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Inventor(s)	Maeda; Atsushi et al.

Eye plate lifting feature with roof side applique

Abstract

An autonomous vehicle roof top sensor module includes a shell configured to attach to a roof of an autonomous vehicle. The shell defines an interior in which a sensor is arranged. The sensor is for detecting a characteristic of the autonomous vehicle or a characteristic of an environment surrounding the autonomous vehicle. The shell includes two flanges, each of which includes two lifting features arranged thereon. The lifting features provide a connection point in the form of a through hole for attaching a mechanical lift system to the shell for lifting of the shell onto the roof. The module also includes two appliques that are attach to the roof and cover the lifting features, the flanges, and two portions of the roof not covered by the shell.

Inventors: **Maeda; Atsushi (Chofu, JP), Nakamura; Leo (Yokohama, JP)**

Applicant: **Honda Motor Co., Ltd.** (Tokyo, JP)

Family ID: **1000008762236**

Assignee: **Honda Motor Co., Ltd. (Tokyo, JP)**

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Primary Examiner: Pape; Joseph D.

Attorney, Agent or Firm: Rankin, Hill & Clark LLP

Background/Summary

BACKGROUND

(1) Autonomous and other vehicles may include a roof top package including sensors that monitor an environment around the vehicle and provide information for navigating the vehicle. Challenges arise when trying to incorporate such a package onto the vehicle, such as preventing water intrusion into an interior of the vehicle, arranging the package on top of the roof to secure it to the vehicle, and adequately supporting the outer casing of the package and supporting the sensors mounted therein.

BRIEF DESCRIPTION

(2) According to one aspect, a vehicle includes a roof top module. The roof top module includes a shell attached to a roof of the vehicle, the shell defining an interior; a lifting feature arranged on a flange of the shell and configured for lifting of the shell; an electronic device arranged in the interior; and an applique attached to the roof of the vehicle. The applique covers the lifting feature, the flange, and a portion of the roof not covered by the shell.

(3) According to another aspect, an autonomous vehicle roof top sensor module includes a shell configured to attach to a roof of an autonomous vehicle, the shell defining an interior; a lifting feature arranged on a flange of the shell and configured for lifting of the shell onto the roof; a sensor arranged in the interior, and configured to detect a characteristic of the autonomous vehicle or a characteristic of an environment surrounding the autonomous vehicle; and an applique configured to attach to the roof of the vehicle and cover the lifting feature, the flange, and a portion of the roof not covered by the shell.

(4) According to another aspect, a method of making a vehicle includes providing a roof top module including a shell defining an interior; an electronic device arranged in the interior; a lifting feature arranged on a flange of the shell; and an applique. The method includes using the lifting feature to lift the roof top module onto a roof of the vehicle; attaching the roof top module to the roof; and attaching the applique to the roof to cover the flange, the lifting feature, and a portion of the roof not covered by the shell.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** is a perspective exploded view of a vehicle with a roof top sensor module according to the present subject matter.

(2) FIG. **2** is a perspective view of a roof top sensor module according to the present subject matter.

(3) FIG. **3** is a cross sectional view of a roof top sensor module according to the present subject matter.

(4) FIG. **4** is a perspective view of a portion of an interior of a roof top module according to the present subject matter.

(5) FIG. **5** is a cross section view of the root top module of FIG. **4** taken along line **5**-**5**.

(6) FIG. **6** is a perspective view of a lifting feature according to the present subject matter.

(7) FIG. **7** is a perspective view of a portion of a roof top module including a lifting feature according to the present subject matter.

(8) FIG. **8** is a side view of a portion of a roof top module including a lifting feature according to the present subject matter.

(9) FIG. **9** is a cross section view of a roof top module according to the present subject matter.

(10) FIG. **10** is a perspective view of an interior portion of a roof top module according to the present subject matter.

(11) FIG. **11** is a cross sectional view of a portion of a roof top module according to the present subject matter.

DETAILED DESCRIPTION

(12) Referring to the figures, a vehicle **2** includes a module **4**, which is connected to the vehicle **2** and includes one or more electronic devices **6**. The vehicle **2** is not particularly limited, and may include a fully user-driven vehicle (all driving performed by the user and no driving automation), a semi-autonomous driven vehicle (some driving performed by the user and some driving automation), or a fully autonomous driven vehicle (complete driving automation and no driving performed by the user). In a non-limiting example, the vehicle **2** is a fully-autonomous driven land vehicle configured to transport people, animals, and/or goods.

(13) The module **4** is modular in construction, and may be arranged anywhere on the vehicle **2**. In a non-limiting example, the module **4** is arranged on a top of the vehicle **2**, such as on the roof **8** of the vehicle **2**, and thus is also referred to herein as a roof top module **4** (“RTM **4**”) as it is arranged over the roof **8**. In a non-limiting example, the RTM **4**, also referred to herein as a “roof top sensor module”) is mounted to the front portion of the roof **8** of the vehicle **2** as depicted in the figures. The module **4** can be arranged in other locations, such as on the rear portion of the roof **8** or even on the sides or bottom of the vehicle **2**.

(14) The RTM **4** may include one or more electronic devices **6**. The electronic devices **6** may include a suite of sensors **10** including one or more sensors **10** for detecting characteristics of the vehicle **2**, and/or the environment surrounding the vehicle **2** including objects or people around the vehicle **2**, and thus may be called a roof top sensor module **4**. Other types of electronic devices **6** and non-electronic components may be included as part of the RTM **4**. The electronic devices **6** may be powered by a power source (not shown) associated with the vehicle **2**, and may be in communication with a vehicle control unit that operates to control one or more functions of the vehicle, e.g. a navigation system that control navigation of the vehicle **2**, so as to provide information about the detected characteristics to the vehicle control unit for its operation.

(15) The sensors **10** may include various kinds of instruments for detecting characteristics of the vehicle or of the external environment around the vehicle **2**, for example, movement, objects, temperature, moisture/humidity, light, electromagnetic signals/waves/fields/radiation, etc. In a non-limiting example, the electronic devices **6** include a radar **10**A for detecting people or objects in the environment around the vehicle **2**.

(16) The RTM **4** may include a shell **12** defining an interior **14** in which other components,

including the electronic devices **6**, may be housed. The shell **12** may include a top panel **16**, a bottom panel **18**, and a front panel **20**. The shell **12** may include more or fewer panels. The RTM **4** may also include a right-side panel **22** and a left-side panel **24**, also referred to herein as "appliques". The front panel **20** may include one or more apertures **30** through which the sensors **10** can detect characteristics of the vehicle **2** and/or the environment surrounding the vehicle **2**. The top panel **16**, the bottom panel **18**, and the front panel **20** may combine by connecting to form the interior **14**, while the right-side panel/applique **22** and the left-side panel/applique **24** may be used to cover portions of the other panels and/or portions **32**, **34** of the roof **8**. The shell **12** may combine with these and other panels of the vehicle **2** to define the exterior surface of the vehicle **2**.

(17) The top panel **16** may face up, the bottom panel **18** may be arranged under the top panel **16** and be connected to a central portion **26** the roof **8**, and the front panel **20** may face forward with the apertures **30** also facing forward. The shell **12** thus covers the central portion **26** of the roof **8**. The two side appliques **22**, **24** may be connected to the roof **8**, and/or the shell **12**, to cover respective right and left flanges **28**A, **28**B of the top panel **16**, i.e. flanges **28** of the shell **12**, including the lifting features **84**, and respective right and left portions **32**, **34** of the roof **8** not otherwise covered by the shell **12**.

(18) The present subject matter includes a connection and sealing arrangement for making a secure connection between the RTM **4** and the roof **8**, and also for inhibiting water/liquid from leaking into an interior **62** of the vehicle **2** as defined by the roof **8**. The sealing arrangement includes one or more bolts **36**, one or more cap nuts **38**, one or more gaskets **40**, and/or one or more ribs **42**, which cooperate with one or more respective openings **46** in the roof **8** to thereby connect RTM **4** to the roof **8** in a water-tight/liquid-tight manner such that water or other liquid, including water or liquid in the interior **14** of the shell **12**, from leaking from above the openings **46** in the roof **8**, through the openings **46**, and into the interior **62** of the vehicle **2**.

(19) In this sealing arrangement, the bottom panel **18** may be connected directly the roof **8** of the vehicle **2**. The other panels of the RTM **4** may be connected directly with the roof **8** in a similar manner as described herein with respect to the bottom panel **18**, and/or be indirectly connected to the roof **8** via connection with the bottom panel **18**.

(20) The gaskets **40** may be in the shape of an O-ring or other shapes, and may include a foam sealing material (e.g. a closed or semi-closed cell foam made from EPDM rubber, i.e. ethylene propylene diene monomer rubber foam) or other types of sealing materials. A first gasket **40**A may be arranged between the roof **8** and the bottom panel **18** and creates a seal between the roof **8** and the bottom panel **18** around the shaft **44**, and a second gasket **40**B may be arranged between the bottom panel **18** and the rib **42** and creates a seal between the bottom panel **18** and the rib **42** around the shaft **44**. The ribs **42** may have a general U-shape in cross section (See FIG. **5**) and include generally vertical portions **72** extending up from a base **74**, thus defining a channel **82** between the vertical portions **72** above the base **74**.

(21) The sealing arrangement includes a shaft **44** of each bolt **36** being inserted, and thus extending, up through an opening **46** in the roof **8**, up through an opening **48** in the first gasket **40**A, up through a respective opening **50** in the bottom panel **18** (i.e. an opening **50** in the shell **12**), up through an opening **52** in the second gasket **40**B, and through a respective opening **54** in a rib **42**, and then connected to the cap nut **38**. The cap nut **38** is arranged in the rib **42** on the base **74** between the two vertical portions **72**, is arranged over the shaft **44**, and is securely connected to (e.g. threaded onto) the shaft **44**, thus sandwiching the bottom panel **18**, the two gaskets **40**, the rib **42**, and the roof **8** between the head **56** of the bolt **36** and the cap nut **38**, thereby connecting the bottom panel **18** directly to the roof **8**. The bottom panel **18** may be connected to remaining openings **46** in the roof **8** in the same manner.

(22) A common rib **42** may extends over the two or more openings **46** and thus when the bottom panel **18** is connected to the roof **8**, the common rib **42** may be sandwiched at each of the two more openings **46** between two or more respective cap nuts **38** and the bottom panel **18**. This is shown in

FIG. **3** for example, where a common rib **42**A spans over two openings **50**A, **50**B in the bottom panel **18**, common rib **42**B spans over two openings **50**C, **50**D in the bottom panel **18**, and common rib **42**C spans over three openings **50**E, **50**F, **50**G in the bottom panel **18**. These ribs **42**A, **42**B, **42**C may be adhered in place on the top surface **68** of the bottom panel **18** by an adhesive. The use of the rib **42** is optional, and some openings **50** in the bottom panel **18** may not have a rib **42** extending over them. For example, opening **50**F, **50**G, and **50**H do not have a rib **42** extending over them, and thus when the bottom panel **18** is connected to the roof **8**, no rib **42** is compressed between the cap nut **38** and the head **56** of the bolt **36**.

(23) The bottom panel **18** is connected to the roof **8** by mating external threads on the shaft **44** of the bolt **36** with internal threads on the cap nut **38**, which thus securely connects the cap nut **38** to the shaft **44**. The threads are such that turning the cap nut **38** in a first direction relative to the bolt **36** ("tightening") decreases a distance between the head **56** of the bolt **36** and the cap nut **38**, thus squeezing the rib **42**, the roof **8**, the two gaskets **40**, and the bottom panel **18** between them. Turning the cap nut **38** in the opposite second direction relative to the bolt **36** ("loosening") increases a distance between the head **52** of the bolt **36** and the cap nut **38**. Other connection devices may be used to secure the cap nut **38** to the shaft **44** of the bolt **36**.

(24) When secured/connected together, the bolt **36** and the cap nut **38** operate to seal the openings **46** in the roof **8** to inhibit water/liquid from entering into the interior **62** of the vehicle **2** through the opening **46**. When secured/connected to the bolt **36**, the cap nut **38** defines a blind hole, which may be threaded, and into which the shaft **44** is inserted such that the cap nut **38** covers (e.g. completely covers) a top portion **140** of the shaft **44**. The top portion **140** of the shaft **44** may be that portion that is arranged in the interior **14**, and/or extends up past (upward in FIG. **5**) the opening **54** in the rib **42**. The shaft **44** and the cap nut **38** are connected to each other in the interior **14**. The top portion **140** of the shaft **44** includes the tip **142** of the shaft **44**. When secured to the bolt **36**, the cap nut **38** also presses against, and thus seals to, the top surface **60** of the rib **42** around the opening **54** in the rib **42** and around the shaft **44**; the first gasket **40**A is compressed between, and thus seals to, the top surface **64** of the roof **8** and the bottom surface **66** of the bottom panel **18** and around the opening **50** in the bottom panel **18** and around the opening **54** in the rib and around the shaft **44**; and the second gasket **40**B is compressed between, and thus seals to, the top surface **68** of the bottom panel **18** and the bottom surface **70** of the rib **42**, and around the opening **50** in the bottom panel **18**, around the opening **46** in the roof **8**, and around the shaft **44**. This connects the shell **12** to the roof **8**. These seals formed by connecting the cap nut **38** and gaskets **40** may be liquid/water tight and seal around an entirety of the shaft **44** and openings **46**, **50**, including the top portion **140** of the shaft **44** being covered and thus sealed by the cap nut **38**, and thus preventing liquid passing through these seals, contacting the shaft **44**, and entering into the interior **62** of the vehicle **2** through the openings **46**, **50**. If water or other liquid is present in the interior **14** of the shell **12** or between the bottom panel **18** and the roof **8**, then these seals may inhibit/prevent such water/liquid from entering through the opening **46** in the roof **8** into the interior **62** of the vehicle **2** that is defined by the roof **8**.

(25) Moreover, the vertical portions **72** may act as dams to any water/liquid that may be on the top surface **68** of the bottom panel **18**, and thus inhibit such water/liquid from reaching the opening **54** in the rib **42**, and thus providing even more protection against leaking through the opening **54** into the interior **62** of the vehicle **2**. The sealing arrangement may include other components being sandwiched between the head **56** of the bolt **36** and the cap nut **38**, including a stiffener **76** and roof arch **78**.

(26) The bottom panel **18** may be connected to the roof **8** before the bottom panel **18** is connected to the top panel **16** and/or to the front panel **20**, i.e. before the panels are connected to form the shell **12** and the interior **14**. In this instance, the cap nut **38** may be accessible at the top surface **68** of the bottom panel **18**, and thus simply held in place, e.g. by hand, at the opening **50** in the bottom panel **18** when it is threaded onto the bolt **36**.

(27) Alternatively, the bottom panel **18** may be first connected to one or both of the top panel **16** and the front panel **20** to form the shell **12** and the interior **14** of the shell **12**, and thereafter the shell may be connected to the roof **8**. In this instance, the cap nut **38** may not be accessible at the top surface **68** of the bottom panel **18** since the cap nut **38** is located in the interior **14** of the shell **12**. In order to thread the cap nut **38** and bolt **36** together, the cap nut **38** may be pre-arranged and secured on the top surface **68** of the bottom panel **18** around the opening **50** in the bottom panel **18** (e.g. by adhesive or friction fit), then the bottom panel **18** may be connected to the top panel **16** and front panel **20** to form the interior **14** of the shell **12**. The shell **12** may then be arranged on the roof **8** such that the openings **50** in the bottom panel **18** are aligned with respective openings **46** in the roof **8**. The bolt **36** may then be inserted, e.g. from the interior **62** of the vehicle **2**, up through the openings **46** in the roof **8** and the openings **50** in the bottom panel **18**, and threaded into respective cap nuts **38** secured on the top surface **68** of the bottom panel **18** in order to connect the bottom panel **18**, and thus the RTM **4**, to the roof **8**.

(28) A method of making the vehicle **2**, e.g. an autonomous vehicle **2**, includes providing the RTM **4**, attaching the RTM **4** to the roof **8** of the vehicle **2** by inserting the shaft **44** of the bolt **36** up through the opening **46** in the roof **8** and up through the opening **50** in the shell **12** such that the top portion **140** of the shaft **44** is arranged in the interior **14**, and connecting the shaft **44** and the cap nut **38** to each other in the interior **14**.

(29) The shell **12** (including the top panel **16**, bottom panel **18**, and front panel **20**) may be arranged in place on the roof **8** so that it can be connected to the roof **8** (by connecting the bottom panel **18** to the roof **8** using the bolt **36** and cap nut **38**), and such arranging can be accomplished by hand or with the aid of a mechanical lift system. In order to aid placement of the shell **12** on the roof **8**, the present subject matter includes one or more eye plate lifting features **84** that are configured for lifting the shell **12** onto the roof **8** of the vehicle **2** by allowing a lifting mechanism to connect to the shell **12** via the lifting feature **84**. In a non-limiting example, the shell **12** is arranged in place on the roof **8** using four lifting features **84** arranged at respective locations on the shell **12**. More or less lifting features **84** can be utilized.

(30) Each lifting feature **84** may include a lift plate **86**, a nut **90**, and a rivet **92**. The lift plate **86** may include three through holes **96**, **98**, **100** extending through its thickness. A first portion **102** of the lift plate **86** is bent (up in FIG. **6**) at an approximate right angle to a remaining portion **104** of the lift plate **86**, such that the first portion **102** of the lift plate **86**, which defines at least a portion of the first through hole **96**, is arranged approximately perpendicular the remaining portion **104** of the lift plate **86**, which defines the second and third through holes **98**, **100** as shown in FIG. **6**. The second through hole **98** is arranged along a length of the lift plate **86** between the first through hole **96** and the third through hole **100**. The nut **90** is internally threaded and may be welded (or not) to a bottom surface **106** of the lift plate **86** around the second through hole **98**. The nut **90** may also be part of a one-piece construction with the lift plate **86**, such as being integrally formed with the lift plate **86**. Alternatively, the first through hole **96** could be internally threaded, and the nut **90** may thus be eliminated.

(31) The lift plate **86** may be arranged under the bottom panel **18** where the first portion **102** of the lift plate **86** is inserted up through a slot **108** in the bottom panel **18**, which insertion operates to align the lift plate **86** with the bottom panel **18**. The rivet **92** may be inserted up through the third through hole **100** of the lift plate **86** and a through hole **110** in the bottom panel **18** and crimped to thereby connect the lift plate **86** to the bottom panel **18**. The rivet **92** may be replaced by a weld or other connector, or omitted.

(32) The lifting feature **84** may also be arranged under a flange **28** of the top panel **16** (which is a flange **28** of the shell **12**), by inserting the first portion **102** of the lift plate **86** up through a slot **112** in the flange **28**, which insertion operates to align the lifting feature **84** with the flange **28** and the top panel **16**. The rivet **92** may be arranged in a cut out **118** in the flange **28** so as to allow the bottom panel **18** and the flange **28** to lie flush against each other in the area of the flange **28**, e.g.

the remaining portion **104** of the lift plate **86** lies flush against the bottom surface **66** of the flange **28**. The flange **28** may be sealed to the bottom panel **18** so as to prevent water intrusion into the interior **14**. A bolt **114** is then inserted, and thus extends, from the top and down through a hole **116** in the flange **28**, through a corresponding hole (not shown) in the bottom panel **18**, and then through the second through hole **98** in the lift plate **86** so as to engage the nut **90** at the bottom of the lift plate **86**. The bolt **114** is then threaded into the nut **90** and tightened to connect the lifting feature to the flange **28** of the top panel **16** and to the bottom panel **18**. A connector of a mechanical lift system may then releasably connect with the first portion **102** and first through hole **96** of the lift plate **86**, which extend above the flange **28**. The first through hole **96** thus forms an eye in the eye lift plate **86**. This allows the mechanical lift system to engage the shell **12** for lifting the shell **12** to arrange it on the roof **8**.

(33) If the bottom panel **18** is initially connected to the top panel **16** and the front panel **20** to form the interior **14** of the shell **12**, then the bottom panel **18** may be almost completely covered by the top panel **16** and front panel **20**, and thus the lifting feature **84** may allow the bottom panel **18** to be engaged for lifting the shell **12** by the lifting feature **84** being arranged under and engaging the bottom panel **18** for lifting the shell **12** in place on the roof **8**. The lifting feature **84**, because it engages the bottom panel **18**, thus allows for the lifting of the bottom panel **18**, and thus the shell **12** using the connector of the mechanical lift system.

(34) In order then to cover the exposed flanges **28**, the RTM **4** includes the right-side panel **22** that is connected to the roof **8** to cover the right flange **28**A and a right portion **32** of the roof **8** not otherwise covered by the shell **12**, and the left-side panel **24** that is connected to the roof **8** to cover the left flange **28**B and the left portion **34** of the roof **8** not otherwise covered by the shell **12**.

(35) A method of making a vehicle includes providing a roof top module **4** including the shell **12** defining the interior **14**; the electronic device **6** (e.g. the sensor **10**) arranged in the interior **14**; the lifting feature **84** arranged on the flange **28** of the shell **12**; and the applique **22**, **24**. The method includes using the lifting feature **84** to lift the roof top module **4** onto a roof **8** of the vehicle **2**; attaching the roof top module **4** to the roof **8**; and attaching the applique **22**, **24** to the roof **8** to cover the flange **28**, the lifting feature **84**, and a portion **32**, **34** of the roof **8** not covered by the shell **12**.

(36) The RTM **4** may include internal support structures arranged in the interior **14** of the shell **12** that connect the top panel **16** to the bottom panel **18** in a way that adds rigidity and support to the front center section of the top panel **16**, i.e. where the sensors **10** are arranged, and the structures provide a mounting location for the sensors **10** in the interior **14**. The structures may include a bracket **120**. The top panel **16** may be connected to the bracket **120**, which in turn is connected to the bottom panel **18** (either directly or through another component), which in turn is connected to the roof **8**, thus supporting and offering rigidity to the front center section of the top panel **16**.

(37) The bracket **120** may have a general C-shaped cross section (See FIG. **9**) including a bottom facet **122**, top facet **124**, and a middle facet **126** extending between and connecting together the bottom facet **122** and the top facet **124**. The bracket **120** extends laterally along a width of the RTM **4** and provides support for the top panel **16** along the width of the top panel **16** to inhibit sagging of the top panel **16** due to its own weight. The bottom facet **122** and the top facet **124** may each be arranged essentially horizontal, and the middle facet **126** may be arranged essentially vertical and thus may be angled by about 90 degrees with respect to each of the bottom facet **122** and the top facet **124**. However, this configuration is not required and bracket **120** can have other configurations and/or the three facets **122**, **124**, **126** may have other orientations.

(38) The top panel **16** may be connected to the top facet **124**, e.g. directly using a connector **130**. The bottom facet **122** may be connected to the bottom panel **18**, either directly or through direct connect with a bottom bracket **128**, which is directly connected to the bottom panel **18**. FIG. **11** depicts the bottom facet **122** of the bracket **120** being connected to the bottom bracket **128** with a mechanical fastener **136**, and the bottom bracket **128** may then be connected directly to the bottom

panel **18** and roof **8**. The bottom facet **122** or the bottom bracket **128** may be directly connected to the roof **8** using one or more of the bolts **36** and cap nuts **38**.
(39) The bracket **120** may include one or more stiffener plates **132**, each of which may have a general triangle shape, and be arranged perpendicular to both, extend between, and be connected to both, the bottom facet **122** and the middle facet **126**. The stiffener plates **132** may be included to provide support for the bottom facet **122** and the middle facet **126** so as to maintain the mutual orientation of the bottom facet **122** and the middle facet **126**. The stiffener plates **132** may also be arranged perpendicular to both, extend between, and be connected to both, the top facet **124** and the middle facet **126** so as to maintain the mutual orientation of the top facet **124** and the middle facet **126**. The bracket **120** may be a one-piece component where the stiffener plates **132**, the bottom facet **122**, the top facet **124** and the middle facet **126** are part of the one-piece bracket **120**, such as being integrally formed with each other. Alternatively, the bracket **120** may be a multiple-piece component where the stiffener plates **132**, the bottom facet **122**, the top facet **124** and the middle facet **126** are separately formed and then connected to each other.
(40) The front panel **20** may also be connected to the bracket **120**, e.g. the top portion of the front panel **20** may be connected at a top to the top facet **124** of the bracket **120** with the mechanical fastener **136**, and thus the front panel **20** may be supported and made rigid by the bracket **120** in a similar way as the top panel **16**. The bottom portion of the front panel **20** may be connected at a bottom to the bottom panel **18** with a fastener **138**.
(41) The sensors **10** may be mounted to the bracket **120**, e.g. to the middle facet **126**, and thus the bracket **120** is referred to herein as a sensor bracket **120**. The sensor bracket **120** may include one or more sensor openings **134** in the middle facet **126**, through which respective sensors **10** are inserted and mounted to the bracket **120**. When the sensors **10** are mounted to the bracket **120**, the sensors **10** may align with the apertures **30** in the front panel **20**, through which the sensors **10** can detect characteristics of the vehicle **2** and/or the environment surrounding the vehicle **2**. The weight of the sensors **10**, when mounted on the bracket **120**, may be transferred through the bracket **120** to the bottom panel **18** and to the roof **8**, and may thus not be transferred to the top panel **16** and thus may inhibit a front middle portion of the top panel **16** from sagging or warping down into the interior **14** under its own weight or under the weight of the sensors **10**.
(42) It will be appreciated that various of the above-disclosed and other features and functions, or alternatives or varieties thereof, may be desirably combined into many other different systems or applications. Also that various presently unforeseen or unanticipated alternatives, modifications, variations or improvements therein may be subsequently made by those skilled in the art which are also intended to be encompassed by the following claims.

Claims

1. A vehicle including a roof top module, the roof top module comprising: a shell attached to a roof of the vehicle, the shell defining an interior; a lifting feature arranged on a flange of the shell and configured for lifting of the shell, wherein the lifting feature includes a lift plate having a first portion bent at an angle relative to a remaining portion, the first portion being positioned above the flange, and the remaining portion being positioned under the flange; an electronic device arranged in the interior; and an applique attached to the roof of the vehicle; wherein the applique covers the lifting feature, the flange, and a portion of the roof not covered by the shell.
2. The vehicle according to claim 1, wherein: the vehicle is an autonomous vehicle; the electronic device comprises a sensor that detects a characteristic of the autonomous vehicle or a characteristic of an environment surrounding the autonomous vehicle; and the sensor is in communication with a navigation system of the autonomous vehicle.
3. The vehicle according to claim 1, wherein the lift plate is attached to the flange with a bolt and nut.

4. The vehicle according to claim 3, wherein: the shell includes a top panel and a bottom panel connected together to define the interior; the top panel includes the flange; the remaining portion is arranged under the bottom panel; and the first portion extends up through a slot in the bottom panel, and up through a slot in the flange so that the first portion is arranged above the slot in the bottom panel and above the slot in the flange.
5. The vehicle according to claim 4, wherein: the lift plate includes a second through hole; and the bolt extends down through a hole in the flange, down through a hole in the bottom panel, and down through the second through hole, and is threaded to the nut under the lift plate to thereby connect the lift plate to the flange and to the bottom panel.
6. The vehicle according to claim 5, wherein the nut is welded to a bottom surface of the lift plate.
7. The vehicle according to claim 5, wherein: the lift plate includes a third through hole; and a rivet extends through the third through hole and through a through hole in the bottom panel to thereby connect the lift plate to the bottom panel.
8. The vehicle according to claim 7, wherein the flange includes a cut out, and the rivet is arranged in the cut out.
9. The vehicle according to claim 8, wherein the remaining portion is flush against a bottom surface of the bottom panel.
10. The vehicle according to claim 1, wherein: the shell covers a central portion of the roof; the flange is a right flange of the shell; the lifting feature is a first lifting feature; the applique is a right-side panel that covers the right flange of the shell, the first lifting feature, and a right portion of the roof; the shell further includes a left flange including a second lifting feature; and the roof top module further includes a left-side panel that covers the left flange, the second lifting feature, and a left portion of the roof.
11. An autonomous vehicle roof top sensor module comprising: a shell configured to attach to a roof of an autonomous vehicle, the shell defining an interior; a lifting feature arranged on a flange of the shell and configured for lifting of the shell onto the roof, wherein the lifting feature includes an angled plate member having an upper section extending above the flange and a lower section disposed beneath the flange, the upper section oriented at a non-zero angle relative to the lower section; a sensor arranged in the interior, and configured to detect a characteristic of the autonomous vehicle or a characteristic of an environment surrounding the autonomous vehicle; and an applique configured to attach to the roof of the autonomous vehicle and cover the lifting feature, the flange, and a portion of the roof not covered by the shell.
12. The autonomous vehicle roof top sensor module according to claim 11, wherein: the shell includes a top panel and a bottom panel connected together to define the interior; the top panel includes the flange; the lifting feature includes a lift plate; the lift plate includes a first portion defining a first through hole; the first portion extends up through a slot in the bottom panel, up through a slot in the flange so that the first through hole is arranged above the flange; a remaining portion of the lift plate is arranged under the flange and under the bottom panel; and the first portion is bent at an angle with respect to the remaining portion.
13. The autonomous vehicle roof top sensor module according to claim 12, wherein: the lift plate includes a second through hole; and a bolt extends down through a hole in the flange, down through a hole in the bottom panel, and down through the second through hole, and is threaded to a nut welded to a bottom surface of the lift plate to thereby connect the lift plate to the flange and to the bottom panel.
14. The autonomous vehicle roof top sensor module according to claim 13, wherein: the lift plate includes a third through hole; a rivet extends through the third through hole and through a through hole in the bottom panel to thereby connect the lift plate to the bottom panel; the flange includes a cut out; the rivet is arranged in the cut out; and the remaining portion is flush against the bottom panel.
15. A method of making a vehicle comprising: providing a roof top module, the roof top module

including: a shell defining an interior; an electronic device arranged in the interior; a lifting feature arranged on a flange of the shell, wherein the lifting feature includes a lift plate having a first portion bent at an angle relative to a remaining portion, the first portion being positioned above the flange, and the remaining portion being positioned under the flange; and an applique; using the lifting feature to lift the roof top module onto a roof of the vehicle; attaching the roof top module to the roof; and attaching the applique to the roof to cover the flange, the lifting feature, and a portion of the roof not covered by the shell.

16. The method according to claim 15, wherein: the shell includes a top panel and a bottom panel connected together to define the interior; the top panel includes the flange; the lifting feature includes a lift plate; the lift plate includes a first portion defining a first through hole; the first portion extends up through a slot in the bottom panel, up through a slot in the flange so that the first through hole is arranged above the flange; a remaining portion of the lift plate is arranged under the flange and under the bottom panel; and the first portion is bent at an angle with respect to the remaining portion.

17. The method according to claim 16, wherein: the lift plate includes a second through hole; and a bolt extends down through a hole in the flange, down through a hole in the bottom panel, and down through the second through hole, and is threaded to a nut welded to a bottom surface of the lift plate to thereby connect the lift plate to the flange and to the bottom panel.

18. The method according to claim 17, wherein: the lift plate includes a third through hole; a rivet extends through the third through hole and through a through hole in the bottom panel to thereby connect the lift plate to the bottom panel; the flange includes a cut out; the rivet is arranged in the cut out; and the remaining portion is flush against the bottom panel.

19. The method according to claim 15, wherein, the vehicle is an autonomous vehicle; the electronic device comprises a sensor that detects a characteristic of the autonomous vehicle or a characteristic of an environment surrounding the autonomous vehicle; and the sensor is in communication with a navigation system of the autonomous vehicle.

20. The vehicle according to claim 1, wherein the first portion of the lift plate defines a through hole positioned above the flange to provide a connection point for a mechanical lift system, wherein the angular relationship between the first portion and the remaining portion provides mechanical advantage during lifting operations, and wherein the lift plate is configured to facilitate self-alignment of the shell during installation onto the roof of the vehicle.