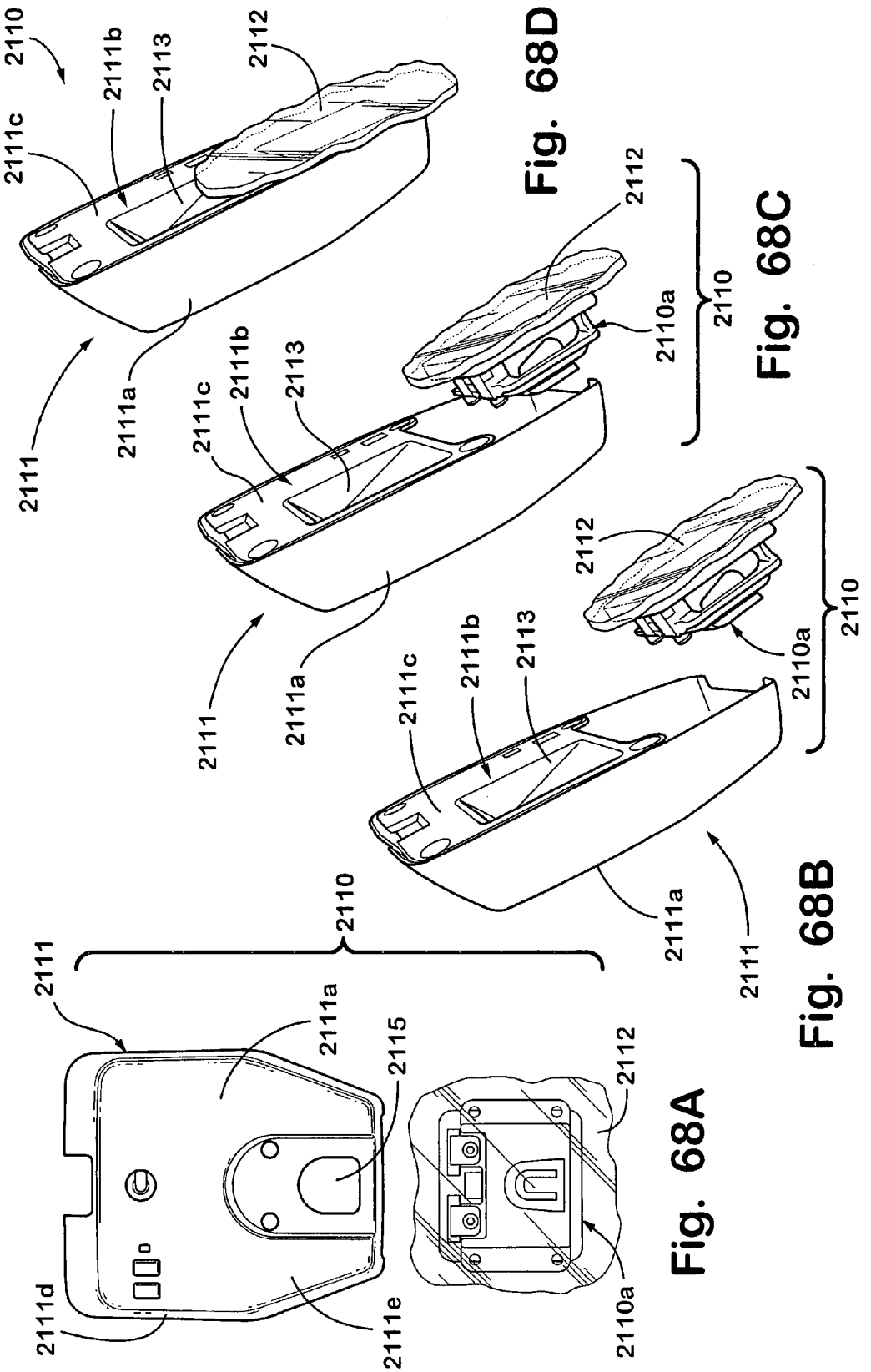


Fig. 68D

Fig. 68C

Fig. 68B

Fig. 68A

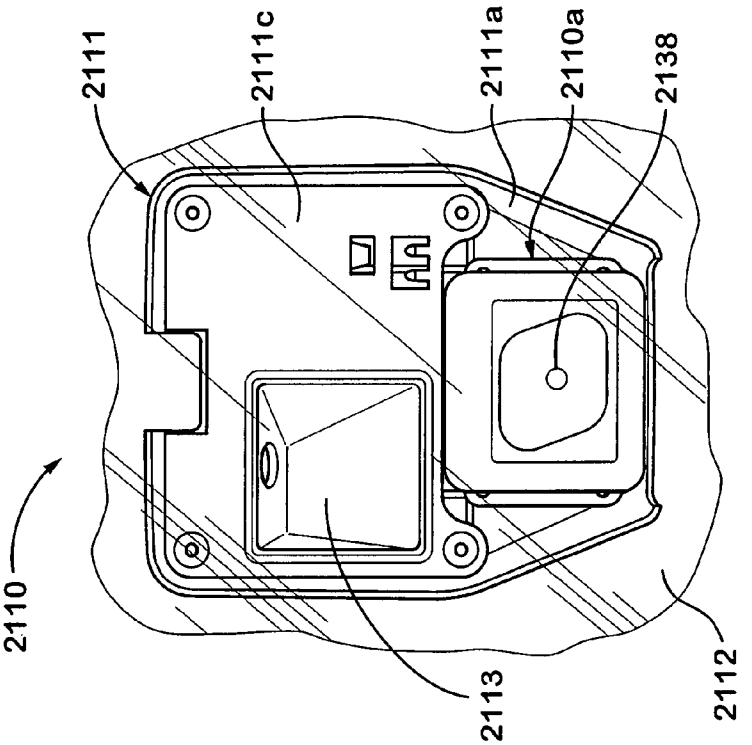


Fig. 68F

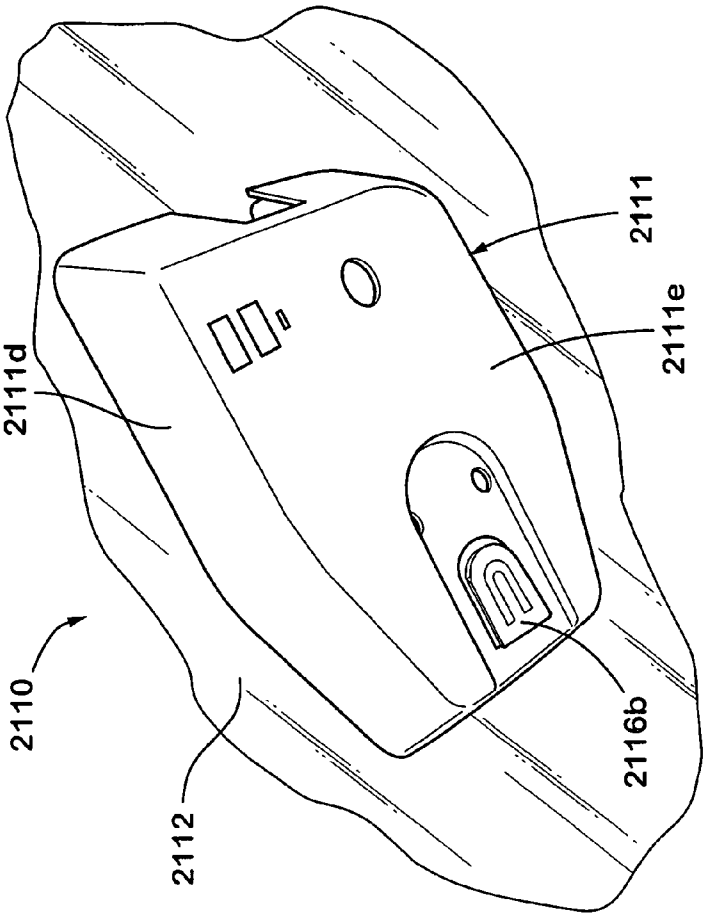


Fig. 68E

VEHICLE ACCESSORY MODULE

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation of U.S. patent application Ser. No. 10/958,087, filed Oct. 4, 2004, now U.S. Pat. No. 7,188,963, which is a division of U.S. patent application Ser. No. 10/355,454, filed Jan. 31, 2003, by Schofield et al., entitled VEHICLE ACCESSORY MODULE, now U.S. Pat. No. 6,824,281, which claims priority of U.S. provisional applications, Ser. No. 60/420,560, filed Oct. 23, 2002; Ser. No. 60/398,346, filed Jul. 24, 2002; Ser. No. 60/381,314, filed May 17, 2002; Ser. No. 60/374,724, filed Apr. 23, 2002; Ser. No. 60/364,008, filed Mar. 14, 2002; and Ser. No. 60/350,965, filed Jan. 31, 2002, which are all hereby incorporated herein by reference in their entireties.

FIELD OF THE INVENTION

The present invention relates generally to accessories useful for a vehicle and, more particularly, to accessories used in windshield electronic modules and interior rearview mirror assemblies.

BACKGROUND OF THE INVENTION

Certain accessories of a vehicle, such as a rain sensor or imaging sensor, typically are mounted tight against an interior surface of a windshield or window. This is required in some cases to maintain a desired distance between a light emitter/light sensor and the interior surface of the windshield, and/or to optically couple the component to the windshield, and/or to substantially seal the component at the windshield to prevent dust, dirt, smoke or other contaminants from affecting the component. In order to mount the accessories, it is desirable to move the accessories generally perpendicular to the surface of the window to avoid scratching of the window or the accessory by sliding the accessory relative to the window. It may be difficult for automobile assembly-line operators to mount such accessories onto, for example, a mirror mounting button on the interior surface of the windshield of a vehicle being assembled, since the assembly processes require multiple operations at the vehicle assembly plant.

Many camera-based accessories used in vehicles today require viewing through a window or windshield of the vehicle. The camera or sensor may be a contacting type of sensor, where the sensor is in contact with the interior surface of the windshield, or may be spaced from the windshield. It is desired to provide a blacked out area or ceramic frit region in areas where such accessories are mounted at the windshield, in order to enhance the appearance of the vehicle. Therefore, an aperture or port may have to be formed in the frit layer for the camera or image sensor to be aligned with. However, the frit layer then may include the port or aperture even for vehicles where the camera-based accessory is not selected as an option. In order to provide an appropriate frit layer for the camera-based accessory option, the vehicle manufacturer may need to plan or design different frit layers for different options available to the vehicle, which may result in a proliferation of windshields and part numbers for the different optional accessories.

Therefore, there is a need in the art for an accessory module that overcomes the shortcomings of the prior art devices.

SUMMARY OF THE INVENTION

The present invention is intended to provide an accessory module which is readily mountable at an interior surface of a windshield of a vehicle. The accessory module is mounted and preferably loaded to and against the windshield to maintain close and tight coupling of accessories within the module, such as a rain sensor, temperature sensor, image sensor and/or the like. The accessory module may have a head portion or accessory housing which is attached to or movably attached to a base portion which is mountable at an interior surface of a vehicle windshield.

According to an aspect of the present invention, an accessory system for a vehicle comprises a vehicle windshield having a first attachment member affixed thereto, an accessory module assembly comprising a mounting portion and a head portion, and an interior rearview mirror assembly. The mounting portion is configured to mount to the first attachment member and extends generally upward when mounted to the first attachment member. The mounting portion has a second attachment member. The head portion is at an upper portion of the mounting portion and extends generally horizontally and rearwardly from the upper portion with respect to the vehicle when the mounting portion is mounted to the first attachment member. The head portion comprises electronic circuitry for at least one accessory. The interior rearview mirror assembly comprises a mirror casing and a reflective element, and is mountable to the second attachment member. The head portion of the accessory module assembly extends from the upper portion of the mounting portion generally above the mirror casing. The head portion is at least one of viewable and user accessible above the mirror casing when the mirror assembly is mounted to the second attachment member.

The head portion may be movably attached to the upper portion of the mounting portion and may be movable relative to the mounting portion. The head portion may be pivotally mounted to the upper portion of the mounting portion and may be pivotable sidewardly relative to the mounting portion about a generally vertical pivot axis to adjust the angle of the accessory housing with respect to the driver of the vehicle, and/or may be pivotable upwardly and downwardly relative to the mounting portion about a generally horizontal pivot axis to adjust the angle of the accessory housing with respect to the driver of the vehicle.

The head portion may be articulatably mounted to the upper portion of the mounting portion and may be articulatable relative to the mounting portion about a pivot axis, wherein the pivot axis comprises a generally horizontal pivot axis when the mounting portion is mounted to the first attachment member. The head portion may be articulatable between a mounting orientation or folded orientation, where the head portion is positioned to be generally along the mounting portion, and an in-use orientation or non-folded orientation, where the head portion extends generally horizontally and rearwardly from the upper portion with respect to the vehicle when the mounting portion is mounted to the first attachment member. The head portion may be articulatable to the mounting orientation to facilitate mounting of the accessory module assembly to the first mirror attachment member. The head portion may extend generally horizontally and rearwardly with respect to the vehicle and generally above the mirror casing when the mounting portion is mounted to the first attachment member and when the head portion is in the in-use

orientation and when the interior rearview mirror assembly is mounted to the second mounting member. The accessory module assembly may comprise a biasing element which biases the head portion toward the in-use orientation relative to the mounting portion.

Optionally, the head portion may comprise a display element and/or a user input device associated with the accessory. The display element and/or user input device may be viewable and/or user accessible above the mirror casing when the mirror assembly is mounted to the second attachment member.

Optionally, the at least one accessory may comprise at least two accessories. The accessories of the head portion may at least comprise a compass sensor and a compass display, or a microphone and a user input device (where the accessory module may provide a vehicular telecommunication function and/or a telephonic function), or a user input device and a garage door opener device (where the garage door opener device is operable to actuate a garage door opener for opening a garage door) or the like.

According to another aspect of the present invention, an accessory system for a vehicle comprises a vehicle windshield having a first attachment member affixed thereto, an accessory module assembly comprising a mounting portion and a head portion, and an interior rearview mirror assembly. The mounting portion is configured to mount to the first attachment member and to extend generally upward when mounted to the first attachment member. The mounting portion has a second attachment member. The head portion is pivotally attached to the mounting portion and houses electronic circuitry of at least one accessory. The interior rearview mirror assembly comprises a mirror casing and a reflective element and is mountable to the second attachment member. The head portion of the accessory module assembly extends from the mounting portion generally above the mirror casing, such that the head portion is viewable and/or user accessible above the mirror casing when the mirror assembly is mounted to the second attachment member.

According to another aspect of the present invention, an accessory system for a vehicle comprises a vehicle windshield having an attachment member affixed thereto, an accessory module assembly and an interior rearview mirror assembly. The accessory module assembly comprises a mounting portion for mounting the accessory module assembly to the attachment member, and a head portion for housing electronic circuitry associated with at least one accessory. The head portion is articulatably mounted to the mounting portion and is articulatable relative to the mounting portion between a folded orientation, wherein the head portion is folded generally along the mounting portion, and a non-folded orientation, wherein the head portion extends generally from the mounting portion. The interior rearview mirror assembly comprises a mirror casing and a reflective element, and is mountable to the mounting portion of the accessory module assembly.

According to yet another aspect of the present invention, an accessory module assembly includes a loading element/device, which functions generally to move and load the accessory module or a housing of the accessory module toward and against the windshield in a generally perpendicular motion with respect to the interior surface of the windshield. The loading device loads the accessory module against the windshield to maintain a tight and close interface between the accessory module and the windshield.

The accessory module may comprise a mounting portion which is attachable at a windshield portion of the vehicle and a housing for housing at least one accessory. The loading device or loading element may be configured to load the housing toward and against the windshield along the mounting portion in a generally perpendicular motion with respect to the interior surface of the windshield.

In one form, the loading device includes a ratcheting device which ratchets the accessory module toward engagement with the windshield. The ratcheting device may include a plurality of teeth or the like on corresponding portions of a body of the accessory module and an extender, which may mount to and extend from a mirror mounting button on a windshield. The corresponding teeth provide ratcheting of the module body toward and against the windshield, while also substantially limiting or precluding movement of the module body away from the windshield.

In another form, the loading device may include a pivotable hinge device which pivots the accessory module body toward engagement with the windshield.

The accessory module of the present invention may include one or more accessories and controls and may include a display, indicator and/or user interface buttons or switches or the like. The accessory module may include an electrical connection to the vehicle power and controls. The electrical connection may be connected during ratcheting or loading of the accessory module toward and against the windshield, such as via a snap connection, press contact or other means of connecting electrical components within the accessory module to the electrical system of the vehicle.

The accessory module may also include an electrical connector for connecting the electrical components or circuitry of the mirror head as the mirror head is mounted to the accessory module. The accessory module may include a pin connector or the like extending through and from a ball member, such that electrical connection is made as the mirror head is snapped or otherwise secured to the ball member.

According to another aspect of the present invention, an accessory module for a vehicle comprises a housing for housing at least one accessory of the vehicle and a pivotable hinge device positionable at a headliner portion of the vehicle. The housing is pivotably mounted at the pivotable hinge device, which is configured to pivot the housing toward and into engagement with a windshield of the vehicle. The hinge device is -configured to substantially lock the housing into engagement with the windshield.

The accessory module may include a mirror attachment member at the housing for attaching an interior rearview mirror assembly when the housing is substantially locked into engagement with the windshield. The accessory module may also include an electrical connector for connecting to at least one electrical component or circuitry of the interior rearview mirror assembly. The electrical connector may connect the at least one electrical component or circuitry of the interior rearview mirror assembly as the interior rearview mirror assembly is mounted to the mirror attachment member.

The hinge device may be biased to urge the housing toward and against the windshield. The hinge device may comprise a spring-loaded hinge device, which urges and substantially locks the housing toward and into engagement with the windshield.

Therefore, the present invention provides an accessory module which is readily installed and/or loaded against the windshield of the vehicle. The accessory module is mounted to the windshield via connection to a standard attachment member, such as a mounting button, at the windshield, and then urged or loaded against the windshield via generally perpendicular movement of the accessory module toward the vehicle. The accessory module thus provides an attachment element which is familiar and readily acceptable to an assem-

bly plant operator. Also, the accessory module of the present invention may provide for a deproliferation of part numbers at a vehicle assembly plant, since fewer part numbers for the interior rearview mirror assemblies may be needed. For vehicles with different accessories selected, a different assembly module may be mounted to the mounting attachment or button at the windshield.

Also, the accessory module or accessory module assembly of the present invention provides a head portion which may extend generally rearwardly from a mounting portion mounted to the vehicle and may extend generally above the rearview mirror when the rearview mirror is mounted to the mounting portion, such that the head portion is viewable and/or user accessible generally above the rearview mirror. The head portion may be movably or pivotally or articulatably mounted to the base or mounting portion, which is mountable to a mounting member or button at the windshield. The head portion may pivot or articulate to facilitate installation of the base portion and accessory module assembly to the mounting member, whereby the head portion may unfold or pivot to extend generally rearwardly from the base portion and generally above the mirror assembly. The accessory module thus may enhance the assembly or installation process for the accessory module to the vehicle windshield at the vehicle assembly plant. The accessory module may include a head portion which is selected to provide the desired accessory, accessories, function or functions and a common mounting portion or base.

These and other objects, advantages, purposes and features of the present invention will become apparent upon review of the specification in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side elevation and partial sectional of an interior rearview mirror assembly and accessory module in accordance with the present invention;

FIG. **2** is a perspective view of a mirror mounting button on an interior surface of a window;

FIG. **3** is a perspective view of an extension of the present invention as mounted on the button of FIG. **2**;

FIG. **4** is a perspective view of a mirror mount on the extension of FIG. **3**;

FIG. **5** is a perspective view of an accessory module body in accordance with the present invention on the extension of FIGS. **3** and **4**;

FIG. **6** is a side elevation of the accessory module of FIG. **5**, with an interior rearview mirror mounted to the mirror mount in accordance with the present invention;

FIG. **7** is a sectional view taken along the line VII-VII in FIG. **5**, showing the accessory module as the module body is being moved along the extension;

FIG. **8** is a sectional view similar to FIG. **7**, showing the accessory module body mounted to the extension and loaded against the window;

FIG. **9** is a sectional view taken along the line IX-IX in FIG. **5**, showing an image sensor mounted within the accessory module;

FIG. **10** is a lower plan view of an accessory module of the present invention similar to the accessory module of FIGS. **5-9**;

FIG. **11** is a block diagram of examples of accessories and functions of an accessory module in accordance with the present invention;

FIGS. **12**A and **12**B are side elevation and partial sectional views of an alternate embodiment of the accessory module of the present invention;

FIGS. **12**C and **12**D are front elevations of alternate embodiments of the accessory module and mirror assembly of FIGS. **12**A and **12**B, as looking forwardly with respect to the vehicle;

FIG. **13** is a perspective view of another alternate embodiment of an accessory module in accordance with the present invention;

FIG. **14** is a side elevation and partial sectional view of an alternate embodiment of an accessory module in accordance with the present invention, which is pivotable into engagement with the windshield;

FIG. **15** is a side elevation and partial sectional view of another alternate embodiment of an accessory module in accordance with the present invention, which is pivotable into engagement with the windshield;

FIG. **16** is a lower plan view of the accessory module of FIG. **15**;

FIG. **17** is a perspective view of another alternate embodiment of an accessory module in accordance with the present invention which extends along a headliner of the vehicle;

FIG. **18** is a side sectional view of another alternate embodiment of an accessory module in accordance with the present invention;

FIG. **19** is a perspective view of a platform for mounting electrical circuit boards or other electrical connections suitable for use with the present invention;

FIG. **20** is a sectional view of another alternate embodiment of an accessory module in accordance with the present invention, with a removable circuit board;

FIG. **21** is a sectional view of another alternate embodiment of an accessory module in accordance with the present invention, with a removable circuit board;

FIG. **22** is a perspective view of another alternate embodiment of an accessory module in accordance with the present invention, with removable or interchangeable side pods;

FIG. **23**A is a perspective view of another alternate embodiment of an accessory module in accordance with the present invention;

FIG. **23**B is a sectional view of the accessory module taken along the line B-B in FIG. **23**A;

FIGS. **24**A and **24**B are perspective views of another accessory module in accordance with the present invention;

FIGS. **25**A-**25**C are perspective views of a mirror assembly mounted on the accessory module of FIGS. **24**A and **24**B;

FIGS. **26**A-**26**D are views of another accessory module in accordance with the present invention;

FIG. **27** is a side elevation and partial sectional view of another accessory module in accordance with the present invention;

FIG. **28** is a partial sectional view of an extender and fastener for the accessory module of FIG. **27**;

FIG. **29** is a forward facing view of the accessory module and interior rearview mirror assembly of FIG. **27**;

FIG. **30** is a perspective view of a printed circuit board suitable for use with the accessory module of FIGS. **27** and **29**;

FIG. **31** is a top plan view of a vehicle incorporating the accessory module of FIGS. **27-30**;

FIG. **32** is a side elevation of the vehicle of FIG. **31**;

FIG. **33** is a side elevation of another accessory module in accordance with the present invention;

FIG. **34** is a side elevation of yet another accessory module in accordance with the present invention;

FIG. **35**A is a plan view of a windshield button useful with an accessory module of the present invention;

FIG. **35**B is a side elevation of the windshield button of FIG. **35**A;

FIG. **36** is a side elevation and partial sectional view of a mount extension of the present invention adapted to mount on the windshield button of FIGS. **35**A and **35**B;

FIGS. **37**A and **37**B are a side view and a top view of another mounting button useful with an accessory module of the present invention;

FIGS. **38**A and **38**B are perspective views of a mount extension and button of an accessory module in accordance with the present invention;

FIG. **38**C is a side elevation and partial sectional view of the accessory module of FIGS. **38**A and **38**B;

FIG. **38**D is a sectional view taken along the line D-D in FIG. **38**C;

FIGS. **39**A and **39**B are a plan view and a side view of another mounting button useful with an accessory module of the present invention;

FIGS. **40**A and **40**B are a plan view and a side view of a mount extension of the present invention adapted to mount on the windshield button of FIGS. **39**A and **39**B;

FIG. **41** is a partial sectional view of the retaining tab of the mount extension of FIGS. **40**A and **40**B as mounted on the button of FIGS. **39**A and **39**B;

FIG. **42**A is a plan view of another mounting button useful with an accessory module of the present invention;

FIG. **42**B is a sectional view of a retaining tab or hook of the button taken along the line B-B in FIG. **42**A;

FIGS. **43**A and **43**B are a plan view and a side view of a mount extension of the present invention adapted to mount to the button of FIG. **42**A;

FIG. **43**C is a sectional view taken along the line C-C in FIG. **43**B;

FIG. **44** is a side and partial sectional view of the retaining tab of the button of FIGS. **42**A and **42**B and the spring and hook of the mount extension of FIGS. **43**A-C, as retained together;

FIGS. **45**A and **45**B are a plan view and a side view of a windshield mounting member with an extension at an end thereof having a mounting button for a mirror;

FIGS. **46**A-C are a plan view, a side view and an end view of a mounting button useful with an accessory module of the present invention;

FIGS. **47**A and **47**B are an end view and a side view of a mount extension of the present invention adapted to mount to the mounting button of FIGS. **46**A-C;

FIG. **48** is a side elevation and partial sectional view of the retaining tabs or hooks of the mounting button of FIGS. **46**A-C and the mount extension of FIGS. **47**A and **47**B, as retained together;

FIGS. **49**A and **49**B are a plan view and a side view of a mounting button useful with an accessory module of the present invention;

FIGS. **50**A and **50**B are a plan view and a side view of a mount extension of the present invention adapted to mount to the mounting button of FIGS. **49**A and **49**B;

FIG. **51** is a plan view of a retainer for securing the mount extension of FIGS. **50**A and **50**B to the button of FIGS. **49**A and **49**B;

FIGS. **52**A and **52**B are a plan view and a side view of a mounting button arrangement for mounting an accessory module of the present invention to the windshield;

FIG. **53** is a side elevation and sectional view of a mount extension and accessory module of the present invention adapted for mounting to the button arrangement of FIGS. **52**A and **52**B;

FIGS. **54**A and **54**B are a plan view and a side view of another mounting button arrangement for mounting an accessory module of the present invention to the windshield;

FIG. **55** is a side elevation and sectional view of a mount extension and accessory module of the present invention adapted for mounting to the button arrangement of FIGS. **54**A and **54**B;

FIGS. **56**A and **56**B are a plan view and a side view of another mounting button arrangement for mounting an accessory module of the present invention to the windshield;

FIG. **57** is a side elevation and sectional view of a mounting tab for securing the accessory module to the button arrangement of FIGS. **56**A and **56**B;

FIGS. **58**A-D are perspective views of another accessory module in accordance with the present invention;

FIG. **59** is a perspective view of another accessory module of the present invention with an electrochromic mirror assembly mounted thereto;

FIG. **60** is a perspective view of another accessory module of the present invention with a prismatic mirror assembly mounted thereto;

FIGS. **61**A-I are perspective views of other embodiments of an accessory module in accordance with the present invention;

FIGS. **62**A and **62**B are perspective views of an articulatable accessory module of the present invention, with an interior rearview mirror assembly attached thereto;

FIGS. **63**A-D are perspective views of the articulatable accessory module of FIGS. **62**A and **62**B, with the interior rearview mirror assembly removed therefrom;

FIGS. **64**A and **64**B are perspective views of a base or mounting portion useful with the articulatable accessory module of FIGS. **62**A, **62**B and **63**A-D;

FIG. **64**C is a perspective view of a support or stiffening member useful with the articulatable accessory module of FIGS. **62**A, **62**B and **63**A-D;

FIG. **65** is a perspective view of another articulatable accessory module in accordance with the present invention;

FIGS. **66**A-C are plan views of an accessory housing for an accessory module in accordance with the present invention;

FIGS. **67**A-D are perspective, side and plan views of an accessory mounting module of an accessory module in accordance with the present invention; and

FIGS. **68**A-F are plan and perspective views of the accessory module and accessory housing and mounting module of FIGS. **66**A-C and **67**A-D.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings and the illustrative embodiments depicted therein, an accessory module **10** is mountable to and against a windshield **12** and is positioned generally between an interior rearview mirror assembly **14** and the windshield **12** (FIGS. **1** and **5-10**). The accessory module **10** is mounted toward and against an interior surface **12***a* of the windshield in a manner which allows the body **10***a* of the accessory module to move generally perpendicularly relative to the interior surface **12***a* and to be loaded against or biased toward and to the windshield, as discussed in detail below, and such as disclosed in commonly assigned U.S. provisional applications, Ser. No. 60/381,314, filed May 17, 2002 by Schofield et al. for VEHICLE ACCESSORY MODULE; Ser. No. 60/374,724, filed Apr. 23, 2002 by Schofield et al. for VEHICLE ACCESSORY MODULE; Ser. No. 60/364,008, filed Mar. 14,2002 by Schofield for VEHICLE ACCESSORY MODULE; and Ser. No. 60/350,965, filed Jan. 31, 2002 by Schofield for VEHICLE ACCESSORY MODULE, which are all hereby incorporated herein by reference. Accessory module **10** may include one or more accessories, such as a rain

sensor, a forward facing image sensor, a headlamp control, a temperature sensor, an antenna, a microphone, a speaker, a rearward facing image sensor, a security system, a display, indicators, user interface buttons, switches or the like, interior lights, GPS controls, a humidity sensor, a compass sensor, an electrochromic (EC) mirror control, a remote keyless entry control, a toll collection control, and/or any other accessories or controls of the vehicle, such as discussed below.

Accessory module **10** is mounted to the vehicle windshield and includes an extender **16**, which is mounted to and extends from a mounting attachment **18** (such as a conventional mirror mounting button) at the windshield **12**. As shown in FIG. **2**, mounting button **18** is bonded or otherwise secured to interior surface **12***a* of windshield **12**. A mounting portion **16***a* of the extender **16** is slid or otherwise moved into engagement with the button **18**. Extender **16** includes a second mounting attachment or button **16***b* (FIG. **3**) at its outer end for receiving a mirror mount **20** thereon (FIG. **4**). The button-on-button attachment may be similar to the attachments disclosed in U.S. Pat. No. 4,930,742, which is hereby incorporated herein by reference. The extender **16** provides a rigid extension of a mounting button from the interior surface of the windshield for mounting the mirror assembly to the windshield.

Extender **16** provides a structural, load bearing connection between the attachment member **18** and the mount **20** of the support arm **22** (FIG. **6**) of the mirror **14** (or the mount of the mirror, as shown in FIG. **1**) that is attachable to the accessory module. As such, extender **16** is preferably fabricated of a rigid, load bearing material, such as a metallic material or metal, such as a die cast metallic material, such as die cast zinc or die cast aluminum or the like. Extender **16** may be a solid member, or may include channels or passageways therealong, which may include a wireway passage, such as for wirings to pass therethrough. The length of extender **16** is sufficient for the housing or body **10***a* of the accessory module to slide over, but not so long as to create an excessive moment arm. Preferably, the length of extender **16** is selected to be approximately 0.5 inches to 3.5 inches, more preferably, approximately 0.75 inches to 2.5 inches, and, most preferably, approximately one to two inches. The extender **16** also provides structural support for the body of the accessory module **10**.

Extender **16** is formed and adapted to mount to a particular mounting attachment member **18** at the windshield at one end of extender **16**. The opposite end of the extender **16** is formed as a replication of the attachment member or button at the windshield of that particular vehicle. The extender of the present invention thus provides a mounting attachment member **16***b* for mounting a mirror mount thereto in the same manner as the mirror mount would mount to the attachment member **18** at the windshield. The extender may have some or all of the plastics of the accessory module molded to the extender. Optionally, the extender may be die cast, such as a die cast metal (preferably die cast zinc or die cast aluminum) or otherwise formed, such as by molding of an engineering plastic, such as a filled nylon engineering plastic or the like, and may be formed as a structural skeleton member, without affecting the scope of the present invention. A cover, such as a plastic or polymeric cover, may be snapped or otherwise affixed or attached to the skeleton extender, without affecting the scope of the present invention.

Advantageously, and for example, different extenders may be used to adapt the accessory module for applications in different vehicles, such as vehicles manufactured by different vehicle manufacturers. For example, the extender may be die cast, such as in a metal die casting tool, which requires significantly less tooling costs than molds or the like, such that in order to adapt the accessory module for an application in another vehicle line or manufacturer (where the mounting attachment member or button may differ from one another), a new extender may be formed such that the mounting portion **16***a* of the new extender accepts the button on the new vehicle and the second mounting attachment member **16***b* matches or substantially replicates the button of the other vehicle, while the body **10***a* of the module **10** remains the same or substantially the same. This provides a low cost change to the module and allows for the same module body to be used in different vehicles. Accordingly, a common accessory module body may be sold to different vehicle manufacturers with an appropriate extender combined with the body. This provides substantially reduced costs for different applications, since new injection molding tools are not required to mold a new accessory module body for each application or vehicle line or vehicle manufacturer.

Optionally, such as for aftermarket applications, the extender may be formed or die cast to have a mounting portion **16***a* for one vehicle (such as, for example, a vehicle manufactured by Ford Motor Company), and a mounting attachment member or button **16***b* for another vehicle (such as, for example, a vehicle manufactured by General Motors Corporation or Volkswagen or Audi or BMW). This allows a person in the aftermarket to install the accessory module in the vehicle and to replace the mirror in the vehicle with a mirror designed for a different vehicle.

As best shown in FIGS. **7** and **8**, the body **10***a* of accessory module **10** is slid over and along extender **16** until a portion of the body **10***a* of accessory module **10** is engaged with and loaded toward the interior surface **12***a* of windshield **12**. The mirror mount **20** is mounted to the second attachment member **16***b* at the end of extender **16**. Interior rearview mirror **14** is pivotally mounted to a ball member **20***a* extending from mirror mount **20** in a known manner. As shown in FIG. **6**, interior rearview mirror **14** may include a pivotable mounting arm **22** which pivotally receives ball member **20***a* therein. However, interior rearview mirror **14** may otherwise pivotally receive ball member **20***a* in a socket (not shown) in the casing **24** of mirror **14**, or may otherwise mount to the end of mirror mount **20** or extender **16**, without affecting the scope of the present invention. Preferably, the mirror and accessory mounting components provide a breakaway type connection or mount, such as the types disclosed in U.S. Pat. Nos. 6,172,613; 6,087,953; 5,820,097; 5,377,949; and/or 5,330,149, which are hereby incorporated herein by reference.

The body **10***a* of accessory module **10** includes a structural member **26** and a cover **28**, which together define a cavity **30** within accessory module **10** for mounting or receiving accessories therein. Structural member **26** includes a plate portion **32** and a mounting portion **34** extending from plate portion **32**. The mounting portion **34** of structural member **26** provides an opening or passageway **34***a* for receiving extender **16** therethrough. In the illustrated embodiment, mounting portion **34** includes a plurality of teeth or projections **34***b* extending from at least a portion of the mounting portion **34***a*, while extender **16** likewise includes a plurality of teeth or projections **16***c* extending outwardly therefrom. The corresponding teeth **34***b*, **16***c* engage one another as structural member **26** is pressed along extender **16** and toward windshield **12** to provide a ratcheting of body **10***a* toward and against windshield **12**. The teeth are angled to allow for movement of body **10***a* along extender **16** toward the windshield, yet substantially preclude movement of body **10***a* away from the windshield, such that accessory module **10** is retained tightly or snugly against the interior surface **12***a* of windshield **12**.

Preferably, the teeth **34***b* are positioned along a flexible tab or portion (not shown) of mounting portion **34** of structural member **26** to allow the tab to be flexed radially outward and away from extender **16** to allow for removal of body **10***a* of accessory module **10** from the windshield for service, maintenance or replacement. Preferably, the tab or other ratcheting or loading device may be accessible from the outer portion of the module (such as at the second button **16***b*) to allow for easy release of the ratcheting or loading device. The tab may be flexed using a screwdriver or other tool inserted between the tab and extender **16** or via any other means to disengage the tab from the extender. Although shown and described as having a plurality of teeth engaging other teeth to ratchet and retain the module body against the windshield, other means for providing a generally perpendicular movement of the module body toward and against the windshield may be implemented, such as a threaded fastener retaining the module body to an extender or the like, without affecting the scope of the present invention.

Preferably, structural member **26** includes a retaining tab **36** (FIGS. **7** and **8**), which loads against the mounting button **18** to secure the joint between the module and the button to minimize vibration of the module. In the illustrated embodiment, the retaining tab **36** is biased toward the button, such that as the structural member **26** is loaded against the windshield, the retaining tab **36** loads and is biased against the mounting button **18**. Preferably, in order to further secure the accessory module to the button **18**, the housing or structural member may substantially encase the extender **16**, such that the housing or structural member closes over the slotted portion of the mounting portion **16***a* of extender **16**, which allowed the extender to slide over the mounting button **18** on the windshield **12**. The extender **16** is thus substantially precluded from sliding off from the mounting button **18**.

The cover **28** and structural member **26** of module **10** may snap or otherwise be secured together to define the cavity **30**. Optionally, the cover **28** may define the plate along the interior surface of the windshield, such that the cover is attachable to the structural member at each end of a mounting portion of a structural member positioned or mounted around the extender. Optionally, as shown in FIG. **7**, accessory module **10** may include a sealing or cushioning member or strip **27** around the plate or cover portion of the module to cushion and/or seal the body **10***a* of accessory module **10** at the interior surface **12***a* of windshield **12**, in order to limit or substantially preclude vibration or rattle between the module and the windshield. The sealing or cushioning member may comprise a soft material, such as an elastomeric material, such as a thermoplastic rubber material, and may be sufficiently resilient and dimensioned to provide a cushion between the module and the windshield and may take on the form of the windshield to further seal and cushion the accessory module at the windshield and to reduce noise and vibration of the accessory module. The cushioning member may cushion the module against the windshield and may take on the form of the windshield such that the cushioning member functions to adapt the module to different angles or curvatures of the windshield as the module is moved toward and loaded against the windshield.

As shown in FIG. **7**, accessory module **10** may include an accessory **38**, such as a rain sensor (such as the type disclosed in commonly assigned U.S. Pat. Nos. 6,320,176; 6,353,392 and 6,313,454, which are hereby incorporated herein by reference), an image sensor (such as a video camera, such as a CMOS imaging array sensor, a CCD sensor or the like, such as the types disclosed in commonly assigned, U.S. Pat. Nos. 5,550,677; 6,097,023 and 5,796,094, which are hereby incorporated herein by reference), a temperature sensor (such as a contact temperature sensor for measuring the temperature at or of the windshield), an antenna, or any other sensor or device which is desirable to mount in tight or close engagement with the windshield. The accessory or sensor **38** protrudes through an opening **32***a* in the plate **32** and may include a biasing member or spring **40** which biases the accessory outward from accessory module **10** and toward windshield **12**. Accordingly, as the accessory module is loaded toward and against the windshield, the accessory **38** contacts the interior surface **12***a* of the windshield **12** and is pressed against the surface via biasing member **40**, as shown in FIG. **8**. The accessory **38** is thus optically coupled or positively coupled to the windshield and retained in intimate contact with the windshield. The accessory **38** may further include a sealing member (not shown) around a circumference of the accessory to engage the interior surface of the windshield and substantially seal the accessory to that portion of the interior surface of the windshield to protect that area of the windshield and the accessory from contaminants, such as dirt, dust, smoke, moisture or the like from affecting the performance of the accessory.

Although shown and described as coupling the accessory to or loading the accessory against the windshield, the accessory module of the present invention may alternately provide an accessory which is stood off from or spaced from the windshield. Such an arrangement may be suitable for an antenna or the like, since the antenna reception may be interfered with by the windshield, which may comprise an electrically conductive windshield or the like. The accessory module thus may provide a stand off antenna location to limit or substantially preclude such interference.

As shown in FIG. **9**, accessory module **10** may also or otherwise include an accessory **42** which is desirable to be oriented in a generally horizontal position or at a desired angle with respect to the windshield or horizontal. Such an accessory may comprise a forward facing image sensor or camera (preferably a video camera, such as a CMOS imaging array sensor, a CCD sensor or the like, such as the types disclosed in commonly assigned, U.S. Pat. Nos. 5,550,677; 6,097,023 and 5,796,094, which are hereby incorporated herein by reference) or a compass sensor or the like. The forward facing image sensor may be useful in an optical rain sensor, such as the types disclosed in U.S. Pat. Nos. 6,353,392; 6,320,176 and 6,313,454, which are hereby incorporated herein by reference, a headlamp control system, a lane departure detection or warning system, such as the types described in U.S. provisional applications, Ser. No. 60/433,700, filed Dec. 16, 2002, and Ser. No. 60/377,524, filed May 3, 2002, which are hereby incorporated herein by reference, an adaptive cruise control system, a sign recognition system and warning system, a night vision system, a pedestrian detection system, a vehicle classification identification system, a vehicle compatibility detection system, a pre-crash avoidance system, an emergency response image capture system, an environmental detection system (such as for detecting rain, fog, or the like), an ambient light level detection system, a vehicle relative position (such as for detecting the roll, yaw or the like of the vehicle), a compass calibration system (where the image captured from the image sensor is monitored to determine changes in direction of the vehicle to track the direction the vehicle is heading), a GPS system (where the image captured from the image sensor is monitored to determine the location of the vehicle when a signal from the GPS satellite(s) is interrupted), an electronic toll collection system, or any other system, without affecting the scope of the present invention.

Preferably, accessory module **10** includes a mounting device **44** for such an accessory **42**, which is adjustable to set the accessory **42** to be horizontal or to be at the desired angle regardless of the angle of the windshield to which accessory module **10** is loaded. Mounting device **44** provides a mounting platform or structure **44***a* for securing accessory **42** within cavity **30** of body **10***a* of accessory module **10**. Mounting device **44** may be positioned at and partially through an opening **32***b* of plate **32** to provide a passageway from accessory **42** to the windshield **12**.

The mounting device **44** may be adjustable relative to the structural plate or member **32** or to the housing **28** of accessory module **10** to align or orient the accessory **42** at the desired orientation. For example, the mounting device **44** may include a spherical member or ball joint (not shown) which allows for rotation or pivotal movement of the accessory **42** relative to housing **28** or plate **32** of accessory module **10** into the proper alignment or orientation (such as via rotation or pivotal movement of a portion of the platform **44***a*). Mounting device **44** may include an outer sealing member **44***b* which engages and seals against the interior surface **12***a* of windshield **12** to provide a sealed chamber **44***c* in which the accessory **42** is positioned. The ball joint may also include a wiping seal along the spherical member to seal the chamber **44***c*. The sealing members limit or substantially preclude dirt, dust, moisture, smoke or other contaminants from contacting or otherwise affecting the operation of accessory **42** of accessory module **10**.

Although it is desirable to substantially seal an accessory within the accessory module, it may, in some cases, be desirable to provide a ventilation element, such as a ventilation passage, such as an air passage between the interior surface of the windshield and the component or a surface of the component closest to the windshield, in order to provide cooling of the accessory via air flow through the passage. Accordingly, the accessory module of the present invention may include such a passageway along the interfacing surface against the windshield. The surface(s) of the accessory module facing the windshield may include heat dissipating elements, such as, for example, heat dissipaters, fins or the like.

Many electronic components are rated at a high temperature from a stationary soak application. However, such components may not function in an optimal manner when at these higher temperatures. Optionally, forced cooling may be provided to the accessories or components of the accessory module, such as by a fan or the like (preferably, a low current fan, a solar powered fan or the like) to rapidly cool the accessories or components of the accessory module. The forced cooling element may be activated when the ignition of the vehicle is activated and then time out or deactivate a period of time following activation. The forced cooling element thus functions to rapidly lower the temperature of the components or accessories, so that they may function optimally, even after prolonged soaking in extreme temperatures, such as while the vehicle has been parked, such as on a sunny day.

Optionally, a surface of the accessory module closest to the windshield may be treated, such as by a deposition, painting, film, adhesive coating or the like, to provide a reflecting characteristic to the module, so as to reflect infrared radiation or the like which the module may be exposed to at the windshield. The air passage and/or treatment may thus reduce the effects of sun loading or thermal loading on the accessory module.

Accessory module **10** may further include electrical connections for any electrical components within accessory module **10** or at or within mirror **14**. For example, the mounting button **18** and/or second button **16***b* may include -electrical contacts which engage corresponding contacts at the mounting portion **16***a* of extender **16** and/or mirror mount **20**, respectively, as the mounting portions are slid onto the buttons, such that electrical signals are provided to accessory module **10** and/or to mirror **14** via the contacts. The mounting button **18** may be electrically connected to a power source of the vehicle or other electrical system or the like via an electrical connector or wiring harness or via contacting a conductor at the windshield, such as a conductor which is integral with the glass of the windshield or deposited on the interior surface of the windshield and which is connected to the vehicle power source or other electrical system of the vehicle. The mirror mount **20** may then include an electrical connector or wiring which extends through an opening or passageway (not shown) in ball member **20***a* and into the housing **24** of mirror **14** for connection to electrical components or circuitry within housing **24**. The electrical connector may extend from the ball member and be sufficiently rigid to provide a snap connection or the like to a corresponding connector positioned within housing **24** as housing **24** is snapped or otherwise secured to ball member **20***a*.

Optionally, the electrical connections to accessory module **10** may be provided via other means, such as other sliding means, rotating contacts, screw or fasteners (such as tightening of a screw at the button to make an electrical contact or connection), or plug type connectors or contacts (such as an electrical contact of a spring loaded contact on the housing contacting a conductor at the windshield, such as a conductor which is integral with the glass of the windshield or deposited on the interior surface of the windshield), such that the accessory module makes its electrical connections as the body **10***a* is ratcheted or loaded against the windshield. Also, the electrical connections to the mirror **14** may be provided via other means, such as other sliding means, rotating contacts, screw or fasteners (such as tightening of a screw at the second button to make an electrical contact or connection), or plug type connectors or contacts, such that the mirror makes its electrical connections as it is mounted to the extender.

Typically, the mounting button **18** is provided on the windshield by the glass or windshield manufacturer, such that the windshield is shipped to the vehicle assembly plant with the button affixed thereon. Preferably, the mirror manufacturer may then supply the accessory module, which includes the extender **16** and the body **10***a,* along with the mount **20** and mirror **14**, as a single package to be mounted to the button **18** on the windshield at the vehicle assembly plant. The structural component **26** and housing **28** may be only partially installed onto the extender **16** as shipped to the assembly plant, such that the extender may be secured to the button prior to the module body being moved or loaded toward and against the windshield. This last step may be performed at the vehicle assembly plant after the extender has been secured to the button and after any electrical components or connections have been provided at or near the module. As the module body is then ratcheted or otherwise moved toward tight engagement with the windshield, the components, such as the image sensor, rain sensor and/or the like, may also be loaded against the windshield while the electrical connections to the vehicle electrical and/or control system may be simultaneously made.

Optionally, the extender may be made and supplied as a separate part or component from the accessory module, without affecting the scope of the present invention. However, such an approach may be less desirable, particularly with respect to the assembly plant operations.

Optionally, the accessory module may be provided with an electrical connector **70** (FIG. **1**), such as a wire and multi-pin

connector or the like, extending from the accessory module for connecting to or plugging into a corresponding connector provided at a headliner or overhead console of the vehicle. For example, an overhead console **71** of the vehicle may extend toward the glass or window area, such that the overhead console may be at or close to or adjacent to the windshield, such as described in U.S. Pat. No. 6,445,287, and in U.S. patent application, Ser. No. 10/232,122, filed Aug. 30, 2002, now U.S. Pat. No. 6,975,215, which are hereby incorporated herein by reference, and may provide a feed or outlet or socket or connector **72** for connecting the electrical connector **70** of the accessory module thereto. Such a connection arrangement allows the vehicle manufacturer to provide an outlet at the overhead console or headliner of the vehicle to provide electrical connection and/or communication between various accessories or systems or power source of the vehicle and the accessory module and/or interior rearview mirror assembly, whereby the vehicle manufacturer does not have to provide a cable or wiring harness extending down from the overhead console or headliner, as is typically done with conventional mirror assemblies and the like. The accessory module manufacturer and/or supplier may thus provide the electrical connector or plug for extending to and connecting to the connector or outlet at the overhead console or headliner of the vehicle when the accessory module is mounted at the windshield of the vehicle. This allows for enhanced freedom in the harness and/or connection between the accessory module and the overhead console or headliner, whereby the accessory module may provide a high speed connection or different wires or cables as desired or required to power and/or drive the particular accessories and/or the like within the accessory module and/or the mirror assembly.

It is further envisioned that such a connector or outlet or plug or socket or the like may be provided at an overhead console or headliner of a vehicle for connection to an electrical wire or connector of other modules or components, such as a connector from an interior rearview mirror assembly or other type of accessory module or a separate windshield electronic module or the like. The connector at the overhead console or headliner may provide for electrical connection to items or components or accessories of an accessory module, mirror assembly, windshield electronic module or the like which may share circuitry with other items or components or accessories of the vehicle, such as at the overhead console or headliner, and/or may provide for electrical power connection to the accessory module, mirror assembly, windshield electronic module or the like, and/or may provide for electrical communication to or control of items, components or accessories of the accessory module, mirror assembly, windshield electronic module or the like, such as from another accessory or system of the vehicle.

Optionally, the accessory module may include a rechargeable battery or power source, such as a rechargeable battery pack (such as shown generally at **74** in FIG. **6**) or the like, which may provide power to the accessory or accessories of accessory module **10** and/or of mirror assembly **14**. The accessory module may then comprise a stand alone battery operated accessory module and may not require electrical connection to a vehicle power source or the like. Preferably, the rechargeable battery pack is attachable to and detachable from the accessory module to ease removal and recharging of the battery pack when the power supply of the battery pack is low. The accessory module may include contacts or connectors at a battery pack receiving portion of the module which electronically connect to the accessories or circuit board of the accessory module (similar electrical connections may electronically connect the accessory module to one or more accessories of the interior rearview mirror assembly). The contacts or connectors may contact or connect to corresponding contacts or connectors at the battery pack when the battery pack is attached to the battery pack receiving portion of the module, such that the rechargeable battery pack is electronically connected to the accessories or circuit board of the accessory module when attached to the accessory module.

The rechargeable battery pack may include a plug or connector which is configured or adapted to plug into a vehicle power jack or outlet, such as a cigarette lighter type of outlet in the vehicle. The connector or plug may be molded into or integrated into the battery pack, such that the battery pack may be removed or unplugged from the accessory module and plugged into the power outlet of the vehicle to recharge the battery or batteries of the rechargeable battery pack. The accessory module or battery pack may include a low power indicator which may be activated or illuminated or deactivated when the power level of the battery pack is reduced to a low level whereby the battery pack requires recharging. Also, the batter pack may include a full charge indicator to indicate when the battery pack has completed the recharging process while plugged into the vehicle outlet.

The battery pack may thus be recharged by the vehicle power source or battery, such as while the vehicle is being driven or even when the vehicle is not in operation. The recharging process may result in a minimal draw of power from the vehicle, such that the battery pack may be recharged when the vehicle is not running, but may not significantly drain the battery or power supply of the vehicle. After the battery pack is recharged, the battery pack may be unplugged from the vehicle outlet and plugged into or attached to the accessory module to provide power to the accessory or accessories of the accessory module and/or the mirror assembly. Optionally, solar panels or the like may be provided as a primary source for recharging of the battery pack, without affecting the scope of the present invention.

Although shown and described as being attachable to and detachable from the accessory module, it is envisioned that a rechargeable battery pack in accordance with the present invention may be equally applicable for removably mounting to a mirror assembly or other module or console of the vehicle, in order to provide power to an accessory or accessories at or within the mirror assembly or other module or console of the vehicle. The rechargeable battery pack of the present invention provides a rechargeable battery or power source and may be suitable for use with a stand alone accessory module, console or mirror assembly, whereby the accessory module, console or mirror assembly may include various accessories, but may not require electrical connection to the vehicle power source or the like. Optionally, a portion of the accessory module, such as a head portion or the like, may include such a rechargeable battery pack and may be detachable from the rest of the accessory module, whereby the portion of the accessory module may be plugged into a power outlet of the vehicle to recharge the rechargeable battery pack contained or housed therein.

The accessory module of the present invention may also include one or more antennae, which may be mounted as a separate component of the module, or may comprise conductive elements attached to or deposited directly onto the surfaces of the structural member or the cover plate of the accessory module. The antenna may be useful for a GPS system, a mobile/remote transaction system, such as a smart card system or an electronic toll collection system or the like, a remote keyless entry system, a communication system and/or any other system which may transmit a signal and/or receive a signal via an antenna.

Accessory module **10** may include any other accessories or components which it would be desirable to have in the general location of the interior rearview mirror. Because the accessory module is positioned at the interior rearview mirror and may be electrically coupled to the mirror, the accessory module may allow for decontenting of the mirror, such that many accessories, which may have been previously positioned at or within the mirror housing, are positioned at or within the accessory module. The mirror may still include lights, electrochromic elements or the like, and may receive the appropriate electrical signals from the connection between the mirror and the mount at the extender. However, other electrical components and/or controls and/or circuitry may be moved to the accessory module of the present invention.

The accessory module of the present invention may include various accessories or features, such as shown in FIG. **11**. For example, the accessory module may include one or more displays, such as a text display, an icon display, a display on demand type display, such as a video or touch screen interface display, a biometric imager, such as for fingerprint authentication or the like, an infrared sensor, such as a zonal temperature-sensor, such as suitable for an auto climate control, a forward facing image sensor, such as described above, a rearward facing image sensor (such as for biometric imaging (such as for face recognition, iris recognition or the like), seat height or position detection, drowsiness detection, safety/restraints object detection and position, emergency response image capture system, intrusion detection or the like), an electronic field sensor (such as the type disclosed in commonly assigned U.S. patent application, Ser. No. 09/992,119, filed Nov. 14, 2001 by McCarthy et al. for VEHICLE COMPARTMENT OCCUPANCY DETECTION SYSTEM, now U.S. Pat. No. 6,768,420, which is hereby incorporated herein by reference), a microphone (such as the type disclosed in commonly assigned U.S. Pat. Nos. 6,243,003 and 6,278,377, and/or U.S. patent application, Ser. No. 09/466,010, filed Dec. 17, 1999 by DeLine et al. for INTERIOR REARVIEW MIRROR SOUND PROCESSING SYSTEM, now U.S. Pat. No. 6,420,975, which are hereby incorporated herein by reference), a speaker, a telematics module (which may include a GPS module or system, a wireless communication module or system, an antenna for a GPS or phone or communication system or the like, a human/machine interface (HMI), a display, such as an LED display, dot matrix display, alpha numeric display, video display or the like, a microphone and/or microphone circuits, which may be operable for speech or voice recognition, noise reduction or noise cancellation), a speaker, a rechargeable battery pack, a humidity sensor, a compass sensor and/or compass control, an electrochromic (EC) control, a remote keyless entry sensor, a tire pressure monitoring system (TPMS), an electronic toll collection sensor, an emergency or roadside assistance system, an intelligent headlamp control and memory, user interface controls (such as buttons, switches or the like for controlling various accessories of the vehicle, such as a sunroof, a communication system, lamps, security systems, displays or the like) or any other accessories, sensors, lights, indicators, displays, or the like which may be suitable for mounting or positioning at or within the accessory module. The accessory module may also provide for glare reduction characteristics of the rearview mirror.

For example, the accessory module and/or the mirror assembly may include one or more other accessories, such as one or more electrical or electronic devices or accessories, such as antennas, including global positioning system (GPS) or cellular phone antennas, such as disclosed in U.S. Pat. No. 5,971,552, a communication module, such as disclosed in U.S. Pat. No. 5,798,688, a blind spot detection system, such as disclosed in U.S. Pat. Nos. 5,929,786 and/or 5,786,772, transmitters and/or receivers, such as a garage door opener device for actuating a garage door opening mechanism for opening a garage door or the like, such as disclosed in U.S. Pat. Nos. 6,396,408; 6,362,771; and 5,798,688, a digital network, such as described in U.S. Pat. No. 5,798,575, a high/low headlamp controller, such as disclosed in U.S. Pat. Nos. 5,796,094 and/or 5,715,093, a memory mirror system, such as disclosed in U.S. Pat. No. 5,796,176, a hands-free phone attachment, a video device for internal cabin surveillance and/or video telephone function, such as disclosed in U.S. Pat. Nos. 5,760,962 and/or 5,877,897, a remote keyless entry receiver, lights, such as map reading lights or one or more other lights or illumination sources, such as disclosed in U.S. Pat. Nos. 5,938,321; 5,813,745; 5,820,245; 5,673,994; 5,649,756; 5,178,448; 5,671,996; 4,646,210; 4,733,336; 4,807,096; 6,042,253; and/or 5,669,698, and/or U.S. patent applications, Ser. No. 10/054,633, filed Jan. 22, 2002 by Lynam et al. for VEHICULAR LIGHTING SYSTEM now U.S. Pat. No. 7,195,381; and/or Ser. No. 09/793,002, filed Feb. 26, 2001, now U.S. Pat. No. 6,690,268, microphones, such as disclosed in U.S. Pat. Nos. 6,243,003; 6,278,377; and/or 6,420,975, speakers, a compass, such as disclosed in U.S. Pat. Nos. 5,924,212; 4,862,594; 4,937,945; 5,131,154; 5,255,442; and/or 5,632,092, a tire pressure monitoring system (TPMS), such as the types disclosed in U.S. Pat. Nos. 6,294,989; 6,445,287; and/or 6,472,979, and in U.S. patent applications, Ser. No. 10/232,122, filed Aug. 30, 2002, now U.S. Pat. No. 6,975,215; and Ser. No. 10/279,059, filed Oct. 23, 2002, now U.S. Pat. No. 6,774,774, a seat occupancy detector, a trip computer, an ONSTAR® system and/or the like (with all of the above-referenced patents and patent applications being commonly assigned to Donnelly Corporation, and with the disclosures of the referenced patents and patent applications being hereby incorporated herein by reference in their entireties). The accessory or accessories may be positioned at or within the accessory module housing and/or the mirror casing and may be included on or integrated in a printed circuit board positioned within the respective housing or casing, without affecting the scope of the present invention.

The accessories or components of the accessory module may be connected to the vehicle electronic or communication systems and may be connected via various protocols or nodes, such as Bluetooth, SCP, UBP, J1850, CAN J2284, Fire Wire 1394, MOST, LIN and/or the like, depending on the particular application of the accessory module of the present invention. The accessory module may be electronically integrated with the vehicle electrical and/or control systems. For example, the accessory module may connect to a sunroof control, a rain sensor control, a mass motion sensor, a roof lighting control, a microphone/cell phone control, a climate control, an electrochromic mirror reflective element or cell control and/or the like. The accessory module may provide an output to the vehicle system or systems over a communication bus, such as a high beam activation level (which may be dependent on the module interface type, such as duty cycle, active/inactive, percent illumination, etc.), an intelligent headlamp control enabled/fault indicator status, a rain sensor status, a compass status, an ambient light level status (which may be an interior or exterior lighting status), an exterior condition status, an autolamp status, a sunload status and/or the like. The accessory module may also receive various inputs over the communication bus or communication line, such as an intelligent headlamp control enabled/disabled status, a transmission status (such as park, reverse, neutral, drive, low or other gear settings), a headlamp status, a vehicle speed, a steering wheel

angle, a turn signal status, and/or the like. The accessory module may be in electrical communication with the interior rearview mirror assembly, such as for controlling an electrochromic cell of the mirror and/or a microphone of the mirror and/or the like, and may be in communication with a telematics system of the vehicle, such as to provide a signal from a microphone or speaker at the accessory module and/or the interior rearview mirror assembly. The accessory module may include a vehicle connector for connecting to a wire or cable of the vehicle, which may provide power and electrical communication to the accessory module, such as via a communication bus or the like. Optionally, the accessory module may include a rechargeable battery pack, such as described above, and may thus comprise a stand alone accessory module and thus may not require electrical connection to the vehicle wiring and/or controls.

Accessory module **10** may also include user interface controls, such as buttons, switches or the like, displays, indicators, microphones, speakers or the like. Some of these may be provided at or along a display or interface area above the mirror, such as shown at display or interface area **46** in FIGS. **12**A-D and **13**. Optionally, accessory module **10** may include an extension (such as shown in FIGS. **59-65**) which extends over or under the mirror **14** to provide easier or enhanced access and viewing of various user interface controls or displays or the like, without affecting the scope of the present invention. It is further envisioned that display or interface portion or area **46** may comprise an upwardly extending display or user interface portion and may be extendable and retractable relative to the mounting button area of the accessory module, such that the extension may be moved upward to provide clearance over the mirror (as shown in FIGS. **12**A, **12**B and **13**) or such that the extension may be moved upward toward the headliner of the vehicle, depending on the application of the accessory module of the present invention.

Referring now to FIG. **14**, an accessory module **110** in accordance with the present invention is loaded toward and against the interior surface **12***a* of the windshield **12** via pivotal movement of the accessory module **110** about a pivot axis or joint **111** at the headliner **113** of the vehicle. The accessory module **110** includes a mirror mount **120** which extends from a lower portion of the module for mounting a mirror assembly **114** thereto. Accessory module **110** may include any and/or all of the accessories or components discussed above with respect to accessory module **10** and may provide for electrical connection to the electrical components or accessories via electrical connection when the module is pivotably mounted at the headliner and/or when the module is pivoted toward and against the windshield to load the module against the windshield, such as via electrical contacts or plugs or the like, as discussed above. The accessory module **110** may be loaded toward and against the windshield via a ratcheting of the module as it is pivoted toward engagement with the windshield or via other means for loading and retaining the module at the windshield.

Optionally, as shown in FIGS. **15** and **16**, an accessory module **210** may be pivotally mounted at the headliner **213** of the vehicle, such as at a pivot axis or joint **211**, and may include an expandable area **228***a* of the housing **228** to provide a continuous module housing **228** while accommodating flexing of the module housing as the module is pivoted toward or away from the windshield. As shown in FIGS. **15** and **16**, some of the interface controls, displays, lights, indicators and/or the like may be positioned at a control console at and along the headliner of the vehicle, without affecting the scope of the present invention.

Optionally, the accessory module of the present invention may be an extension of a header portion of the vehicle and/or a header console of the vehicle, such as to provide a viewing area or display visible through the windshield from outside the vehicle, such as described in commonly assigned, U.S. patent application, Ser. No. 09/710,016, filed Nov. 10, 2000 by Schofield et al. for TIRE INFLATION ASSISTANCE MONITORING SYSTEM, now U.S. Pat. No. 6,445,287, which is hereby incorporated herein by reference. The module or lobe extending down from the header portion or console may be spring mounted or otherwise loaded or biased toward the windshield and may include a cushioning or sealing member to cushion the module against the windshield.

Optionally, the header portion or console may be installed at the roof or header of the vehicle (such as before the windshield is installed to the vehicle) and may include a lobe or module which may be movable forwardly with respect to the vehicle to move and load the module against the interior surface of the windshield after the windshield is installed in the vehicle. The module may be spring loaded to move and load the module toward and against the windshield, or may be ratcheted forward or otherwise moved toward the windshield to move and load the module toward and against the windshield of the vehicle. The module may then be retractable or movable away from the windshield to facilitate access, service, maintenance or replacement of the accessory module.

Referring now to FIG. **17**, an accessory module **310** in accordance with the present invention may comprise a housing **328** which extends at least partially across the headliner **313** of the vehicle and provides a mount **320** for mounting a mirror assembly **314** thereto. In the illustrated embodiment, the accessory module **310** extends entirely across the headliner between the A-pillars of the vehicle to provide a continuous module along and above the upper edge of the windshield. The accessory module **310** may include one or more sun visors **315**, which may fold down or be pulled down and unrolled from within the accessory module **310** to provide shielding of the sun from the driver's or passenger's eyes. The accessory module **310** may include any and/or all of the accessories or components discussed above with respect to accessory module **10** and may provide for electrical connection to the electrical components or accessories via electrical connection when the module is mounted along the headliner (such as via screws, snaps, or other fasteners) and against the windshield (whereby the module is preferably loaded against the windshield), such as via electrical contacts or plugs or the like, similar to those discussed above.

Referring now to FIGS. **18**, an accessory module **410** may be biased or spring loaded against the interior surface **12***a* of the windshield via a biasing member or spring **429** along the mounting arm **422**. Spring **429** is positioned between a raised portion or stop **422***a* along mounting arm **422** of mirror **414** and a cover **428** of accessory module **410**. The accessory module **410** may include accessories, displays, user interface controls and/or the like, as discussed above with respect to accessory module **10**.

As shown in FIG. **19**, an accessory module in accordance with the present invention may include a plate or platform **50**, which may further include a main board or power bus **52** mounted or affixed thereto. The platform **50** may then include one or more electronic sub-boards **54**, which may be attached to the platform **50** as desired, depending on the particular application of the accessory module and on the desired features or accessories of the module.

It is further envisioned that an accessory module **510** (FIG. **20**) may include a removable, plug-in module **552**, which may be installed in or removed from the module depending on

the application of the module and the desired functions and features of the module. The accessory module **510** may include a removable panel **528***a* at housing **528** to facilitate access to the plug-in module **552**. Alternately, a plug-in module or card **562** may be retained in connection with an electrical connector via a retention clip **564**, as shown in FIG. **21**. As also shown in FIG. **21**, the mirror mount **520** may connect to an exterior surface of housing **528** of accessory module **510**.

Optionally, an accessory module **610** (FIG. **22**) of the present invention may include a center module **610***a* mounted to or at the windshield in a manner according to the present invention. The center module **610***a* may provide a connector **668** along one or both sides of the center module for connection of one or more side pod modules **610***b*, **610***c*. The center module **610***a* and/or the side pod modules **610***b*, **610***c* may include various accessories, displays, controls, indicators and/or the like, such as discussed above with respect to accessory module **10**. The electrical connections to the side pod modules **610***b*, **610***c* may be made as the side modules are snapped or otherwise attached or mounted to center module **610***a*, such as via electrical connectors **668**, **669**.

As shown in FIGS. **23**A and **23**B, an accessory module **710** may mount to the windshield **12** and include an opening or passageway **734***a* for fitting the accessory module around a mounting button **718**, mount **720** and mounting arm **722** of a mirror **714**. The accessory module **710** may include a structural mounting portion or member **726** and a cover **728**, which define a cavity **730** for housing various accessories or the like. The accessories may include any accessories, controls, indicators, displays and/or the like as discussed above.

Referring now to FIGS. **24**A, **24**B and **25**A-C, an accessory module **810** is mountable to a mounting button (not shown) at a windshield of a vehicle and provides a second mounting button **816***a* for mounting a mirror mount **820** and mirror **814** to accessory module **810**. The second mounting button **816***a* is positioned within a pocket or recessed area, where the pocket allows sufficient clearance for the mirror mount **820** to fit in and slide onto the button **816***a*. The accessory module may extend upward and over the mirror **814**, as can be seen in FIGS. **25**B and **25**C, to provide access to one or more user interface controls or buttons **811** at an upper end of the accessory module **810**.

In the illustrated embodiment of FIGS. **24**A, **24**B and **25**A-C, the accessory module may provide buttons **811**, such as for actuating a garage door opener device or system of the vehicle or accessory module for actuating a garage door opener mechanism for opening a garage door or the like, such as the types described in U.S. Pat. Nos. 6,396,408; 6,362,771; 5,798,688 and 5,479,155, which are hereby incorporated herein by reference, such as the type available from Johnson Controls, Inc. of Plymouth, Mich., under the name HOMELINK®. The accessory module **810** includes a mounting portion **810***a* and an upper extension **810***b* which extends over the mirror **814**. The angle of the upper portion **810***b* relative to the lower portion **810***a* is selected according to the angle of the windshield of the targeted vehicle, such that the buttons are directed generally parallel to the floor of the vehicle when the accessory module is mounted to the windshield. Desirably, the upper portion may be pivotable so that the upper portion may be canted toward the driver and secured in such position, or the upper portion may desirably be rigidly canted toward the driver (such as approximately 10-35 degrees, and preferably 15-25 degrees), to provide enhanced visibility and access to the buttons by the driver of the vehicle.

Optionally, the upper portion **810***b* of the accessory module may include an information display, such as a compass display (not shown). Desirably, all of the compass circuitry, including the vacuum fluorescent display and the compass sensors, may be created on one circuit board, thus allowing economy of parts fabrication. Also, because the accessory module, when mounted to the windshield, is rigid and does not move, the orientation of the compass sensing element, such as a magnetoresistive sensor, such as described in U.S. Pat. No. 5,802,727, and U.S. patent application, Ser. No. 09/540,702, filed Mar. 31, 2000 by Schierbeek et al. for VEHICLE COMPASS COMPENSATION, now U.S. Pat. No. 6,513,252, which are hereby incorporated herein by reference, remains substantially fixed relative to the vehicle. The compass and/or compass display may be of the types disclosed in U.S. provisional application, Ser. No. 60/420,010, filed Oct. 21, 2002 for INTERIOR REARVIEW MIRROR WITH COMPASS, which is hereby incorporated herein by reference.

Optionally, the accessory module of the present invention may be mounted on the button at the windshield during a first operation at the vehicle assembly plant. For example, the module mounting member may be adapted to be attached to the button (preferably in a detachable way), and may include a mechanical fastener, such as a screw or other fastener, or a snap type connection or the like to secure the mounting member the button. Because the second button on the accessory module is a replicate of the button on the windshield, the mirror may mount on the second button during a second operation. Optionally, the accessory module may be provided to a vehicle assembly plant with the mirror assembly preattached to the module. The entire assembly may thus be adapted to be readily mounted to the attachment member or button at the windshield in a single operation at the vehicle assembly plant. The accessory module of the present invention preferably provides visual and mechanical guides or cues to facilitate the mounting operation as the accessory module is mounted to the windshield.

Referring now to FIGS. **26**A-**26**D, an accessory module **910** is mountable at and/or loadable against an interior surface of a vehicle windshield, such as in a similar manner as discussed above with accessory module **10**. Accessory module **910** is substantially similar to accessory module **10** discussed above, such that a detailed discussion of the features and characteristics of the accessory module will not be repeated herein. As shown in FIGS. **26**C and **26**D, the rearview mirror assembly **914**, which is mounted to the mounting portion **920** at accessory module **910**, may include a microphone **915**. Microphone **915** may be mounted at an upper portion of the mirror assembly **914** and beneath an upper, curved portion **910***b* of the body **910***a* of accessory module **910**. The microphone **915** may be of the type disclosed in commonly assigned, U.S. Pat. Nos. 6,243,003 and 6,278,377, and/or U.S. patent application, Ser. No. 09/466,010, filed Dec. 17, 1999 by DeLine et al. for INTERIOR REARVIEW MIRROR SOUND PROCESSING SYSTEM, now U.S. Pat. No. 6,420,975, and/or U.S. provisional applications, Ser. No. 60/415,233, filed Oct. 1, 2002 by DeBoer et al. for INTERIOR REARVIEW MIRROR ASSEMBLY WITH ACCESSORY, Ser. No. 60/429,360, filed Nov. 26, 2002 by Weller for MICROPHONE SYSTEM FOR VEHICLE, which are all hereby incorporated herein by reference.

Referring now to FIGS. **27**-**32**, a stand-alone accessory module **1010** is mounted to an interior-surface **12***a* of a windshield **12** of a vehicle and includes an extender **1016**, which is mounted to and extends from a mounting attachment **1018** (such as a conventional mirror mounting button) at the windshield **12**. A mounting portion of the extender **1016** may be slid or otherwise moved into engagement with the button

1018, as discussed above with respect to accessory module 10. Thus, accessory module 10 may detachably attach (and preferably breakaway if impacted, such as in an accident) to button 1018 (such as using a fastenerless attachment element, such as a top clip attachment, such as described in U.S. Pat. No. 5,576,687, which is hereby incorporated herein by reference) or may be secured thereto using a screw or similar fastener.

Extender 1016 may comprise a die-cast metallic member or a plastic molded member or the like, without affecting the scope of the present invention. As shown in FIG. 28, extender 1016 may include a channel or passageway 1017, such as a cylindrical passageway and/or threaded passageway, extending lengthwise through the extender, such that a threaded fastener or screw 1015 may be threaded through the extender to an opening or indentation in the button to retain or secure the extender to the button. The screw may be countersunk into the extender to provide a generally flat surface at the opposite end from the button end. Further, the channel may include a larger diameter passageway 1017*a* (large enough for the head of the fastener to be driven into to countersink the head of the fastener within the extender), which may extend substantially into the extender 1016 to allow the fastener 1015 to be partially threaded onto a threaded portion 1017*b* of the passageway, yet still be substantially within the countersunk portion. Because the fastener 1015 is initially positioned at least partially within the extender, a drive tool may be easily aligned with and engaged with the head of the fastener for driving the fastener into its securing position. The accessory module, including the extender and screw, may thus be provided to the vehicle assembly plant, whereby the screw or fastener may be easily driven into and/or against the mounting button 1018 by an operator at the vehicle assembly plant. The operator may then slide or otherwise position the extender onto the button and drive the screw or fastener into place to secure the extender to the button and windshield.

Extender 1016 includes a second mounting attachment or button at its outer end for receiving a mirror mount 1020 thereon (FIG. 27). The button-on-button attachment may be similar to the attachments disclosed in U.S. Pat. No. 4,930,742, which is hereby incorporated herein by reference. In addition to providing structural support for the housing of the accessory module and for the accessories included therein or mounted or attached thereto, the extender provides a rigid extension of a mounting button from the interior surface of the windshield for mounting (and supporting) an interior rearview mirror assembly 1014 to the windshield 12. The interior rearview mirror assembly may comprise a prismatic mirror assembly or an electrochromic mirror assembly or the like, without affecting the scope of the present invention, and with the interior rearview mirror assembly preferably forming a detachable and/or breakaway attachment to the outer end of extender 1016 of accessory module 1010.

Similar to extender 16, discussed above, extender 1016 provides a structural, load bearing connection between the attachment member 1018 and the mount 1020 of a support arm 1022 of the interior rearview mirror assembly 1014 (or the mount of the mirror, such as shown in FIG. 1) that is attachable to accessory module 1010. As such, extender 1016 is preferably fabricated of a rigid, load bearing material, such as a metallic material or metal, such as a die cast metallic material, such as die cast zinc or die cast aluminum or the like. Extender 1016 may comprise a solid member, or may include channels or passageways therealong, which may include a wireway passage, such as for wirings to pass therethrough or a channel-way to accommodate a screw type fastener, such as described above. The length of extender 1016 is sufficient for the housing or body 1011 of accessory module 1010 to slide over/secure to, but not so long as to create an excessive moment arm or to unduly move the reflective element of the interior rearview mirror assembly that attaches to the accessory module toward and close to the driver of the vehicle. Extender 1016 also provides structural support for the body of the accessory module and for any accessories contained therein or attached thereto.

As discussed above with respect to accessory module 10, extender 1016 is formed and adapted to mount to a particular mounting attachment member 1018 at the windshield at one end of extender 1016. For O.E.M. automaker installations, the opposite end of the extender is typically formed as a replication of the attachment member or button at the windshield of that particular vehicle (however, as previously indicated, the opposite end of the extender may be different from the button that the extender is mounted to so as to allow aftermarket installation of an accessory module that has a mirror mounting end for a mirror that anticipates a different button). Similar to extender 16, extender 1016 may have some or all of the plastics of the accessory module molded to the extender, such as by integral molding. Optionally, the extender may be die cast, such as a die cast metal (preferably die cast zinc or die cast aluminum) or otherwise formed, such as by molding of an engineering plastic, such as a filled nylon engineering plastic or the like, and may be formed as a structural skeleton member. Extender 1016 may be a solid construction or a hollow construction, such as a solid or hollow slug, and is preferably of limited length or extension so as to both facilitate ease of attachment to the mirror button by a vehicle assembly line operator (and where a screw or other fastener is used, the driving of the screw by the operator) and to minimize the further extension of the mirror reflector of the mirror assembly toward the driver when the mirror assembly is mounted to the extender. Preferably, the extension is no more than approximately two inches long, more preferably, no more than approximately 1.25 inches long, and most preferably, no more than approximately 0.75 inches long, to provide a sufficient space between the mirror mount 1020 and the mounting button 1018 for housing or body 1011. A cover, such as a plastic or polymeric cover, may then be snapped or otherwise affixed or attached to the skeleton extender, without affecting the scope of the present invention.

Housing or body 1011 of accessory module 1010 includes a base portion or fixed portion 1011*a* and an upper portion or movable portion or head portion 1011*b* extending from the base portion, as shown in FIG. 27. Base portion 1011*a* may be integrally molded with or onto extender 1016 or may snap or otherwise be secured to extender 1016, such as in the manners described above. For example, body 1011 can be formed in a separate molding operation and can snap onto extender 1016 as desired, without affecting the scope of the present invention. Body 1011 includes a mounting portion 1011*c* for mounting head portion 1011*b* to base portion 1011*a*, and preferably for movably or pivotably mounting head portion 1011*b* to base portion 1011*a*. Although shown as having the head portion 1011*b* positioned above the base portion 1011*a*, it is envisioned that a head portion (or tail portion) may also or otherwise be mounted at a lower end of the base portion and positioned below the base portion and interior rearview mirror assembly, without affecting the scope of the present invention.

The mounting portion 1011*c* of housing 1011 preferably allows for different types of head portions to be mounted to a standard or common base portion. The different heads may be tooled up or manufactured with different accessories associated therewith. For example, if a vehicle is made with a

display as an option, a head portion with the display option may be mounted to the base portion of the accessory module, whereas if a vehicle is made with a garage door opener option, a head portion with such a garage door opener option may be mounted to the base portion. Clearly, other accessories or options may be incorporated into accessory module **1010**, without affecting the scope of the present invention. The base portion thus may be a common part, while the head portion may be selected to match a desired function or option of the vehicle and may be mounted to the base portion. In such applications, all of the electronics, such as electronic circuitry for a compass system and display, a temperature display, a garage door opener device or system and associated buttons, a user input device or buttons, such as for a telematics system or the like, a microphone and/or any other desired system or systems or accessory or accessories may be positioned at or within the head portion, such that the accessory module may comprise the same base portion irrespective of the selected option or options or function or functions of the head portion.

The different modules with different features may mount to the mounting portion **1011***c* and optionally may be movably or adjustably mounted thereto. For example, the mounting portion **1011***c* may include pivot or swivel elements, such as a ring or partial ring of detents or indents or a ball joint or other type of swivel joint connection, which allows head portion **1011***b* to pivot or swivel relative to base portion **1011***a*, such as side to side and about a generally vertical pivot axis when the accessory module is mounted to the vehicle, so as to direct the head portion **1011***b* toward the driver, and/or up and down and about a generally horizontal pivot axis when the accessory module is mounted to the vehicle, so as to adjust a level at which the head portion is positioned. This allows for the different modules to be mounted to the generally fixed base portion and adjusted to an appropriate orientation for optimal viewing by the driver of the vehicle, even though the module may be installed in different vehicles, such as different vehicles with different angled windshields or different driver's head position relative to the windshield. However, in certain installations, the module mounting portion may have a preset angle, such that the head portion may snap onto the base portion and be generally fixed (such as at a preset angle) relative to the base portion, without affecting the scope of the present invention.

The detent ring allows for the head (or tail) portion to pivot or swivel and to click or snap or lock into place at one or more particular angles (such as at approximately six degrees downward and approximately twelve degrees toward the driver). The detent ring may include several detents, such that the head portion may be adjusted to one of several positions or orientations relative to the base portion. The head portion may be adjusted to an appropriate position when installed and then generally fixed or locked relative to the base portion, or may be adjustably mounted such that the head portion may be later adjusted by the driver of the vehicle if desired. The swivel or pivot mounting elements may be molded into the housing portions of the accessory module, or may be attached thereto, without affecting the scope of the present invention.

Optionally, the mounting portion **1011***c* may provide a swivel joint which may include a generally spherical ball shaped member which includes a plurality of dimples or indentations on its surface (such as similar to the surface of a golf ball), such that a corresponding portion of the mounting portion may at least partially receive the ball shaped member and engage an appropriate one or ones of the dimples or indentations to substantially secure or fix the head portion in a desired orientation relative to the base portion of the accessory module. The head portion may be adjustable via pivotal movement of the head portion relative to a horizontal direction or the x and y axes of the vehicle and/or relative to a vertical direction, such as left and right and/or up and down, to horizontally and/or vertically adjust the orientation of the head portion at various angles relative to the base portion.

As shown in FIGS. **31** and **32**, the head portion **1011***b* of accessory module **1010** may be angled or canted to a desired orientation with respect to the windshield and with respect to a location corresponding to a typical location of the head of the driver of the vehicle. Preferably, the head portion of the accessory module is pivotable to be canted or positioned at an angle A with respect to the longitudinal axis **1009** (FIG. **31**) of the vehicle which is approximately 8-18 degrees toward the driver of the vehicle, more preferably, approximately 10-15 degrees, and most preferably, approximately 11-13 degrees. Also, the head portion **1011***b* may be angled downwardly toward the driver's head at an angle B with respect to a generally horizontal plane **1007** (FIG. **32**). Preferably, the head portion may be angled downwardly toward the driver's head location at an angle greater than approximately 1 degree and less than approximately 15 degrees, and more preferably, greater than approximately 5 degrees and less than approximately 10 degrees downward.

Accessory module **1010** may include various accessories within base portion **1011***a* and/or head portion **1011***b*. For example, in the illustrated embodiment, base portion **1011***a* of accessory module **1010** includes a forward facing video image sensor or system **1062**. The image sensor or system **1062** may include an intelligent rain sensor (such as the type disclosed in commonly assigned U.S. Pat. Nos. 6,320,176; 6,353,392; 6,313,454; 6,341,523; and 6,250,148; and/or in U.S. patent applications, Ser. No. 10/023,162, filed Dec. 17, 2001 by Lynam for RAIN SENSOR MOUNT FOR USE IN A VEHICLE, now U.S. Pat. No. 6,516,664; and Ser. No. 10/348,514, filed Jan. 21, 2003 by Lynam for RAIN SENSOR MOUNTING SYSTEM, now U.S. Pat. No. 6,968,736, which are all hereby incorporated herein by reference), an image or vision system or sensor (including an imaging sensor, such as a video camera, such as a CMOS imaging array sensor, a CCD sensor or the like, such as the types disclosed in commonly assigned, U.S. Pat. Nos. 5,550,677; 6,097,023 and 5,796,094, which are hereby incorporated herein by reference), an intelligent headlamp controller (such as the type disclosed in U.S. Pat. No. 5,796,094 and/or in U.S. provisional applications, Ser. No. 60/420,560, filed Oct. 23, 2002; Ser. No. 60/398,346, filed Jul. 24, 2002; Ser. No. 60/381,314, filed May 17, 2002 by Schofield et al. for VEHICLE ACCESSORY MODULE; Ser. No. 60/374,724, filed Apr. 23, 2002 by Schofield et al. for VEHICLE ACCESSORY MODULE; Ser. No. 60/364,008, filed Mar. 14, 2002 by Schofield for VEHICLE ACCESSORY MODULE; and Ser. No. 60/350,965, filed Jan. 31, 2002 by Schofield for VEHICLE ACCESSORY MODULE, which are all hereby incorporated herein by reference), an intelligent lane departure warning system, such as the types described in U.S. provisional applications, Ser. No. 60/433,700, filed Dec. 16, 2002, and Ser. No. 60/377,524, filed May 3, 2002, which are hereby incorporated herein by reference, and/or the like. The image sensor may be implemented with any type of vehicle vision system or the like, such as a vision or imaging system utilizing principles disclosed in U.S. Pat. Nos. 6,396, 397 and 6,201,642, and/or U.S. patent applications, Ser. No. 10/010,862, filed Dec. 6, 2001, now U.S. Pat. No. 6,757,109; and Ser. No. 09/199,907, filed Nov. 25, 1998, now U.S. Pat. No. 6,717,610, which are hereby incorporated herein by reference. As discussed above, the accessory module of the present invention may provide for positive perpendicular coupling of the base portion of the accessory module to the

windshield to optically couple such sensors toward and against the windshield if desired.

Base portion **1011***a* of the illustrated embodiment of FIG. **27** further may include a short-range radio frequency (RF) transceiver **1064** for communication with other vehicle electronic or communication systems and may communicate to such systems via various protocols or nodes, such as Bluetooth, SCP, UBP, J1850, CAN J2284, Fire Wire 1394, MOST, LIN and/or the like, depending on the particular application of the accessory module of the present invention. The accessory module may be electronically integrated with the vehicle electrical and/or control systems. For example, the accessory module may connect to a sunroof control, rain sensor control, mass motion sensor, roof lighting control, microphone/cell phone control, climate control, or the like, without affecting the scope of the present invention.

As shown in FIG. **27**, head portion **1011***b* may include a microphone or microphone array **1066** for receiving audio or voice signals from within the cabin of the vehicle. The microphone or microphone array may be part of a communication system, such as disclosed in U.S. Pat. Nos. 6,243,003 and 6,278,377, and in U.S. patent application, Ser. No. 09/466,010, filed Dec. 17, **1999** by DeLine et al. for INTERIOR REARVIEW MIRROR SOUND PROCESSING SYSTEM, now U.S. Pat. No. 6,420,975, which are hereby incorporated herein by reference. Preferably, as shown in FIG. **27**, microphone **1066** is mounted or positioned at an underside of head portion **1011***b*, which shelters the microphone from direct moisture intrusion, such that the microphone or microphone array is sheltered from direct exposure to debris or rain or the like, such as when the accessory module is mounted in a convertible.

Head portion **1011***b* preferably includes a single circuit element **1052** (FIGS. **27** and **30**), such as a printed circuit board (PCB) mounted at least partially within head portion **1011***b*. As shown in FIG. **30**, printed circuit board **1052** may include a display element **1054** along or partially along an edge of the board and may include one or more user-actuatable controls or buttons **1056** near or adjacent to the display element **1054**. The display element may be any type of display, such as a vacuum fluorescent (VF) display, a light emitting diode (LED) display, an electroluminescent (EL) display, a liquid crystal (LCD) display, a video screen display or the like, and may be for displaying various information (as discrete characters, icons or the like, or in a multi-pixel manner) to the driver of the vehicle, such as compass heading information, passenger side inflatable restraint (PSIR) information, tire pressure status, and/or the like. The buttons may be for actuating or controlling various accessories or controls or components associated with the vehicle, such as for a compass calibration setting or zone setting, a telematics actuation, a garage door opener device, an electronic toll control (such as disclosed in U.S. patent application, Ser. No. 09/793,002, filed Feb. 26, 2001 by Schofield et al. for VIDEO MIRROR SYSTEMS INCORPORATING AN ACCESSORY MODULE, now U.S. Pat. No. 6,690,268, which is hereby incorporated herein by reference), and/or the like, or may be for switching the display between various functions or modes, without affecting the scope of the present invention. The head portion **1011***b* may include appropriate openings along its face **1011***d*, such that the display element **1054** is visible through one opening, while the buttons or controls may partially protrude through other corresponding openings when an appropriate circuit board is installed within the head portion. This allows for the manufacturer of the printed circuit board to easily place the board in the head portion of the accessory module of the present invention.

As shown in FIG. **30**, the printed circuit board **1052** may include other electronic components **1058**, such as integrated circuits, resistors, capacitors, diodes and/or the like. The printed circuit board or element may also include one or more accessories, such as a compass sensor **1060** for a compass system of the vehicle, such as a compass system of the type disclosed in commonly assigned U.S. Pat. No. 5,255,442, and U.S. patent application, Ser. No. 09/540,702, filed Mar. 31, 2000 by Schierbeek et al. for VEHICLE COMPASS COMPENSATION, now U.S. Pat. No. 6,513,252, which are hereby incorporated herein by reference. The compass sensor may be a magneto-resistive sensor, a magneto-capacitive sensor, a magneto-inductive sensor, or a flux-gate sensor or the like, without affecting the scope of the present invention. In this regard, it is preferable that the head portion is not user movable or adjustable by the driver or occupant of the vehicle when installed in the vehicle, so that the alignment of the compass sensor is predictable relative to the x and y axes of the vehicle and generally invariant over the driving use of the vehicle. The head portion may be set relative to the base portion at a generally fixed or preset angle, but preferably is a fixed mount that may not be adjustable by a user, such as a driver or occupant of the vehicle, in such an application. The head portion thus may be generally fixedly positioned at the or relative to the base portion when the accessory module is mounted at the vehicle, and thus may be non-adjustable by a driver or occupant of the vehicle during normal use of the vehicle and/or the accessory module.

Preferably, the accessory module of the present invention may include a network bus, such as a CAN bus or a LIN bus, such as disclosed in U.S. Pat. No. 6,291,905, which is hereby incorporated herein by reference. The network bus may be operable to communicate with other systems of the vehicle, such as with accessories or elements of the interior rearview mirror assembly.

Optionally, the interior rearview mirror assembly may include an electrochromic rearview mirror, preferably utilizing a solid polymer matrix electrochromic medium, such as described in U.S. Pat. No. 5,910,854, which is hereby incorporated herein by reference. The network bus of the accessory module may then be in communication with the reversing system of the vehicle, such that the accessory module knows when the vehicle is shifted into reverse. The bus may then be operable to communicate this to the electrochromic rearview mirror assembly to disable the electrochromic dimming of the mirror when the vehicle is in reverse, as is desired and known in the art. The accessory module of the present invention thus may provide for hard wiring between the printed circuit board within the accessory module and the rearview mirror assembly, and may thus eliminate the need for hard wiring the mirror to the reverse system of the vehicle. The mirror assembly may be hard wired to the bus or node of the accessory module, which is only a minimal distance, such as approximately three inches, and substantially less distance than wiring from the mirror to the reverse system. The present invention thus may provide for a node or bus in the head portion of the accessory module and may allow the interior rearview mirror assembly to be manufactured without a CAN bus or other type of network bus or node.

The interior rearview mirror assembly may include other accessories in addition to the accessories contained in or mounted to the accessory module. For example, the interior rearview mirror assembly may include lights, and may be a modular rearview mirror assembly, such as described in U.S. Pat. No. 6,124,886, which is hereby incorporated herein by

reference, or may have various other accessories, such as disclosed in U.S. Pat. No. 6,222,460, which is hereby incorporated herein by reference.

The accessory module **1010** thus allows for a display and/or user actuated controls to be adjusted or canted to a desirable orientation with respect to the windshield and the driver of the vehicle. The interior rearview mirror may be pivoted or adjusted independent of the accessory module and may be separately detachable from the accessory module. The adjustable portion of the accessory module may be interchangeable with other portions, depending on the desired or selected options for the particular vehicle in which the accessory module is being installed. The selected adjustable head (or tail) portion may be mounted to a common base portion and adjusted to the desired orientation. The accessory module of the present invention thus allows for various accessories to be mounted within an accessory module which is mountable to the windshield of various vehicles. The adjustable nature of the head or tail portion relative to the generally fixed base portion allows the display or control functions to be optimally oriented with respect to the driver of the particular vehicle, and accounts for various angles of windshields and other design parameters of various vehicles, without requiring specific mounting components. Optionally, the accessory module may include a rechargeable battery pack, such as described above with respect to accessory module **10**. The battery pack may be removable or detachable from the accessory module and may plug into a power outlet of the vehicle for recharging, or the portion of the accessory module that houses the battery pack, such as the head portion of the accessory module, may be detachable and may be plugged into a power outlet of the vehicle for recharging.

Referring now to FIGS. **33** and **34**, an accessory module **1110** is mountable to a windshield mounted button **1118** at an interior surface **12***a* of a windshield **12** of a vehicle. Similar to accessory module **10**, discussed above, accessory module **1110** includes a mounting extender **1116**, which mounts to button **1118** via a mounting portion **1116***a* and includes a second mounting button or mirror attachment member or the like **1116***b* for mounting an interior rearview mirror assembly **1114** to accessory module **1110**. As shown in FIGS. **33** and **34**, the mounting buttons **1118**, **1116***b* may be staggered, such that the mirror mounting button **1116***b* is positioned above the windshield button **1118**. This allows for easy attachment or securement of extender **1116** and accessory module **1110** to windshield button **1118**, such as via a fastener **1115**, while maintaining access to the fastener after the interior rearview mirror assembly **1114** has been mounted to accessory module **1110**. Fastener **1115** may then be driven generally straight through the accessory module and extender and into the windshield button **1118**, without interference with the mirror mounting button **11 16***b*, to secure accessory module **1110** to windshield button **1118**.

As shown in FIG. **33**, and as discussed above with respect to accessory module **1010**, accessory module **1110** may include a lower body portion or stalk or stem portion **1111***a* and an upper or head portion or accessory housing **1111***b* mounted to an upper end of stalk portion **1111***a*. Head portion **1111***b* may be adjustably mounted to stalk portion **1111***a* at a joint **1111***c* (such that a driver of the vehicle may pivot or swivel the head portion to a desired angle toward the driver's head area) or may be generally fixedly secured to stalk portion **1111***a*, such as at a desired or preset angle toward the driver area. For example, the desired angle may be preset and selectable at the vehicle manufacturing plant. This allows the lower or stalk portion **1111***a* to be a common part for various applications of the accessory module, whereby a desired head or cap portion **1111***b* may be mounted to the stalk portion in accordance with the vehicle model or options selected for a particular vehicle.

Because it is desirable to provide generally flat circuitry for the electrical components of the mirror and/or accessory module, head portion **1111***b* may be adapted to receive a flat printed circuit board **1152** therewithin. It is also preferable to have the circuitry on a single or unitary circuit board, rather than two boards with wires connecting them. This avoids bending of the circuitry and may reduce or substantially avoid wires between the circuit board and the associated components. In the illustrated embodiment of FIG. **33**, circuit board **1152** is directly connected to a display **1154**, user actuable buttons **1156**, a microphone **1166**, and a forward facing camera or image sensor **1162**, each of which is positioned at or within or partially within head portion **1111***b* of accessory module **1110** in the immediate vicinity of the flat circuit board **1152**. However, a circuit board may be positioned in head portion **1111***a* and connected to other accessories or additional accessories, such as discussed above and/or below, without affecting the scope of the present invention.

As shown in FIG. **34**, a different or optional head portion **1111***b'* may be provided on stalk portion **1111***a* of accessory module **1110**. Head portion **1111***b'* is adapted to receive a second printed circuit board **1153** therewithin, which is associated with other components or circuitry of accessory module **1110** and/or interior rearview mirror assembly **1114**. For example, circuit board **1153** may be directly connected to other user actuable buttons **1157** or the like at or within head portion **1111***b'*. Head portion **1111***b'* provides a double decker circuit board arrangement or double decker bus arrangement within the head portion. The different head portions **1111***b*, **1111***b'* may be selected depending on the particular application of the accessory module. For example, head portion **1111***b* may be selected and mounted to lower portion **1111***a* if the vehicle includes a compass option or the like, while head portion **1111***b'* may be selected and mounted to lower portion **1111***a* if additional or other options are associated with the vehicle at which the accessory module is mounted.

Referring now to FIGS. **35-57**, alternate embodiments are shown of a mount extender or extension in accordance with the present invention which is adapted for mounting to a ring shaped mounting button or a mounting button, which is otherwise opened in the center region of the button. The ring-shaped buttons are suitable for applications where a rain sensor or other accessory may be included as part of the mounting extension, such that the accessory may be coupled to or loaded against the windshield as the mounting extension is pressed or mounted onto the button, or where an accessory may be part of the button or may be a separate component positioned within the button and against the windshield. For example, a rain sensor may be positioned at the center region of a generally ring-shaped or U-shaped windshield mounted button, such as disclosed in U.S. Pat. Nos. 6,250,148 and 6,341,523 and in U.S. patent applications, Ser. No. 10/023,162, filed Dec. 17, 2001 by Lynam for RAIN SENSOR MOUNT FOR USE IN A VEHICLE, now U.S. Pat. No. 6,516,664; and Ser. No. 10/348,514, filed Jan. 21, 2003 by Lynam for RAIN SENSOR MOUNTING SYSTEM, now U.S. Pat. No. 6,968,736, which are all hereby incorporated herein by reference.

As shown in FIGS. **35**A and **35**B, a mounting button **1218** is generally ring-shaped or open, so as to allow an accessory, such as a rain sensor or the like (not shown), to be positioned at a central region of the mounting button **1218**, and generally loaded or positioned against the windshield (not shown in

FIGS. **35**A and **35**B). Mounting button **1218** is bonded or otherwise secured or affixed to the interior surface of the windshield, and includes a plurality or ridges or notches or teeth **1218***a* at two or more of the side walls **1218***b* of button **1218**. In the illustrated embodiment, each of three side walls **1218***b* of button **1218** include teeth **1218***a*.

A mounting extension **1216** (FIG. **36**) may include a second mirror mounting button **1216***b* at an outer end thereof. Similar to mounting extension **16**, discussed above, the mirror mounting button **1216***b* may be a conventional shaped mounting button for mounting an interior rearview mirror assembly thereto. At least two of the side walls **1216***c* of mounting extension **1216** include a corresponding mounting tab or portion **1216***a* extending inwardly from a lower edge of the mounting extension.

The mounting extension **1216** may be secured to mounting button **1218** by aligning the mounting tabs **1216***a* with the corresponding notches or teeth **1218***a* of mounting button **1218** and pressing mounting extension **1216** generally perpendicularly toward the windshield. The teeth **1218***a* may include a tapered opening or passageway **1218***c* (FIG. **35**B) to ease alignment of the tabs **1216***a* with teeth **1218***a*. The mounting tabs **1216***a* engage the teeth **1218***a* of button **1218** as mounting extension **1216** is pressed onto button **1218**. The teeth **1218***a* of button **1218** are tapered, as can be seen in phantom in FIG. **35**B, to allow for a ratcheting attachment of the mounting extension **1216**, such that the rain sensor or other accessory **1238** may be generally perpendicularly loaded or pressed against and retained against the windshield. Additionally, a spring or biasing member **1238***a* may be provided at a cross member or support **1216***d* extending across mounting extension **1216** between opposite side walls **1216***c* of mounting extension **1216**. The biasing member **1238***a* functions to push or bias the rain sensor into engagement with the windshield as the mounting extension is pressed into place on the button. Optionally, the accessory or rain sensor may be a component of the mounting extension **1216**, such that the accessory is pressed into engagement with the windshield as the mounting extension is mounted to the button **1218**. An outer housing or casing (not shown) of an accessory module may be mounted or secured to the mounting extension, as discussed above.

As shown in FIGS. **37**A and **37**B, a generally U-shaped mounting button **1218'** is securable to an interior surface **12***a* of the windshield. Mounting button **1218'** includes a tapered or ramped portion **1218***a'*, which includes a stop surface **1218***b'*. Ramped portion **1218***a'* is positioned along and recessed within each side of button **1218'**. An accessory module **1210** may be mounted to button **1218'** by sliding the accessory module up and onto the button (the accessory module may include a mount extension of the types discussed herein which slides onto the button), over the ramped portion **1218***a'* and past the stop surface **1218***b'*. The stop surface **1218***b'* substantially precludes movement of the accessory module in the opposite direction, so as to retain the module on the button. Button **1218'** has clearance for a rain sensor (not shown) to be positioned within the U-shaped button and not interfere with the sliding and mounting of the accessory module onto the button. The accessory module and/or mounting extension may be secured to button **1218'** via a spring type attachment or the like. For example, the accessory module may include a spring (not shown) which flexes or deflects as it slides over the ramp **1218***a'* and flexes back after the spring passes the ramped portion **1218***a'*. The spring then engages the opposite facing stop surface **1218***b'* and thus provides resistance to movement in the opposite direction, so as to retain the module on the button **1218'**. However, other mounting means may be implemented, such as set screws or the like securing the module to the button from one or both sides, without affecting the scope of the present invention.

Referring now to FIGS. **38**A-D, an accessory module **1310** includes an accessory **1338**, such as a rain sensor or the like, and is mounted at an interior surface **12***a* of the windshield **12** of a vehicle. A generally ring-shaped mounting button **1318** is secured to the interior surface **12***a* of the windshield **12** and includes at least one lip or hook portion **1318***a* (FIGS. **38**A and **38**C) at one end of button **1318** and at least one tab or hook portion **1318***b* at the other end of button **1318**. As can be seen in FIG. **38**B, hook portion **1318***a* may be positioned along spaced apart openings or slots **1318***d* along the end of button **1318**, while hook portion **1318***b* may be at a slot **1318***c* extending along the end of button **1318**. The central region of button **1318** is generally open to receive accessory **1338** therein, such that accessory **1338** may be loaded against the windshield at the center region of button **1318**.

Accessory module **1310** includes a mounting extension **1316** for mounting to button **1318**. As best shown in FIG. **38**B, mount extension **1316** includes a plurality of hooks or tabs **1316***a* at one end for engaging the hook portion **1318***a* of button **1318**, and one or more springs or tabs **1316***c* at the other end for engaging hook portion **1318***b* of button **1318**, in order to secure mount extension **1316** to button **1318**. As shown in FIG. **38**A, the springs **1316***c* may be spaced apart to provide clearance for a connector **1338***a* of accessory **1338** to pass therethrough to facilitate electrical connection of the accessory to the vehicle wiring. Similar to mount extension **16**, discussed above, mount extension **1316** includes a mirror mounting button **1316***b* at an outer portion for mounting an interior rearview mirror assembly thereto. As shown in FIG. **38**D, mount extension **1316** may include an accessory mounting or loading member **1316***d*, such as a strip of two sided adhesive foam or the like, to secure the accessory **1338** to mount extension **1316** and/or to load the accessory toward and against the windshield **12**.

Mount extension **1316** is mounted to button **1318** via insertion of hooks **1316***a* into hook portion **1318***a* and then pressing mount extension **1316** toward button **1318** to engage springs **1316***c* with hook portion **1318***b*. The accessory **1338** may then be loaded and retained against the windshield by mount extension **1316**. Accessory module **1310** further includes a cover or housing **1328** which is secured to mount extension **1316**, such as via fasteners **1329** (FIG. **38**D) or the like.

With reference to FIGS. **39**A-**41**, another embodiment of the present invention includes a mounting button **1318'**, which may be generally ring-shaped and includes a raised tab or hook portion **1318***a'* along one wall and a pair of openings **1318***c'* defined within a pair of raised loops or rings **1318***d'* at or toward an opposite end of button **1318'** from raised tab **1318***a'* (FIGS. **39**A and **39**B). A corresponding mounting button **1316'** may include side walls and a mirror mounting button **1316***b'* (FIGS. **40**A and **40**B). A lip or extension or hook **1316***a'* may extend outwardly from a lower portion of one end or wall of mount extension **1316'**, while a pair of tabs or hooks **1316***c'*, such as a stamped member or spring, may extend from each side of mount extension **1316'**. Lip **1316***a'* may be inserted within raised tab **1318***a'* of button **1318** and then mounting extension **1316'** may be pushed generally toward the button **1318'** and windshield **12** to secure the mounting extension **1316'** to the button **1318'**. As shown in FIG. **41**, as mounting extension **1316'** is pressed onto button **1318'**, hooks **1316***c'* may flex outwardly as they slide over the raised rings or portions **1318***d'* around the openings **1318***c'*, and then flex inward into engagement with the openings

1318*c'* in button **1318'** to retain mounting extension **1316'** to button **1318'**. Although shown as having openings **1318***c'* and hooks **1316***c'* positioned along the side of the respective components, the openings and hooks may be positioned along an upper side or edge of the button **1318'** and mount extension **1316'**, respectively, without affecting the scope of the present invention.

As shown in FIG. **40**B, mounting extension **1316'** may include one or more accessories **1338'**, such as a rain sensor or the like. The components of accessory **1338'** may be positioned or clipped or snapped into the appropriate spaces or openings or recesses **1316***d'* in mounting extension **1316'**. A housing or casing (not shown) of the accessory module may be provided around and secured to the mounting extension **1316'**, such as discussed above. Mount extension **1316'** may further provide one or more fastening locations (not shown), such as threaded openings or the like, for receiving a fastener to secure the cover or housing of the accessory module thereon, such as discussed above with respect to accessory module **1310**.

Referring now to FIGS. **42**A-**44**, a ring-shaped mounting button **1418** (FIGS. **42**A and **42**B) may be secured to a windshield and includes a plurality of generally rigid raised tabs, hooks or extensions **1418***a* spaced around a perimeter wall **1418***b* of button **1418** (the hooks may be spaced or positioned at two or more of the sides of button **1418**). The tabs **1418***a* may have a generally flat locking surface **1418***a'* for engaging and locking at a retaining spring **1419**, as discussed below. A mounting extension **1416** includes a mirror mounting button **1416***b* and side walls **1416***c* (FIGS. **43**A-C). Each of the side walls **1416***c* may include a retaining spring **1419** connected thereto, such as at a pair of openings or apertures **1416***c'* at opposite ends of each side wall **1416***c*. The springs are positioned generally along a lip or tab or hook **1416***a* of the respective side walls **1416***c*. As shown in FIG. **43**C, the retaining springs **1419** may be curved or wave-shaped to allow for flexing of the spring at the desired regions as the spring engages the respective tab **1418***a* on the button **1418**. As can be seen with reference to FIG. **44**, as mounting extension **1416** is pressed onto and over tabs **1418***a* of button **1418**, springs **1419** will flex as tabs **1418***a* engage the springs and will function to engage the locking surface **1418***a'* of tabs **1418***a* when mounting extension **1416** is pressed over the button **1418** and toward the windshield a sufficient amount. The tabs **1416***a* and **1418***a* and the spring **1419** function to limit or substantially preclude disconnection of the mounting extension **1416** from the button **1418** after the mounting extension **1416** has been mounted on button **1418** and loaded against the windshield.

As shown in FIGS. **45**A and **45**B, a mounting button **1518** useful with an accessory module of the present invention may be generally ring-shaped, as discussed above, and may provide multiple mounting portions or tabs or apertures **1518***a* for mounting to a correspondingly formed mounting portion of a mounting extension (not shown). Mounting button **1518** further includes a mirror mounting button **1517** extending from a portion thereof, such as extending upward from an upper wall **1518***b* of mounting button **1518**. Mounting button **1518** may then receive or mount a mounting extension and associated housing of an accessory module at mounting portions **1518***a*, while receiving an interior rearview mirror assembly (not shown) at button **1517**, such that the mirror assembly may be positioned generally above the accessory module.

Referring now to FIGS. **46**A-**48**, a mounting extension **1616** mounts to a ring-shaped mounting button **1618** and is retained thereto via a retaining hook or retainer **1619** (FIG. **48**). As shown in FIGS. **46**A-C, mounting button **1618** includes side walls **1618***c*, which include a plurality of spaced apart, raised tabs or extensions **1618***a* extending upwardly or outwardly therefrom. Each of the tabs **1618***a* includes a generally flat locking surface **1618***a'*. Likewise, mounting extension **1616** includes opposite side walls **1616***c* with a plurality of spaced apart tabs or extensions **1616***a* extending downwardly or outwardly therefrom (FIGS. **47**A and **47**B). Each of the tabs **1616***a* also includes a generally flat locking surface **1616***a'*. Similar to mounting extension **16**, mounting extension **1616** also includes a mirror mounting button **1616***b* for receiving an interior rearview mirror assembly at an outer end of mounting extension **1616** from the windshield of the vehicle.

Mounting tabs **1618***a* and **1616***a* are correspondingly spaced and alternating so as to align with the gaps between the other tabs **1616***a* and **1618***a*, respectively. As mounting extension **1616** is pressed toward mounting button **1618**, the tabs align with the respective gaps and the mounting extension is moved toward the windshield until the flat locking surfaces **1618***a'* and **1616***a'* generally oppose one another and define a gap therebetween, as shown in FIG. **48**. Retaining hook **1619**, which may be a separate component or may be part of a housing or casing or cover of the accessory module associated with mounting extension **1616**, may then be slid or snapped or otherwise positioned between the opposed surfaces **1618***a'*, **1616***a'* to secure the mounting extension **1616** to the mounting button **1618**. For example, retaining hook **1619** may be a generally continuous edge or lip of a cover or housing of the accessory module, and may snap or slide between all of the hooks or tabs on both sides of the button and the mounting extension. The cover may be a separate part or may be attached to the mounting extension, without affecting the scope of the present invention. As the mounting extension is pressed into place on the button, the retainer **1619** flexes outward as it engages the hooks of the button, and then snaps into place between the hooks once it clears the hooks of the button. As shown in FIG. **47**A, mounting extension **1616** may also include openings or holes **1616***e* for receiving posts or the like from the cover or housing of the accessory module to secure the cover to the mounting extension.

Referring now to FIGS. **49**A-**51**, a mounting extension **1716** (FIGS. **50**A and **50**B) mounts to a ring-shaped mounting button **1718** (FIGS. **49**A and **49**B) and is retained thereto via a retainer or plug **1719** (FIG. **51**). As shown in FIGS. **49**A and **49**B, mounting button **1718** includes side walls **1718***c*, which include a plurality of raised rings or loops **1718***b* extending upwardly or outwardly therefrom. Each of the tabs **1718***b* defines an opening **1718***a* therethrough. Likewise, mounting extension **1716** includes opposite side walls **1716***c* with a plurality of openings **1716***a* therethrough (FIG. **50**B). Similar to mounting extension **16**, mounting extension **1716** also includes a mirror mounting button **1716***b* for receiving an interior rearview mirror assembly at an outer end of mounting extension **1716** from the windshield of the vehicle (FIGS. **50**A and **50**B).

Mounting openings **1718***a* and **1716***a* are correspondingly spaced so as to align with one another as mounting extension **1716** is positioned at mounting button **1718**. When the openings are aligned with one another, retainer **1719** engages the openings to retain the mounting extension **1716** to mounting button **1718**. As shown in FIG. **51**, retainer **1719** includes a pair of opposite engaging portions or locking portions **1719***a* and a pair of springs or biasing members **1719***b* between the locking portions **1719***a*. Each of the locking portions **1719***a* includes a pair of locking extensions **1719***c* for inserting through the openings **1718***a*, **1716***a* to secure the mounting

extension **1716** to the mounting button **1718**. Retainer **1719** may further include a center extension **1719***d* which may be pushed inward to retract the locking extensions **1719***c*, in order to allow the locking extensions to be aligned with the openings **1718***a* of button **1718**. The center extension **1719***d* may be pressed inwardly partially through a center hole or opening **1716***d* in side walls **1716***c* of mounting extension **1716**, and then released when the openings **1716***a*, **1718***a* are aligned. Retainer **1719** may be slidably positioned within mounting extensions **1716** and biased in opposite outwardly directions, such that as mounting extension **1716** is placed at mounting button **1718**, the locking extensions **1719***c* will slide outwardly through opening **1718***a* when the openings **1716***a*, **1718***a* are aligned and the center extension **1719***d* is released.

Referring to FIGS. **52**A, **52**B and **53**, another ring-shaped mounting button **1818** may be secured to a windshield **12** for mounting a mounting extension **1816** of an accessory module **1810** thereto. Mounting button **1818** includes a raised lip or hook or projection **1818***a* extending from one wall **1818***c* of button **1818**. A second button or fastening member or portion **1817** may be positioned on the windshield **12** and spaced from button **1818**. Mounting extension **1816** includes a lip or extension **1816***a* extending therefrom for engagement with and within the raised lip or hook **1818***a* of mounting button **1818**. The accessory module **1810** further includes a fastener portion **1819** having an opening or passageway **1819***a* therethrough, which is spaced from mounting extension **1816** but is fixedly secured or mechanically fastened to mounting extension **1816**. For example, fastener portion **1819** may be part of a housing or casing (a portion of which is shown at **1828** in FIG. **53**) of the accessory module **1810** which is mechanically fastened to the mounting extension, or may otherwise be generally rigidly connected to mounting extension **1816**. As can be seen with reference to FIGS. **52**B and **53**, lip **1816***a* of mounting extension **1816** is inserted into the raised projection **1818***a* of mounting button **1818**, such that fastener portion **1819** is generally aligned with second button **1817** at the windshield. A fastener (not shown) may then be driven through passageway **1819***a* and into second button **1817**, which may have a threaded opening **1817***a* or the like.

Similarly, as shown in FIGS. **54**A, **54**B and **55**, a second button or fastening portion **1817'** may include a hook or lip **1817***a'* extending from the windshield **12**. A fastener portion **1819'** of an accessory module **1810'** may then include a correspondingly formed lip or snap **1819***a'* which engages lip **1817***a'* as the accessory module and/or the mounting extension is pressed toward the windshield. As discussed above, fastener portion **1819'** may be connected to or mechanically fastened to mount extension **1816**, such as via a housing or casing **1828'** of accessory module **1810'**. The corresponding lip portions function to retain the mounting extension and the accessory module to the mounting button at the windshield.

Also, as shown in FIGS. **56**A and **56**B, mounting button **1818** may be mounted to the windshield **12** near a headliner **13** of a vehicle. As shown in FIG. **57**, the vehicle may include a tab or mounting portion **1817"**, such as a tab protruding from the sheet metal **15** of the vehicle. An accessory module **1810"** includes the mounting extension (not shown in FIGS. **56**A, **56**B and **57**) and further includes a snap or tab **1819"** extending therefrom for engagement with the tab **1817"**. As discussed above, the snap **1819"** is mechanically fastened to the mounting extension. As the lip **1816***a* of mount extension **1816** is inserted into lip **1818***a* of button **1818**, the tab **1819"** may be inserted into the headliner **13** and into engagement with tab **1817"** to secure the accessory module **1810"** to the vehicle. The accessory module may thus hook onto the windshield button and then snap into the headliner of the vehicle. The housing or cover **1828"** of the accessory module is preferably formed so as to substantially cover tab **1819"** to enhance the appearance of the accessory module **1810"**.

Referring now to FIGS. **58**A-D, another embodiment of an accessory module **1910** in accordance with the present invention is mountable at and loadable against an interior surface of a vehicle windshield, such as in a similar manner as discussed above with accessory module **10**. Accessory module **1910** is substantially similar to accessory modules **10** and **910** discussed above, such that a detailed discussion of the features and characteristics of the accessory module will not be repeated herein. A housing **1928** of accessory module **1910** may include a recessed area **1928***a* around a mirror mounting member **1916***b* of a mount extension, in order to provide clearance for slidable engagement of a mirror mount **1920** onto mounting member or button **1916***b* of the mount extension. The recessed area **1928***a* allows the mirror mount **1920** of an interior rearview mirror assembly **1914** to be positioned within the recessed area, while allowing for slidable mounting of the mirror mount **1920** to the button **1916***b*. The mirror mount **1920** may be secured to button **1916***b* via a fastener **1920***a* or other fastening or securing means, without affecting the scope of the present invention.

Referring now to FIGS. **59**, **60** and **61**A-I, upper portions of various accessory modules or accessory module assemblies are shown. The upper portion or head portion or accessory housing may provide a compass display, a temperature display and/or other information displays or the like for viewing by a driver of the vehicle above the rearview mirror assembly. The upper portion may include user inputs, such as buttons for actuating a telematics system, a communication system and/or the like. The upper portion of the accessory module may further include a microphone at a lower region thereof. The accessory module may be otherwise substantially similar to the various embodiments of accessory modules discussed above, such that a detailed discussion of the accessory module will not be included herein. The accessory modules may receive an electrochromic mirror assembly, as shown in FIG. **59**, or a prismatic mirror assembly, as shown in FIG. **60**, without affecting the scope of the present invention.

The upper portion or head portion may include all of the electronic components or electronic circuitry necessary to provide the desired function of the upper portion, while the lower portion or base may be a common part to any of the accessory modules, such as those shown in FIGS. **59-61**I, irrespective of the accessory or accessories housed in or associated with the respective head portions. The head portions may provide one or more accessories or functions, and may be swapped or switched to provide other accessories or functions to the respective base portion. For example, a head portion may provide a compass and/or temperature function, such as shown in FIGS. **61**A-I, and/or may provide a telematics function (and may include a microphone), such as shown in FIGS. **61**C-E, **61**H and **61**I, and/or may provide any other suitable or desirable accessory or function. A particular head portion, which may have the desired accessory or combination of accessories and associated controls or buttons, may thus be selected and mounted to a common base portion for mounting the desired accessory module to a vehicle having the corresponding options or features. As can be seen in FIGS. **59-61**I, the head portion extends generally rearwardly from the mounting portion with respect to the vehicle and is viewable and/or user accessible generally above the rearview mirror when the accessory module assembly is mounted in the vehicle, but optionally may be at a side or below the mirror.

It is envisioned that in some vehicle button arrangements, the distance between the mounting button on the windshield and the headliner of the vehicle may not provide sufficient clearance to allow an accessory module of the present invention to align with the attachment member or mounting button during installation of the accessory module onto the button. The extender and/or accessory module must have enough clearance to slide down onto and into engagement with the button on the windshield. In situations where the distance between the button and the headliner is insufficient to provide clearance for the accessory module during installation of the accessory module (i.e., the top of the accessory module may interfere with the headliner as the accessory module is being installed on the mounting button or the windshield form may interfere with the accessory module above the mounting button, such that the accessory module or operator or worker at the vehicle assembly line may mark or damage the headliner or may foul or scratch the windshield as the operator at the assembly line mounts the accessory module to the mounting button), an articulatable accessory module of the present invention may be provided which includes a jointed portion or joint, hinge or pivot to allow for folding or bending of the accessory module.

For example, and with reference to FIGS. **62**A, **62**B and **63**A-D, a foldable or articulatable accessory module or accessory module assembly or windshield electronics module or assembly **2010** (and/or the articulatable accessory module or windshield electronics module **2010'** shown in FIG. **65**) includes a mounting or base portion or lower extension **2011***a* and an articulatable or foldable head portion or accessory housing **2011***b,* which is pivotally or foldably mounted to mounting portion **2011***a.* Accessory module **2010**, **2010'** is adapted so head portion **2011***b* can fold down toward and may be stowed at or near or along mounting portion **2011***a,* such that the accessory module **2010**, **2010'** may be assembled on the windshield in the folded orientation and then unfolded to an unfolded orientation at the windshield of the vehicle, as discussed below. Mounting portion **2011***a* includes a mount (such as mount **2016***a* of mounting portion **2011***a'* in FIG. **64**A) which is configured to slide over an attachment member, such as a button (also not shown), positioned at and/or affixed to a windshield of a vehicle, in a similar manner as described above. Mounting portion **2011***a* also provides an attachment member, such as button **2016***b* (FIGS. **63**A-D), for receiving a mounting portion **2014***a* of an interior rearview mirror assembly **2014**. Interior rearview mirror assembly **2014** may comprise any mirror assembly manufactured with a mount, such as, for example, a wedge type mount or any other mirror mount type, which is adapted for mounting to button **2016***b* of mounting portion **2011***a.* The mirror assembly **2014** may comprise one of a family of base prismatic mirror assemblies or base electrochromic mirror assemblies, since additional features typically added as part of a mirror assembly may be part of or housed in the accessory module **2010**, **2010'**.

Head portion or accessory housing **2011***b* may comprise an upper and lower cover which are sandwiched around a pivot or pivot axle or rods **2011***d* of a mount extension **2011***a'* (FIGS. **64**A and **64**B) which protrudes or extends from base portion **2011***a.* Also sandwiched inside the head portion are the electronics and circuitry which provide the desired functions and accessories to accessory module **2010**, **2010'**. Head portion **2011***b* may include one or more accessories and/or electronic circuitry for one or more accessories and/or a printed circuit board (not shown), such as described above. Head portion **2011***b* also may provide a display element or display **2054**, such as a compass display, a temperature display and/or any other information or status display and/or the like, at an end of head portion **2011***b* which extends over and is viewable above the mirror reflective element **2014***b* and casing **2014***c,* as can be seen in FIGS. **62**A and **62**B. Display **2054** may include a display lens, buttons or other user input devices and/or a combination of a display lens and buttons depending on the particular display function and application of accessory module **2010**, **2010'**. The head portion **2011***b* may also provide user interface controls or buttons and/or accessories (not shown), such as described above.

The two cover pieces of head portion **2011***b* may be molded out of a polymeric resin, such as an ABS, a glass filled Nylon or some other engineering grade plastic or the like which may be suited to the desired application by providing or achieving the desired rigidity, appearance, moldability, cost and/or the like. The display lens may comprise an acrylic material or a polycarbonate material or other suitable light transmitting polymeric material or the like which provides the desired optical properties and resistance to scratches. The buttons may comprise an engineering grade plastic and/or a resilient/elastomeric plastic, such as silicone or the like, or an elastomeric thermoplastic, such as Santoprene® or the like, depending on the particular application and the desired appearance, wear, backlighting, cost and/or the like.

Lower extension or base portion **2011***a* may comprise an upper and lower cover sandwiched around mount extension **2011***a'* which includes pivot axle **2011***d* that protrudes out of the cover pieces to provide the rotational pivot for the head portion **2011***b.* The mount extension **2011***a'* provides the ability of mounting onto a conventional mirror mounting button or attachment member on the windshield, such as a wedge style button or the like on the windshield, while also providing a secondary mirror mounting button or attachment member that a conventional channel mount of a rearview mirror assembly may mate to. The mount extension **2011***a'* may comprise a die cast piece, such as comprising aluminum or other metallic material or the like, depending on which best meets the desired rigidity and cost criterion of the extension. The two cover pieces may be molded out of a polymeric resin, such as a an ABS, a glass filled Nylon or some other engineering grade plastic or the like which may be suitable for the application of accessory module **2010**, **2010'**.

The lower extension or base portion **2011***a* of accessory module **2010**, **2010'** may be assembled by locating the mount extension **2011***a'* onto posts or the like molded in the upper cover of the base portion. The upper cover may include snap features along a perimeter of the cover and the lower cover may have mating snap features along a perimeter, such that the upper cover may snap to the lower cover around the mount extension. The base portion may include anti-vibration/anti-rattle elements. For example, either or both covers may have crush ribs molded into them that may allow the covers to hold tightly to the mount extension to substantially preclude a rattle condition and also to take up any tolerance difference from part to part.

The head portion may be assembled by snapping the lower cover onto the mount extension. The printed circuit board (PCB) may be located onto posts or the like that may be molded in the lower cover of the head. The display lens or buttons may be slid into a groove that is molded into the lower cover. The upper cover may snap onto or otherwise secure to the lower cover. The head portion may include anti-vibration/anti-rattle elements. For example, either or both covers may have crush ribs molded into them that may allow the covers to hold tightly to the printed circuit board and display lens to substantially preclude a rattle condition and also to take up any tolerance difference from part to part.

When assembled together, head portion **2011***b* is pivotally mounted to base portion **2011***a*, such as at an upper end of base portion **2011***a*. Pivot axle **2011***d* of mount extension **2011***a'* has two rod shapes that come out of the top of the mount extension and may be snapped into corresponding cylindrical sockets (not shown) in the lower cover of the head portion as the head portion is attached to the base portion. Head portion **2011***b* thus may be pivotably attached to pivot axle or rods **2011***d* of mount extension **2011***a'* of base portion **2011***a*, and may be generally fixedly retained in one or more desired orientations relative to base portion **2011***a*, such as via a knob or bump on one of the components (such as the knob or bump **2011***f* on mount extension **2011***a'* in FIGS. **64**A and **64**B) sliding in a groove (not shown) until it engages a divot (also not shown) in the other component to lock the head portion in place relative to the base portion. For example, the groove and the divot may be features that are molded into the lower cover of the head portion, and may be located around a pivot point defined at the cylindrical socket or sockets that are also molded into the lower cover of the head portion for receiving the pivot axle or rods **2011***d*. The knob or raised bump **2011***f* or the like may be provided next to each of the rods **2011***d* of mount extension **2011***a'* such that when the lower cover of the head portion is assembled to the mount extension **2011***a'*, the knobs **2011***f* may slide in the corresponding grooves as the head portion is rotated about the pivot axle until the knobs lock in place in the divots to secure the head portion in a desired orientation relative to the base portion.

In order to provide clearance to the headliner of the vehicle during the installation of the accessory module **2010**, **2010'** to the attachment member or mounting button, head portion **2011***b* may fold down toward mounting portion **2011***a* to an installation or mounting or folded position or orientation (FIGS. **63**C and **63**D), such that head portion **2011***b* will not interfere with the headliner while mounting portion **2011***a* is slid down along and over the mounting button on the vehicle windshield. Head portion **2011***b* is mounted to mounting portion **2011***a* at a pivot joint **2011***c*, such as defined by pivot axle or rods **2011***d* and the corresponding sockets, and is foldable or articulatable between the installation or mounting or folded orientation or position and an installed or in-use or non-folded orientation or position (FIGS. **62**A, **62**B, **63**A, **63**B and **65**). When in the folded orientation, head portion **2011***b* is positioned generally along the mounting portion, such as shown in FIGS. **63**C and **63**D. Pivot joint **2011***c* may comprise a spring-loaded pivot joint or the like, which may have a biasing element or biasing member or spring or the like, and which may be biased toward the installed position to substantially secure or retain the head portion **2011***b* in the installed or non-folded position after the accessory module is mounted to the windshield mounting button or the like. Optionally, the pivot joint **2011***c* may provide detents or stops to retain the head portion **2011***b* in one of the positions relative to mounting portion **2011***a*. As shown in FIGS. **64**A and **64**B, a mounting portion **2011***a'* may provide a pivot axle or bar **2011***d*, which may be pivotally received in a corresponding clasp or groove (not shown) of the head portion. The base and head portions **2011***a*, **2011***b* of accessory module **2010**, **2010'** may comprise plastic material, such as engineering plastics or the like, or may be die cast components, which may be covered with a cosmetic plastic cover and/or may be decorated, such as by being painted or by use of a decorative film appliqué or tape of the like, without affecting the scope of the present invention.

The articulatable accessory module **2010**, **2010'** thus may fold or articulate between a mounting or folded orientation or position, which facilitates mounting of the accessory module assembly to the mounting member or button on the windshield by reducing or obviating mechanical interference between the head portion and the roof structure, such as at the joint between the vehicle windshield and the roof area, such as at the headliner area, and an in-use or non-folded orientation or position, where the accessory module is unfolded after mounting to the mounting member or button on the windshield, in order for the accessory to be usable/viewable by the driver or occupant of the vehicle during normal use in the vehicle. Such folding/articulation may include a breakaway capability, whereby should the mirror head be impacted, such as in an accident, the mirror head would move and/or break away to reduce potential injuries.

The windshield manufacturer at the windshield manufacturing site or facility may place or adhere or bond or otherwise secure a mounting member or mounting button on an interior surface of a windshield and toward the upper portion of the windshield in a conventional manner, and may ship the windshield (with the mounting button attached thereto) to a vehicle or automobile assembly plant where the windshield and other components of a vehicle are assembled to a vehicle or automobile as the vehicle moves along the vehicle assembly line. The accessory module may be supplied or provided to the vehicle assembly plant from an accessory module supply or assembly site or facility with a corresponding mirror assembly already attached or mounted thereto, or the mirror assembly may be supplied from a mirror assembly or supply site or facility and may be mounted or attached to the accessory module at the vehicle assembly plant, without affecting the scope of the present invention. As the vehicle proceeds along the assembly line, with the windshield (and button) installed thereon, an operator may mount an appropriate accessory module and rearview mirror assembly to the mounting button.

In some vehicles, there may be insufficient clearance between the mounting button and the headliner or header or roof of the vehicle to facilitate non-interference mounting of an accessory module, whereby a non-folded accessory module may interfere with the headliner or the accessory module. Also, in some vehicles, regardless of whether there is sufficient clearance between the mounting button and the headliner, the curvature or shape of the windshield may hinder or limit attachment of an accessory module onto the mounting button, whereby an accessory module or the operator may foul or scratch or otherwise mark the windshield above the mounting button during the installation process. However, the articulatable accessory module of the present invention avoids such interferences by providing an articulatable head portion which folds down for installation of the accessory module onto the mounting button. The operator thus may mount the articulatable accessory module to the mounting button while the accessory module is in its folded orientation (which reduces the space required to install the accessory module and thus avoids interference with the headliner and/or the windshield during the installation process), and then may unfold the accessory module to its non-folded orientation after the accessory module is mounted to the mounting button on the windshield.

During the installation process of attaching accessory module **2010**, **2010'** to the windshield of a vehicle, head portion **2011***b* may be articulated or folded down relative to mounting portion **2011***a* to the installation position or orientation, where the head portion may be positioned generally along the mounting portion. The head portion **2011***b* may be held in this position by an operator installing the accessory module **2010**, **2010'** or may be retained in this position by a

detent or other locking device or retainer. Mounting portion **2011***a* is then positioned at the windshield and above the attachment member or mounting button to align the mount of mounting portion **2011***a* with the attachment member or mounting button. Because head portion **2011***b* is folded down toward or generally along or over mounting portion **2011***a* (as shown in FIGS. **63**C and **63**D), head portion **2011***b* is lowered to provide additional clearance between the accessory module **2010**, **2010'** and the headliner of the vehicle and/or the windshield itself during the installation process. Mounting portion **2011***a* is then slid down along and onto or over the attachment member or mounting button and secured thereto in a similar manner as discussed above. The folded down position also may allow a vehicle harness to be connected to the accessory module without obstruction or the need for secondary covers or the like.

After mounting portion **2011***a* is secured to the attachment member, such as a mounting button, of the windshield, and after the wire or wire harness (if applicable) is connected to the vehicle wire harness or accessory module, the head portion **2011***b* may be unfolded or moved to its installed or in-use position, as shown in FIGS. **62**A, **62**B, **63**A, **63**B and **65**. The head portion **2011***b* may be manually moved to its in-use position by the operator (such as by pushing the head portion to overcome the detents or the like or by releasing a locking device or retainer or the like), or may automatically unfold or move to its in-use position upon release of the head portion by the operator (such as by a spring loaded or biased pivot joint or the like). When raised or moved to the in-use or installed position, the operator (i.e., the worker at the vehicle assembly line) or the spring or biasing member may urge the head portion toward the windshield to a preferred position or orientation with respect to the particular vehicle at which the accessory module is mounted, so that, for example, the head portion extends generally rearwardly and is generally horizontal and the buttons or display or the like of the head portion are facing generally rearward with respect to the vehicle. Optionally, a stiffening member **2017** (FIG. **64**C) may be provided along base or mounting portion **2011***a* and/or head portion **2011***b* to support and retain or substantially lock the head portion in its installed and in-use position.

For example, during assembly of a vehicle at a vehicle assembly plant, a windshield (with a mounting attachment or button or the like affixed or mounted thereto) may be supplied or provided at the vehicle assembly plant and installed at a vehicle at an assembly line. An operator may install the articulatable accessory module assembly of the present invention by folding the accessory module to its folded orientation and sliding or otherwise moving or positioning or mounting the mounting portion of the accessory module onto the mounting attachment at the windshield. The operator (or a retaining device, such as a detent, band or clip or the like) may retain the accessory module in its folded orientation during the mounting process. The operator (or another operator or a spring or biasing element or the like) may then unfold or pivot or urge the accessory module to its non-folded orientation after the accessory module is mounted to the mounting attachment. The operator may install the accessory module to the mounting attachment with the mirror assembly already mounted to the accessory module (where the accessory module and mirror assembly may be provided as an assembled unit or where the operator first mounts the mirror assembly to the mounting attachment of the accessory module before mounting the accessory module (with the mirror assembly mounted thereto) to the mounting attachment at the windshield), or the accessory module may be mounted to the mounting attachment at the windshield separate from the mirror assembly (where the operator or another operator along the assembly line mounts the mirror assembly to the accessory module after the accessory module has been mounted to the mounting attachment at the windshield and preferably after the accessory module is unfolded to its non-folded orientation). Optionally, and preferably before the accessory module is unfolded to its non-folded orientation, an operator may complete an electrical connection between the accessory module and the vehicle wiring, such as by connecting a wire or wire harness of the accessory module to a corresponding wire or socket or the like of the vehicle, or by connecting a wire or wire harness of the vehicle to the accessory module, or by contacting one or more electrical contacts at the vehicle, such as at the windshield, mounting attachment or headliner of the vehicle, with one or more corresponding electrical contacts of the accessory module.

As best shown in FIG. **65**, head portion **2011***b* may be pivotable or articulatable about a pivot axis which comprises a generally horizontal pivot axis when the base portion **2011***a* is mounted to the mounting button on the windshield. The base portion **2011***a* extends generally upward from the mounting button when attached thereto and may extend generally along the windshield. The head portion **2011***b* extends generally rearwardly with respect to the vehicle and may extend generally horizontally from an upper portion or upper end portion of the base portion when the base portion is mounted to the mounting button on the windshield and the head portion is in the non-folded or in-use orientation or position. The head portion **2011***b* and/or the display region of the head portion is then viewable and/or user accessible generally above the mirror assembly when the mirror assembly is mounted to the base portion **2011***a*.

Optionally, it is further envisioned that head portion **2011***b* may include a camera-based accessory (not shown), such as a rain sensor or the like, at a forward end **2011***e* of head portion **2011***b*, such that unfolding of head portion **2011***b* from mounting portion **2011***a* moves the accessory toward the windshield. In the movement of the head portion **2011***b* toward the in-use position, the head portion may urge the accessory or rain sensor into contact with the interior surface of the windshield and preferably into optical contact with the windshield so that the accessory or rain sensor is optically coupled with the windshield.

After the accessory module **2010**, **2010'** is installed and head portion **2011***b* is moved to its installed position, the interior rearview mirror assembly **2014** may be mounted and secured to the mirror attachment member or attachment button **2016***b* in a similar manner as discussed above. As shown in FIGS. **62**A and **62**B, head portion **2011***b* extends over the reflective element **2014***b* and casing **2014***c* of the interior rearview mirror assembly **2014** so as to be viewable by the driver of the vehicle. The head portion **2011***b* may be configured to provide optimal viewing of the display **2054** by the driver and/or may be adjustable by the driver to adjust the angle of the display with respect to the driver (such as described above with respect to accessory module **1010**) when the head portion is in the installed position.

If an electrochromic (EC) mirror assembly or lighted mirror assembly or other type of prismatic or electrochromic mirror assembly requiring electrical connection is to be assembled to the accessory module, the printed circuit board that is assembled in the head portion may have a harness or wire **2080** (FIG. **65**) that is routed between the covers and out of a hole in the accessory module, such as a hole located on the passenger side parting line of the accessory module (not shown in FIG. **65**). The harness may have a connector or plug **2080***a*, which may be connected to or plugged into the mirror

assembly, such as into a socket or outlet **2082** provided at a rear portion of the casing **2024** of the mirror assembly **2014**, to provide the power and/or controls needed for the mirror assembly and/or accessories or components thereof to function. The harness may be routed along or through a mounting arm **2022** of the mirror assembly **2014** between the accessory module and the rear of the mirror casing **2024** of the rearview mirror assembly. As shown in FIG. **65**, accessory module **2010'** may include a wire cover **2084** extending upward from head portion **2011***b* generally along the windshield **12** and toward the headliner of the vehicle for routing a wire or wire harness **2086** along and through the wire cover between the accessory module and the headliner of the vehicle to provide electrical connection between the accessory module and a vehicle wiring harness in or at the headliner or roof portion of the vehicle.

Accordingly, the head portion of the accessory module assembly of the present invention may be foldably mounted to the mounting or base portion to ease installation of the accessory module to an attachment member or mounting button at a windshield of a vehicle. The pivot joint may be positioned generally above the location of the mounting portion of the extender on the module, such that pivoting, folding, articulating or bending of the module at the pivot joint decreases the effective length or height of the accessory module above the mounting portion, in order to provide additional clearance between the uppermost portion of the accessory module and the headliner of the vehicle during installation of the accessory module. The accessory module may be provided to the vehicle assembly plant in a folded over orientation to facilitate assembly or installation of the accessory module onto the mounting button. After the accessory module is mounted to the mounting button, the accessory module may be unfolded or straightened out to its unfolded orientation. The accessory module may be spring loaded to ease the unfolding process after the accessory module is mounted to the button. The accessory module may then be unfolded and may snap or otherwise lock or secure in the unfolded orientation to substantially preclude folding or bending of the accessory module after installation of the accessory module to the mounting button on the windshield of the vehicle. Although shown as being unfolded to be positioned generally above the rearview mirror assembly when the rearview mirror assembly is mounted to the accessory module assembly, it is envisioned that the accessory module or accessory module assembly of the present invention may also or otherwise extend sidewardly or downwardly to be viewable and/or accessible at one or both sides of the rearview mirror assembly or generally below the rearview mirror assembly.

Referring now to FIGS. **66**A-C, **67**A-D and **68**A-F, a windshield mounted electronic accessory module **2110** comprises a mounting module **2110***a* mounted or secured to an interior surface of a windshield (shown at **2112** as a portion of the windshield) and an accessory housing **2111** mounted to the mounting module **2110***a*. Accessory housing **2111** includes a casing **2111***a* and a cover plate **2111***b* (shown removed from casing **2111***a* in FIG. **66**C) mounted to casing **2111***a* and defining a windshield facing side or surface **2111***c* of housing **2111**. Housing **2111** may also provide user interface buttons or controls **2111***d* at an interior surface or portion **2111***e* of casing **2111***a* for a user to press or adjust to control the accessory or accessories associated with accessory module **2110** or other accessories or the like associated with the vehicle.

Casing **2111***a* includes an aperture or passageway **2115** therethrough for receiving a mirror mounting extension **2116** and mirror mounting button **2116***b* of accessory mounting module **2110***a*, discussed below. Cover plate **2111***b* defines a cavity **2113** which is recessed within casing **2111***a*. Accessory module housing **2111** includes a camera or image sensor (not shown), which is positioned within housing **2111** and aligned with an aperture or opening **2113***a* at cavity **2113** of cover plate **2111***b*. As can be seen with reference to FIGS. **68**B-D, cavity **2113** is angled with respect to the windshield facing side or surface **2111***c* of cover plate **2111***b*, such that the camera is positioned generally horizontally and directed forwardly through the windshield **2112** when accessory module housing **2111** is mounted to mounting module **2110***a*, as discussed below.

Accessory mounting module **2110***a* is substantially similar to accessory module **1310**, discussed above, and includes an accessory **2138**, such as a rain sensor or the like, which may be loaded against the interior surface of the windshield, such as by using the principles disclosed in U.S. Pat. Nos. 6,341,523 and 6,250,148, and/or in U.S. patent applications, Ser. No. 10/023,162, filed Dec. 17, 2001 by Lynam for RAIN SENSOR MOUNT FOR USE IN A VEHICLE, now U.S. Pat. No. 6,516,664; and Ser. No. 10/348,514, filed Jan. 21, 2003 by Lynam for RAIN SENSOR MOUNTING SYSTEM, now U.S. Pat. No. 6,968,736, which are all hereby incorporated herein by reference. Accessory mounting module **2110***a* is mounted at the interior surface of the windshield, such as via an attachment member or mounting button at the windshield or via a suitable adhesive or bonding material or the like. As discussed above with respect to accessory module **1310**, a central region of accessory mounting module **2110***a* is generally open to receive accessory **2138** therein, such that accessory **2138** may be loaded against the windshield at the center region of the module. Accessory mounting module **2110***a* includes a mounting extension **2116** which further includes a mirror attachment member or mounting button **2116***b* at an end thereof for mounting an interior rearview mirror assembly (not shown) to mounting module **2110***a*. Because mounting module **2110***a* is substantially similar to accessory module **1310** discussed above, a detailed discussion of the module will not be repeated herein.

As can be seen with reference to FIGS. **68**A-F, accessory module housing **2111** may be mounted to accessory mounting module **2110***a* by positioning accessory module housing **2111** at mounting module **2110***a* and aligning aperture **2115** of housing **2111** with attachment member **2116***b* of mounting module **2110**. Accessory module housing **2111** may then be moved or pressed into place over mounting module **2110***a* while attachment member **2116** protrudes through aperture **2115**. As discussed above with respect to accessory module **1310**, accessory module housing **2111** may snap or otherwise secure to mounting module **2110***a* to retain accessory module housing **2111** at the windshield. The interior rearview mirror assembly may then mount to mirror attachment member **2116***b*. When assembled and mounted at the windshield, the camera of accessory module housing **2111** is positioned adjacent to the cavity **2113** of cover plate **2111***b* and oriented in a generally horizontal position for viewing through the aperture **2113***a* and capturing an image of a scene occurring exteriorly and generally forwardly of the vehicle.

It is further envisioned that the windshield facing surface **2110***b* of the mounting module **2110***a* and/or the windshield facing surface **2111***c* of housing **2111** may include a black out surface or material or skirt or curtain type of layer or material, preferably a resilient material, such as an elastomeric material, such as a silicone material or the like, or a blackened or darkened or otherwise colored surface or layer, to provide a black out region at the windshield interface of the mounting module **2110***a* and/or housing **2111**. The darkened or black-

ened region may provide a port or aperture aligned with the rain sensor of the mounting module **2110***a* or camera within the housing **2111**. Thus, the need for a ceramic frit layer or the like on the windshield at the mounting area of the accessory module may be obviated. This also improves the assembly process of the vehicle, since the operator does not have to align the rain sensor and/or camera with an aperture in a frit layer as the operator mounts the accessory mounting module to the windshield.

The present invention thus facilitates a reduction or deproliferation of part numbers at a vehicle assembly plant. For optional camera based accessories, such as rain sensors or headlamp controls or the like, or other accessories which may be included in a windshield mounted electronic accessory module of the present invention, multiple different interior rearview mirror assemblies and associated part numbers are not required. For example, the accessory module or modules may have one part number or may have a family part number with a particular number or letter assigned to the particular accessory option or combination (such as, for example, an eight digit part number for the accessory module followed by the letter A for a rain sensor only option, B for a rain sensor option and a headlamp control option, and/or the like). The vehicle line may then only have a restricted or reduced number of different interior rearview mirror assemblies and associated part numbers for use with the accessory modules (such as, for example, a base prismatic mirror assembly, a lighted prismatic mirror assembly, a base electrochromic mirror assembly and a lighted electrochromic mirror assembly and/or the like). Thus, multiple mirror assemblies with various options and their associated part numbers may not be required, thereby improving the assembly process of the vehicle.

Therefore, the present invention provides an accessory module which includes a head portion which extends from a mounting portion generally rearwardly with respect to the vehicle and generally above an interior rearview mirror assembly mounted or attached to the mounting portion of the accessory module. The accessory module may also or otherwise include a head portion which extends generally rearwardly with respect to the vehicle and generally to one or both sides or generally below the rearview mirror assembly mounted or attached to the mounting portion of the accessory module. The head portion of the accessory module may be movable or pivotable or articulatable relative to the mounting portion. The head portion may articulate relative to the mounting portion to a folded or mounting orientation to facilitate mounting of the accessory module to the mounting attachment or button at the windshield. The accessory module of the present invention thus enhances the process of installing or mounting or attaching the accessory module to the button at the vehicle windshield.

An accessory module in accordance with the present invention may be movable into engagement with the windshield of a vehicle such that the accessory module may be moved generally perpendicularly toward and loaded against the windshield. The present invention may include a rotating mirror mount/breakaway mount for mounting the accessory module to a mount extension that includes electrical contacts. When the accessory module is connected mechanically to the mount extension, the electrical contacts may be inserted in such a way that the electrical connections are made at the same time. The accessory module mount may comprise a single or dual pivot mount or a breakaway mount. The accessory module mount may make electrical connection or contact with electrical connectors or pins at the mounting button or the like at the windshield or headliner of the vehicle when the mount is mechanically connected or mounted to the mounting button or mounting extension or the like. The accessory module may be of the type disclosed in commonly assigned U.S. patent application, Ser. No. 10/054,633, filed Jan. 22, 2002 by Lynam et al. for VEHICULAR LIGHTING SYSTEM, now U.S. Pat. No. 7,195,381; U.S. provisional applications, Ser. No. 60/420,560, filed Oct. 23, 2002 by Schofield et al. for VEHICLE ACCESSORY MODULE; Ser. No. 60/398,346, filed Jul. 24, 2002 by Schofield et al. for VEHICLE ACCESSORY MODULE; Ser. No. 60/381,314, filed May 17, 2002 by Schofield et al. for VEHICLE ACCESSORY MODULE; Ser. No. 60/374,724, filed Apr. 23, 2002 by Schofield et al. for VEHICLE ACCESSORY MODULE; Ser. No. 60/364,008, filed Mar. 14, 2002 by Schofield for VEHICLE ACCESSORY MODULE; and Ser. No. 60/350,965, filed Jan. 31, 2002 by Schofield for VEHICLE ACCESSORY MODULE; and/or International Publication No. WO 01/64481, published Sep. 7, 2001, which are all hereby incorporated herein by reference.

Optionally, the accessory module mount may comprise a bolt on mirror mount/breakaway mount that includes electrical contacts, such that as the bolt on mirror mount is connected to the mount extension, the electrical connections are made. Accordingly, when the accessory module is connected mechanically (and tightened down), the electrical connections are made to provide electrical power and signals to the accessory module. Optionally, the accessory module may include a rechargeable battery pack, such that no power connection to the vehicle power source or battery is required. The rechargeable battery pack may be detachable from the accessory module and may be plugged into a vehicle power outlet for recharging, or a portion of the accessory module housing the battery pack may be detachable for recharging of the battery pack.

The accessory module may be mounted at the windshield in a manner which loads or biases the accessory module toward and against the windshield. This provides, for example, an optical coupling of an accessory of the accessory module with the surface of the window, such as for a rain sensor which is coupled to the surface of the window. Preferably, the accessory module is mounted to the button on the window in a manner which allows perpendicular placement and loading of the module and/or of a rain sensor or camera device to and against the interior surface of the windshield. Optionally, accessory module attachment or mounting member may be movable along the mounting member at the surface of the window, wherein the attachment members are formed to draw the meeting face of the electric module into intimate contact with the surface of the window. The mirror attachment members may comprise a narrowing or widening rail or the like, such that the interference between the attachment members increases to tighten the members together as one is slid or moved along the other.

The accessory module may include an image sensor, such as an imaging array sensor, which is directed forward through the windshield for imaging a forward field of view. The accessory module includes a component that is positionable at the windshield to provide a form of a dust or chemical fogging shroud. The component thus keeps the window clean and unfogged in a portion near or at the image sensor of the accessory module. The component, which may be a sealing member or the like, is preferably loaded against the interior surface of the windshield to define a seal around the image sensor so as to substantially seal the image sensor within a chamber defined by the module and the interior surface of the

windshield. The component may be adjustable to adjust an angle of the image sensor relative to horizontal or relative to the windshield of the vehicle.

The accessory module may include a microphone and a shroud or cover extending at least partially around or over the microphone to protect the microphone from wind noise or blower noise or the like. For example, a clamshell or half-cup type cover may extend over the microphone with the microphone being placed partially therein or just above the shroud. The shroud then functions to direct blown air around and/or away from the microphone to prevent or limit the microphone from receiving or detecting the blown air.

The accessory module may also include a forward looking image sensor which is operable as an ambient light sensor, and which may replace an EC forward ambient light sensor of the interior rearview mirror. Optionally or additionally, a rearfacing image sensor may replace an EC rearward ambient light sensor.

The accessory module may include a smart headlamp control, such as disclosed in U.S. Pat. Nos. 6,097,023 and 5,796,094, which are hereby incorporated herein by reference. The headlamp control may be operable to detect and recognize various street and/or traffic signs via an image sensor. The image sensor and headlamp control may further be operable to recognize the speed limit numbers on a speed limit sign and to warn the driver if the vehicle exceeds the speed limit by a predetermined amount. The accessory module may have an interface (such as voice, touch screen, etc.) that would set a personal threshold for over-speed warning.

Such a system could be implemented for warning signs (turns, hills, etc.) or the like. For example, the image sensor and headlamp control may be operable to detect and recognize a railroad crossing sign and further recognize that the railroad crossing sign is activated (such as by distinguishing the flashing lights characteristic of a railroad crossing signal) due to an approaching train. The accessory module could then warn the driver that the vehicle is approaching a dangerous condition. Additionally, the image sensor and headlamp control may be operable to detect other signals, such as a school bus stopping signal or a pedestrian road crossing signal or the like.

The accessory module of the present invention may include, such as on the printed circuit board (such as on a generally flat circuit board of the type discussed above with respect to accessory modules **1010**, **1110**), a photo sensor, preferably a photo transistor or photo diode, which is responsive to ambient light levels. The printed circuit board may be operable to dim the display intensity of a display of the accessory module during night time driving conditions or other darkened conditions where excessive brightness or glare of the display may be distracting or annoying to the driver of the vehicle. Alternately, the circuitry could be connected to the instrument panel wiring and may be operable to dim the instrument panel lights to provide instrument panel dimming during darkened conditions.

The accessory module of the present invention may include electrochromic control circuitry for controlling the reflectivity of an electrochromic mirror. The circuitry may include a rearward viewing glare detector or sensor and a forward viewing and/or sideward viewing ambient light detector or sensor, such as described in U.S. Pat. No. 4,793,690, which is hereby incorporated herein by reference, or may include a single sensor, such as described in U.S. Pat. No. 5,193,029, which is hereby incorporated herein by reference. The output of the circuitry may control an outside electrochromic mirror as well as the interior rearview electrochromic mirror. It is further envisioned that the circuitry may control an outside electrochromic mirror, while the interior rearview mirror assembly mounted at the accessory module may be a prismatic mirror, without affecting the scope of the present invention. Further, automatic dimming circuitry used in the electrochromic mirror assembly may utilize one or more (typically two) photo sensors to detect glaring and/or ambient lighting. For example, a silicon photo sensor, such as a TSL235R Light-to-Frequency converter (available from Texas Advanced Optoelectronic Solutions Inc. of Plano, Tex.), can be used as such photo sensors. Such light-to-frequency converters comprise the combination of a silicon photodiode and a current-to-frequency converter on a single monolithic CMOS integrated circuit.

Optionally, the accessory module may include a microphone or a plurality of microphones or a sound acquisition system, such as described in commonly assigned, U.S. Pat. Nos. 6,243,003 and 6,278,377, and/or U.S. patent application, Ser. No. 09/466,010, filed Dec. 17, 1999 by DeLine et al. for INTERIOR REARVIEW MIRROR SOUND PROCESSING SYSTEM, now U.S. Pat. No. 6,420,975, which are hereby incorporated herein by reference, which may detect audible signals from a remote source, such as a railroad crossing signal or train whistle. The system may then be operable to further determine whether the railroad crossing signal is activated, by visually and/or audibly recognizing the condition, and to provide a warning to the driver of the subject vehicle that the vehicle is approaching a railroad track with an oncoming train.

In many new vehicles, the headlamps are high intensity discharge headlamps, which require that the headlamps be directed generally parallel to the road, in order to prevent the headlamps from being directed toward the eyes of drivers in oncoming traffic. The headlamp control of the present invention may be operable to detect whether the headlamps are directed more toward the sky or toward the road and then automatically adjust them to make them generally parallel to the road. Additionally, the headlamp control may be operable to control the attitude of the vehicle and/or the pitch of the vehicle in response to a detection of the direction in which the headlamps are directed.

The present invention further includes an interior rearview mirror assembly which is mounted to an interior surface of the windshield or at the headliner of the vehicle. The interior rearview mirror assembly may comprise a prismatic mirror or an electrochromic mirror, such as an electrochromic mirror assembly and electrochromic element utilizing principles disclosed in commonly assigned U.S. Pat. Nos. 5,140,455; 5,151,816; 6,178,034; 6,154,306; 6,002,544; 5,567,360; 5,525,264; 5,610,756; 5,406,414; 5,253,109; 5,076,673; 5,073,012; 5,117,346; 5,724,187; 5,668,663; 5,910,854; 5,142,407 or 4,712,879, which are hereby incorporated herein by reference, or as disclosed in the following publications: N. R. Lynam, "Electrochromic Automotive Day/Night Mirrors", SAE Technical Paper Series 870636 (1987); N. R. Lynam, "Smart Windows for Automobiles", SAE Technical Paper Series 900419 (1990); N. R. Lynam and A. Agrawal, "Automotive Applications of Chromogenic Materials", Large Area Chromogenics: Materials and Devices for Transmittance Control, C. M. Lampert and C. G. Granquist, EDS., Optical Engineering Press, Wash. (1990), which are hereby incorporated by reference herein, and in U.S. patent application, Ser. No. 09/792,002, filed Feb. 26, 2001 by Schofield et al. for VIDEO MIRROR SYSTEMS INCORPORATING AN ACCESSORY MODULE, now U.S. Pat. No. 6,690,268, which is hereby incorporated herein by reference. Optionally, a pod attachment, such as the type disclosed in U.S. Pat. Nos.

5,576,687 and 5,708,410, which are hereby incorporated herein by reference, may attach to the rearview mirror assembly.

The electrochromic mirror element may comprise a pair of substrates, and with the rear surface of the rear substrate (commonly referred to as the "fourth surface" of the reflective element) having a silver reflective coating (that itself may have a copper coating and paint coating applied thereto for corrosion protection) deposited thereon, most commonly using wet chemical silvering, as known in the mirror making art. Optionally, the mirror element may comprise a polymeric reflective film that may be applied to the rear surface of the rear substrate of the electrochromic element after the pair of substrates have been joined to form the electrochromic cell of the electrochromic mirror element. Such a reflective film may comprise a polymeric reflective film, such as an all polymer-thin-film multilayer, high reflective mirror film, such as a multilayer, non-metallic reflective film which may comprise multiple coextrusion of many plastic layers to form a highly reflective mirror film. Such a reflective film thus may comprise multilayers of polymer materials to form a highly reflective mirror film, such as a Radiant Light Film, a Radiant Mirror Film or a Radiant Color Film, such as commercially available from 3M of St. Paul, Minn., such as a Radiant Color Film CM590 or CM500.

The reflective polymeric film may be provided in a reel or roll form or strip and may be attached or applied to the rear surface of the rear substrate, such as via laminating or adhering the film to the substrate material using optical adhesive and/or via rolling or ironing the film or sheet (preferably at an elevated temperature and with vacuum assist) onto the substrate surface, to secure the reflective film to the substrate. It is envisioned that the reflective polymeric film may be unwound or unrolled and applied along an extruded substrate material as the substrate material is generally continuously extruded or cast during a generally continuous extrusion or casting process. The substrate material may then be cut, such as via laser cutting, after the reflective polymeric film is applied thereto to form the rear substrate.

Optionally, the cutting process may occur after an anti-abrasion film or the like is applied to the opposite surface of the substrate material, such as an anti-abrasion film applied to the opposite surface via unrolling and applying the film to the extruded substrate material as the substrate material is generally continuously extruded. The anti-abrasion coated film may thus be laminated to or adhered to or otherwise secured to the front surface of the rear substrate, while the reflective film is applied to the rear surface of the rear substrate. Optionally, a hydrophobic or hydrophilic film may also or otherwise be applied to the substrate. The reflective polymeric film, the anti-abrasion film and the substrate material may all be formed of the same resin to match coefficients of thermal expansion and thus reduce thermal expansion/contraction mismatches between the materials. Of course, it is envisioned that such reflective films or reflective systems may be used for prismatic mirrors as well. In such applications, a glass prism may be formed and the reflective film or reflective polymeric film may be applied to a second or rear surface thereof.

Optionally, the interior rearview mirror assembly may comprise a transflective one way mirror, such as disclosed in commonly assigned U.S. patent application, Ser. No. 10/054,633, filed Jan. 22, 2002 by Lynam et al. for VEHICULAR LIGHTING SYSTEM, now U.S. Pat. No. 7,195,381, which is hereby incorporated herein by reference. Preferably, the mirror reflective element (behind which the video display screen is disposed so that the image displayed is visible by viewing through the mirror reflective element) of the interior mirror assembly comprises a transflective mirror reflector such that the mirror reflective element is significantly transmitting to visible light incident from its rear (i.e. the portion furthest from the driver in the vehicle), with at least about 15% transmission preferred, at least about 20% transmission more preferred and at least about 25% transmission most preferred, while simultaneously, the mirror reflective element is substantially reflective to visible light incident from its front (i.e. the position closest to the driver when the interior mirror assembly is mounted in the vehicle), with at least about 60% reflectance preferred, at least about 70% reflectance more preferred and at least about 75% reflectance most preferred. Preferably, a transflective electrochromic reflective mirror element is used (such as is disclosed in U.S. patent application, Ser. No. 09/793,002, entitled VIDEO MIRROR SYSTEMS INCORPORATING AN ACCESSORY MODULE, filed Feb. 26, 2001, now U.S. Pat. No. 6,690,268 and in U.S. Pat. Nos. 5,668,663 and 5,724,187, the entire disclosures of which are hereby incorporated by reference herein) that comprises an electrochromic medium sandwiched between two substrates.

The interior rearview mirror assembly may include a display on demand (DOD) display (such as disclosed in commonly assigned, U.S. patent application, Ser. No. 10/054,633, filed Jan. 22, 2002 by Lynam et al. for VEHICULAR LIGHTING SYSTEM, now U.S. Pat. No. 7,195,381, U.S. patent application, Ser. No. 09/793,002, entitled VIDEO MIRROR SYSTEMS INCORPORATING AN ACCESSORY MODULE, filed Feb. 26, 2001, now U.S. Pat. No. 6,690,268 and in U.S. Pat. Nos. 5,668,663 and 5,724,187, the entire disclosures of which are hereby incorporated by reference herein) which comprises two displays located in the mirror assembly. When the left turn signal is turned on, a blind spot/lane change aid camera view or hazard indication may be displayed in the mirror (preferably via a display on demand indicia or display) on the right hand side. This is because the view in the mirror on the left hand side is more critical to the driver of the vehicle when making a left hand turn. The opposite would be true with right turn signal. However, the signals may be displayed on the other sides as well, without affecting the scope of the present invention. For example, when the left turn signal is activated, the blind spot camera view or hazard indication may be displayed in the mirror (preferably via a display on demand indicia or display) on the left hand side. Optionally, the mirror may include a display portion at the right hand side of the mirror which is angled or canted relative to the main reflective surface of the mirror, such that the angled display portion is canted toward the driver of the vehicle to enhance viewing of the angled display portion by the driver, such as the display type disclosed in commonly assigned, U.S. patent application, Ser. No. 09/793,002, entitled VIDEO MIRROR SYSTEMS INCORPORATING AN ACCESSORY MODULE, filed Feb. 26, 2001, now U.S. Pat. No. 6,690,268, which is hereby incorporated by reference herein.

The display can also be accomplished when a single large display is used in interior rearview mirror (such as via a DOD indicia or display) where only a portion of the display is activated to show the image. This can also be accomplished with displays located on the ends of the mirror surface (such as non-DOD displays). In this case the blind spot image would be displayed on the same side as the turn indicated.

The interior rearview mirror assembly may include a single large display, which provides a display surface behind the whole mirror surface that allows images, icons, text, etc. to be placed anywhere on the viewable mirror surface.

Also, any of the vehicular accessories disclosed above, such as interior rearview mirror assemblies and accessory

modules, such as windshield electronic modules, and having at least a portion with a view through the front windshield of the vehicle, can include ultra small information displays, such as are disclosed in U.S. provisional application, Ser. No. 60/314,457, entitled VEHICLE INFORMATION DISPLAY, filed Aug. 23, 2001; and in U.S. patent application, Ser. No. 10/225,851, filed Aug. 22, 2002, now U.S. Pat. No. 6,847,487, the entire disclosures of which are hereby incorporated by reference herein. Such ultra-small displays may be of a transmissive-type or a reflective type. For example, the ultra small liquid crystal display (LCD) available from Kopin Corporation of Taunton, Mass. is a transmissive type. Kopin Corporation utilizes silicon-on-insulator SOI wafers to build transmissive displays. Kopin Corporation's product utilizes thin monocrystal silicon thin film transistors Si-TFT of several microns peeled off from the circuit board to filter out light, and employs a field sequential method, which shows images in accordance with sequentially changing red, green, and blue. The display has a high degree of transmissivity because it does not need color filters. Image quality depends on color purity of the light emitting diode used as the illumination source.

The micro-display may be used as a gauge (replace TFT because do not have to cut TFT glass to fit, just the screen glass).

The present invention may further include an electronic field sensor (EFS) which is operable to: sense motion; detect when motion stops, in order to prevent SID/Sleep Apnea; and/or sense intrusion.

The EFS may be combined with Thermile Pile (FOV or multiple sensors); with image sensor (all types) (FOV or multiple sensors); with a microphone; and/or with Smart Release (FOV or multiple sensors).

The sensor design (size, shape, type, material, # of sensors, sensitivity, etc.) may be adjusted or adapted depending on the particular vehicle or application of the EFS.

Examples of electronic field sensors are disclosed in commonly assigned U.S. patent application, Ser. No. 09/992,119, filed Nov. 14, 2001 by McCarthy et al. for VEHICLE COMPARTMENT OCCUPANCY DETECTION SYSTEM, now U.S. Pat. No. 6,768,420, which is hereby incorporated herein by reference.

The present invention further provides for a combination of multiple features (i.e. rain, headlamp, etc.) in a single chip/sensor of the accessory module or interior rearview mirror assembly.

Changes and modifications in the specifically described embodiments can be carried out without departing from the principles of the present invention, which is intended to be limited only by the scope of the appended claims, as interpreted according to the principles of patent law.

The invention claimed is:

1. An accessory module system for a vehicle, said accessory module system comprising:

an interior rearview mirror assembly, said interior rearview mirror assembly comprising an interior rearview mirror assembly mounting portion;

an accessory module separate from said interior rearview mirror assembly, said accessory module comprising an accessory module mounting portion;

at least two accessories housed at least partially by said accessory module, one of said at least two accessories comprising a camera and another of said at least two accessories comprising a rain sensor, said camera having a lens;

a first attachment member at an interior surface of a windshield of a vehicle;

said accessory module mounting portion being configured to detachably mount to said first attachment member;

said accessory module comprising a windshield facing portion that opposes the interior surface of the vehicle windshield when said accessory module mounting portion is mounted to said first attachment member at the interior surface of the vehicle windshield, and wherein said windshield facing portion is disposed generally at the vehicle windshield when said accessory module mounting portion is mounted to said first attachment member;

said camera being disposed in said accessory module, said accessory module comprising structure to angle said camera with respect to said windshield facing portion of said accessory module, said camera being angled by said structure of said accessory module and with respect to said windshield facing portion to at least partially compensate for the angle of the windshield itself, said camera having a forward field of view through said windshield facing portion and through the vehicle windshield when said accessory module mounting portion is mounted to said first attachment member, and wherein a principal axis of the forward field of view of said camera is directed generally at or below horizontal when said accessory module mounting portion is mounted to said first attachment member;

wherein said lens of said camera is spaced from the interior surface of the vehicle windshield when said accessory module mounting portion is mounted to said first attachment member at the interior surface of the vehicle windshield; and

wherein said interior rearview mirror assembly mounting portion detachably mounts to at least one (a) a second attachment member disposed at a portion of said accessory module that generally opposes said windshield facing portion, (b) a second attachment member at the interior surface of the vehicle windshield and spaced from said first attachment member, and (c) a header portion of the vehicle remote from said first attachment member.

2. The accessory module system of claim **1** further comprising a resilient element disposed between said windshield facing portion of said accessory module and the interior surface of the vehicle windshield to at least one of cushion and seal said accessory module relative to the interior surface of the vehicle windshield when said accessory module mounting portion is mounted to said first attachment member at the interior surface of the vehicle windshield.

3. The accessory module system of claim **1**, wherein said accessory module comprises a cover and said mounting portion, said cover being attachable to said mounting portion and said mounting portion comprising said windshield facing portion and being configured to mount to said first attachment member at the interior surface of the vehicle windshield.

4. The accessory module system of claim **1**, wherein said accessory module is detachably mounted to said attachment member at the interior surface of the vehicle windshield via a fastenerless attachment.

5. The accessory module system of claim **1**, wherein said camera is associated with at least one of (i) said rain sensor, (ii) a headlamp control system, (iii) a lane departure detection or warning system, (iv) an adaptive cruise control system, (v) a sign recognition system, (vi) a night vision system, (vii) a pedestrian detection system, (viii) a vehicle classification identification system, (ix) a vehicle compatibility detection system, (x) a pre-crash avoidance system, (xi) an emergency response image capture system, (xii) an environmental detec-

tion system, (xiii) an ambient light level detection system, (xiv) a vehicle relative position detection system, (xv) a compass calibration system, (xvi) a global positioning system, and (xvii) an electronic toll collection system.

6. An accessory module system for a vehicle, said accessory module system comprising:

an interior rearview mirror assembly. said interior rearview mirror assembly comprising an interior rearview mirror assembly mounting portion;

an accessory module separate from said interior rearview mirror assembly, said accessory module comprising an accessory module mounting portion;

at least one accessory housed at least partially said accessory module, said at least one accessory comprising a camera, said camera haying a lens;

wherein said camera is associated with at least one of (i) a rain sensing system, (ii) a headlamp control system, (iii) a lane departure detection or warning system, (iv) an adaptive cruise control system, (v) a sign recognition system, (vi) a night vision system, (vii) a pedestrian detection system, (viii) a vehicle classification identification system, (ix) a vehicle compatibility detection system, (x) a pre-crash avoidance system, (xi) an emergency response image capture system, (xii) an environmental detection system, (xiii) an ambient light level detection system, (xiv) a vehicle relative position detection system, (xv) a compass calibration system, (xvi) a global positioning system, and (xvii) an electronic toll collection system;

a first attachment member at an interior surface of a vehicle-windshield of a vehicle;

said accessory module mounting portion being configured to detachably mount to said first attachment member;

said accessory module comprising a windshield facing portion that opposes the interior surface of the vehicle windshield when said accessory module mounting portion is mounted to said first attachment member at the interior surface of the vehicle windshield, wherein said windshield facing portion is disposed generally at the vehicle windshield when said accessory module mounting portion is mounted to said first attachment member;

said camera being disposed in said accessory module, said accessory module comprising structure to angle said camera with respect to said windshield facing portion of said accessory module, said camera is angled by said structure of said accessory module and with respect to said windshield facing portion to at least partially compensate for the angle of the windshield itself, said camera having a forward field of view through said windshield facing portion and through the vehicle windshield when said accessory module mounting portion is mounted to said first attachment member;

wherein said lens of said camera is spaced from the interior surface of the vehicle windshield when said accessory module mounting portion is mounted to said first attachment member at the interior surface of the vehicle windshield; and

wherein said interior rearview mirror assembly detachably mounts to at least one (a) second attachment member at a portion of said accessory module that generally opposes said windshield facing portion, (b) a second attachment member at the interior surface of the vehicle windshield and spaced from said first attachment member, and (c) a header portion of the vehicle remote from said first attachment member.

7. The accessory module system of claim **6** further comprising a resilient element disposed between said windshield facing portion of said accessory module and the interior surface of the vehicle windshield to at least one of cushion and seal said accessory module relative to the interior surface of the vehicle windshield when said accessory module mounting portion is mounted to said first attachment member at the interior surface of the vehicle windshield.

8. The accessory module system of claim **6**, wherein a principal axis of the forward field of view of said camera is directed generally at or below horizontal when said accessory module mounting portion is mounted to said first attachment member.

9. The accessory module system of claim **6**, wherein said accessory module comprises a cover and said mounting portion, said cover being attachable to said mounting portion and said mounting portion comprising said windshield facing portion and being configured to mount to said first attachment member at the interior surface of the vehicle windshield.

10. The accessory module system of claim **6**, wherein said accessory module is detachably mounted to said attachment member at the interior surface of the vehicle windshield via a fastenerless attachment.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,533,998 B2
APPLICATION NO. : 11/716834
DATED : May 19, 2009
INVENTOR(S) : Kenneth Schofield et al.

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

Column 53:
Line 7, Claim 6, "." after "assembly" should be --,--.
Line 13, Claim 6, Insert --by-- after "partially".
Line 15, Claim 6, "haying" should be --having--.
Line 31, Claim 6, "vehicle-windshield" should be --vehicle windshield--.

Column 54:
Line 14, Claim 6, Insert --a-- before "second".

Signed and Sealed this

Thirteenth Day of October, 2009

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office