



US 20250263035A1

(19) **United States**

(12) **Patent Application Publication**  
**Smith et al.**

(10) **Pub. No.: US 2025/0263035 A1**

(43) **Pub. Date: Aug. 21, 2025**

(54) **RETRACTABLE STEP AND SIDE BAR  
ASSEMBLY FOR RAISED VEHICLE**

Jan. 16, 2017, now Pat. No. 10,077,016, which is a  
continuation of application No. 14/846,433, filed on  
Sep. 4, 2015, now Pat. No. 9,550,458.

(71) Applicant: **Lund Motion Products, Inc.**, Ann  
Arbor, MI (US)

(60) Provisional application No. 62/171,780, filed on Jun.  
5, 2015.

(72) Inventors: **Anthony Nicholas Smith**, Huntington  
Beach, CA (US); **Eric Charles Bajza**,  
Orange, CA (US); **William Franklin  
Bibb, VI**, Littleton, CO (US)

**Publication Classification**

(21) Appl. No.: **19/199,760**

(22) Filed: **May 6, 2025**

(51) **Int. Cl.**  
**B60R 19/48** (2006.01)  
**B60R 3/00** (2006.01)  
**B60R 3/02** (2006.01)  
**B60R 19/42** (2006.01)

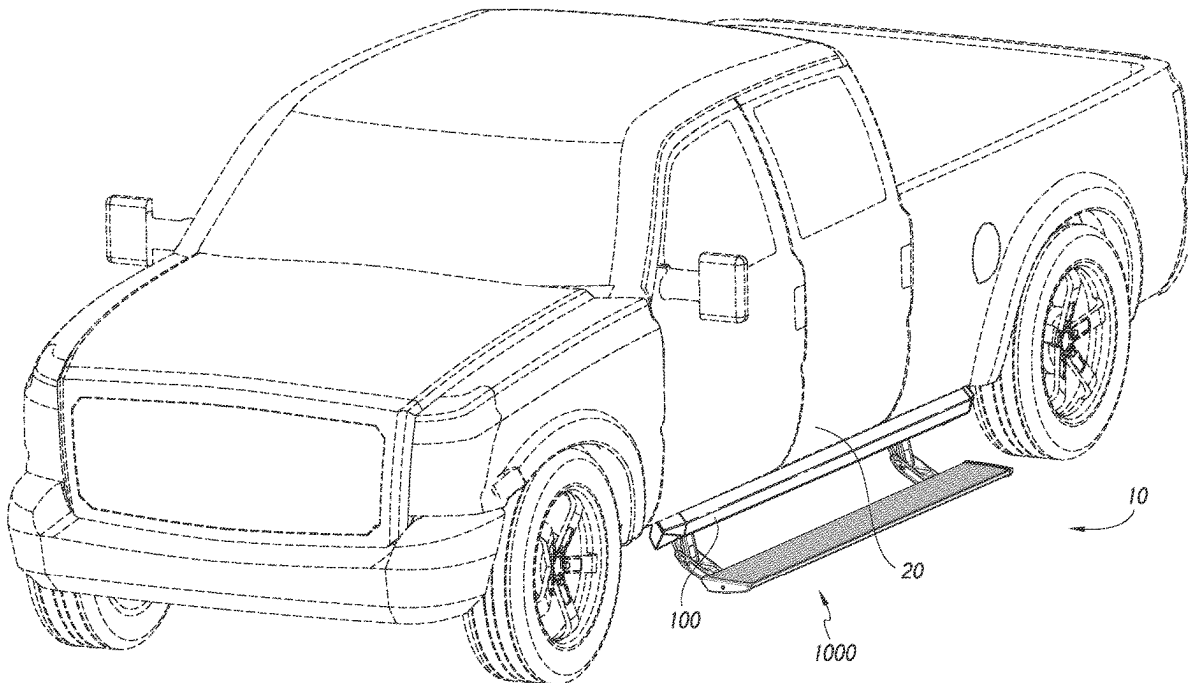
(52) **U.S. Cl.**  
CPC ..... **B60R 19/48** (2013.01); **B60R 3/002**  
(2013.01); **B60R 3/02** (2013.01); **B60R 19/42**  
(2013.01)

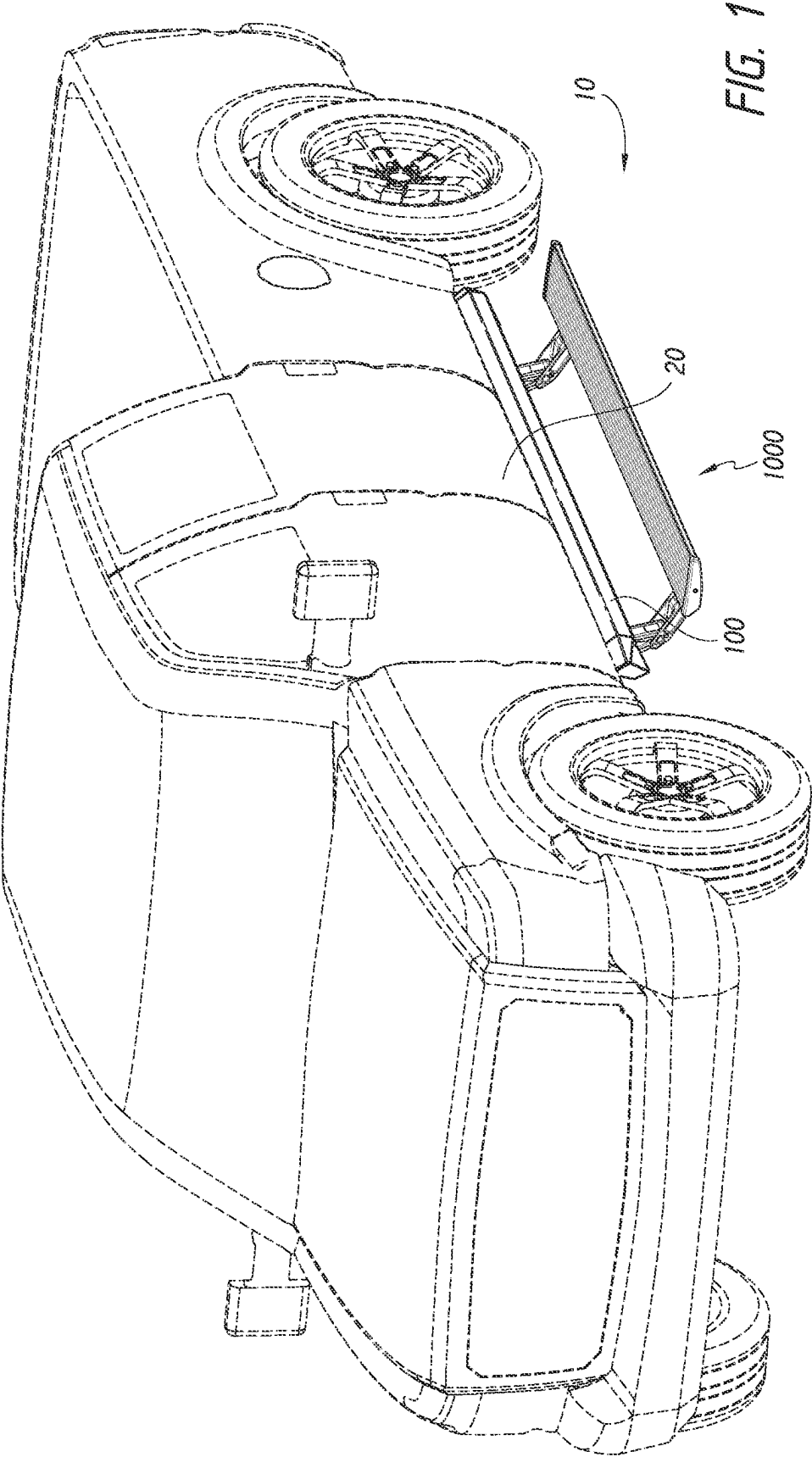
**Related U.S. Application Data**

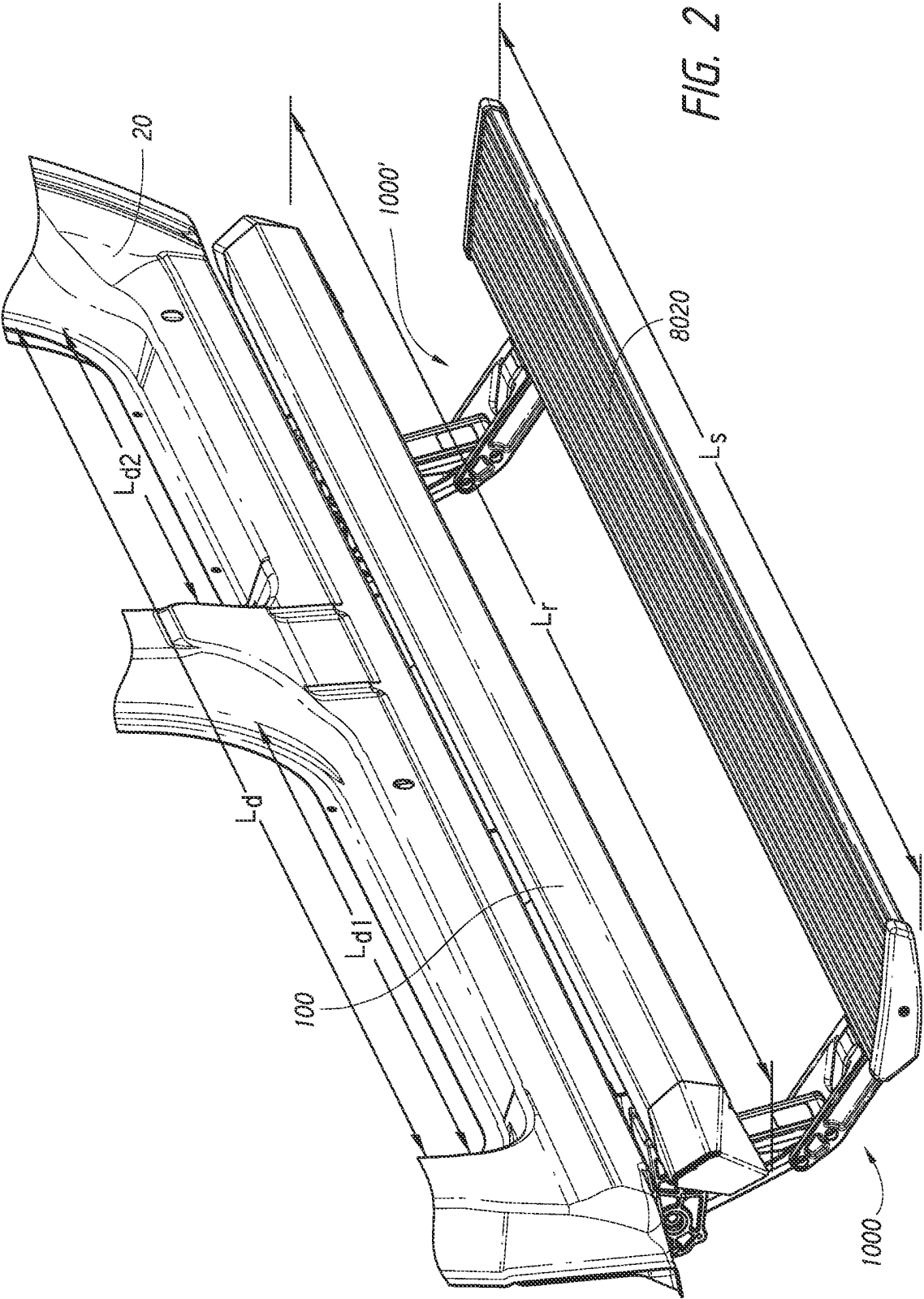
(63) Continuation of application No. 18/675,975, filed on  
May 28, 2024, now Pat. No. 12,291,157, which is a  
continuation of application No. 18/334,248, filed on  
Jun. 13, 2023, now Pat. No. 11,999,309, which is a  
continuation of application No. 17/455,301, filed on  
Nov. 17, 2021, now Pat. No. 11,713,012, which is a  
continuation of application No. 17/016,690, filed on  
Sep. 10, 2020, now Pat. No. 11,180,100, which is a  
continuation of application No. 16/123,462, filed on  
Sep. 6, 2018, now Pat. No. 10,773,670, which is a  
continuation of application No. 15/406,982, filed on

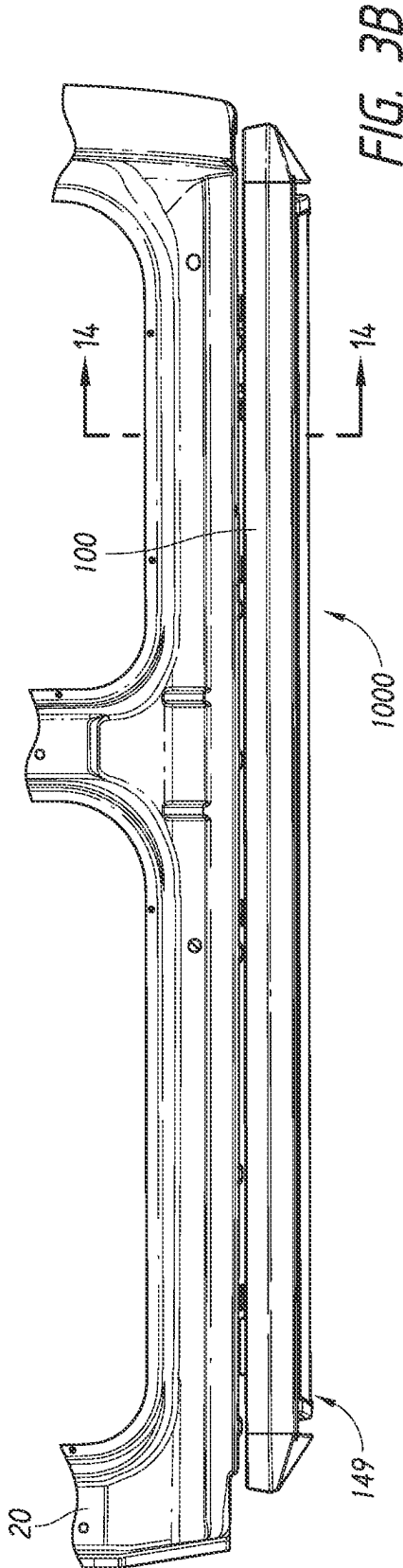
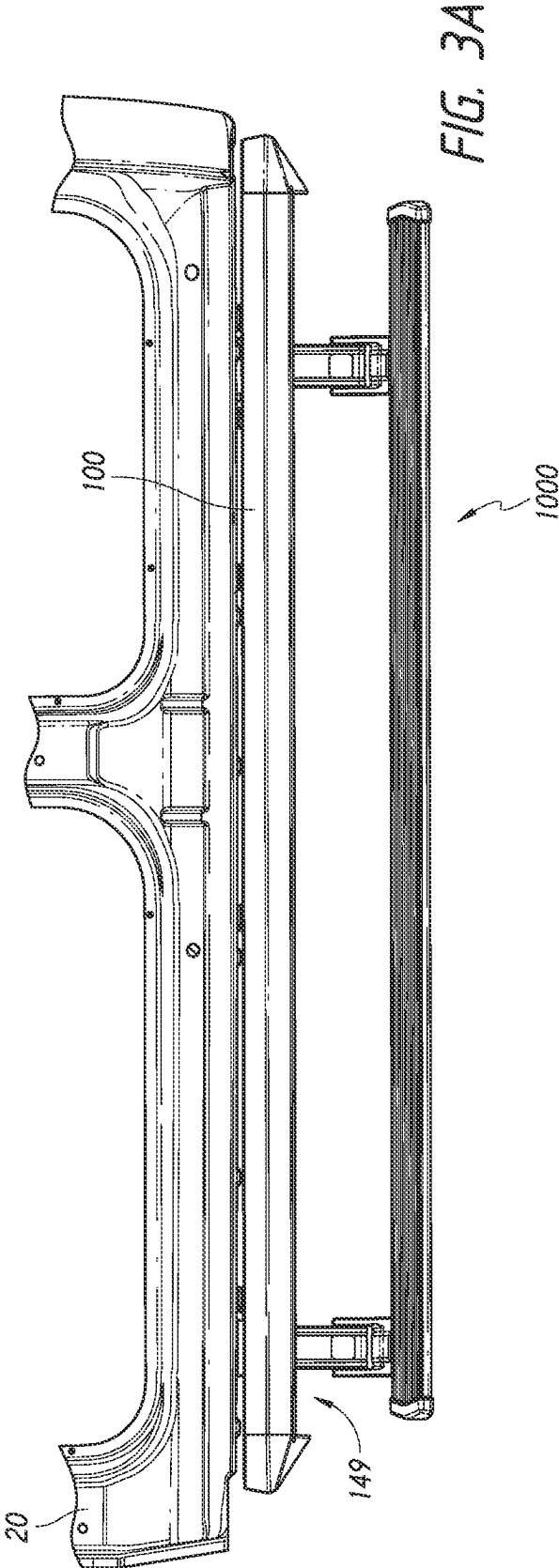
(57) **ABSTRACT**

A retractable step and side bar assembly that can be used for  
raised vehicles, such as trucks. The retractable step can be  
configured to provide for significant reach in a deployed  
position to allow for a user to enter the raised vehicle.  
Further, in the stowed position the retractable step can be  
located within the side bar, thereby providing a low profile  
as well as an enhanced aesthetic appearance.









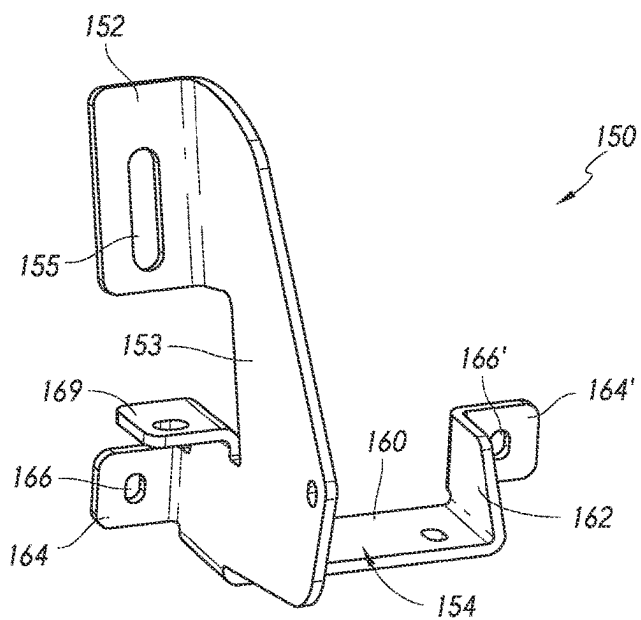


FIG. 4A

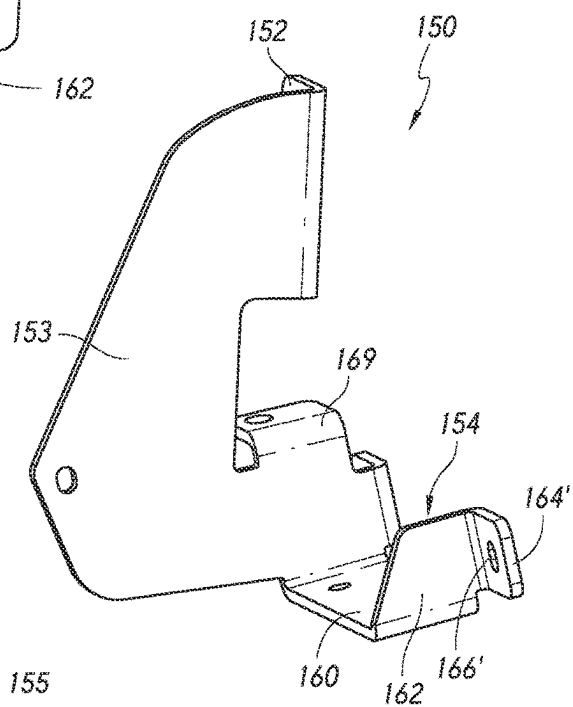


FIG. 4B

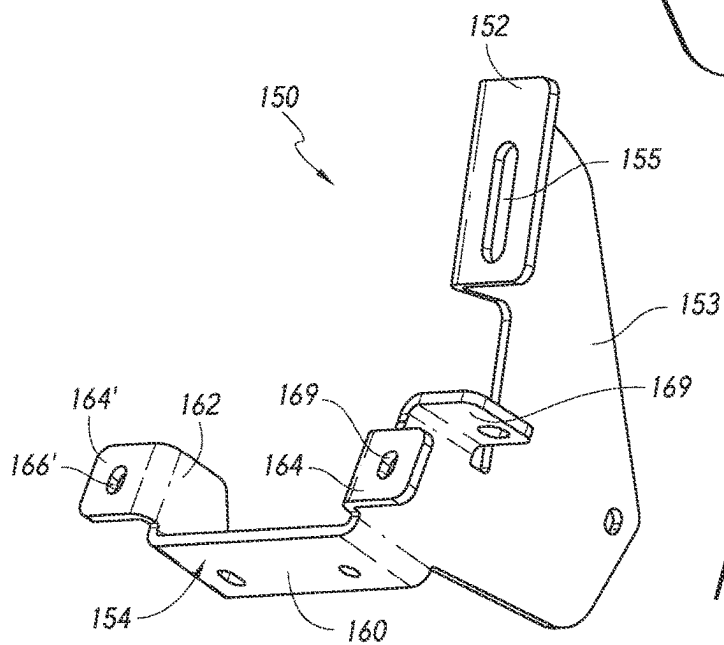
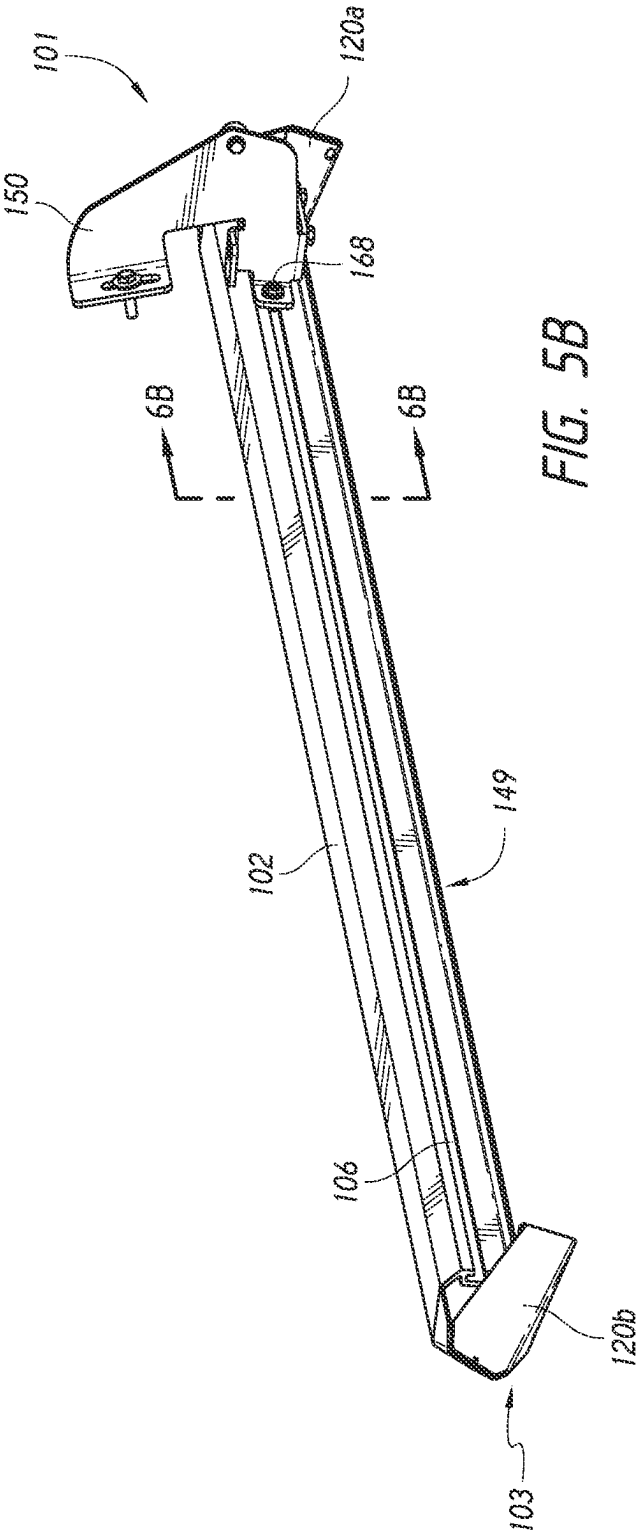
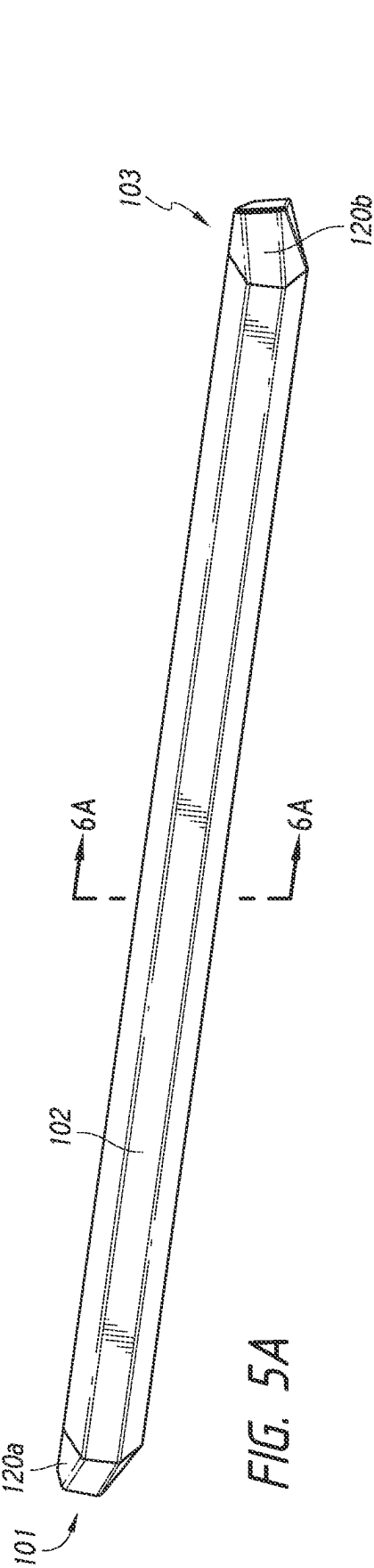


FIG. 4C



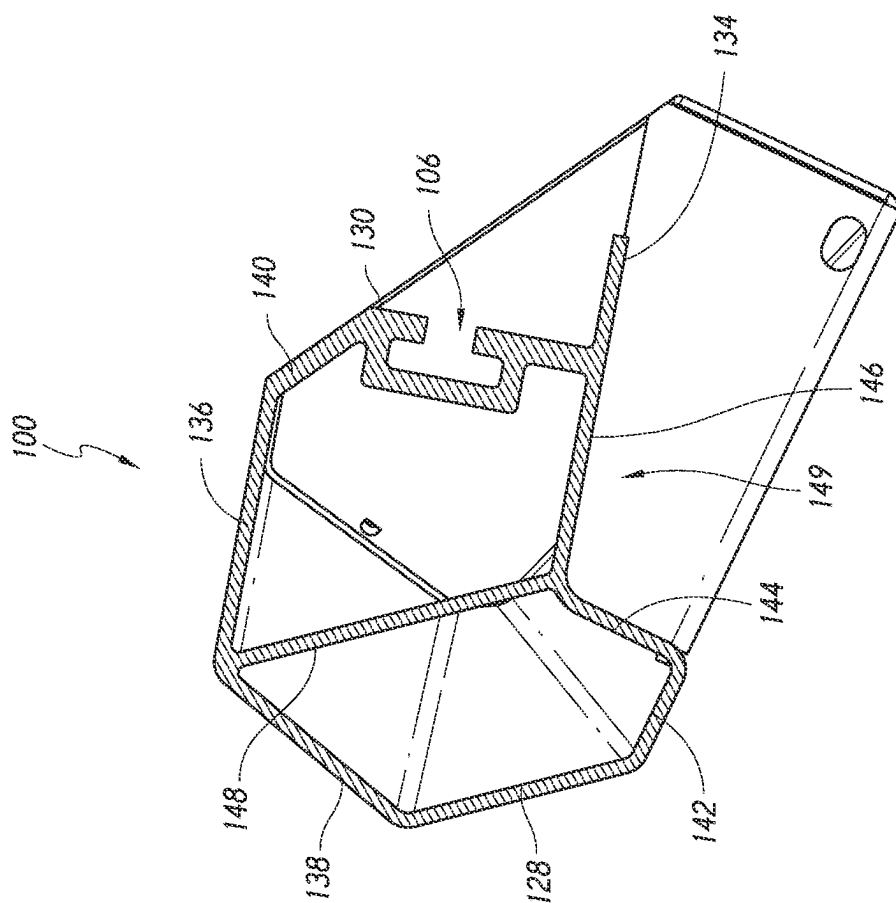
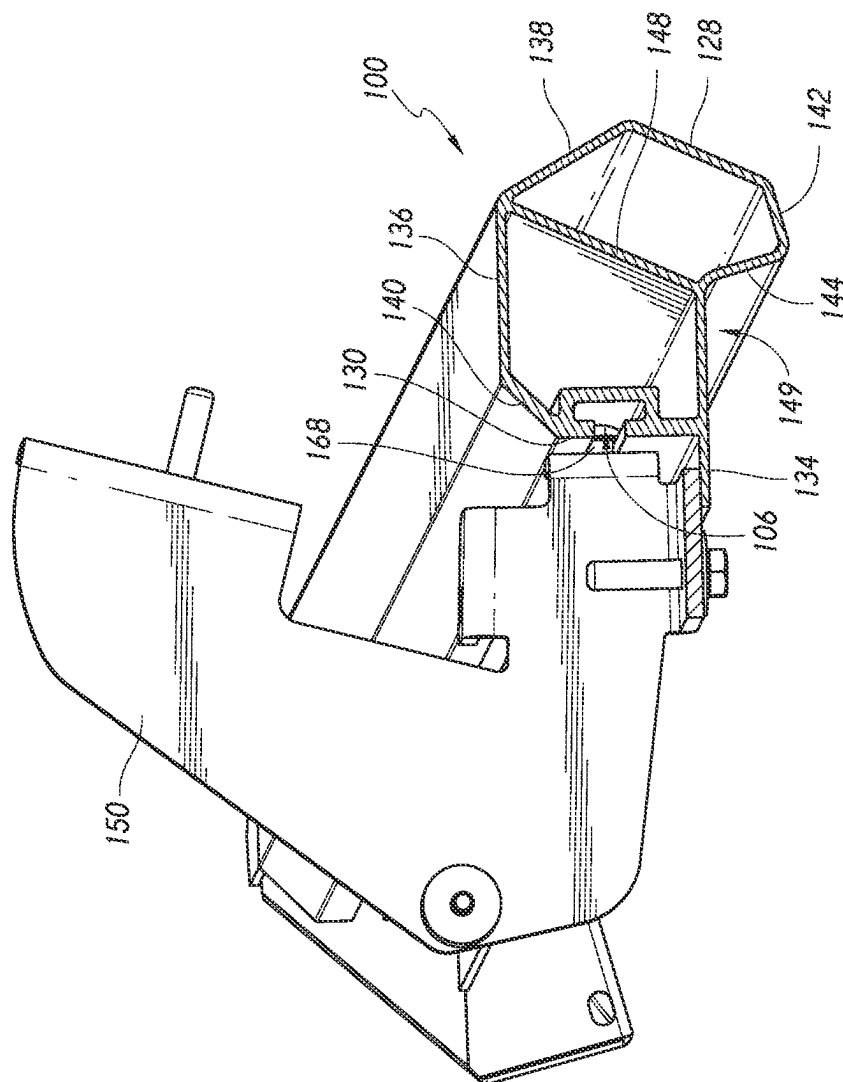


FIG. 6A



68  
Fig.



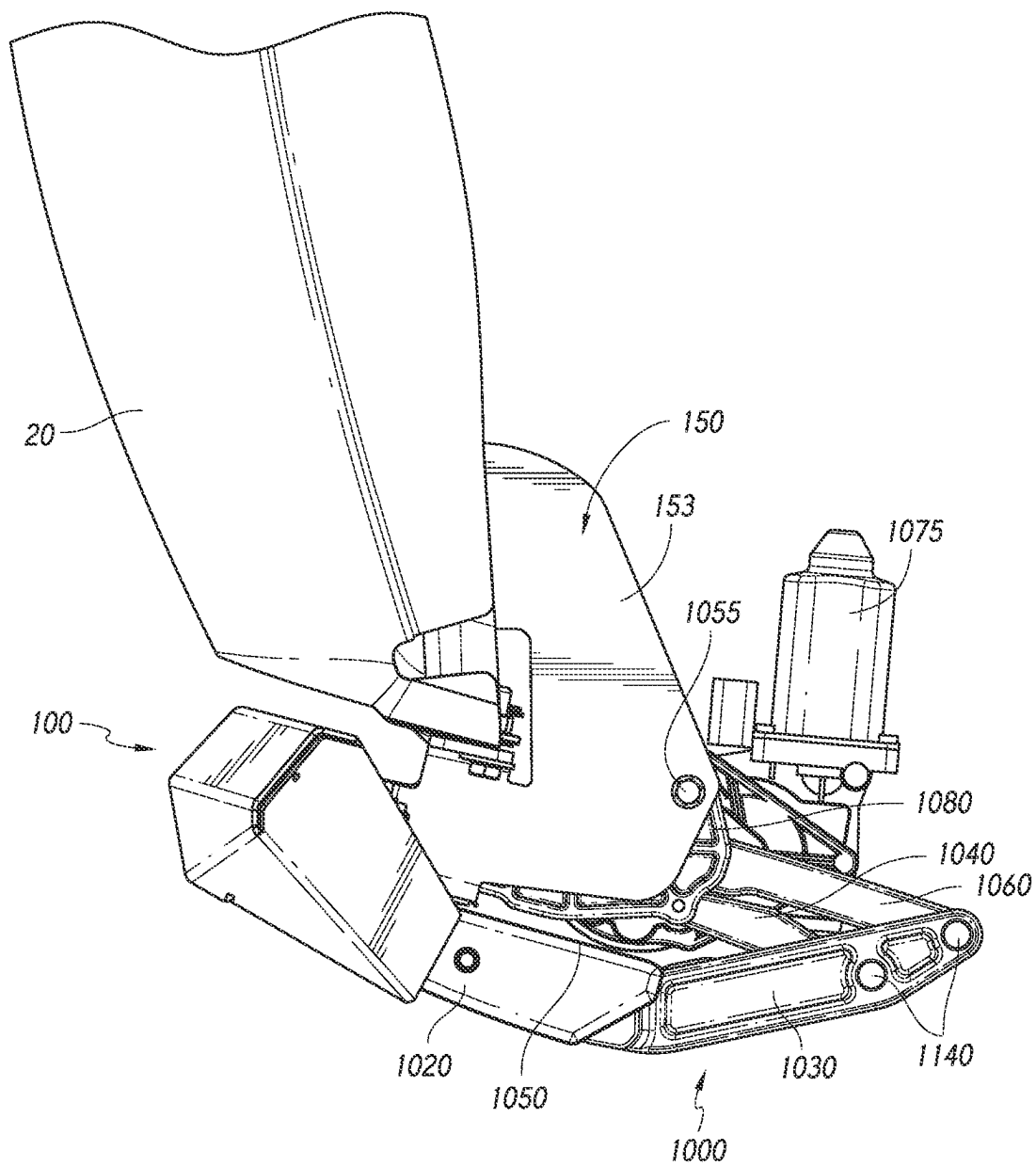
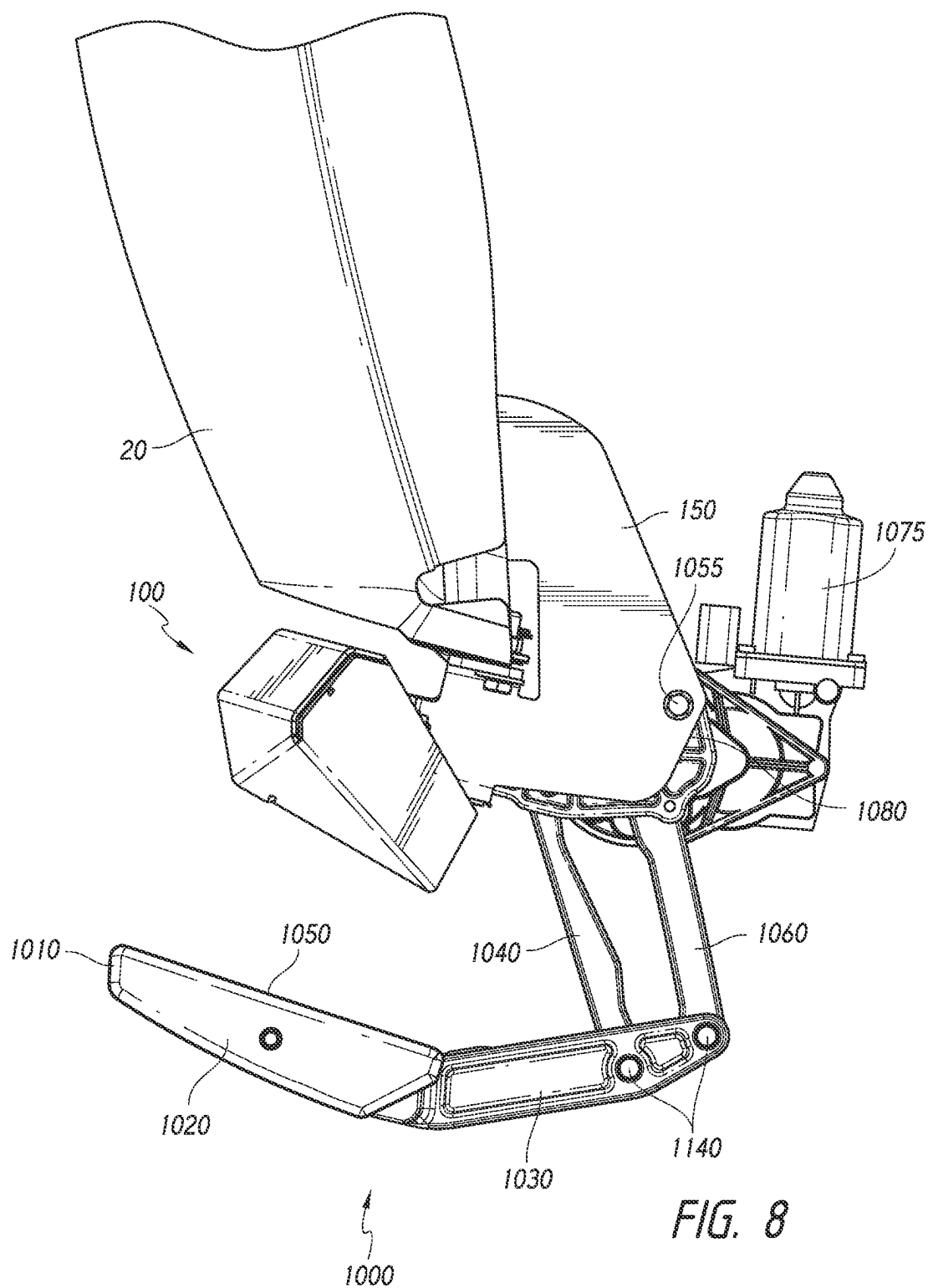
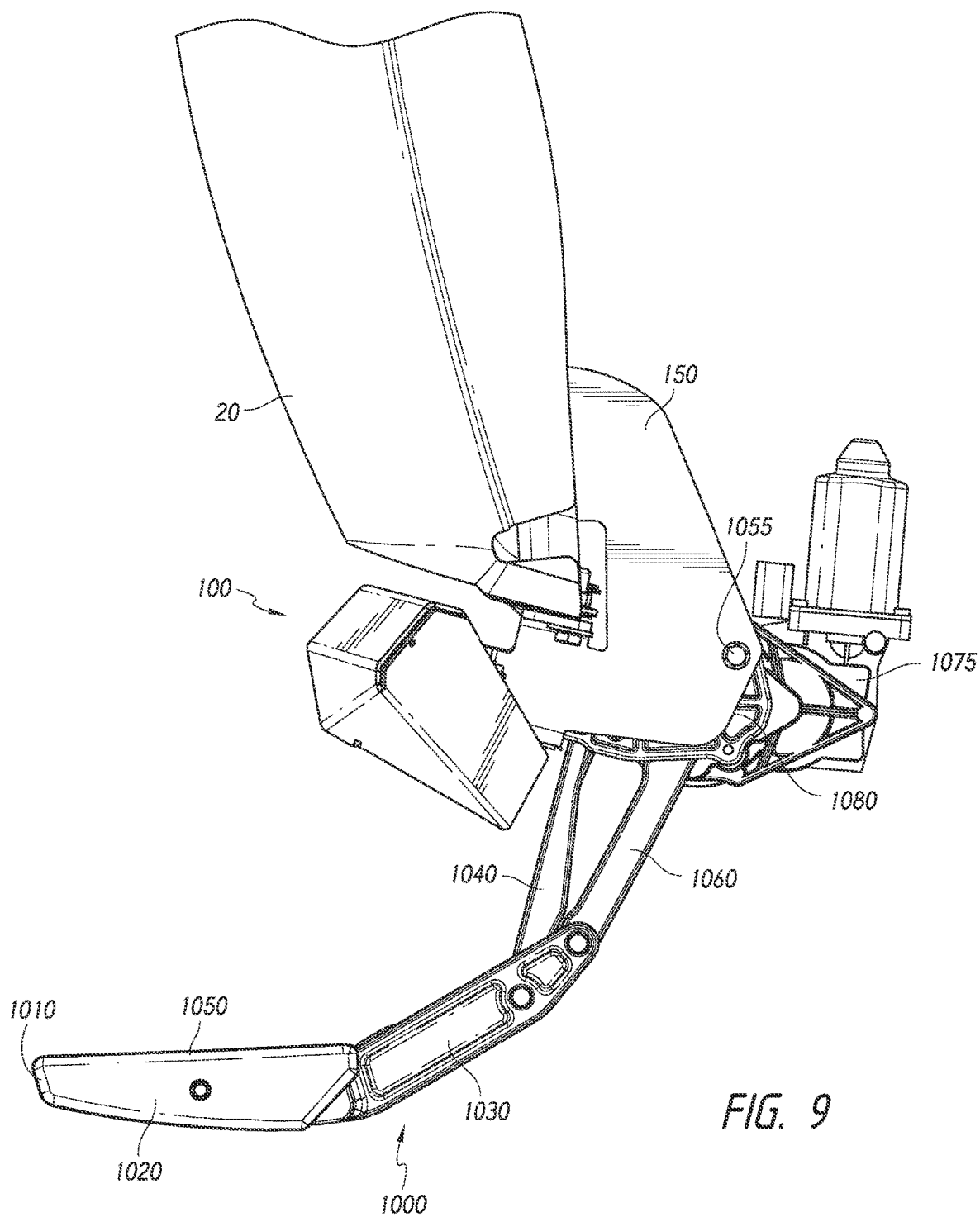
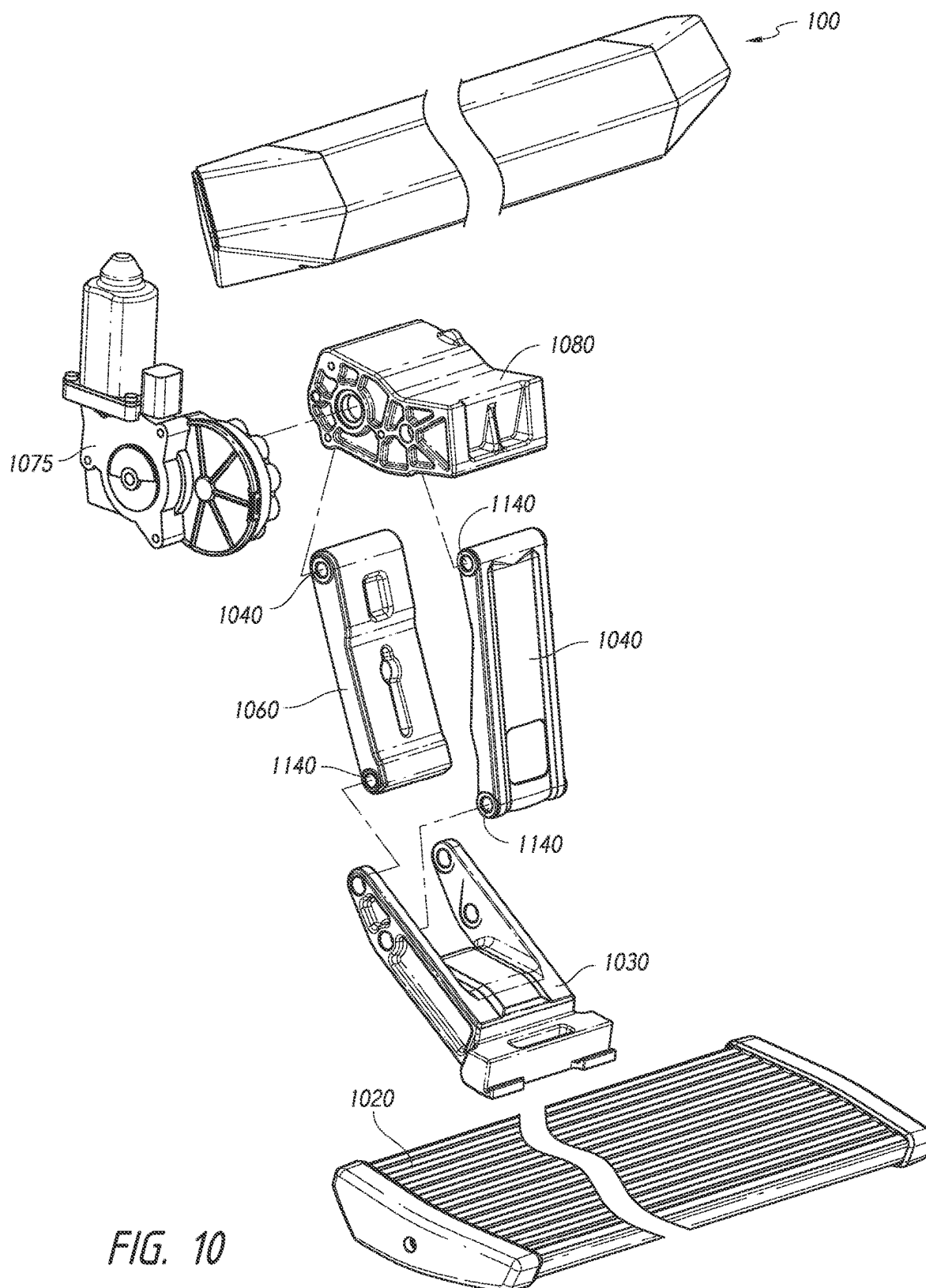


FIG. 7







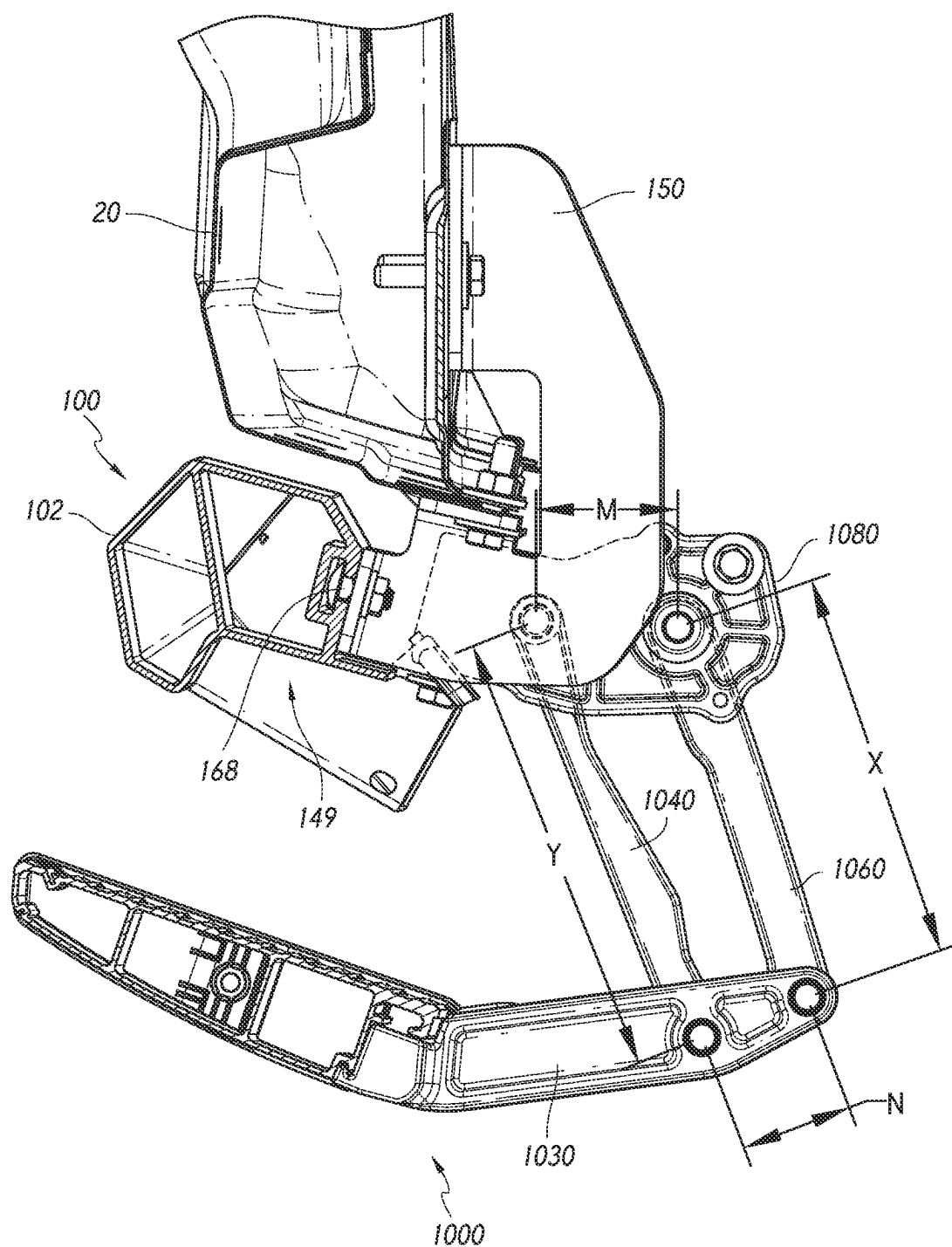
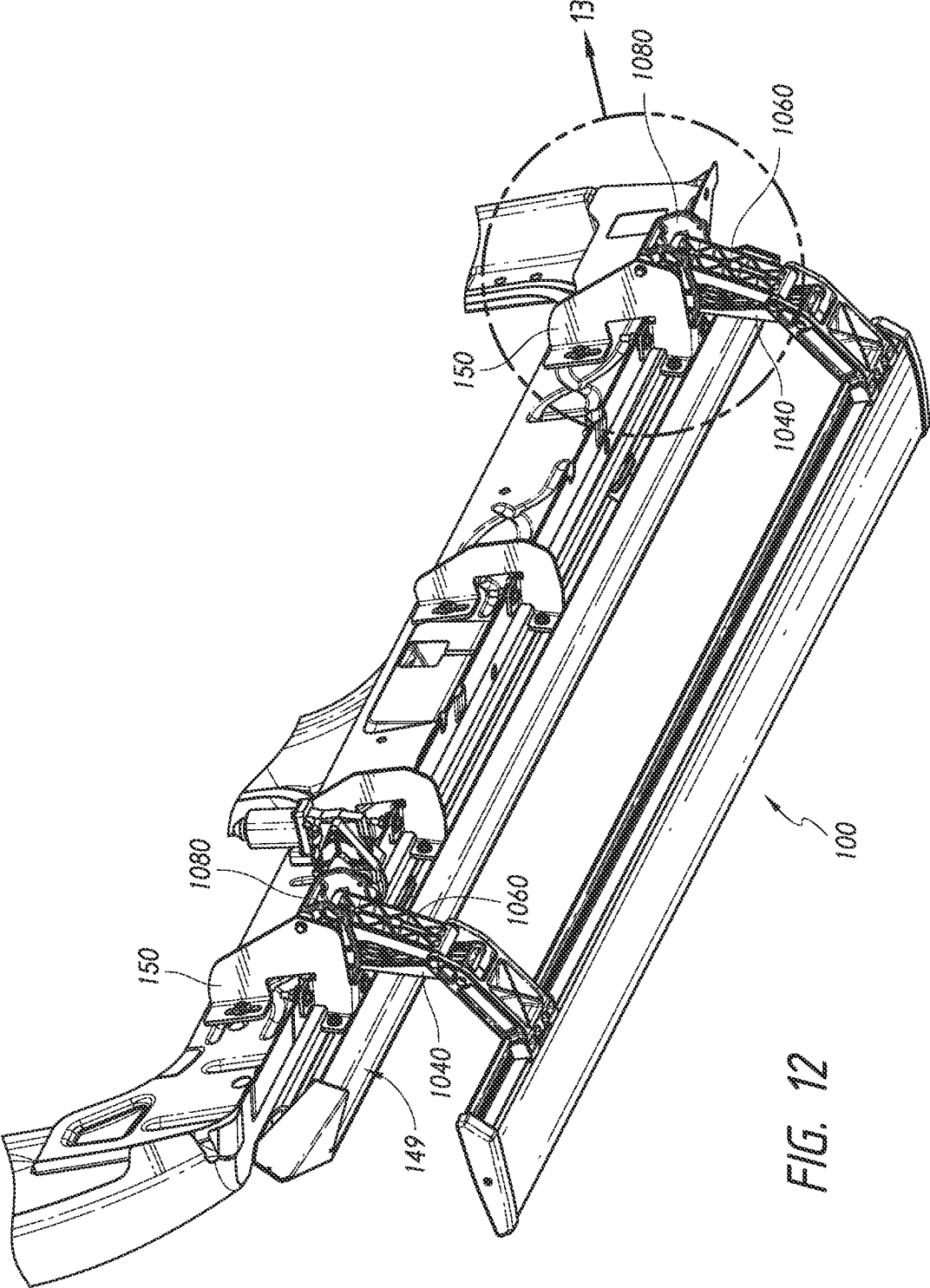
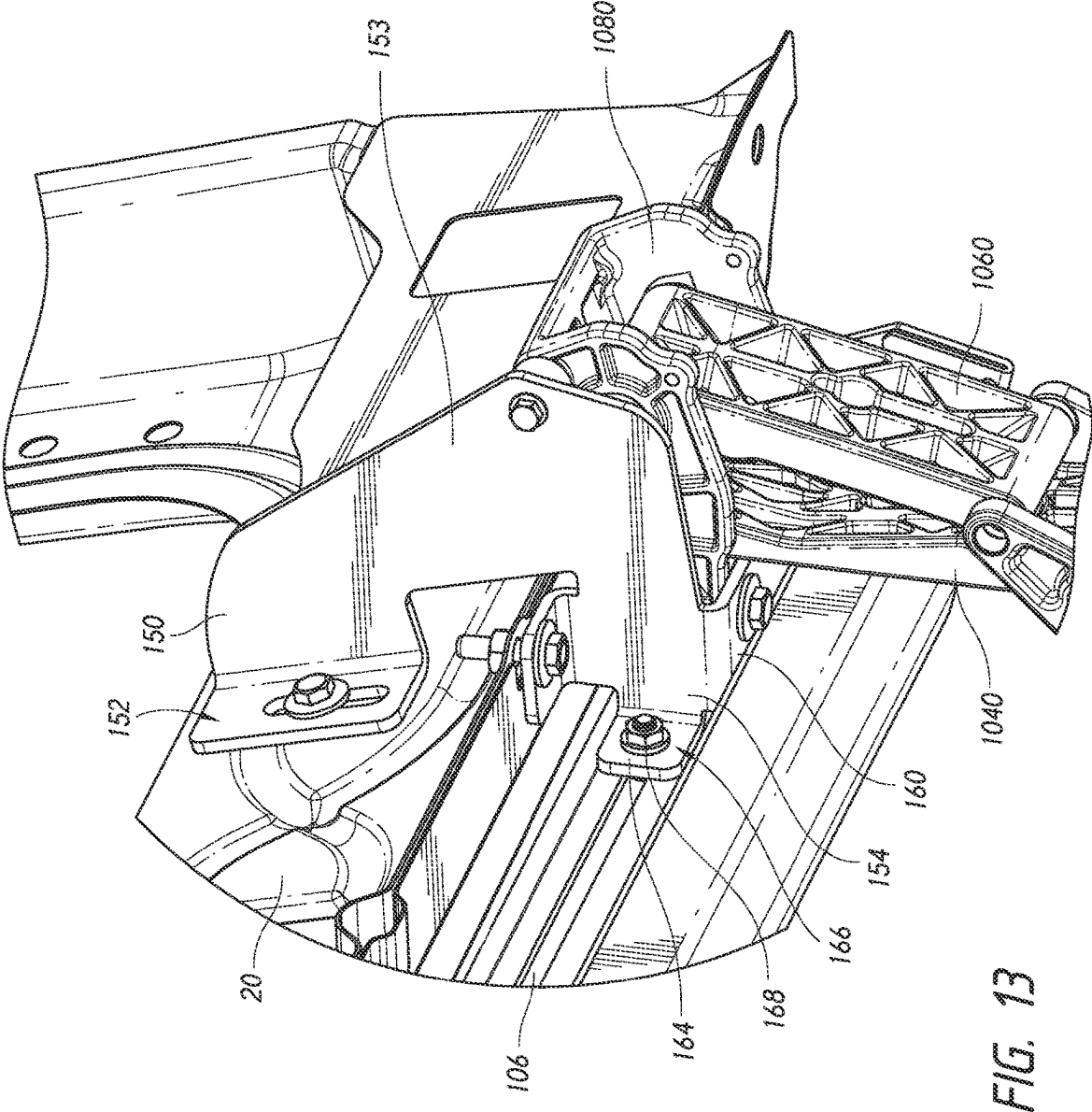


FIG. 11





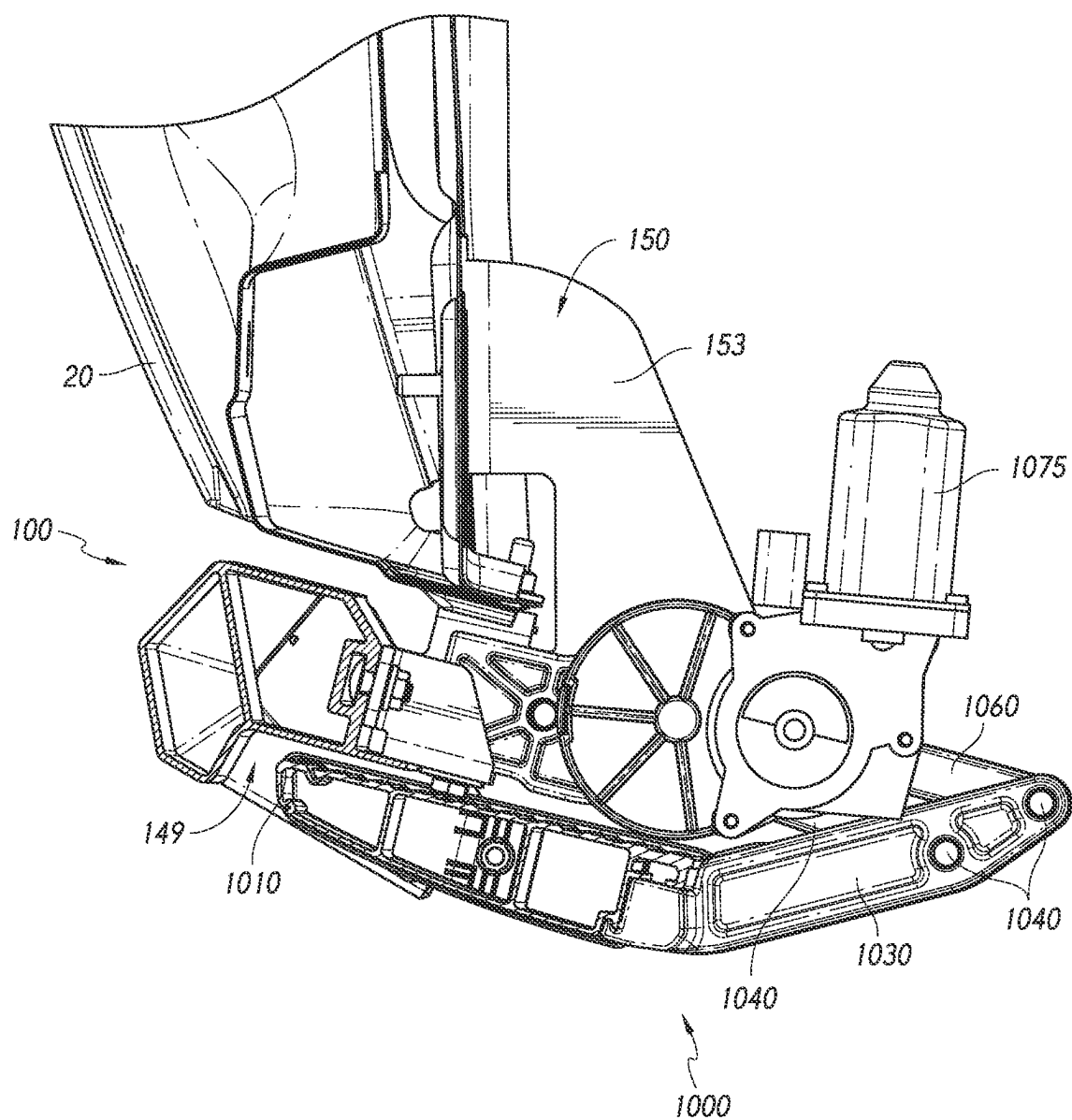


FIG. 14



## RETRACTABLE STEP AND SIDE BAR ASSEMBLY FOR RAISED VEHICLE

### INCORPORATION BY REFERENCE TO ANY PRIORITY APPLICATIONS

[0001] Any and all applications for which a foreign or domestic priority claim is identified in the Application Data Sheet as filed with the present application are hereby incorporated by reference under 37 CFR 1.57.

### BACKGROUND

#### Field

[0002] This disclosure relates generally to a retractable step and side bar assembly for a raised vehicle.

#### Description of the Related Art

[0003] Many types of vehicles, including sport utility vehicles (e.g. JEEP® brand vehicles), pickup trucks, and vans, are raised off the ground farther than normal passenger automobiles. The increased height of the floor of the passenger cab from the ground makes it difficult to enter and exit these vehicles.

[0004] In addition, if the vehicles are driven over rough terrain, their lower body panels and door panels are susceptible to being scratched, dented, or otherwise damaged by rocks or other ground debris. To address this issue, the nerf bars or rock rails can function to protect the body of the vehicles from being damaged from below. Moreover, nerf bars can be mounted to the vehicle to provide a stepping surface to assist the driver and passengers in entering and exiting these vehicles.

### SUMMARY

[0005] Typically, running boards, side bars, and/or nerf bars are used to help a user access a vehicle. Further, these side bars can provide for enhanced aesthetics of the vehicle. However, the side bars can have significant limitations as side bars sit too high because of necessary ground and side clearance. This creates a stepping platform positioned too high and too inboard, thus creating an awkward ingress/egress for a user. That being said, it is desirable to keep the aesthetics of the side bars while still providing ease of access for a user to enter a vehicle.

[0006] Accordingly, embodiments of the disclosure allow for a user to lower an additional step to a low, functional stepping height to get in and out of the vehicle, yet stow them to the higher position for vehicle operation behind the side bar, creating the necessary ground clearance while also improving the vehicle aesthetics.

[0007] Moreover, many users enjoy the aesthetics of nerf bars without needing the structural support of the nerf bars. Accordingly, disclosed herein are side bars that can be used as aesthetic replacements for the nerf bars, without requiring the structural support they provide. As disclosed in detail below, they can be used in conjunction with a retractable step to provide for advantageous aesthetics for a raised vehicle while still assisting a user enter and exit the vehicle.

[0008] One area where standard deployable running boards fall short is on the more extreme vehicles, lifted higher than the typical truck. For such vehicles, it has been recognized that it would be desirable for the step to be deployed even lower than the linkage packaging allows. An

embodiment that combines the side bar and vehicle step assembly allows one to stow the boards at an even lower level, without compromising the aesthetics, and desirably also allows the boards to be deployed to a lower level. Simply said, a lower stowed position facilitates a lower deployed position, and doing this in combination with the side bar accomplishes this while still looking good.

[0009] Disclosed herein are embodiments of a combination side bar and vehicle step assembly, the assembly comprising a side bar configured to be mounted to a vehicle by at least one mounting bracket defining a mounting surface configured to mate with the vehicle and an extendable vehicle step comprising a stepping platform connected to at least one pair of arms, the at least one pair of arms connected to a frame, the frame being connected to the at least one mounting bracket, wherein the extendable vehicle step is movable between a stored and a deployed position, where the vehicle step is in the deployed position below and outboard to the side bar, and when the extendable vehicle step is in the deployed position, the stepping platform is at least partially outboard to the side bar.

[0010] In some embodiments, when the extendable vehicle step is in the stored position, the stepping platform can be at least partially inboard from the mounting surface.

[0011] Also disclosed herein are embodiments of a combination side bar and vehicle step assembly, the assembly comprising a side bar configured to be mounted to a vehicle by at least one mounting bracket defining a mounting surface configured to mate with the vehicle, and an extendable vehicle step having a distal end, the extendable step comprising a stepping platform connected to at least one pair of arms, the at least one pair of arms connected to a frame, the frame being connected to the at least one mounting bracket, wherein the extendable vehicle step is movable between a stored and a deployed position, and the vehicle step is in the deployed position below and outboard of the side bar, and wherein the side bar comprises a channel on a lower surface, the channel sized and configured to at least partially enclose the extendable vehicle step in the stored position.

[0012] Also disclosed herein are embodiments of a vehicle assembly, the assembly comprising a vehicle having a first door and a side bar connected to the vehicle by at least one mounting bracket, the side bar positioned external to the first door, and an extendable vehicle step, the extendable step comprising a stepping platform connected to at least one pair of arms, the at least one pair of arms connected to a frame, the frame being connected to the at least one mounting bracket such that the extendable vehicle step is positioned external to the at first door, the vehicle step defining a distal end, wherein the extendable vehicle step is movable between a stored and a deployed position, and the vehicle step is in the deployed position below and outboard of the side bar, and wherein the side bar comprises a channel on a lower surface, the channel sized and configured to at least partially cover the distal end of the extendable vehicle step in the stored position.

[0013] In some embodiments, a length of the side bar can be at least  $\frac{3}{4}$  a width of the first door and a length of the stepping platform can be at least  $\frac{1}{2}$  the width of the first door. In some embodiments, a length of the side bar can be at least a width of the first door and a length of the stepping platform can be at least  $\frac{1}{2}$  the width of the first one door. In

some embodiments, a length of the side bar and a length of the stepping platform can be at least a width of the first door.

**[0014]** In some embodiments, the extendable vehicle step can be self-energizing. In some embodiments, a plurality of mounting brackets can be configured to connect the side bar to the vehicle.

**[0015]** Also disclosed herein is a vehicle assembly, the assembly comprising a vehicle having a first door and a side bar connected to the vehicle by at least one mounting bracket, the side bar positioned external to the first door, and an extendable vehicle step, the extendable step comprising a stepping platform connected to at least one pair of arms, the at least one pair of arms connected to a frame, the frame being connected to the at least one mounting bracket such that the extendable vehicle step is positioned external to the at first door, wherein the extendable vehicle step is movable between a stored and a deployed position, where the vehicle step is in the deployed position below and outboard of the side bar, and wherein the frame is configured to be located at least partially below a body of the vehicle.

**[0016]** In some embodiments, the frame can be configured to be located fully below the body of the vehicle.

**[0017]** Also disclosed herein is a vehicle assembly, the assembly comprising a vehicle having a first door and a side bar, the side bar comprising a longitudinal opening generally facing towards the vehicle, at least one mounting bracket, the at least one mounting bracket having a first end configured to attached to a body of the vehicle a second end configured to attach to the side bar, a fastener coupling the at least one mounting bracket to the side bar, the fastener configured to extend into and be retained within the longitudinal opening, and an extendable vehicle step, the extendable step comprising a stepping platform connected to at least one pair of arms, the at least one pair of arms connected to a frame, the frame being connected to the at least one mounting bracket such that the extendable vehicle step is positioned external of the at first door, wherein the extendable vehicle step is movable between a stored and a deployed position, where the vehicle step is in the deployed position below and in front of the side bar, and wherein the side bar is configured to be translatable with respect to the at least one mounting bracket by sliding the fastener through the longitudinal opening.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0018]** FIG. 1 illustrates an embodiment of a combination of a side bar and stepping structure in the deployed position.

**[0019]** FIG. 2 illustrates an angled view of an embodiment of a combination of a side bar and stepping structure in the deployed position.

**[0020]** FIG. 3A illustrates a front view of an embodiment of a combination of a side bar and stepping structure in the deployed position.

**[0021]** FIG. 3B illustrates a front view of an embodiment of a combination of a side bar and stepping structure in the stowed position.

**[0022]** FIGS. 4A-C illustrate views of an embodiment of a mounting structure.

**[0023]** FIG. 5A illustrates a front view of an embodiment of a side bar.

**[0024]** FIG. 5B illustrates a back view of an embodiment of a side bar.

**[0025]** FIG. 6A illustrates a cross-sectional view of an embodiment of a side bar.

**[0026]** FIG. 6B illustrates a cross-sectional view of an embodiment of a side bar attached to an embodiment of a mounting bracket.

**[0027]** FIG. 7 illustrates an embodiment of a combination of a side bar and stepping structure in the stowed position.

**[0028]** FIG. 8 illustrates an embodiment of a combination of a side bar and stepping structure in the intermediate position.

**[0029]** FIG. 9 illustrates an embodiment of a combination of a side bar and stepping structure in the stowed deployed.

**[0030]** FIG. 10 illustrates an exploded view of an embodiment of a combination of a side bar and stepping structure.

**[0031]** FIG. 11 illustrates an embodiment of a combination of a side bar and stepping structure in the intermediate position.

**[0032]** FIG. 12 illustrates a reverse view of an embodiment of a combination of a side bar and stepping structure attached to a vehicle.

**[0033]** FIG. 13 illustrates the attachment of an embodiment of a combination of a side bar and stepping structure attached to a vehicle.

**[0034]** FIG. 14 illustrates a cross-sectional view of an embodiment of the side bar and stepping structure in the stowed configuration.

#### DETAILED DESCRIPTION

**[0035]** Disclosed herein are combinations of a stepping structure with a side bar, in particular for use on the sides of vehicles. The side bar and step combination can be uniquely formed to provide for a low profile in the retracted position, where the step is minimized exposed below the side bar, while also having significant reach in the deployed position to allow for a user to easily use the step to access the vehicle itself. The combination of the side bar **100** and step **1000**, forming a combination assembly **10**, attached to a vehicle **20** is shown in FIGS. 1-2. Further, FIGS. 3A-B show the combination assembly **10** in the deployed (FIG. 3A) and the stowed (FIG. 3B) positions. As shown, the combination assembly **10** advantageously allows for the step **1000** to be partially hidden by the side bar **100** when in the stowed position, improving overall aesthetics of the combination assembly **10**. However, the combination assembly **10** is usable with many other types of vehicles, for example standard cab pickup trucks, extended cab pickup trucks, and sport utility vehicles such as JEEP® brand vehicles, and the type of vehicle does not limit the disclosure.

#### Side Bar

**[0036]** As shown in the previous figures, the side bar **100** can be attached to a vehicle **20**, generally on the underside of the frame. The side bar **100** can extend generally away from the frame of the vehicle **20** (e.g., outboard). In some embodiments, the side bar **100** can include a side bar main body **102** configured for mounting to vehicle **20** via mounting brackets **150**.

**[0037]** The mounting bracket **150**, shown in FIGS. 4A-C, can have a generally c-shaped structure having vehicle attachment portion **152**, a body **153**, and a side bar attachment portion **154**. The vehicle attachment portion **152** can be generally the top of a c-shape structure, while the side bar attachment portion **154** can be generally the bottom. The body **153** can connect the vehicle attachment portion **152** to the side bar attachment portion **154**.

[0038] The vehicle attachment portion 152 can be generally configured to be located above the side bar attachment portion 154, and can be located generally on the inside surface of the body of vehicle 20. The vehicle attachment portion 152 can be configured to be mounted onto the vehicle 20, such as through an aperture 155, thereby keeping the mounting bracket 150 in place. The attachment portion 152 can extend perpendicularly from the body 153 to form a flange or mounting surface which can mate with vehicle 20 where the aperture 155 can be located. In some embodiments, the vehicle attachment portion 152 can have a greater thickness than the body 153. Thus, as discussed, the mounting bracket 150 is configured to mate with portions of the vehicle body (such as shown in FIG. 13) and secure the bracket 150 in both a vertical direction and a horizontal direction with respect to the ground. Thus can be done through the use of fasteners or welding, though the attachment means does not limit the disclosure. It is noted that the configuration of the mounting bracket 150 can be adjusted to match the mounting requirements of a particular vehicle.

[0039] The side bar attachment portion 154 can be configured to be attached to the side bar 100. As shown in FIGS. 4A-C, the side bar attachment portion 154 can be formed by a plurality of surfaces. A base surface 160 can be formed generally on the bottom of the mounting bracket 150, extending generally perpendicular to the bottom of the body 153. The base surface 160 can be configured to slide against a surface of the side bar 100, discussed below, in some embodiments. Further, attached to the base surface 160 and extending upwards and generally parallel to the body 153 is the secondary surface 162. Extending perpendicular to the front end of the body 153 and secondary surface 162 are a pair for attachment surfaces 164/164'. These attachment surfaces 164/164' can have at least one aperture 166/166' extending therethrough. Accordingly, in some embodiments a fastener, 168, such as a bolt, screw, or other member can extend through the aperture 166/166', allowing it to connect to the side bar 100, as discussed in detail below. In some embodiments, a frame surface 169 can extend away from the body 153 generally parallel to the base surface 160 but in the opposite direction. This surface can be configured to attach to a frame of a vehicle 20.

[0040] In some embodiments, a plurality of mounting brackets 150 can be used to attach the side bar 100 to the vehicle 20. In some embodiments, the mounting brackets 150 can be spaced apart at a particular distance, though the spacing does not limit the disclosure.

[0041] As shown in FIGS. 5A-B, side bar main body 102 itself can extend from a first end 101 to a second end 103. It can be defined by a plurality of walls, each wall having and/or defining outer and inner surfaces that additionally extend from the first to the second end 101/103. As shown in the cross section of FIG. 6A, the side bar main body 102 can have a front wall 128 and a back wall 130, which face away from and towards the vehicle 120, respectively. The back wall 130 can have a channel formed therein to define an opening 106, described in detail below. Further, below the back wall 130 there can be an extension wall 134 which extends generally perpendicular to the back wall 130 and extends farther than the back wall 130, and the extension wall 134 can be in contact with the base wall 160 of the mounting bracket 150, and can help to support the mounting bracket 150. Further, the side bar main body 102 can have

a top wall 136. As shown in the figures, the top wall 136 can be connected to the front and back walls 130/132 by angled or connection walls 138/140.

[0042] In addition, the side bar main body 102 can have a bottom wall 142 connected to the front wall 130. Connecting the bottom wall 142 and the back wall 130 are two walls that meet at an approximately perpendicular angle, thus forming a channel 149 on generally the bottom-back side of the side bar main body 102. The step distal end facing or vertical wall 144 can be generally parallel to the back wall 130 and connected to the bottom wall 130. The stepping member facing or horizontal wall 146 can extend from the vertical wall 144 to the back wall 130. In some embodiments, the horizontal wall 146 extends beyond the back wall 130, thus forming the extension wall 134. Thus, the vertical and horizontal walls 144/146 form the channel 149 in the side bar main body 102. The channel 149 can be sized and configured to receive at least a portion of the step 200, as discussed in detail below, thus providing for aesthetic improvements, as well as improved clearance.

[0043] While a particular shape of the side bar main body 102 is shown and discussed, it will be known that the particular size and dimensions of the side bar main body 102 does not limit the disclosure. Further, the walls disclosed may change shape throughout the length of the side bar main body 102.

[0044] In some embodiments, an internal connection wall 148 can be used to strengthen the side bar main body 102. In some embodiments, the side bar main body 102 is hollow. In some embodiments, the side bar main body 102 is solid and filled/or in with another material.

[0045] In some embodiments, the side bar main body 102 extends between a first end 101 and a second end 103 and is formed to have a channel-shape defining a longitudinal opening 106 extending at least partially between the first and second ends 101/103 of the back wall 130 of the side bar main body 102. The longitudinal opening 106 can extend partially into the back wall 130 to retain a fastener. In some embodiments, the longitudinal opening 106 can extend the full length of the side bar main body 102, and thus be open at the first and second ends 101/103. In some embodiments, the longitudinal opening 106 only extends partially along the length of the side bar main body 102, thereby being closed at either the first or second ends 101/103, or both. As shown in FIG. 6B, the longitudinal opening 106 can be sized and configured to receive and retain a fastener 168 that protrudes through the apertures 166/166' of the mounting bracket 150. Thus, the side bar 100 can be attached to the mounting bracket 150. In some embodiments, the fasteners 168 can be configured to be tightened within the longitudinal opening 106. Therefore, the side bar 100 can be moved with respect to the mounting bracket 150, and thus vehicle 20, allowing for the position of the side bar 100 to be adjusted. Accordingly, when the side bar 100 is in the desired position, the fasteners 168 can be tightened, thus stopping motion of the side bar 100 with respect to the mounting bracket 150.

[0046] In some embodiments, such as shown in FIGS. 5A-B, the side bar main body 102 may be provided with a first end cap 120a connected to the first end 101 of the side bar main body 102 and a second end cap 120b connected to the second end 103 of the side bar main body 102. In some embodiments, the end caps 120 a, 120 b (collectively referred to as 120) can be mirror images of each other and are shaped to match the cross-sectional profile of the side bar

main body **102**. In some embodiments, the end caps **120** may have a greater dimension than the side bar main body **102**, thereby providing end coverings of the channel **149**. In the embodiment shown, the end caps **120** are welded to the side bar main body **102**. However, other connections means are certainly possible, such as the use of fasteners.

[0047] Referring back to FIG. 2, in some embodiments, the side bar **100** length ( $L_r$ ) can extend at least half of a length of the vehicle **20**. In some embodiments, the side bar **100** length ( $L_r$ ) can extend at least  $\frac{3}{4}$  of a length of the vehicle **20**. In some embodiments, the side bar **100** length ( $L_r$ ) can extend at least half of a length of a door ( $L_{d1}$  or  $L_{d2}$ ) on one side of the vehicle **20**. In some embodiments, the side bar **100** length ( $L_r$ ) can extend at least  $\frac{3}{4}$  of a length of a door ( $L_{d1}$  or  $L_{d2}$ ) on one side of the vehicle **20**. In some embodiments, the side bar **100** length ( $L_r$ ) can extend at least half of a length of two doors ( $L_d$ ) on one side of the vehicle **20**. In some embodiments, the side bar **100** length ( $L_r$ ) can extend at least  $\frac{3}{4}$  of a length of two doors ( $L_d$ ) on one side of the vehicle **20**. In some embodiments, the side bar **100** length ( $L_r$ ) can extend at least a length of two doors ( $L_d$ ) on one side of the vehicle **20**. In some embodiments, the side bar **100** length ( $L_r$ ) can extend about 2, 3, 4, 5, 6, 7, or 8 feet. In some embodiments, the side bar **100** length ( $L_r$ ) can extend at least about 2, 3, 4, 5, 6, 7, or 8 feet.

[0048] In some embodiments, the side bar main body **102** may be formed from an initially flat sheet, for example a flat sheet of about 11 gauge steel. Other sheet thicknesses may also be used, and the particular thickness does not limit the disclosure. The side bar main body **102** may be formed by other processes as well, for example by stamping, casting, or extrusion, and the particular method of manufacturing does not limit the disclosure.

[0049] In some embodiments, the side bar **100** may be a modular side bar as discussed in U.S. Pat. App. No. 2015/0091270, hereby incorporated by reference in its entirety.

#### Stepping Structure

[0050] FIG. 1 additionally illustrates an embodiment of such a vehicle step **1000** that can be used in conjunction with the side bar **100** to form the combination assembly **10**. FIG. 7 illustrates the vehicle step **1000** in a stowed position. As shown, the vehicle step **1000** can be composed of numerous components, further discussed below, which can allow for translation of the vehicle step **1000** from a stowed position (FIG. 7) through an intermediate position (FIG. 8) and to a deployed position (FIG. 9) and back again, and can help a user to enter and exit a vehicle. In some embodiments, the vehicle step **1000** can be located under a vehicle door, such as the front or back doors, or below the trunk, though the particular location of the vehicle step **1000** is not limiting. In some embodiments, the vehicle step **1000** can move to the deployed position when a vehicle door is opened and move to a stowed position when an open vehicle door is closed. In some embodiments, the vehicle step **1000** can be moved manually. In some embodiments, the vehicle step **1000** can move through the press of a button or activation of a switch, and can operate independently of motion of a vehicle door, such as disclosed in U.S. patent application Ser. No. 14/169,626, published as U.S. 2015/0123374 A1, hereby incorporated by reference in its entirety.

[0051] As shown, the vehicle step **1000** can contain a stepping platform **1020**. The stepping platform **1020** can extend generally parallel to the ground and can be configured for a user to step on to allow for access into a vehicle. The stepping platform **1020** can be sized to generally receive a user's foot in some embodiments. Thus, a plurality of different stepping platforms **1020** can be used for different parts of a vehicle. In some embodiments, the stepping platform **1020** can extend along a substantial length of a vehicle, such as to be configured like a bar as shown in FIG. 2. Accordingly, in some embodiments only a single stepping platform **1020** is used on each side of the vehicle for the bar-like configuration. In some embodiments, the stepping platform **1020** can be generally the same length as the side bar **100**. In some embodiments, the stepping platform **1020** can have a smaller length than the side bar **100**. In some embodiments, the stepping platform **1020** can have gripping or high friction material on its upper side to help a user enter a vehicle.

[0052] Referring back to FIG. 2, in some embodiments, the stepping platform **1020** length ( $L_s$ ) can extend at least half of a length of the vehicle **20**. In some embodiments, the stepping platform **1020** length ( $L_s$ ) can extend at least  $\frac{3}{4}$  of a length of the vehicle **20**. In some embodiments, the stepping platform **1020** length ( $L_s$ ) can extend at least half of a length of a door ( $L_{d1}$  or  $L_{d2}$ ) on one side of the vehicle **20**. In some embodiments, the stepping platform **1020** length ( $L_s$ ) can extend at least  $\frac{3}{4}$  of a length of a door ( $L_{d1}$  or  $L_{d2}$ ) on one side of the vehicle **20**. In some embodiments, the stepping platform **1020** length ( $L_s$ ) can extend at least a length of a door ( $L_{d1}$  or  $L_{d2}$ ) on one side of the vehicle **20**. In some embodiments, the stepping platform **1020** length ( $L_s$ ) can extend at least half of a length of two doors ( $L_d$ ) on one side of the vehicle **20**. In some embodiments, the stepping platform **1020** length ( $L_s$ ) can extend at least  $\frac{3}{4}$  of a length of two doors ( $L_d$ ) on one side of the vehicle **20**. In some embodiments, the stepping platform **1020** length ( $L_s$ ) can extend at least a length of two doors ( $L_d$ ) on one side of the vehicle **20**. In some embodiments, the stepping platform **1020** length ( $L_s$ ) can extend about 2, 3, 4, 5, 6, 7, or 8 feet. In some embodiments, the stepping platform **1020** length ( $L_s$ ) can extend at least about 2, 3, 4, 5, 6, 7, or 8 feet.

[0053] The stepping platform **1020** can connect to a support component **1030**. In some embodiments, the stepping platform **1020** is attached to the support component **1030** so that the stepping platform **1020** and support component **1030** translate and/or rotate as one unit. In some embodiments, the stepping platform **1020** can rotate separately from the support component **1030**. In some embodiments, support component **1030** and stepping platform **1020** can be a single piece. In some embodiments, the stepping platform **1020** can be integrally formed with the support component **1030**. In some embodiments, the two pieces can be attached to one another through, for example, screws, though the particular attachment means does not limit the disclosure. In some embodiments, the support component **1030** can be substantially thinner than the stepping platform **102**, as shown in, for example, FIG. 2.

[0054] A pair of arms **1040/1060** can rotatably attach to the support component **1030**, allowing for rotation of the support component **1030**, and thus the stepping platform **1020**. The arms **1040/1060** can be attached to the support component **1030** through the rotation axes **1140**. In some embodiments, either one or both of arms **1040/1060** can

have a stop, which can be used to prevent the vehicle step 1000 from moving outside a desired rotation. The stops can be, for example, rubber to prevent motion of the vehicle step 1000 while preventing scratching or other damage. However, the particular makeup of the stops does not limit the disclosure. In some embodiments, the combination of stepping platform 1020, support component 1030, and arms 1040/1060 can be known as the stepping fixture. While only two arms are shown, more arms could be used as well. Further, each arm 1040/1060 could be broken into different segments that may or may not rotate with respect to each other. In some embodiments, another bar can connect arms 1040/1060.

[0055] On the opposite end from the support component 1030, arms 1040/1060 can attach to a frame 1080. The frame 1080 can be attached to the mounting bracket 150 attached to the side bar 100, as discussed above. For example, the frame 1080 may be located approximately at the body 153 of the mounting bracket 150. Screws 1055 can be used to affix the frame 1080 to the mounting bracket 150, though the type of fixture does not limit the disclosure and any type of fixture can be used. In some embodiments, a top surface of the frame 1080 can additionally be attached to the bottom of a vehicle frame.

[0056] By attaching the frame 1080 to the mounting bracket 150, the frame 1080 can be located below the frame of a vehicle. In some embodiments, the entirety of the frame 1080 is below the frame of the vehicle. In some embodiments, at least about 50, 60, 70, 80, 90, 95, or 99% of the frame 1080 can be located below the frame of the vehicle. By having the frame 1080 located below the frame of the vehicle, it allows for the stepping platform 1020 to have a deployed position that is significantly lower than if the frame 1080 was attached to the frame of the vehicle, while not having to make any extensions to the arms 1040/1060. This allows the vehicle step 1000 to be advantageous for raised vehicles, as the stepping platform 1020 can now be located at a comfortable position relative to the ground for a user to step onto.

[0057] In some embodiments, the frame 1080 may contain a fastener that is sized and configured to be inserted into the longitudinal opening 106 of the side bar 100, and can operate in a similar fashion as discussed above with relation to the attachment of the side bar main body 102 to the mounting bracket 150. Accordingly, the side bar 100 can be translatable with respect to the frame 1080, and thus the step 1000.

[0058] In some embodiments, such as shown in FIG. 7, the frame 1080 may extend towards the centerline (e.g., inboard) of the vehicle. Accordingly, the frame 1080 may extend from an inside surface of the frame of the vehicle 20 towards the opposite inside surface of the frame of the vehicle 20. The arms 1040/1060 can be attached to frame 1080 through the rotation axes 1140. In some embodiments, the instant center of the vehicle step 1000 can be located within the vehicle step 1000 when the vehicle step 1000 is in the deployed or stowed position, or in both positions. In some embodiments, the instant center of the vehicle step 1000 is not located outside of the vehicle step 1000. For example, at any given moment, when the vehicle step 1000 is pivoting from one position to another, the stepping platform 1020 can be considered to be pivoting about one point in space (e.g., an “instant center”) within the vehicle step 1000, as viewed perpendicular to the rotational axes 1140,

such as viewed from the perspective of FIG. 7. In some embodiments, this one point could correspond to being within the horizontal dimension of the stepping platform 1020 (corresponding to an x axis in an x-y coordinate system), could correspond to being within vertical dimension of the stepping platform 1020 (corresponding to a y axis in an x-y coordinate system), or could correspond to being within cross-section of the stepping platform 1020 in both the horizontal and vertical dimension.

[0059] In some embodiments, when the vehicle step 1000 is in the deployed position as shown in FIG. 9, the angle between the stepping platform 1020 and arm 1040 can be obtuse. In some embodiments, the angle between the stepping platform 1020 and arm 1040 can be about 90, 100, 110, 120, 130, 140, 150, 160, or 170°. In some embodiments, the angle between the stepping platform 1020 and arm 1040 can be greater than about 90, 100, 110, 120, 130, 140, 150, 160, or 170°. In some embodiments, the angle between the stepping platform 1020 and arm 1040 can be less than about 100, 110, 120, 130, 140, 150, 160, 170, or 180°.

[0060] In some embodiments, when the vehicle step 1000 is in the deployed position as shown in FIG. 9, the angle between the stepping platform 1020 and arm 1060 can be obtuse. In some embodiments, the angle between the stepping platform 1020 and arm 1060 can be about 90, 100, 110, 120, 130, 140, 150, 160, or 170°. In some embodiments, the angle between the stepping platform 1020 and arm 1060 can be greater than about 90, 100, 110, 120, 130, 140, 150, 160, or 170°. In some embodiments, the angle between the stepping platform 1020 and arm 1060 can be less than about 100, 110, 120, 130, 140, 150, 160, 170, or 180°.

[0061] FIG. 10 illustrates an exploded viewpoint of an embodiment of a vehicle step 1000, illustrates an example of how components of the vehicle step 1000 can fit together.

[0062] FIG. 11 illustrates an embodiment of a vehicle step 1000 in an intermediate position, in particular to more easily show dimensions for some of the different parts of the vehicle step 1000.

[0063] In some embodiments, the length (Y) of arm 1040 is the same as the length (X) of arm 1060. In some embodiments, the length (Y) of arm 1040 is different than the length (X) of arm 1060. In some embodiments, the length (Y) of arm 1040 is less than the length (X) of arm 1060. In some embodiments, the length (Y) of arm 1040 is greater than the length (X) of arm 1060.

[0064] In some embodiments, the distance (M) between the frame 1080 rotation points 1140 of arms 1040/1060 are the same as the distance (N) between the support component 1030 rotation points 1140 of arms 1040/1060. In some embodiments, the distance (M) between the frame 1080 rotation points 1140 of arms 1040/1060 is different than the distance (N) between the support component 1030 rotation points 1140 of arms 1040/1060. In some embodiments, the distance (M) between the frame 1080 rotation points 1140 of arms 1040/1060 is greater than the distance (N) between the support component 1030 rotation points 1140 of arms 1040/1060. In some embodiments, the distance (M) between the frame 1080 rotation points 1140 of arms 1040/1060 is less than the distance (N) between the support component 1030 rotation points 1140 of arms 1040/1060.

[0065] In some embodiments, arms 1040/106 are not parallel when in the stowed position. In some embodiments, arms 1040/1060 are not parallel when in the intermediate position. In some embodiments, arms 1040/1060 are not

parallel when in the deployed position. In some embodiments, arms **1040/1060** are not parallel through the entire range of motion of the vehicle step **1000**.

**[0066]** In some embodiments, arms **1040/106** are parallel when in the stowed position. In some embodiments, arms **1040/1060** are parallel when in the intermediate position. In some embodiments, arms **1040/1060** are parallel when in the deployed position. In some embodiments, arms **1040/1060** are parallel through the entire range of motion of the vehicle step **1000**.

**[0067]** Components of the disclosed vehicle step **1000** can comprise a structurally strong and/or light weight material. In some embodiments, the vehicle step **1000** can comprise a fiber reinforced composite material such as a carbon fiber reinforced plastic or thermoplastic with, for example, a polymer matrix or resin. In some embodiments, the vehicle step **1000** can comprise other suitable composites, plastics, thermoplastics, metals, alloys, ceramics, among others, with efficacy, as needed or desired. However, the particular material used does not limit the disclosure.

**[0068]** In some embodiments, a plurality of stepping structures can be used. FIGS. 3A-B illustrate an embodiment which can use a plurality of steps on a single side of a vehicle in order to, for example, retain movable running boards. As shown, a first vehicle step **1000** and a second vehicle step **1000'** can be used to hold a horizontal running board **8020** similar to what is described in detail above. More can be used as well, and the number of attachment mechanisms does not limit the disclosure. In some embodiments, the vehicle steps **1000/1000'** can move in concert, allowing the horizontal running board **8020** to move from the stowed position (FIG. 3B), through the intermediate position and into the deployed position (FIG. 3A).

#### Self-Energizing Mechanism For Vehicle Step

**[0069]** In some embodiments, the vehicle step **1000** can be self-energizing in either the deployed or stowed position, or in both positions. For example, a planar four-bar linkage can be used in some embodiments of the vehicle step **1000**, allowing for stability and predictability in motion of the step. In some embodiments, a planar quadrilateral linkage can be used for self-energizing the vehicle step **1000**. In some embodiments, a planar quadrilateral crank-rocker linkage can be used, which is described below.

**[0070]** In the stowed and deployed positions (respectively shown in FIGS. 7 and 9), the vehicle step **1000** is in a self-energized position so that a load applied to the top of the stepping platform **1020** in a relatively downwards motion does not move the vehicle step **1000** towards an intermediate position.

**[0071]** For example, any force exerted downward onto the bar the stepping platform **1020** of vehicle step **1000** desirably will increase the resistance of the vehicle step **1000** to moving. In some embodiments, the stepping platform **1020** would need to move upward before the vehicle step **1000** can translate.

**[0072]** In some embodiments, a motor **1075** can be used in conjunction with the vehicle step **1000**. In some embodiments the motor **1075** can be rigidly mounted to the underside of a vehicle, such as through the use of a mounting bracket, though the particular mounting method does not limit the disclosure. In some embodiments, the motor **1075** can be located generally adjacent to the vehicle step **1000**.

**[0073]** In some embodiments, the motor **1075** turns a pinion gear about an axis roughly parallel to the plane defined by the underbody of a vehicle. The pinion gear can mesh with drive teeth formed at the end of arm **1060**. Actuation of the motor **1075** can cause the pinion gear to rotate and the arm **1060** to counter-rotate with respect to the motor **1075** and pinion gear. As the arm **1060**, rotates it can push the stepping platform **1020** by virtue of its connection to support component **1030**. Thus, when the motor **1075** rotates, the motor **1075** can move the stepping platform **1020** between a stowed position (FIG. 7) wherein the stepping deck is generally positioned inward from the exterior of the vehicle or fixed running board and a deployed position (FIG. 9) in which the stepping platform **1020** is extended sufficiently to provide a step for at least the forefoot portion of a user's foot.

**[0074]** As the vehicle step **1000** moves between the stowed position and the deployed position under the power of the motor **1075**, arm **1040** rotates as well and the deployed position is reached when the stop contact arm **1060**.

**[0075]** When the vehicle step **1000** is in the deployed position, a downward force exerted on the stepping platform **1020** causes a stop to bear against arm **1060**. This arrangement causes the load on the stepping platform **1020** to be borne primarily by the support component **1030** and arm **1040**. In the deployed position, the vehicle step **1000** takes on a geometry such that the support component **1030** and arm **1040** are loaded in tension. The torque generated by a load on the stepping platform **1020** is opposed by arm **1060**, which is thus loaded in axial compression. Due to the particular configuration, the motor **1075** is isolated from the load on the stepping platform **1020**.

**[0076]** This aspect of the vehicle step **1000** prevents damage to the motor **1075** by eliminating "back-loading," as there is no torque reaction about the end of arm **1060**, even when very heavy loads are placed on the stepping platform **1020**. Thus the motor **1075** is not needed to exert a counter-torque on arm **1060** to support the load on the stepping platform **1020**. This feature also eliminates the need for balky, unreliable clutches or any other means of disconnecting the motor **1075** from the vehicle step **1000**, or retractable stops or the like to engage and support the vehicle step **1000** when in the extended position.

**[0077]** With these features the vehicle step **1000** provides a practical stepping assist for a vehicle user, which can be quickly moved into an extended position for use and retracted out of the way when necessary. As detailed above, this functionality is provided with a minimum of mechanical complexity and a high level of reliability. Moreover, the vehicle step **1000** is easily connected to a vehicle's existing systems to allow even greater usability. For example, the motor **1075** may be connected to the vehicle's electrical system to cause the vehicle step **1000** to quickly move to the extended position upon shutting off the vehicle's engine, placing the vehicle in park, opening a door, or signaling the power door-lock system with a remote device or control such as a key fob control. Similarly, the motor **1075** may be signaled to retract the vehicle step **1000** upon starting the engine, placing the vehicle in drive, closing or locking the door(s) with which the step is associated, etc.

**[0078]** In the embodiment presently under discussion, when the vehicle step **1000** is in the stowed position, it is concealed, preferably completely concealed, from the view of a typical standing adult curbside observer of the vehicle.

In this position the vehicle step **1000**, can be disposed behind the lowest extension or lower edge of the vehicle underbody. In some embodiments, the vehicle step **1000** is not visible to an adult standing **5** feet from the vehicle; in some embodiments, the vehicle step **1000** is not visible to an adult standing **10** feet from the vehicle; in some embodiments, the vehicle step **1000** is not visible to an adult standing **20** feet from the vehicle.

[0079] In some embodiments, a clutch may be used as well.

[0080] In some embodiments, in the self-energized position there can be some slight rotational movement of the stepping platform **1020**. For example, the stepping platform **1020** can rotate approximately **0.5**, **1**, **2**, **3**, **4**, or **5** degrees without movement of the vehicle step **1000** or/or moving the vehicle step **1000** to a position where the vehicle step **1000** is not still self-energized. In some embodiments, the stepping platform **1020** can rotate approximately less than **0.5**, **1**, **2**, **3**, **4**, or **5** degrees without translating the vehicle step **1000** or/or moving the vehicle step **1000** to a position where the vehicle step **1000** is not still self-energized. This ensures that the vehicle step **1000** remains self-energized even if the stepping platform **1020** is bumped and/or moves somewhat.

#### Integration of Stepping Structure and Side Bar

[0081] In some embodiments, the side bar **100** and step **1000** can be attached to one another through the use of a mounting bracket **150**. In some embodiments, the side bar **100** and step **1000** can be removably attached to one another. In some embodiments, the side bar **100** and step **1000** can be permanently attached to one another. Further, as discussed above, the side bar **100** may be configured to translate in comparison to the step **1000**.

[0082] FIG. **12** shows a reverse viewpoint with the step **1000** in the deployed position. As shown, the frame **1080** of the step **1000** can be attached to a mounting bracket **150**. The mounting bracket **150** can then be attached to the vehicle. Further, the side bar **100** can also be attached to the mounting bracket **150**, thereby forming the combination assembly **10**. As shown in FIG. **12**, a plurality of mounting brackets **150** can be used in the combination assembly **10**. In some embodiments, the mounting brackets **150** may attach to both the step **1000** and side bar **100**. In some embodiments, the mounting brackets **150** may only attached to the side bar **100**. FIG. **13** shows a close-up view of the connection portions of the side bar **100**, mounting bracket **150**, and step **1000**.

[0083] FIG. **14** shows a cross section of the side bar **100** and step **1000** in the stowed position. Specifically, as shown, at least a front edge **1010** of the stepping platform **1020** can be located within the channel **149** of the side bar main body **102**. By having the stepping platform **1020** be located within the channel **149**, the combination assembly **10** can have improved aesthetic appeal, as well as allowed the step **1000** to be located out of the way. Without such a channel **149**, the step **1000** would have to be located below or behind the side bar **100**. If it was below the side bar **100**, the step would be located in an unappealing position, and may be more easily damaged than if located within the channel **149**. If the step **100** was located behind the side bar **100**, it would have a significant distance to extend for viable use by a user, which could provide unwanted torque onto the motor **1075**.

[0084] In some embodiments, the step **1000** and side bar **100** can be used on both sides of vehicle **20**. In some

embodiments, the step **1000** and side bar **100** are the same length (Ls/Lr) on both sides of vehicle **20**. In some embodiments, the step **1000** and side bar **100** are the different lengths (Ls/Lr) on both sides of vehicle **20**. In some embodiments, the step **1000** and side bar **100** can have a different length (Ls/Lr). In some embodiments, the step **1000** and side bar **100** can have the same length (Ls/Lr).

[0085] From the foregoing description, it will be appreciated that embodiments of an inventive vehicle step and side bar combination are disclosed. While several components, techniques and aspects have been described with a certain degree of particularity, it is manifest that many changes can be made in the specific designs, constructions and methodology herein above described without departing from the spirit and scope of this disclosure.

[0086] Certain features that are described in this disclosure in the context of separate implementations can also be implemented in combination in a single implementation. Conversely, various features that are described in the context of a single implementation can also be implemented in multiple implementations separately or in any suitable subcombination. Moreover, although features may be described above as acting in certain combinations, one or more features from a claimed combination can, in some cases, be excised from the combination, and the combination may be claimed as any subcombination or variation of any subcombination.

[0087] Moreover, while methods may be depicted in the drawings or described in the specification in a particular order, such steps need not be performed in the particular order shown or in sequential order, and that all steps need not be performed, to achieve desirable results. Other methods that are not depicted or described can be incorporated in the example methods and processes. For example, one or more additional methods can be performed before, after, simultaneously, or between any of the described methods. Further, the methods may be rearranged or reordered in other implementations. Also, the separation of various system components in the implementations described above should not be understood as requiring such separation in all implementations, and it should be understood that the described components and systems can generally be integrated together in a single product or packaged into multiple products. Additionally, other implementations are within the scope of this disclosure.

[0088] Conditional language, such as “can,” “could,” “might,” or “may,” unless specifically stated otherwise, or otherwise understood within the context as used, is generally intended to convey that certain embodiments include or do not include, certain features, elements, and/or steps. Thus, such conditional language is not generally intended to imply that features, elements, and/or steps are in any way required for one or more embodiments.

[0089] Conjunctive language such as the phrase “at least one of X, Y, and Z,” unless specifically stated otherwise, is otherwise understood with the context as used in general to convey that an item, term, etc. may be either X, Y, or Z. Thus, such conjunctive language is not generally intended to imply that certain embodiments require the presence of at least one of X, at least one of Y, and at least one of Z.

[0090] Language of degree used herein, such as the terms “approximately,” “about,” “generally,” and “substantially” as used herein represent a value, amount, or characteristic close to the stated value, amount, or characteristic that still

performs a desired function or achieves a desired result. For example, the terms “approximately”, “about”, “generally,” and “substantially” may refer to an amount that is within less than or equal to 10% of, within less than or equal to 5% of, within less than or equal to 1% of, within less than or equal to 0.1% of, and within less than or equal to 0.01% of the stated amount.

**[0091]** Some embodiments have been described in connection with the accompanying drawings. The figures are drawn to scale, but such scale should not be limiting, since dimensions and proportions other than what are shown are contemplated and are within the scope of the disclosed inventions. Distances, angles, etc. are merely illustrative and do not necessarily bear an exact relationship to actual dimensions and layout of the devices illustrated. Components can be added, removed, and/or rearranged. Further, the disclosure herein of any particular feature, aspect, method, property, characteristic, quality, attribute, element, or the like in connection with various embodiments can be used in all other embodiments set forth herein. Additionally, it will be recognized that any methods described herein may be practiced using any device suitable for performing the recited steps.

**[0092]** While a number of embodiments and variations thereof have been described in detail, other modifications

and methods of using the same will be apparent to those of skill in the art. Accordingly, it should be understood that various applications, modifications, materials, and substitutions can be made of equivalents without departing from the unique and inventive disclosure herein or the scope of the claims.

What is claimed is:

1. A combination side bar and vehicle step assembly, the assembly comprising:

a side bar configured to be mounted to a vehicle by at least one mounting bracket defining a mounting surface configured to mate with the vehicle; and

an extendable vehicle step comprising a stepping platform connected to at least one pair of arms, the at least one pair of arms connected to a frame, the frame being connected to the at least one mounting bracket;

wherein the extendable vehicle step is movable between a stored and a deployed position, where the vehicle step is in the deployed position below and outboard to the side bar, and when the extendable vehicle step is in the deployed position, the stepping platform is at least partially outboard to the side bar.

\* \* \* \* \*