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Retractable Step And Side Bar Assembly For Raised Vehicle

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.

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Background/Summary

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 ¾ a width of the first door and a length of the stepping platform can be at least ½ 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 ½ 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.

Description

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

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

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

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

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

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

[0026] FIG. **6**B 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. **3**A-B show the combination assembly **10** in the deployed (FIG. **3**A) and the stowed (FIG. **3**B) 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 includes a side bar main body **102** configured for mounting to vehicle **20** via mounting brackets **150**.
[0037] The mounting bracket **150**, shown in FIGS. **4**A-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. **4**A-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. **5**A-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. **6**A, 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. **6**B, 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. **5**A-B, the side bar main body **102** may be provided with a first end cap **120***a* connected to the first end **101** of the side bar main body **102** and a second end cap **120***b* 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 (Lr) can extend at least half of a length of the vehicle **20**. In some embodiments, the side bar **100** length (Lr) can extend at least ¾ of a length of the vehicle **20**. In some embodiments, the side bar **100** length (Lr) can extend at least half of a length of a door (L.sub.d1 or L.sub.d2) on one side of the vehicle **20**. In some embodiments, the side bar **100** length (Lr) can extend at least ¾ of a length of a door (L.sub.d1 or L.sub.d2) on one side of the vehicle **20**. In some embodiments, the side bar **100** length (Lr) can extend at least a length of a door (L.sub.d1 or L.sub.d2) on one side of the vehicle **20**. In some embodiments, the side bar **100** length (Lr) can extend at least half of a length of two doors (Ld) on one side of the vehicle **20**. In some embodiments, the side bar **100** length (Lr) can extend at least ¾ of a length of two doors (Ld) on one side of the vehicle **20**. In some embodiments, the side bar **100** length (Lr) can extend at least a length of two doors (Ld) on one side of the vehicle **20**. In some embodiments, the side bar **100** length (Lr) can extend about 2, 3, 4, 5, 6, 7, or 8 feet. In some embodiments, the side bar **100** length (Lr) 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 (Ls) can extend at least half of a length of the vehicle **20**. In some embodiments, the stepping platform **1020** length (Ls) can extend at least ¾ of a length of the vehicle **20**. In some embodiments, the stepping platform **1020** length (Ls) can extend at least half of a length of a door (L.sub.d1 or L.sub.d2) on one side of the vehicle **20**. In some embodiments, the stepping platform **1020** length (Ls) can extend at least ¾ of a length of a door (L.sub.d1 or L.sub.d2) on one side of the vehicle **20**. In some embodiments, the stepping platform **1020** length (Ls) can extend at least a length of a door (L.sub.d1 or L.sub.d2) on one side of the vehicle **20**. In some embodiments, the stepping platform **1020** length (Ls) can extend at least half of a length of two doors (Ld) on one side of the vehicle **20**. In some embodiments, the stepping platform **1020** length (Ls) can extend at least ¾ of a length of two doors (Ld) on one side of the vehicle **20**. In some embodiments, the stepping platform **1020** length (Ls) can extend at least a length of two doors (Ld) on one side of the vehicle **20**. In some embodiments, the stepping platform **1020** length (Ls) can extend about 2, 3, 4, 5, 6, 7, or 8 feet. In some embodiments, the stepping platform **1020** length (Ls) 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 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** ma 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 corresponded 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 embodiments 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. **3**A-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. **3**B), through the intermediate position and into the deployed position (FIG. **3**A).

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, thought he 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.

Claims

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.