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## MOUNTING APPARATUS FOR VEHICLES

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### Abstract

The present disclosure relates to mounting apparatus, and related methods and components, for mounting an accessory to a mounting structure. In one or more embodiments, the mounting structure is a crossbar and/or a rail of a vehicle. In one or more embodiments, a mounting apparatus includes an actuator and a handle pivotably coupled to the actuator. The mounting apparatus also includes one or more locking pins. The handle is configured to rotate relative to a rotational axis and pivot relative to a pivot axis, and one or more links are disposed such that rotation of the handle moves the one or more links to rotate the one or more locking pins.

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### Background/Summary

## INTRODUCTION

[0001] Accessories can be mounted to vehicles, such as on roofs of vehicles or in cabs of vehicles. However, the devices used for mounting can require tools and can be difficult to operate. Moreover, the devices can be difficult to dismount from vehicles, which can increase vehicle footprints and hinder aerodynamic efficiencies.

## SUMMARY

[0002] The present disclosure relates to mounting apparatus, and related methods and components, for mounting an accessory to a mounting structure. In one or more embodiments, the mounting structure is a crossbar of a vehicle and/or a rail of the vehicle.

[0003] In one or more embodiments, a mounting apparatus includes one or more locking pins, and one or more links. The mounting apparatus includes a handle configured to rotate and pivot. Rotation of the handle moves the one or more links to rotate the one or more locking pins into a blocking position relative to a mounting structure. Pivoting of the handle moves the locking pins toward the handle and into a locked position.

[0004] In one or more embodiments, a mounting apparatus includes one or more locking pins, and an actuator bar. The actuator bar is rotatable relative to a rotational axis to rotate the one or more locking pins and slidable along the rotational axis to slide the one or more locking pins. The mounting apparatus includes a plate disposed at least partially between the actuator bar and the one or more locking pins.

[0005] In one or more embodiments, a mounting apparatus includes an actuator and a handle pivotably coupled to the actuator. The mounting apparatus includes one or more locking pins. The one or more locking pins include one or more flange sections. Rotation of the handle rotates the one or more flange sections of the one or more locking pins, and pivoting of the handle slides the one or more locking pins.

[0006] In one or more embodiments a collapsible retention apparatus includes a first support rail, a second support rail spaced from the first support rail to define a spacing therebetween, and a shaft coupled to the first and second support rails. The shaft is rotatable relative to the first and second support rails. The collapsible retention apparatus includes a handle coupled to the shaft, and rotation of the shaft moves the handle into and out of the spacing.

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## Description

### BRIEF DESCRIPTION OF THE DRAWINGS

[0007] So that the manner in which the above recited features of the present disclosure can be understood in detail, a more particular description of the disclosure, briefly summarized above, may be had by reference to embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only exemplary embodiments and are therefore not to be considered limiting in scope, and may admit to other equally effective embodiments.

[0008] FIG. 1 is a schematic front view of a vehicle, according to one or more embodiments.

[0009] FIG. 2 is a schematic perspective view of the mounting apparatus shown in FIG. 1 in a first position, according to one or more embodiments.

[0010] FIG. 3 is a schematic perspective view of the mounting apparatus shown in FIG. 2 in a second position, according to one or more embodiments.

[0011] FIG. 4 is a schematic perspective view of the mounting apparatus shown in FIG. 3 in a third position, according to one or more embodiments.

[0012] FIG. 5 is a schematic cross-sectional side view, along Section 5-5 shown in FIG. 4, of the mounting apparatus, according to one or more embodiments.

[0013] FIG. 6 is a schematic perspective view of the mounting apparatus shown in FIGS. 2-5 with

the second body and the plate hidden, according to one or more embodiments.

[0014] FIG. 7 is a schematic back view of the mounting apparatus shown in FIGS. 2-6, according to one or more embodiments.

[0015] FIG. 8 is a schematic enlarged partial perspective view of the mounting apparatus shown in FIGS. 2-5, according to one or more embodiments.

[0016] FIG. 9 is a schematic side view of the mounting apparatus in the first position shown in FIG. 2, according to one or more embodiments.

[0017] FIG. 10 is a schematic side view of the mounting apparatus in the second position shown in FIG. 3, according to one or more embodiments.

[0018] FIG. 11 is a schematic side view of the mounting apparatus in the third position shown in FIG. 4, according to one or more embodiments.

[0019] FIG. 12 is a schematic perspective view of a collapsible retention apparatus in a first position, according to one or more embodiments.

[0020] FIG. 13 is a schematic perspective view of the collapsible retention apparatus in a second position, according to one or more embodiments.

[0021] FIG. 14 is a schematic enlarged perspective view of the first support rail shown in FIG. 12, according to one or more embodiments.

[0022] FIG. 15 is a schematic side view of the mounting apparatus shown in FIG. 14 in a first position, according to one or more embodiments.

[0023] FIG. 16 is a schematic side view of the mounting apparatus shown in FIG. 15 in a second position, according to one or more embodiments.

[0024] FIG. 17 is a schematic side view of the mounting apparatus shown in FIG. 16 in a third position, according to one or more embodiments.

[0025] FIG. 18 is a schematic side cross-sectional view of the mounting apparatus along Section 18-18 shown in FIG. 14 in the third position, according to one or more embodiments.

[0026] FIG. 19 is a schematic bottom view of the mounting apparatus shown in FIG. 16 in the second position, according to one or more embodiments.

[0027] FIG. 20 is a schematic bottom view of the mounting apparatus shown in FIG. 17 in the third position, according to one or more embodiments.

[0028] FIG. 21 is a schematic bottom view of the first vehicle rail shown in FIGS. 12-14, according to one or more embodiments.

[0029] FIG. 22 is a schematic bottom view of the first vehicle rail shown in FIG. 21, according to one or more embodiments.

[0030] FIG. 23 is a schematic block diagram view of a method of mounting an accessory, according to one or more embodiments.

[0031] To facilitate understanding, identical reference numerals have been used, where possible, to designate identical elements that are common to the figures. It is contemplated that elements and features of one embodiment may be beneficially incorporated in other embodiments without further recitation.

#### DETAILED DESCRIPTION

[0032] The present disclosure relates to mounting apparatus, and related methods and components, for mounting an accessory to a mounting structure. In one or more embodiments, the mounting structure is a crossbar and/or a rail of a vehicle. In one or more embodiments, the vehicle is an automotive vehicle, such as an electric vehicle (e.g., an electric truck, an off-road vehicle, a sport-utility vehicle (SUV), or a service van) or an internal combustion vehicle. Other vehicles are contemplated.

[0033] In one or more embodiments, a mounting apparatus includes an actuator and a handle pivotably coupled to the actuator. The mounting apparatus also includes one or more locking pins. The handle is configured to rotate relative to a rotational axis and pivot relative to a pivot axis, and one or more links are disposed to transfer rotational movement between the handle and the one or

more locking pins.

[0034] In operation, a user can position one or more flange sections of the one or more locking pins into an opening of a crossbar and/or a rail. The user then rotates the handle. The rotation of the handle rotates the one or more locking pins so that the one or more locking pins extend into channel sections on opposite sides of the opening. After rotation of the handle, the handle is pivoted toward the housing, causing the one or more locking pins to abut against opposing plate sections of the crossbar and/or the rail and lock the mounting apparatus to the crossbar and/or the rail. An accessory (such as an awning or a spare tire) can then be mounted to the crossbar and/or rail. For example, an awning can be mounted to the housing using fasteners. As another example, a spare tire can be tied down to a collapsible retention apparatus coupled to the mounting apparatus.

[0035] The mounting apparatus enables a user to reliably, quickly, and easily mount an accessory to a vehicle. The mounting apparatus can be locked using one hand and without driving tools (such as a wrench or screwdriver). Additionally, the mounting apparatus can be quickly unlocked from the crossbar, which improves aerodynamics of the vehicle, allows the vehicle to move through smaller clearances, and allows the mounting apparatus to be more easily stored in the vehicle or another enclosed area.

[0036] The disclosure contemplates that terms used herein such as “couples,” “coupling,” “couple,” and “coupled” may include but are not limited to welding, fusing, melting together, embedding, bonding, interference fitting, and/or fastening such as by using bolts, threaded connections, rivets, pins, and/or screws. The disclosure contemplates that terms such as “couples,” “coupling,” “couple,” and “coupled” may include but are not limited to integrally forming. The disclosure contemplates that terms such as “couples,” “coupling,” “couple,” and “coupled” may include but are not limited to direct coupling and/or indirect coupling, such as indirect coupling through components such as links, brackets, blocks, and/or frames.

[0037] FIG. 1 is a schematic front view of a vehicle **100**, according to one or more embodiments. The vehicle **100** may include multiple sensors **101** and/or multiple cameras **102**. The vehicle **100** includes one or more wheel modules **107**. In the implementation shown in FIG. 1, the vehicle **100** is a truck. The present disclosure contemplates that the subject matter described herein can be used in any other type of vehicle having any numbers of wheels, such as vans and/or SUVs. An accessory **111** is mounted to a mounting structure **112** of the vehicle **100**. In one or more embodiments, the mounting structure **112** includes one or more crossbars. In one or more embodiments, the mounting structure **112** is mounted to a vehicle body **108** (such as a roof of the vehicle body **108**) of the vehicle **100** using one or more mounting apparatus **200** (one mounting apparatus **200** is shown in the front view). In one or more embodiments, the accessory **111** is an awning. The present disclosure also contemplates that the accessory **111** can be a spare tire, a cooler, a fridge, and/or kitchen equipment. Other accessories are contemplated.

[0038] FIG. 2 is a schematic perspective view of the mounting apparatus **200** shown in FIG. 1 in a first position, according to one or more embodiments.

[0039] FIG. 3 is a schematic perspective view of the mounting apparatus **200** shown in FIG. 2 in a second position, according to one or more embodiments.

[0040] FIG. 4 is a schematic perspective view of the mounting apparatus **200** shown in FIG. 3 in a third position, according to one or more embodiments.

[0041] FIGS. 2-4 will be described together. The mounting apparatus **200** includes a housing **201** and one or more locking pins **211**, **212** (two are shown) extending at least partially out of the housing **201** and at least partially into the housing **201**. The mounting apparatus **200** includes a handle **220** configured to rotate relative to (e.g., about) a rotational axis RA1 and pivot relative to a pivot axis PA1. The pivot axis PA1 is oriented at angle relative the rotational axis RA1. In one or more embodiments, the pivot axis PA1 is perpendicular to the rotational axis RA1. In one or more embodiments, the pivot axis PA1 intersects the rotational axis RA1. In one or more embodiments, the pivot axis PA1 is offset by a distance (such as a few centimeters) from the rotational axis RA1.

FIG. 3 shows the handle **220** rotated about the rotational axis **RA1** from the first position shown in FIG. 2 to the second position shown in FIG. 3. The rotation of the handle **220** rotates one or more flange sections **213**, **214** of the one or more locking pins **211**, **212** relative to the housing **201**. The rotational axis **RA1** and the pivot axis **PA1** shown are not limiting and are shown for exemplary purposes. Other axes may be used. For example, a rotational axis may be offset from and/or non-parallel to a longitudinal axis of the actuator bar **241** described below. The rotational axis may be movable (e.g., pivotable) as shown for the rotational axis **RA1**, or the rotational axis can be stationary. As another example, a pivot axis may be offset from and/or parallel to the longitudinal axis of the actuator bar **241** described below. The pivot axis may be movable (e.g., linearly movable) as shown for the pivot axis **PA1**, or the pivot axis can be stationary.

[0042] After rotating the handle **220** to the second position shown in FIG. 3, the handle **220** is pivoted relative to the pivot axis **PA1** and to the third position shown in FIG. 4. The pivoting of the handle **220** moves (e.g., slides) the one or more locking pins **211**, **212** (e.g., along the Z-axis). In one or more embodiments, the one or more locking pins **211**, **212** move (e.g., slide) toward the housing **201** and into the third position. In one or more embodiments, the first position shown in FIG. 2 is an unlocked position, the second position shown in FIG. 3 is an aligned position, and the third position shown in FIG. 4 is a locked position.

[0043] FIG. 5 is a schematic cross-sectional side view, along Section 5-5 shown in FIG. 4, of the mounting apparatus **200**, according to one or more embodiments.

[0044] The housing **201** includes one or more bodies **201a**, **201b** (two are shown in FIG. 5). In one or more embodiments, a plurality of bodies **201a**, **201b** are coupled together. The mounting apparatus **200** includes one or more receptacles **231**, **232**, and the one or more locking pins **211**, **212** are received respectively in the one or more receptacles **231**, **232**. The one or more receptacles **231**, **232** are rotatable (e.g., about the Z-axis) relative to the housing **201**, and the one or more locking pins **211**, **212** are coupled to rotate with the one or more receptacles **231**, **232**. As an example, the locking pins **211**, **212** can respectively include a section having a non-circular (e.g., rectangular or ovular) cross-section received in the respective receptacle **231**, **232** such that rotation of the respective receptacle **231**, **232** rotates the respective locking pin **211**, **212**. In one or more embodiments, the one or more locking pins **211**, **212** are slidable (e.g., toward and away from the housing **201** along the Z-axis) relative to the one or more receptacles **231**, **232** to abut against the mounting structure **112** and disengage from the mounting structure **112**. The rotational axis **RA1** is shown along the Z-axis and the pivot axis **PA1** is shown along the Y-axis.

[0045] The mounting apparatus **200** includes an actuator **240** coupled to the handle **220**. The actuator **240** includes an actuator bar **241**, and the handle **220** is pivotably coupled to the actuator bar **241**. The actuator bar **241** extends at least partially into the housing **201** and at least partially out of the housing **201**. The actuator **240** also includes an actuator receptacle **242**, and the actuator receptacle **242** is rotatable relative to the housing **201** (e.g., about the Z-axis). A plate **245** is disposed at least partially between the one or more locking pins **211**, **212** and the actuator bar **241** of the actuator **240** to transfer linear movement between the actuator bar **241** and the one or more locking pins **211**, **212**. As an example, movement of the plate **245** along a first direction **D1** moves the one or more locking pins **211**, **212** toward the housing **201**, and movement of the plate **245** along a second direction **D2** allows the one or more locking pins **211**, **212** to move away from the housing **201**. For example, gravitational forces and/or biasing forces of one or more biasing elements **247** (such as springs) can move the one or more locking pins **211**, **212** away from the housing **201**. The one or more biasing elements **247** are disposed between the housing **201** and the one or more locking pins **211**, **212**.

[0046] In one or more embodiments, the actuator bar **241** and the one or more locking pins **211**, **212** extend through the plate **245**. In one or more embodiments, the actuator bar **241** includes an outer shoulder **248** configured to abut against the plate **245**. The one or more locking pins **211**, **212** respectively include a head section **215** configured to abut against the plate **245**.

[0047] FIG. 6 is a schematic perspective view of the mounting apparatus **200** shown in FIGS. 2-5 with the second body **201b** and the plate **245** hidden, according to one or more embodiments.

[0048] The mounting apparatus **200** includes one or more links **250** (one is shown) disposed such that rotation of the handle **220** moves the one or more links **250** to rotate the one or more locking pins **211**, **212**. For example, the one or more links **250** transfer rotational movement between the handle **220** and the one or more locking pins **211**, **212**. The one or more links **250** are coupled to the actuator **240**. Rotation of the handle **220** (for example rotation between the first position shown in FIG. 2 and the second position shown in FIG. 3) transfers through the one or more links **250** to rotate the one or more locking pins **211**, **212** into a blocking position relative to the mounting structure **112**. When the one or more locking pins **211**, **212** are in the blocking position, the one or more flange sections **213**, **214** are oriented to abut against the mounting structure **112** when the one or more locking pins **211**, **212** move (e.g., slide) toward the housing **201** along the Z-axis. The one or more receptacles **231**, **232**, and the actuator receptacle **242** are coupled to the one or more links **250**. In one or more embodiments, rotation of any receptacle **231**, **232**, **242** (e.g., about the Z-axis) moves the one or more links **250** (e.g., along the X-Y plane), which in turn rotates the other two of the receptacles **231**, **232**, **242** (e.g., about the Z-axis). In one or more embodiments, the one or more receptacles **231**, **232** include a pair of receptacles **231**, **232** spaced from each other by at least a portion of the one or more links **250**. In one or more embodiments, the one or more links **250** include a common link **251** coupled to the pair of receptacles **231**, **232** and the actuator receptacle **242** of the actuator **240**. In one or more embodiments, the one or more receptacles **231**, **232** and/or the actuator receptacles **242** respectively include a wheel.

[0049] The mounting apparatus **200** includes a cover plate **206** slidable over at least a portion of the housing **201** (such as a portion of a mount plate **207** shown in FIG. 7). The cover plate **206** is slidable to receive at least one of the one or more links **250** in a retention opening **205** of the cover plate **206**.

[0050] FIG. 7 is a schematic back view of the mounting apparatus **200** shown in FIGS. 2-6, according to one or more embodiments.

[0051] The first body **201a** of the housing **201** includes the mount plate **207**. The mount plate **207** includes a first opening **208** having a first size and a second opening **209** having a second size larger than the first size. In one or more embodiments, the first opening **208** is in the shape of a circle and the second opening **209** is in the shape of an elongated slot. Other shapes are contemplated for the first and second openings **208**, **209**. Fasteners (such as bolts) can extend through the openings **208**, **209** and through a portion of the accessory **111** to couple the accessory **111** to the mount plate **207**. The differing sizes of the openings **208**, **209** allow for the accessory **111** to be adjustable with respect to the tilt of the accessory by moving a component (such as one of the fasteners) in the second opening **209** and tilting the accessory relative to the first opening **208**. For example, the tilt can be adjusted to level the accessory **111** if the mounting structure **112** is not level.

[0052] FIG. 8 is a schematic enlarged partial perspective view of the mounting apparatus **200** shown in FIGS. 2-5, according to one or more embodiments.

[0053] The second body **200b** of the housing **201** includes one or more alignment openings **281**, **282** (two are shown) sized and shaped to receive one or more alignment ledges **226**, **227** (two shown) of the handle **220**. The one or more alignment ledges **226**, **227** moving into the one or more alignment openings **281**, **282** helps to ensure that the handle **220** is rotated by a sufficient degree (e.g., about 90 degrees or another value) such that the one or more locking pins **211**, **212** have moved into the blocking position. The one or more alignment openings **281**, **282** also help to ensure that the handle **220** is not pivoted into the locked position until the handle **220** is properly rotated such that the one or more alignment ledges **226**, **227** will move into the one or more alignment openings **281**, **282**. In one or more embodiments, the handle **220** abuts against one or more blocks **831**, **832** (a pair of blocks are shown in FIG. 8) as the handle **220** pivots into and out of the locked

position. The one or more blocks **831**, **832** are disposed in one or more block openings (e.g., recesses) of the second body **201b**.

[0054] The second body **200b** of the housing **201** includes a retention opening **283**, and a latch **828** is coupled to the handle **220**. The latch **828** is sized and shaped to extend through the retention opening **283** and behind a ledge **284** of the second body **200b** of the housing **201** when a latch actuator **810** is actuated. In one or more embodiments, a key can be inserted into a slot **811** of the latch actuator **810** when the mounting apparatus **200** is in the third position (e.g., the locked position), and the key can be turned to rotate a barrel **812** of the latch actuator **810**. The rotation of the barrel **812** pivots the latch **828** to extend through the retention opening **283** and behind the ledge **284**. The latch **828** extending through the retention opening **283** and behind the ledge **284** locks the handle **220** in place relative to the second body **201b** of the housing **201**. For example, the latch **828** abutting against the ledge **284** helps to ensure that the mounting apparatus **200** does not become unlocked without user manipulation. For example, the latch **828** abutting against the ledge **284** resists gravitational forces and/or biasing forces of the one or more biasing elements **247** that may pull on the handle **220**. The latch **828** abutting against the ledge **284** also can resist certain incidental forces acting on the handle **220** (e.g., by a user) that are not intended to unlock the mounting apparatus **200**. Additionally, the latch **828** abutting against the ledge **284** resists the mounting apparatus **200** (and the mounted accessory) becoming unlocked without first using the key to unlock the barrel **812** of the latch actuator **810**.

[0055] The present disclosure contemplates that sections and/or components of the mounting apparatus **200** can be formed of a metal (such as aluminum or steel) and/or non-metallic materials, such as polymer materials (for example additive manufactured (e.g., 3-D printed) glass-filled nylon).

[0056] FIG. **9** is a schematic side view of the mounting apparatus **200** in the first position shown in FIG. **2**, according to one or more embodiments.

[0057] In the first position, the one or more flange sections **213**, **214** are oriented parallel to an opening **113** of the mounting structure **112** such that the one or more flange sections **213**, **214** can be positioned through the opening **113**.

[0058] FIG. **10** is a schematic side view of the mounting apparatus **200** in the second position shown in FIG. **3**, according to one or more embodiments.

[0059] In the second position, a user has rotated the handle **220** such that the one or more flange sections **213**, **214** are rotated to extend into channel sections **1011**, **1012** on opposite sides of the opening **113**. In FIG. **10**, the one or more flange sections **213**, **214** are in an obstructed position such that the one or more flange sections **213**, **214** contact the mounting structure **112** when the one or more flange sections **213**, **214** are moved upwardly.

[0060] FIG. **11** is a schematic side view of the mounting apparatus **200** in the third position shown in FIG. **4**, according to one or more embodiments.

[0061] In the third position, the handle **220** is pivoted toward the second body **201b** of the housing **201**, causing the one or more flange sections **213**, **214** of the one or more locking pins **211**, **212** to abut against opposing plate sections **1015**, **1016** of the mounting structure **112** (e.g., the crossbar) and lock the mounting apparatus **200** to the mounting structure **112**. The accessory **111** (such as an awning) can then be mounted to the housing **201** using fasteners extending through the first and second openings **208**, **209**.

[0062] FIG. **12** is a schematic perspective view of a collapsible retention apparatus **1200** in a first position, according to one or more embodiments. In one or more embodiments, the first position is a collapsed position.

[0063] The collapsible retention apparatus **1200** includes a first support rail **1210**, and a second support rail **1240** spaced from the first support rail **1210** to define a spacing **1201** therebetween. The collapsible retention apparatus **1200** includes a shaft **1270** coupled to the first and second support rails **1210**, **1240**. The shaft **1270** is movable (e.g., rotatable) relative to the first and second

support rails **1210**, **1214**. The collapsible retention apparatus **1200** includes a blocking structure **1271** coupled to the shaft **1270**, and movement (e.g., rotation) of the shaft **1270** moves (e.g., pivots) the blocking structure **1271** into and out of the spacing **1201**. In one or more embodiments, the blocking structure **1271** includes a handle, as shown in FIG. **12**. FIG. **12** shows the blocking structure **1271** positioned in the spacing **1201** to at least partially obstruct a retention opening **1202**. The retention opening **1202** can be formed in a vehicle, such as in a floor of a cab of the vehicle. The retention opening **1202** can retain at least part of a component (such as a spare off-road tire) to securely retain or support the component during driving of the vehicle (e.g., during vehicle braking, acceleration, and cornering). When the collapsible retention apparatus **1200** is in the first position (e.g., the collapsed position), the retention opening **1202** is obstructed such that the component is obstructed from being positioned in the retention opening **1202**.

[0064] The collapsible retention apparatus **1200** includes one or more extensions **1273a**, **1273b** (a pair of extensions is shown) coupled to the shaft **1270** and extending relative to the shaft **1270**. At least one (such as one or all) of the one or more extensions **1273a**, **1273b** includes a first section **1274a**, **1274b** extending radially outwardly relative to the shaft **1270**, a second section **1275a**, **1275b** extending tangentially to the shaft **1270**, and a third section **1276a**, **1276b** extending parallel to the shaft **1270**. The first support rail **1210** includes a first support opening **1211**, and the second support rail **1240** includes a second support opening **1241**. In one or more embodiments, the first support opening **1211** is defined by a first eyelet **1212** and the second support opening **1241** is defined by a second eyelet **1242**. The first and second support rails **1210**, **1240** respectively can include one or more additional eyelets **1213**, **1243** defining one or more additional support openings **1214**, **1244**.

[0065] At least one mounting apparatus **1500** is coupled respectively to the first support rail **1210** and the second support rail **1240**. FIG. **12** shows two mounting apparatus **1500** coupled respectively to the first support rail **1210** and the second support rail **1240**. The mounting apparatus **1500** are used to mount the first and second support rails **1210**, **1240** to a mount structure. The mount structure includes a pair of vehicle rails **1204**, **1205**. The vehicle rails **1204**, **1205** can be disposed in or outside a cab of a vehicle. For example, the vehicle rails **1204**, **1205** can be coupled to a floor in the cab or to a roof of the vehicle.

[0066] The first support rail **1210** and the second support rail **1240** respectively are coupled to a hinge assembly **1251a**, **1251b** that includes a first arm **1252** pivotably coupled to a second arm **1253**. The first arm **1252** is coupled to the respective support rail **1210**, **1240** and the shaft **1270** is disposed at least partially in a section of the second arm **1253**. The first arm **1252** is pivotable relative to the second arm **1253** to pivot the respective support rail **1210**, **1240** toward the shaft **1270** such that the collapsible retention apparatus **1200** can be stored with a reduced footprint when the support rails **1210**, **1240** are removed from the vehicle rails **1204**, **1205**.

[0067] FIG. **13** is a schematic perspective view of the collapsible retention apparatus **1200** in a second position, according to one or more embodiments. In one or more embodiments, the second position is an extended position.

[0068] In the second position (e.g., the extended position), the shaft **1270** has been moved (e.g., rotated) to move (e.g., pivot) the blocking structure **1271** and the one or more extensions **1273a**, **1273b** away from the support rails **1210**, **1240**. The blocking structure **1271** moves to clear the retention opening **1202** such that the component (e.g., the tire) can be positioned in the retention opening **1202**. The one or more extensions **1273a**, **1273b** can abut against part(s) of the vehicle, such as one or more seatbacks in the vehicle. For example, in FIG. **12** the one or more seatbacks can be upright to restrict pivoting of the one or more extensions **1273a**, **1273b**, and in FIG. **13** the one or more seatbacks can be collapsed downwardly such that the one or more extensions **1273a**, **1273b** can pivot and pivot the blocking structure **1271** to clear the retention opening **1202**. After the component is positioned in the retention opening **202**, the component can be coupled to the first and second support rails **1210**, **1240** using devices (such as hooks of ratchet straps or other tie-



down devices) extending into the support openings **1211**, **1214**, **1241**, **1244** and coupled to the eyelets **1212**, **1213**, **1242**, **1243**. The component can be removed from the retention opening **1202**, and the blocking structure **1271** and the one or more extensions **1273a**, **1273b** can be pivoted back to the first position such that the one or more seatbacks can be extended back to the upright position. Hence, the one or more seatbacks can be collapsed and expanded, and the component can be positioned in and out of the retention opening **1202**, without dismounting the collapsible retention apparatus **1200** from the vehicle rails **1204**, **1205**.

[0069] FIG. **14** is a schematic enlarged perspective view of the first support rail **1210** shown in FIG. **12**, according to one or more embodiments.

[0070] As shown in FIGS. **12** and **14**, in one or more embodiments the one or more extensions **1273a**, **1273b** include a first extension **1273a** positioned to abut against a first surface **1207** of the first support rail **1210**, and a second extension **1273b** positioned to abut against a second surface **1208** of the second support rail **1240**.

[0071] FIG. **15** is a schematic side view of the mounting apparatus **1500** shown in FIG. **14** in a first position, according to one or more embodiments.

[0072] FIG. **16** is a schematic side view of the mounting apparatus **1500** shown in FIG. **15** in a second position, according to one or more embodiments.

[0073] FIG. **17** is a schematic side view of the mounting apparatus **1500** shown in FIG. **16** in a third position, according to one or more embodiments.

[0074] FIGS. **15-17** will be described together. The mounting apparatus **1500** includes one or more locking pins **1511**, **1512** (two are shown) extending through a plate **1545** and at least part of (such as a plate section of) the first support rail **1210**. The mounting apparatus **1500** includes a handle **1520** configured to rotate relative to (e.g., about) the rotational axis RA1 and pivot relative to the pivot axis PA1. FIG. **16** shows the handle **1520** rotated about the rotational axis RA1 from the first position shown in FIG. **15** to the second position shown in FIG. **16**. The rotation of the handle **1520** rotates one or more flange sections **1513**, **1514** of the one or more locking pins **1511**, **1512** relative to the plate **1545**. One or more spacers **1561** (a plurality is shown) are disposed about at least one of the one or more locking pins **1511**, **1512**.

[0075] After rotating the handle **1520** to the second position shown in FIG. **16**, the handle **1520** is pivoted relative to the pivot axis PA1 and to the third position shown in FIG. **17**. The pivoting of the handle **1520** moves (e.g., slides) the one or more locking pins **1511**, **1512** (e.g., along the Z-axis). In one or more embodiments, the one or more locking pins **1511**, **1512** move (e.g., slide) toward the plate **1545** and the handle **1520** and into the third position. In one or more embodiments, the first position shown in FIG. **15** is an unlocked position, the second position shown in FIG. **16** is an aligned position, and the third position shown in FIG. **17** is a locked position.

[0076] The mounting apparatus **1500** includes an actuator **1540** coupled to the handle **1520**. The actuator **1540** includes an actuator bar **1541** received at least partially in an actuator receptacle **1542**. The handle **1520** is pivotably coupled to the actuator bar **1541**. The actuator bar **1541** extends through the at least part of the first support rail **1210**, through the plate **1545**, and into the actuator receptacle **1542**. The handle **1520** is rotatable relative to the actuator receptacle **1542** (e.g., about the Z-axis), and the actuator receptacle **1542** pivots with the handle **1520** relative to the plate **1545**. The actuator bar **1541** is coupled to rotate with the handle **1520**. The one or more locking pins **1511**, **1512** rotate relative to the plate **1545** in response to rotation of the handle **1520**. The plate **1545** is disposed at least partially between the one or more locking pins **1511**, **1512** and the actuator bar **1541** of the actuator **1540**.

[0077] A pivot pin **1549** extends in at least part of the handle **1520** and at least part of the actuator bar **1541** to pivotably couple the handle **1520** to the actuator bar **1541**. The pivot pin **1549** extends in at least part of the actuator receptacle **1542** and at least part of the plate **1545** to pivotably couple the actuator receptacle **1542** to the plate **1545**.

[0078] In one or more embodiments, the one or more locking pins **1511**, **1512** are slidable (e.g.,

toward and away from the handle **1520** along the Z-axis) to abut against the first vehicle rail **1204** and disengage from the first vehicle rail **1204**. The first vehicle rail **1204** is shown in ghost in FIGS. **15-17**. The handle **1520** can function as a cam such that pivoting of the handle **1520** imparts linear motion to the actuator bar **1541**. As an example, the pivoting of the handle **1520** and the actuator receptacle **1542** drives the actuator bar **1541** to move the one or more locking pins **1511**, **1512** (e.g., toward and away from the handle **1520** and the pivot pin **1549**). For example, movement of the actuator bar **1541** along the first direction **D1** moves the one or more locking pins **1511**, **1512** toward the handle **1520** and the pivot pin **1549**, and movement of the actuator bar **1541** along the second direction **D2** moves the one or more locking pins **1511**, **1512** away from the handle **1520**. Gravitational forces and/or biasing forces of one or more biasing elements **1547** (such as springs) can move the one or more locking pins **1511**, **1512** away from the handle **1520**. In one or more embodiments, the biasing elements **1547** include spring washers. In one or more embodiments, the biasing elements **1547** respectively include springs stacked on each other, such as cone-shaped spring washers stacked on each other. The one or more biasing elements **1547** are disposed between the plate **1545** and the one or more locking pins **1511**, **1512**.

[0079] The mounting apparatus **1500** includes one or more links **1550a**, **1550b** (two are shown) disposed such that rotation of the handle **1520** moves the one or more links **1550a**, **1550b** to rotate the one or more locking pins **1511**, **1512**. For example, the one or more links **1550a**, **1550b** transfer rotational movement between the handle **1520** and the one or more locking pins **1511**, **1512**. The one or more links **1550a**, **1550b** are also disposed to transfer linear movement between the actuator bar **1541** and the one or more locking pins **1511**, **1512**. The one or more links **1550a**, **1550b** are coupled to the actuator bar **1541** of the actuator **1540**. Rotation of the handle **1520** (for example, rotation between the first position shown in FIG. **15** and the second position shown in FIG. **16**) transfers through the one or more links **1550a**, **1550b** to rotate the one or more locking pins **1511**, **1512** into a blocking position relative to the first vehicle rail **1204**. When the one or more locking pins **1511**, **1512** are in the blocking position, the one or more flange sections **1513**, **1514** are oriented to abut against the first vehicle rail **1204** when the one or more locking pins **1511**, **1512** move (e.g., slide) toward the handle **1520** along the Z-axis. In one or more embodiments, the one or more links **1550a**, **1550b** include a first link **1550a** and a second link **1550b**. The first link **1550a** and the second link **1550b** respectively are coupled to the actuator bar **1541**, a first flange section **1513** of a first locking pin **1511**, and a second flange section **1514** of a second locking pin **1512**. Rotation of the actuator bar **1541** (e.g., about the Z-axis) moves the one or more links **1550a**, **1550b** (e.g., along the X-Y plane), which in turn rotates the one or more locking pins **1511**, **1512** (e.g., about the Z-axis). In one or more embodiments, the first and second links **1550a**, **1550b** are common links.

[0080] FIG. **18** is a schematic side cross-sectional view of the mounting apparatus **1500** along Section **18-18** shown in FIG. **14** in the third position, according to one or more embodiments. FIG. **19** is a schematic bottom view of mounting apparatus **1500** shown in FIG. **16** in the second position, according to one or more embodiments.

[0081] In one or more embodiments, at least one (such as one or all) of the one or more flange sections **1513**, **1514** includes a curved outer edge **1517**. In one or more embodiments, the one or more flange sections **1513**, **1514** respectively include opposing curved outer edges **1517**.

[0082] FIG. **20** is a schematic bottom view of mounting apparatus **1500** shown in FIG. **17** in the third position, according to one or more embodiments.

[0083] FIG. **21** is a schematic bottom view of the first vehicle rail **1204** shown in FIGS. **12-14**, according to one or more embodiments. The first vehicle rail **1204** includes a plurality of recesses **1231** on a bottom side of the first vehicle rail **1204**. The recesses **1231** are semi-circular in shape. The recesses **1231** can be scalloped into the first vehicle rail **1204**. As the mounting apparatus **1500** is moved into the third position, the one or more flange sections **1513**, **1514** can move into a subset of the recesses **1231**. As the one or more flange sections **1513**, **1514** rotate into the third position,

the one or more flange sections **1513**, **1514** can abut against edges **1232** defined by the recesses **1231** to center the locking pins **1511**, **1512** relative to the opening **113** of the first vehicle rail **1204**. The opening **113** can be enclosed by the first vehicle rail **1204** at one or both ends of the opening **113**. After the one or more flange sections **1513**, **1514** are in the third position, the edges **1232** restrict movement (such as linear movement of the mounting apparatus **1500** along a longitudinal axis of the first vehicle rail **1204**). The second vehicle rail **1205** can include the recesses **1231** in the same manner.

[0084] FIG. **22** is a schematic bottom view of the first vehicle rail **1204** shown in FIG. **21**, according to one or more embodiments.

[0085] The first vehicle rail **1204** includes a plurality of recesses **2231**. The recesses **2213** include one or more tapered edges **2232**. The one or more tapered edges **2232** can guide the one or more flange sections **1513**, **1514** into the recesses **2231** as the locking pins **1511**, **1512** slide toward the pivot pin **1549** and the actuator receptacle **1542** and into the third position. After the one or more flange sections **1513**, **1514** are in the third position, the tapered edges **2232** restrict movement (such as linear movement of the mounting apparatus **1500** along a longitudinal axis of the first vehicle rail **1204**).

[0086] FIG. **23** is a schematic block diagram view of a method **2300** of mounting an accessory, according to one or more embodiments.

[0087] The description of the method **2300** includes reference to reference numerals shown in FIGS. **1-11**, and the present disclosure contemplates that subject matter (such as structures and components) other than the subject matter shown in FIGS. **1-11** can be used in relation to the method **2300**. For example, the mounting apparatus **1500** can be used in relation to the method **2300**.

[0088] Operation **2303** includes disposing the mounting apparatus **200** on the mounting structure **112**. In one or more embodiments, the disposing includes positioning the one or more flange sections **213**, **214** of the one or more locking pins **211**, **212** through the opening **113**.

[0089] Operation **2306** includes rotating the handle **220** to rotate the one or more flange sections **213**, **214** of the one or more locking pins **211**, **212**.

[0090] Operation **2309** includes pivoting the handle **220** toward the housing **201** to abut the one or more flange sections **213**, **214** of the one or more locking pins **211**, **212** against the plate sections **1015**, **1016** of the mounting structure **112**.

[0091] Operation **2312** includes coupling (e.g., fastening) the accessory **111** to the mount plate **207** of the mounting apparatus **200**. The present disclosure contemplates that operation **2312** can be conducted before operation **2303** or after operation **2309**.

[0092] Using the handle **220**, the present disclosure contemplates that a user may conduct various operations described herein (such as operations **2303**, **2306**, **2309** of the method **2300**) using one hand and without tools (such as a wrench or screwdriver), which enables quick and easy mounting and dismounting of accessories to and from vehicles. Moreover, the quick and easy dismounting (e.g., releasing) of the mounting apparatus **200** facilitates reduced vehicle footprints and enhanced aerodynamic efficiencies. The mounting apparatus **200** can also be quickly dismounted and stored in the vehicle or another enclosed space. The one or more locking pins **211**, **212** can extend through the opening **113** at any position along the opening **113** such that the mounting apparatus **200** can be locked to the mounting structure **112** at any position along the opening **113**.

[0093] The present disclosure contemplates that the subject matter described herein may be expressed in one or more of the following Examples: [0094] 1. A collapsible retention apparatus, comprising: [0095] a first support rail; [0096] a second support rail spaced from the first support rail to define a spacing therebetween; [0097] a shaft coupled to the first and second support rails, the shaft rotatable relative to the first and second support rails; and [0098] a blocking structure coupled to the shaft, wherein rotation of the shaft moves the blocking structure into and out of the spacing. [0099] 2. The collapsible retention apparatus of Example 1, further comprising one or

more extensions coupled to the shaft and extending relative to the shaft, wherein the blocking structure comprises a handle. [0100] 3. The collapsible retention apparatus of Example 3, wherein the one or more extensions comprise: [0101] a first extension positioned to abut against a first surface of the first support rail; and [0102] a second extension positioned to abut against a second surface of the second support rail. [0103] 4. The collapsible retention apparatus of Example 2, wherein at least one of the one or more extensions comprises: [0104] a first section extending radially outwardly relative to the shaft; [0105] a second section extending tangentially to the shaft; and [0106] a third section extending parallel to the shaft. [0107] 5. The collapsible retention apparatus of Example 1, wherein the first support rail comprises a first support opening, and the second support rail comprises a second support opening. [0108] 6. The collapsible retention apparatus of Example 1, further comprising a mounting apparatus coupled to the first support rail, the mounting apparatus comprising: [0109] one or more locking pins extending through at least part of the first support rail; [0110] a handle configured to rotate relative to a rotational axis and pivot relative to a pivot axis; and [0111] one or more links, wherein rotation of the handle moves the one or more links to rotate the one or more locking pins into a blocking position relative to a mounting structure.

[0112] Benefits of the present disclosure include reliable, quick, and ease of mounting an accessory to a vehicle; enhanced strength of locking and reduced or eliminated chances of damage to rails and/or crossbars; locking mounting apparatus using one hand and without driving tools (such as a wrench or screwdriver); reliable, quick, and ease of unlocking mounting apparatus from the crossbar and/or rail; enhanced vehicle aerodynamics; reduced vehicle footprints (which allow vehicles to move through smaller clearances); and quick and easy storage of accessories and/or mounting apparatus in the vehicle or another enclosed area. For example, the benefits include securely and reliably retaining large and/or heavy components (such as a spare tire).

[0113] It is contemplated that one or more aspects disclosed herein may be combined. As an example, one or more aspects, features, components, operations and/or properties of the vehicle **100**, the accessory **111**, the mounting apparatus **200**, the mounting structure **112**, the implementations shown in FIGS. **9-11**, the collapsible retention apparatus **1200**, the first vehicle rail **1204**, the second vehicle rail **1205**, the recesses **1231**, the recesses **2231**, the mounting apparatus **1500**, and/or the method **2300** may be combined. Moreover, it is contemplated that one or more aspects disclosed herein may include some or all of the aforementioned benefits.

[0114] While the foregoing is directed to embodiments of the present disclosure, other and further embodiments of the disclosure may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

## Claims

1. A mounting apparatus, comprising: one or more locking pins; one or more links; and a handle configured to rotate and pivot, wherein rotation of the handle moves the one or more links to rotate the one or more locking pins into a blocking position relative to a mounting structure, and pivoting of the handle moves the locking pins toward the handle and into a locked position.
2. The mounting apparatus of claim 1, further comprising: one or more receptacles coupled to the one or more links, wherein the one or more locking pins are received respectively in the one or more receptacles, wherein the one or more receptacles are rotatable relative to a housing, and the one or more locking pins are coupled to rotate with the one or more receptacles.
3. The mounting apparatus of claim 1, wherein the one or more locking pins are slidable relative to an actuator to abut against the mounting structure.
4. The mounting apparatus of claim 1, further comprising a cover plate slidable over at least a portion of a housing, wherein the cover plate is configured to receive at least one of the one or more links in a retention opening of the cover plate.

5. The mounting apparatus of claim 2, wherein the one or more receptacles comprise a pair of receptacles spaced from each other by at least a portion of the one or more links.
  6. The mounting apparatus of claim 1, further comprising: an actuator coupled to the handle and the one or more links.
  7. The mounting apparatus of claim 6, wherein the actuator comprises: an actuator bar, wherein the handle is pivotably coupled to the actuator bar.
  8. The mounting apparatus of claim 6, wherein the actuator comprises: an actuator receptacle, wherein the actuator receptacle is rotatable relative to a housing.
  9. A mounting apparatus, comprising: one or more locking pins; an actuator bar, wherein the actuator bar is rotatable rotate relative to a rotational axis to rotate the one or more locking pins and slidable along the rotational axis to slide the one or more locking pins; and a plate disposed at least partially between the actuator bar and the one or more locking pins.
  10. The mounting apparatus of claim 9, further comprising a handle pivotably coupled to the actuator bar.
  11. The mounting apparatus of claim 9, wherein the actuator bar and the one or more locking pins extend through the plate.
  12. The mounting apparatus of claim 11, wherein the actuator bar comprises an outer shoulder configured to abut against the plate.
  13. The mounting apparatus of claim 11, wherein the one or more locking pins comprise a head section configured to abut against the plate.
  14. The mounting apparatus of claim 9, further comprising one or more biasing elements disposed between the plate and the one or more locking pins.
  15. A mounting apparatus, comprising: an actuator; a handle pivotably coupled to the actuator; and one or more locking pins comprising one or more flange sections, wherein: rotation of the handle rotates the one or more flange sections of the one or more locking pins, and pivoting of the handle slides the one or more locking pins.
  16. The mounting apparatus of claim 15, further comprising a housing that comprises one or more alignment openings sized and shaped to receive one or more alignment ledges of the handle.
  17. The mounting apparatus of claim 15, further comprising a housing that comprises a retention opening, wherein the handle comprises a latch sized and shaped to extend through the retention opening and behind a ledge of the housing to lock the handle in place relative to the housing.
  18. The mounting apparatus of claim 15, further comprising: a plate disposed at least partially between the actuator and the one or more locking pins.
  19. The mounting apparatus of claim 15, further comprising a housing, the housing comprising a mount plate comprising a first opening having a first size and a second opening having a second size larger than the first size, wherein a tilt of an accessory is adjustable by moving a component in the second opening and tilting the accessory relative to the first opening.
  20. The mounting apparatus of claim 15, wherein at least one of the one or more flange sections comprises a curved outer edge.
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