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(12) **United States Patent**
Honeycutt

(10) **Patent No.: US 9,169,693 B2**
(45) **Date of Patent: Oct. 27, 2015**

(54) **MOBILE ACCESS UNIT AND CAGE**

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(72) Inventor: **Robert Honeycutt**, Pawleys Island, SC (US)

(73) Assignee: **Safe Rack LLC**, Andrews, SC (US)

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

(21) Appl. No.: **14/336,579**

(22) Filed: **Jul. 21, 2014**

(65) **Prior Publication Data**

US 2014/0326537 A1 Nov. 6, 2014

Related U.S. Application Data

(62) Division of application No. 12/837,480, filed on Jul. 15, 2010.

(60) Provisional application No. 61/244,016, filed on Sep. 18, 2009.

(51) **Int. Cl.**

E06C 1/39	(2006.01)
E06C 5/02	(2006.01)
E06C 7/04	(2006.01)
E06C 5/20	(2006.01)
E06C 7/42	(2006.01)
E06C 5/04	(2006.01)

(52) **U.S. Cl.**

CPC ... ***E06C 5/02*** (2013.01); *E06C 1/39* (2013.01); *E06C 5/04* (2013.01); *E06C 5/20* (2013.01); *E06C 7/04* (2013.01); *E06C 7/42* (2013.01)

(58) **Field of Classification Search**

USPC 182/107–109, 127, 63.1, 64.1, 68.1, 182/68.2, 68.3, 69.4, 69.6, 113, 115, 141, 182/130–132, 101, 102

See application file for complete search history.

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Definiition of 'obliquely' found in Action Based on WordNet 3.0, Farlex clipart collection. © 2003-2012 Princeton University, Farlex Inc.*

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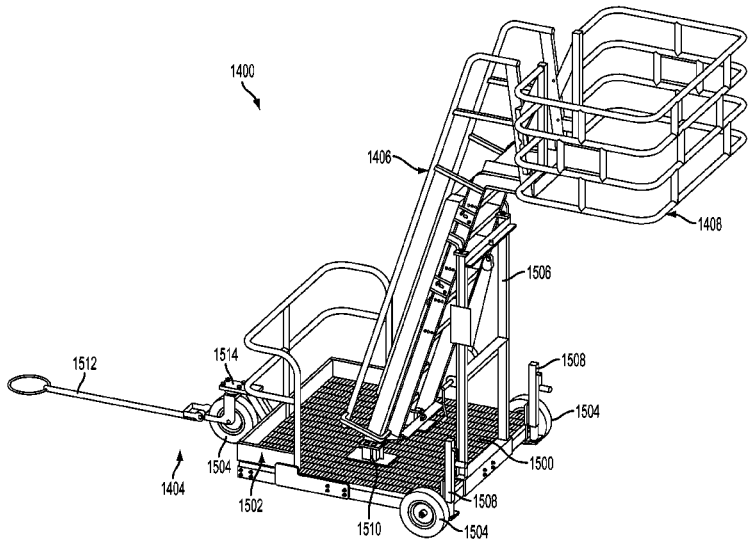
Primary Examiner — Daniel Cahn

(74) *Attorney, Agent, or Firm* — Nelson Mullins Riley & Scarborough, LLP

(57) **ABSTRACT**

Fall restraint equipment comprising a mobile access unit having a mobile platform portion, a ladder portion, and a cage portion. The components of the fall restraint equipment are formed from butterflying, lasering, cutting, bending, and/or stamping continuous pieces of tubular and sheet metal. The components of the mobile access unit are modular and include adapters of varying height that cause the mobile access unit to exhibit varying height.

17 Claims, 37 Drawing Sheets



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Definition for "cage" and "continuous" cited on p. 7 and cited in Examiner's list of references in Office Action issued on Oct. 10, 2012 in parent U.S. Appl. No. 12/837,480.

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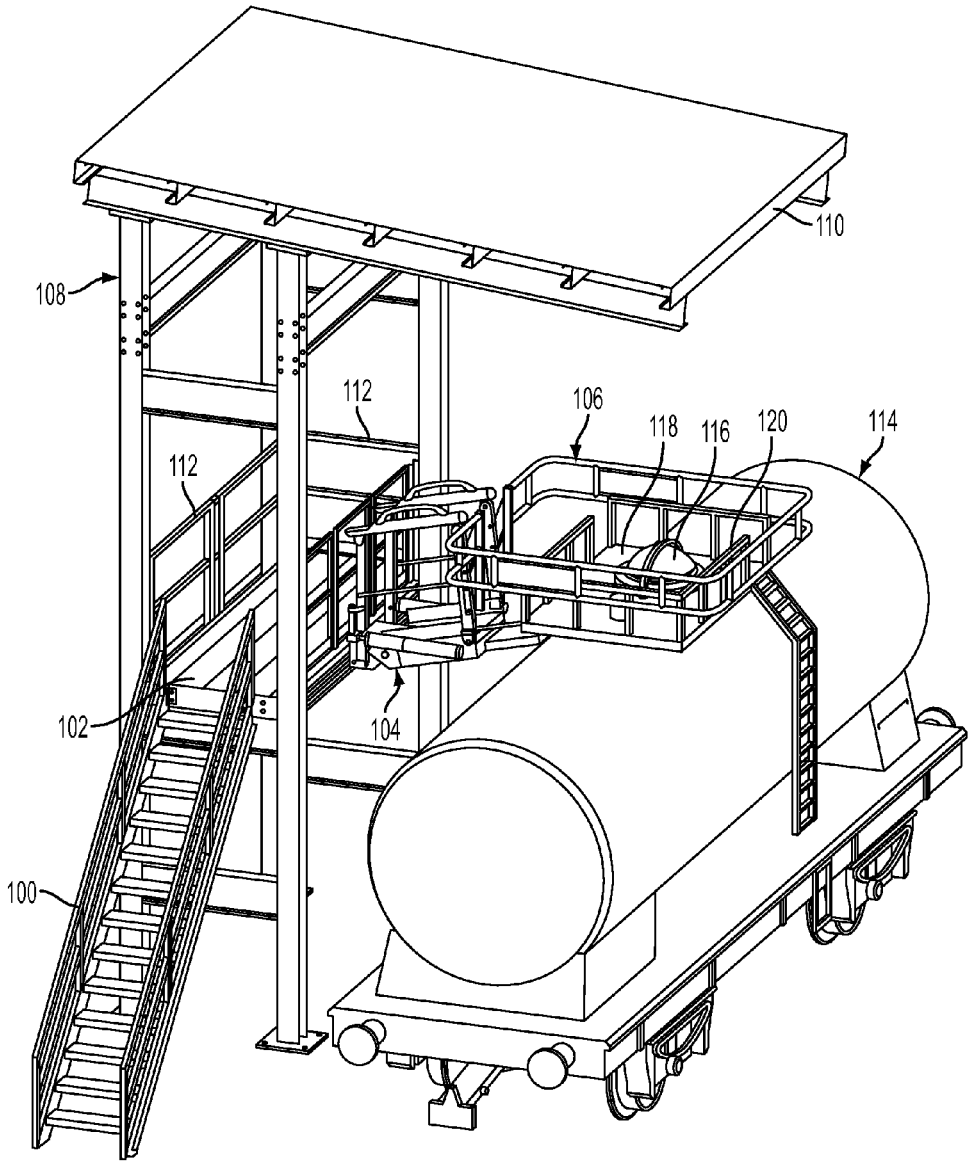
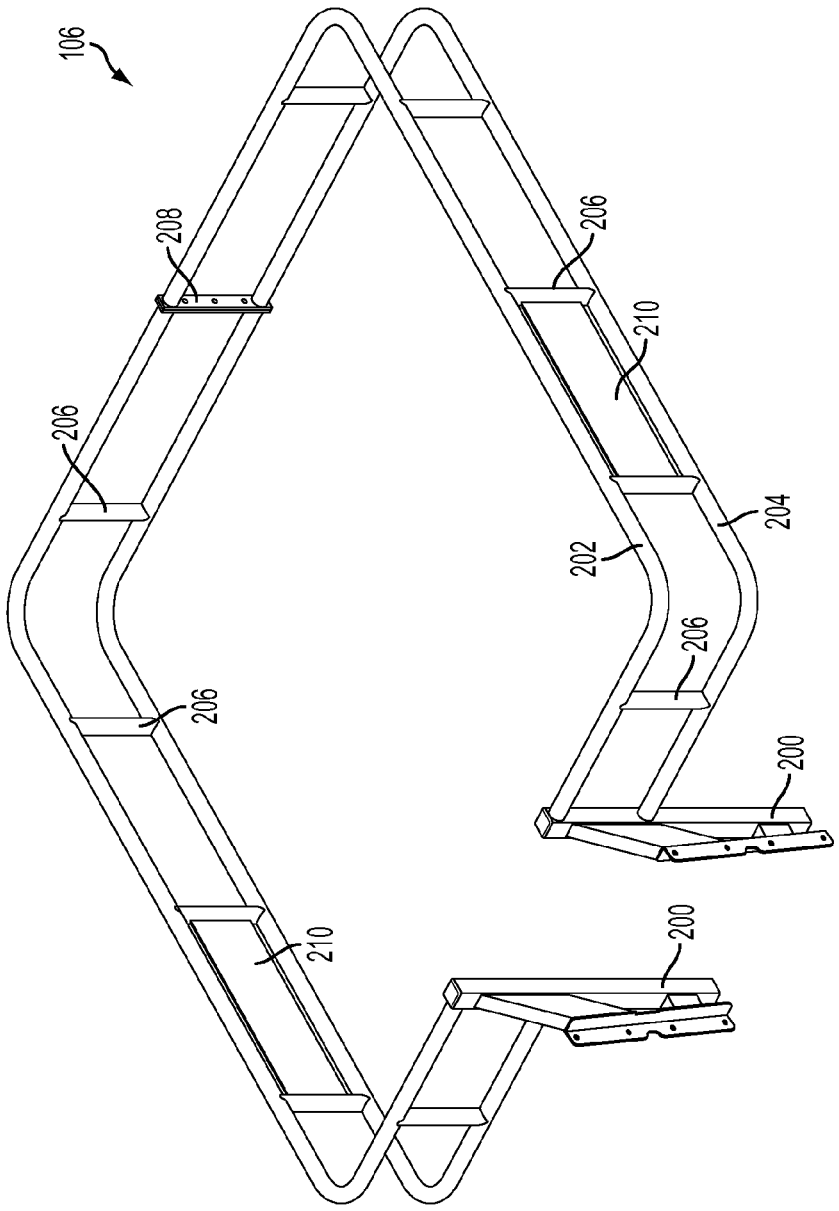


FIG. 1



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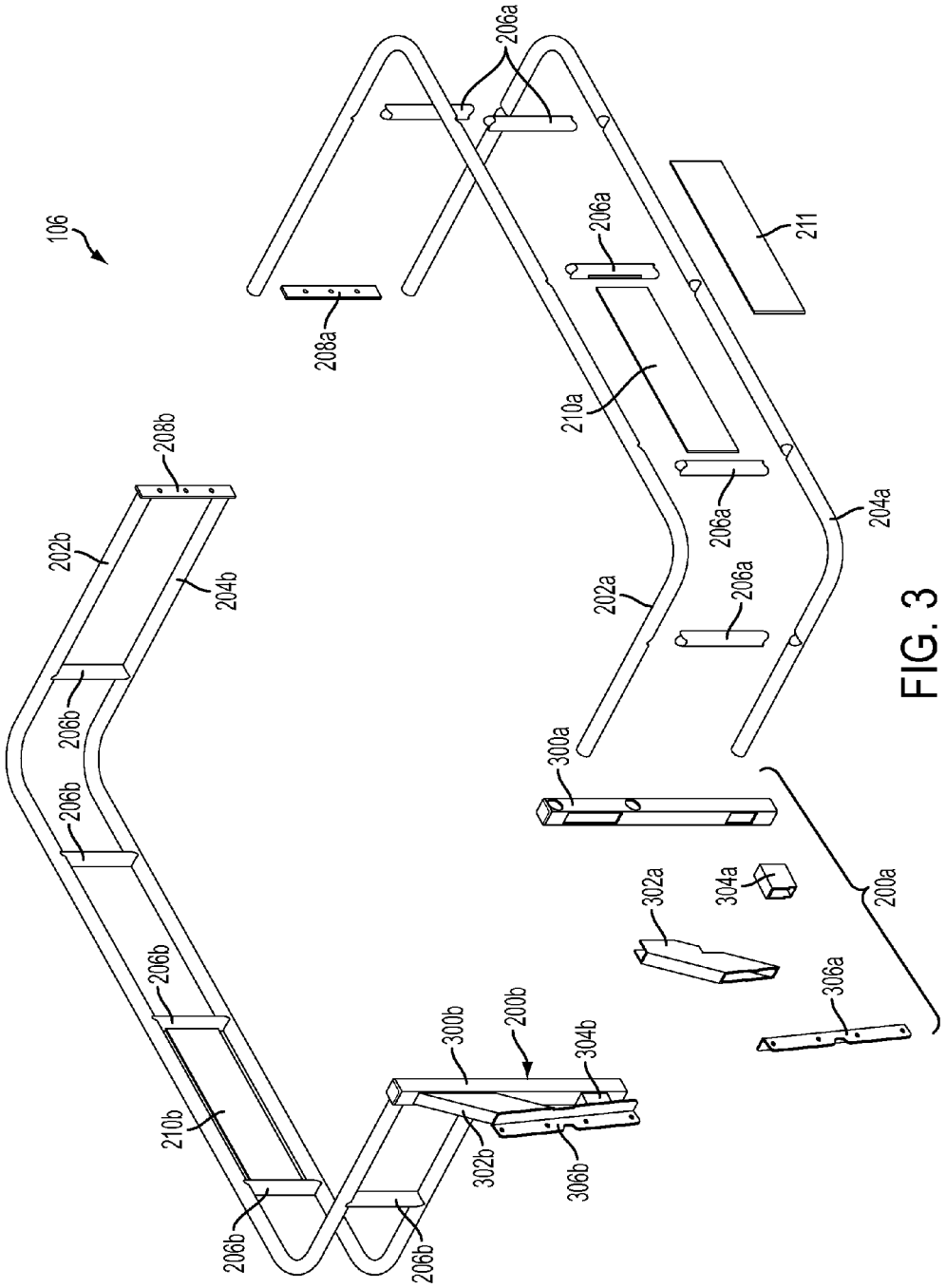
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FIG. 3

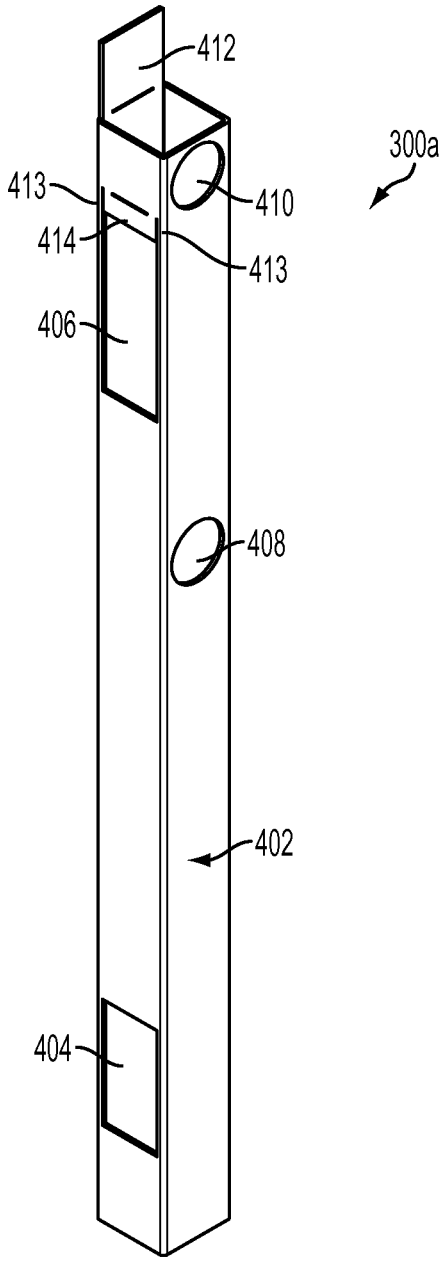


FIG. 4

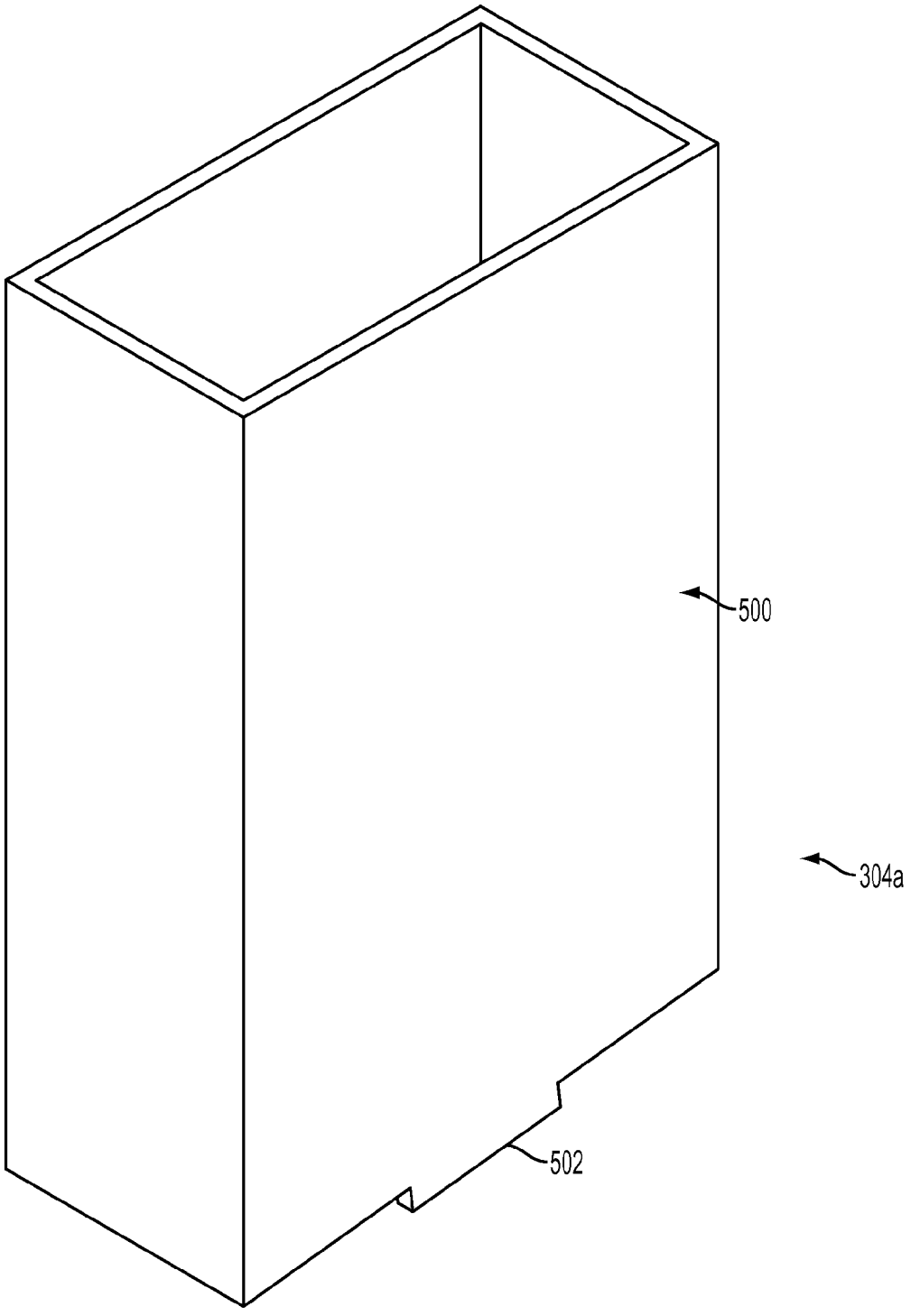
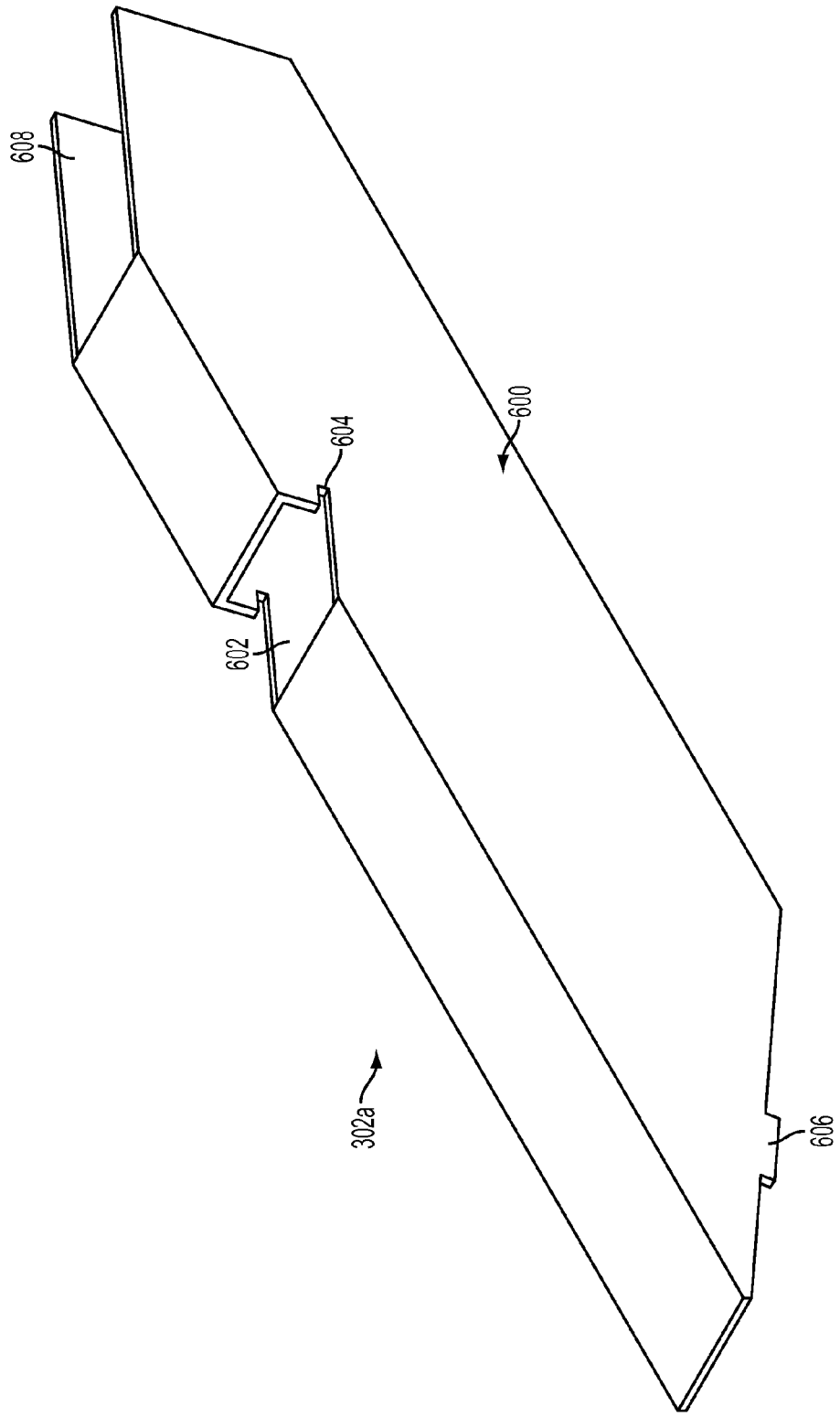


FIG. 5



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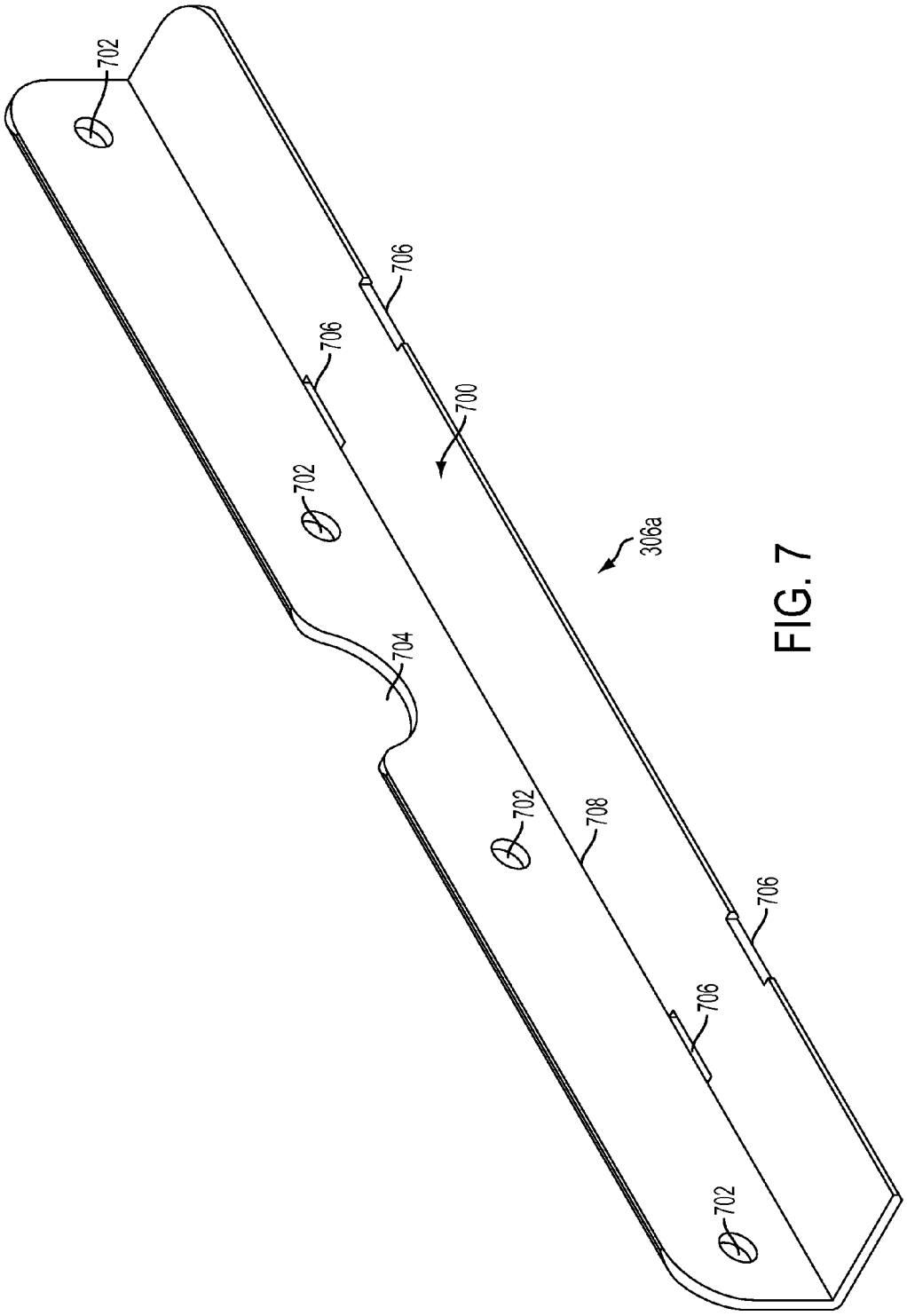

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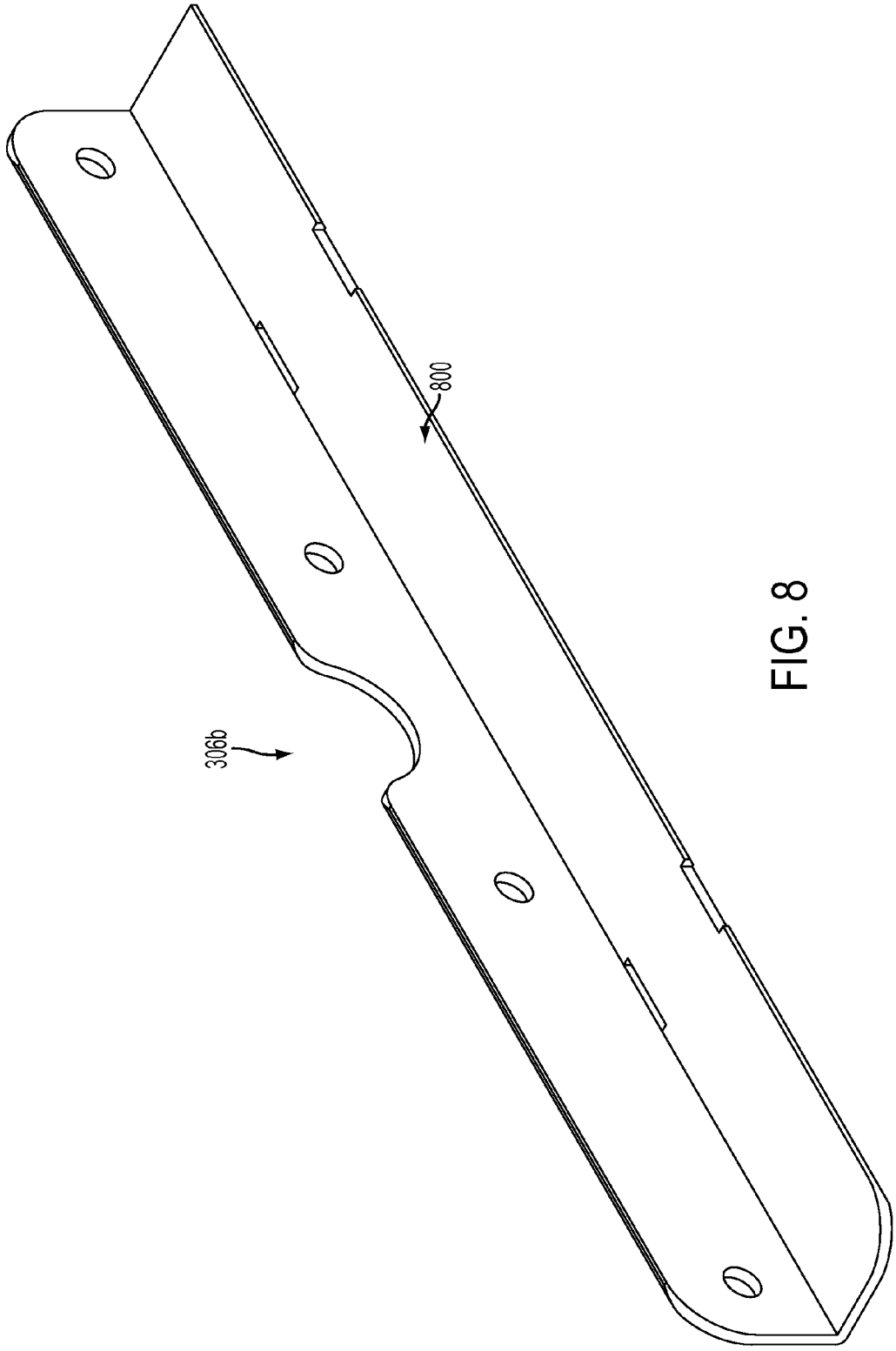

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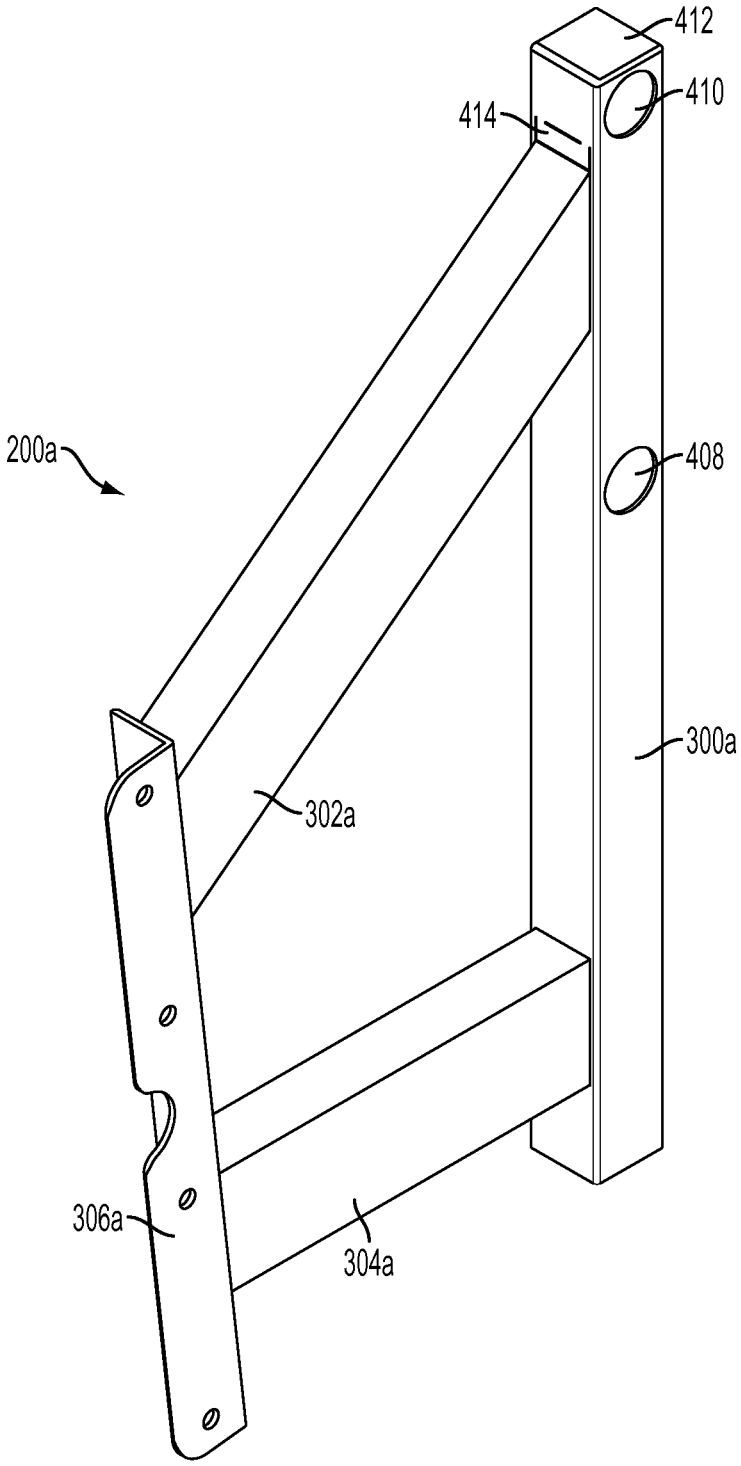

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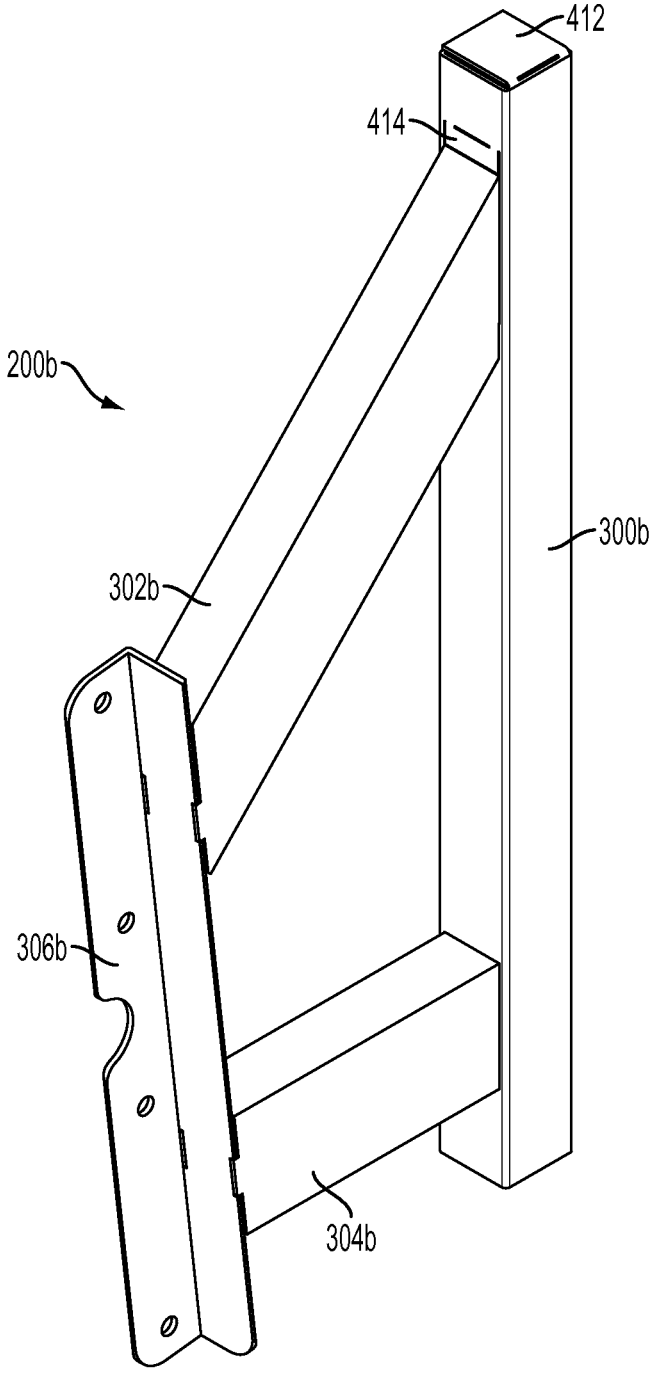
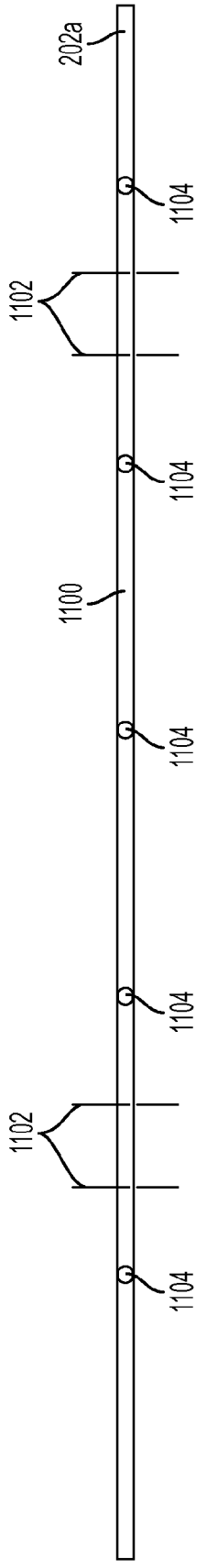


FIG. 10



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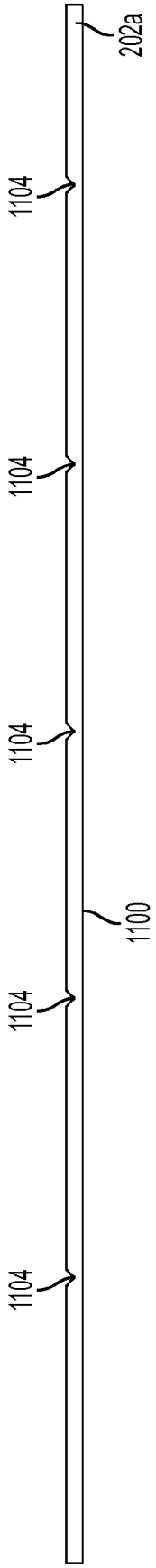
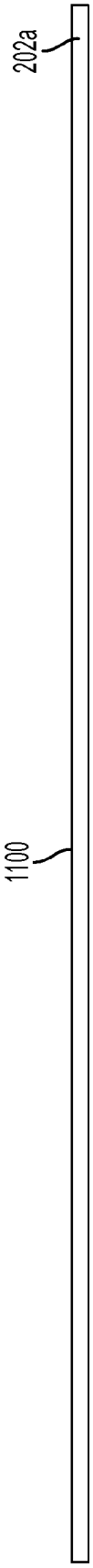


FIG. 12



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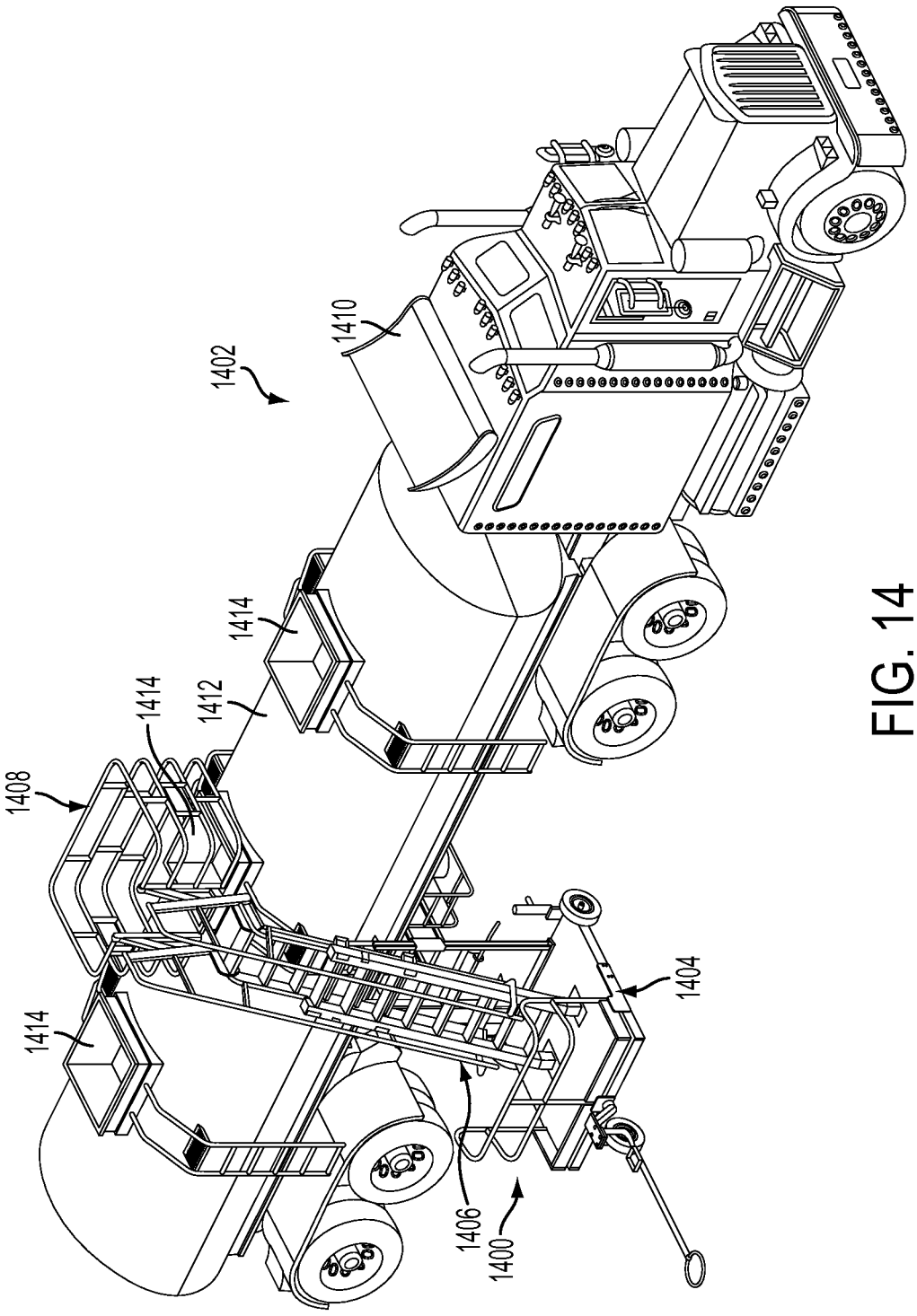

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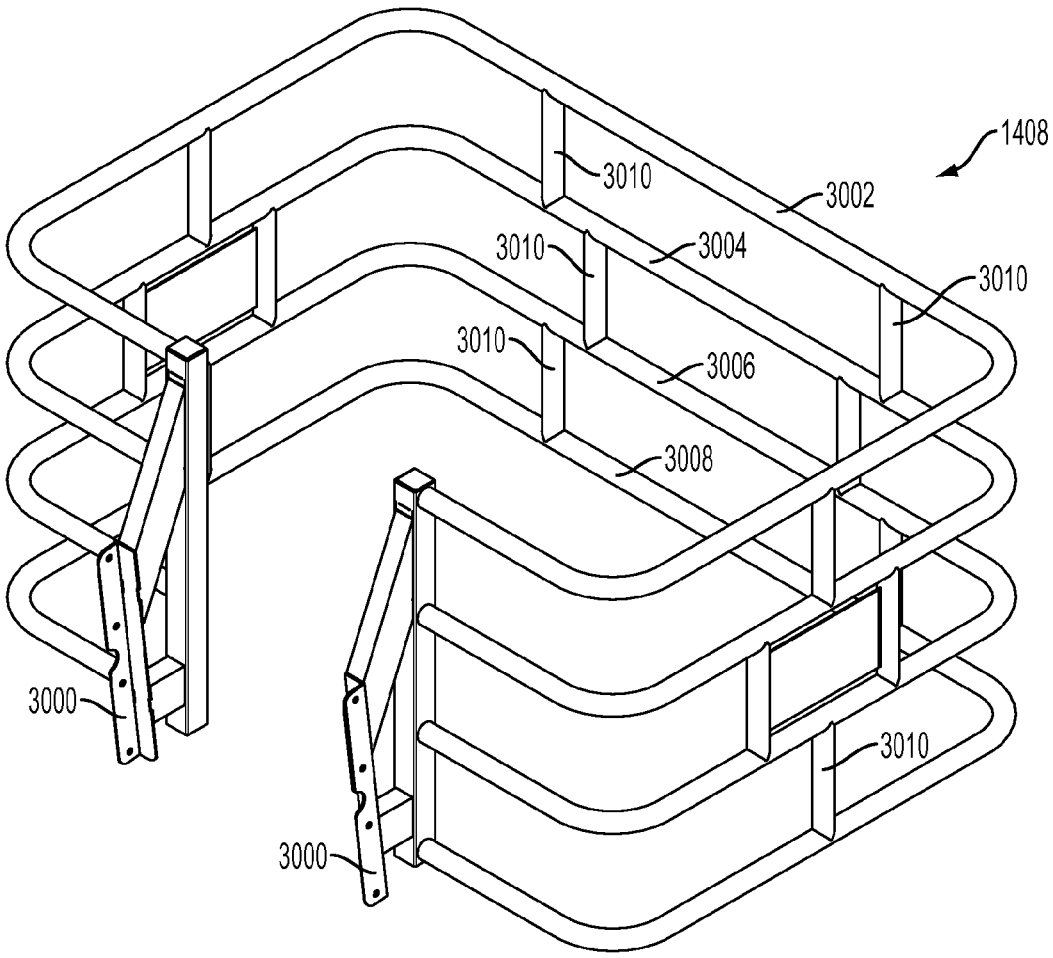

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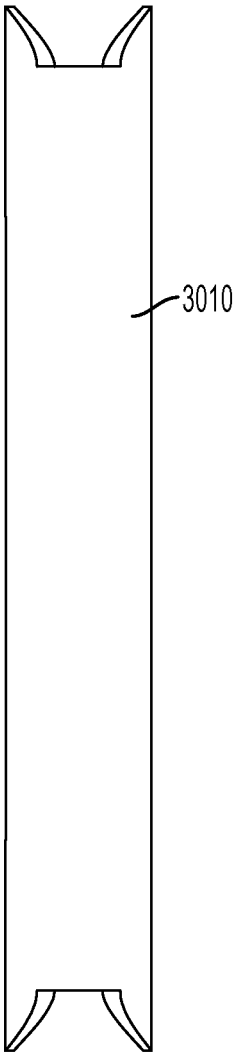

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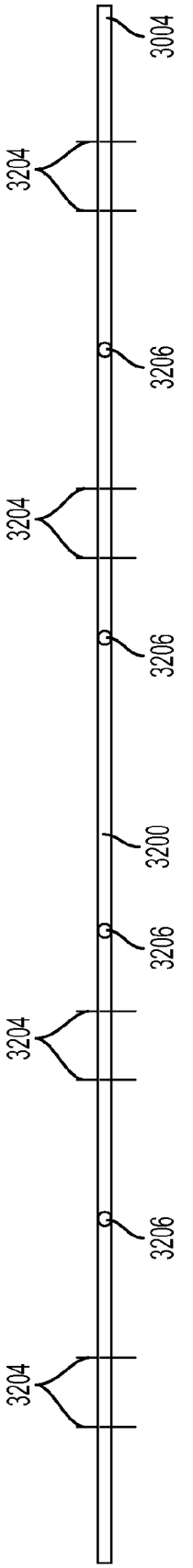

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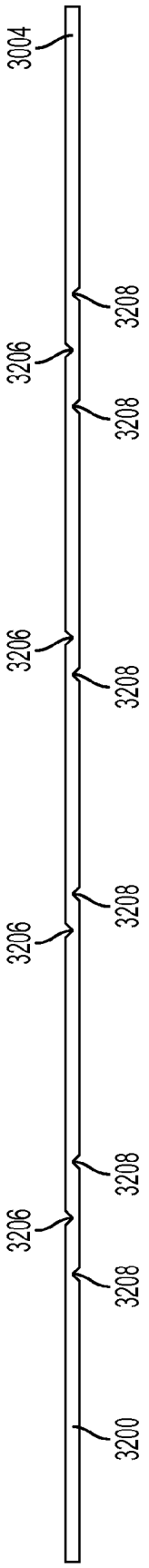

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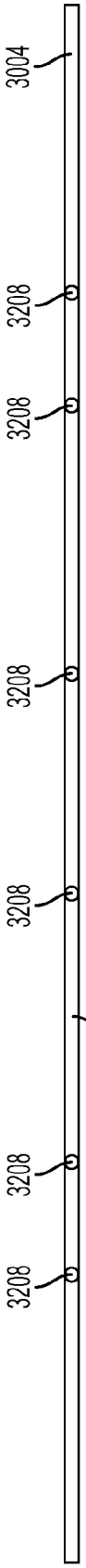

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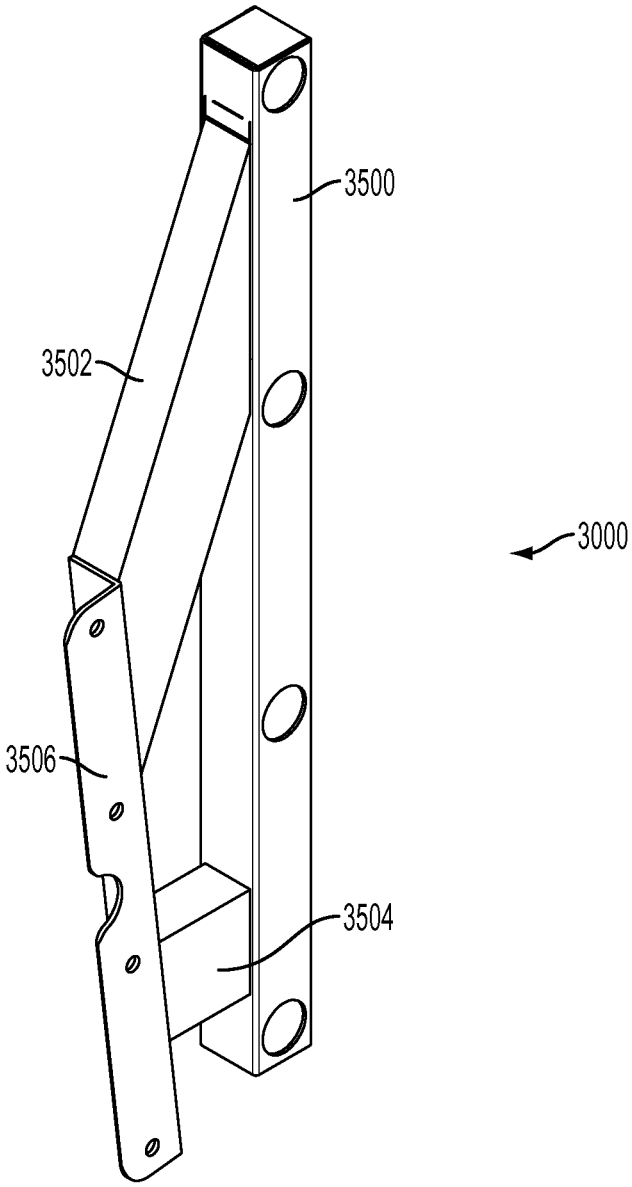

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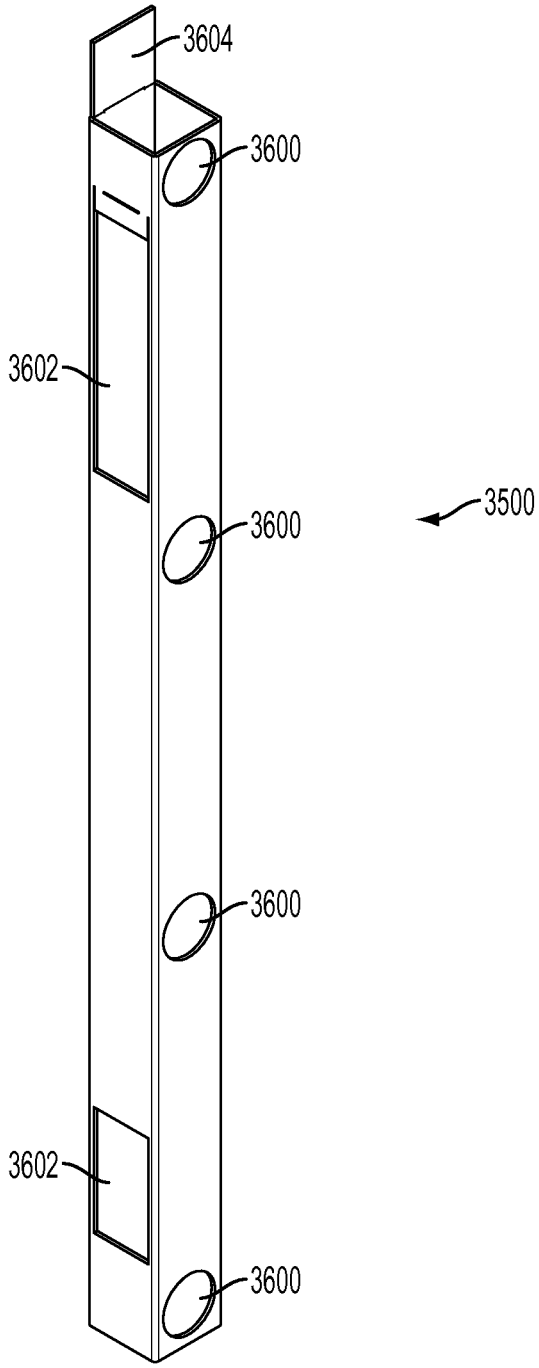

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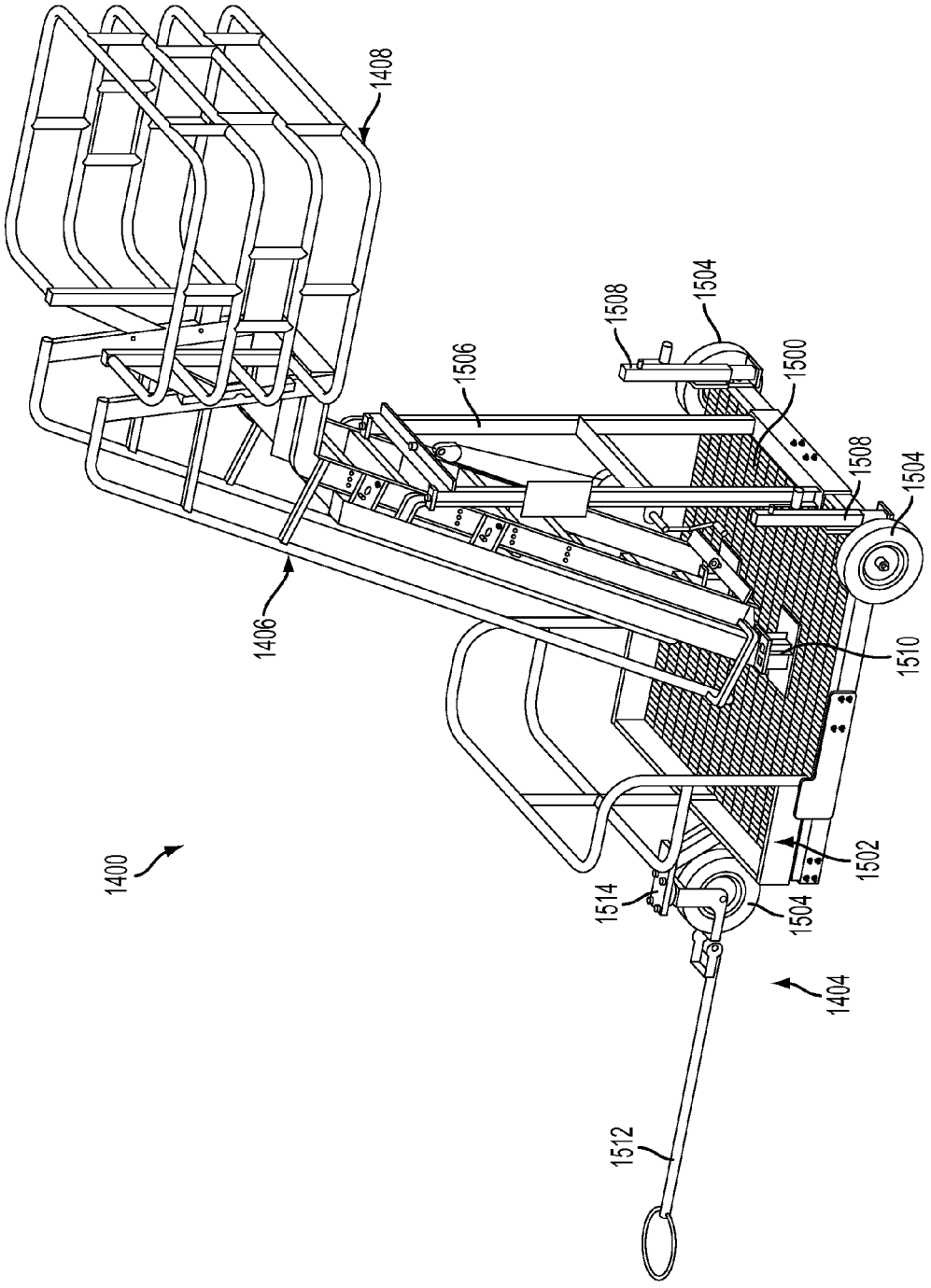
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FIG. 22

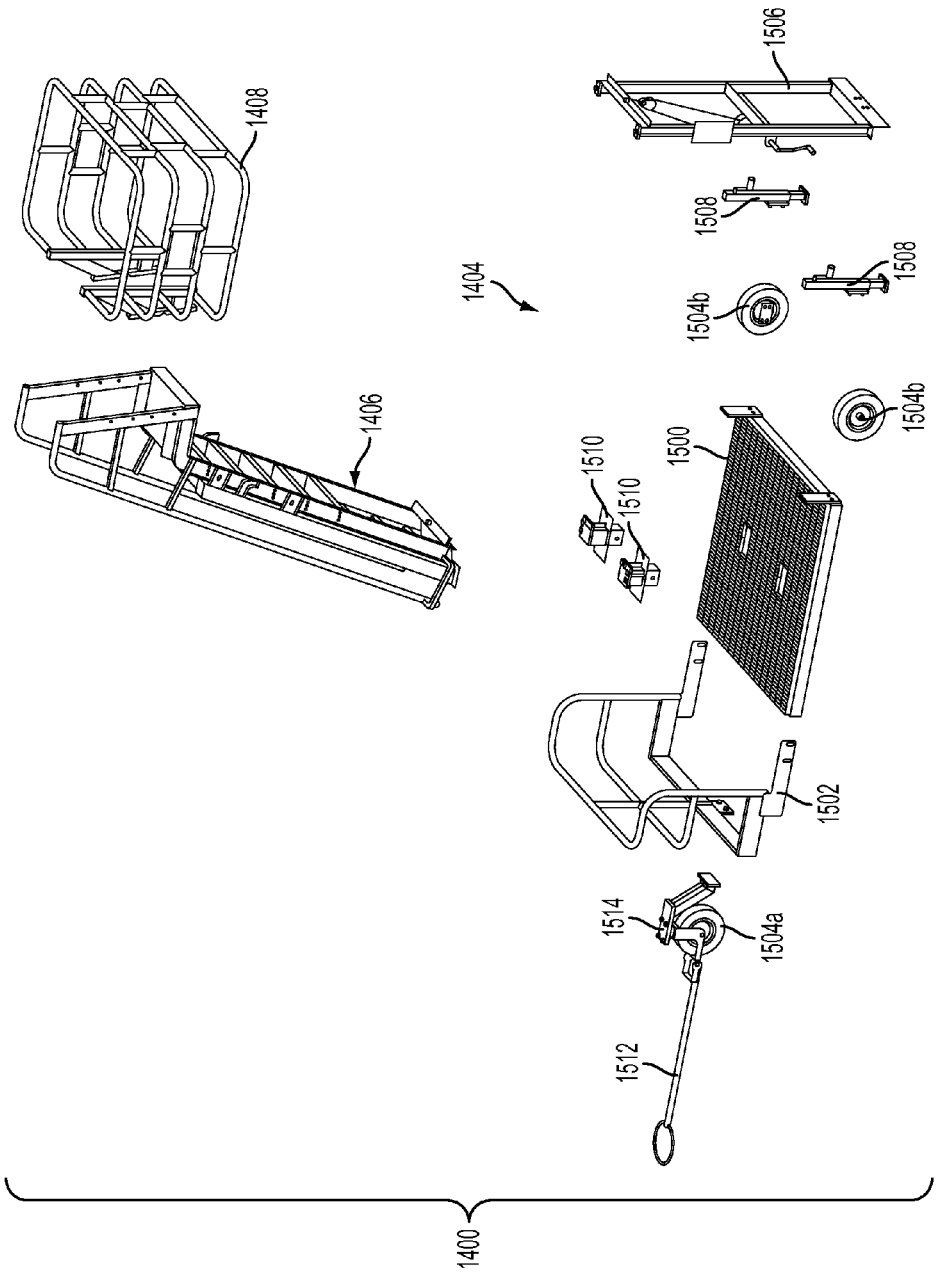
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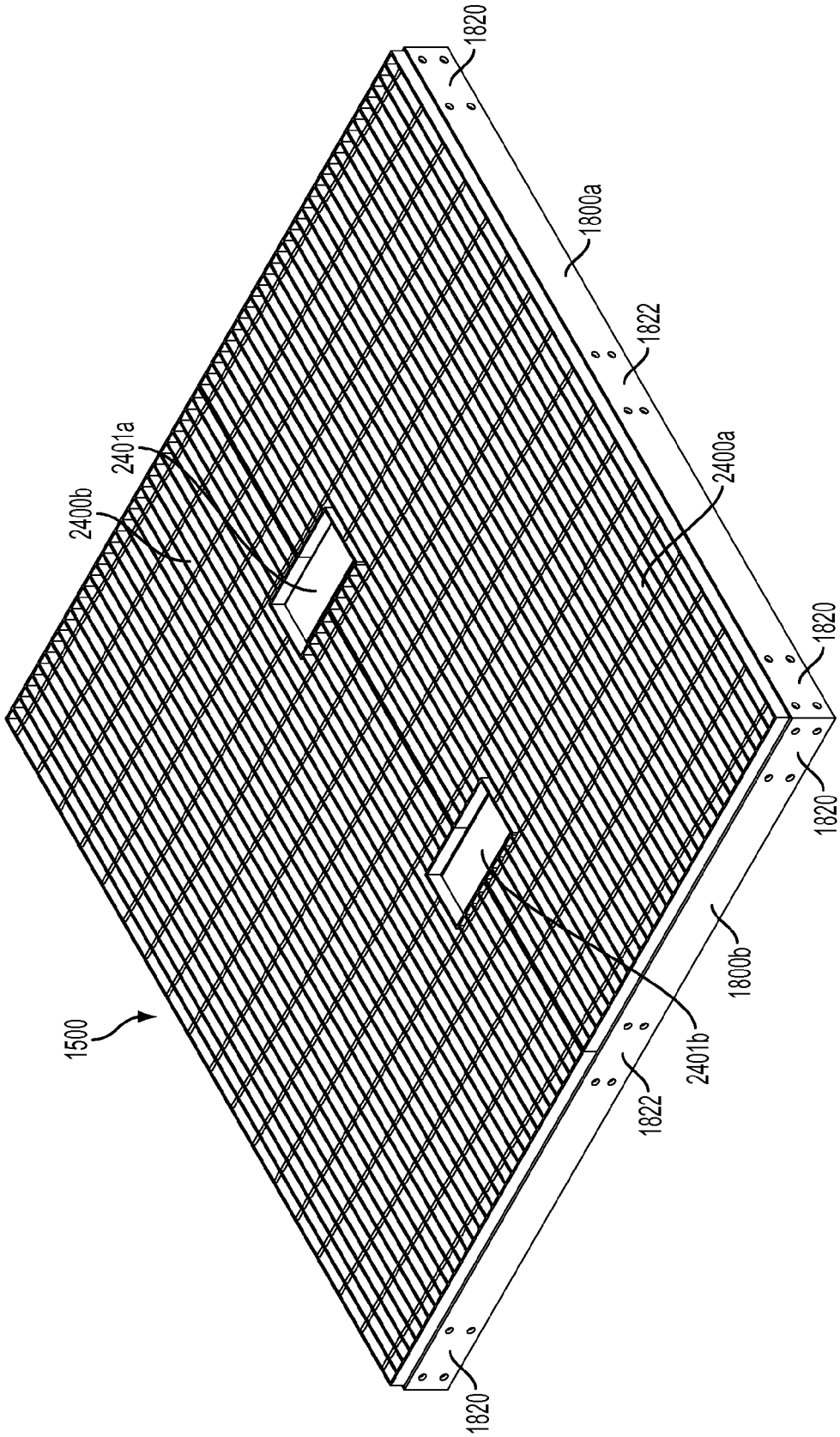
FIG. 23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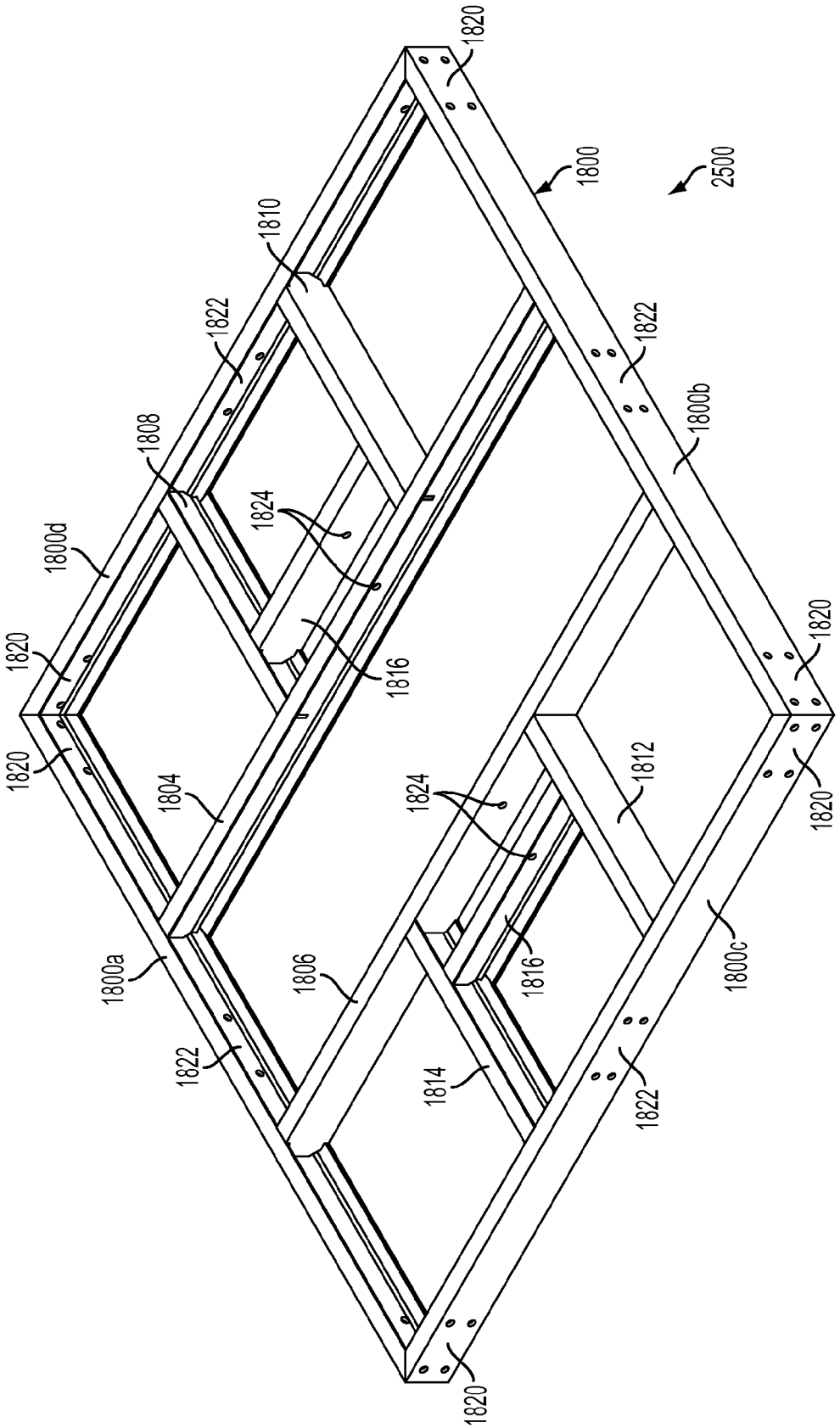
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FIG. 25

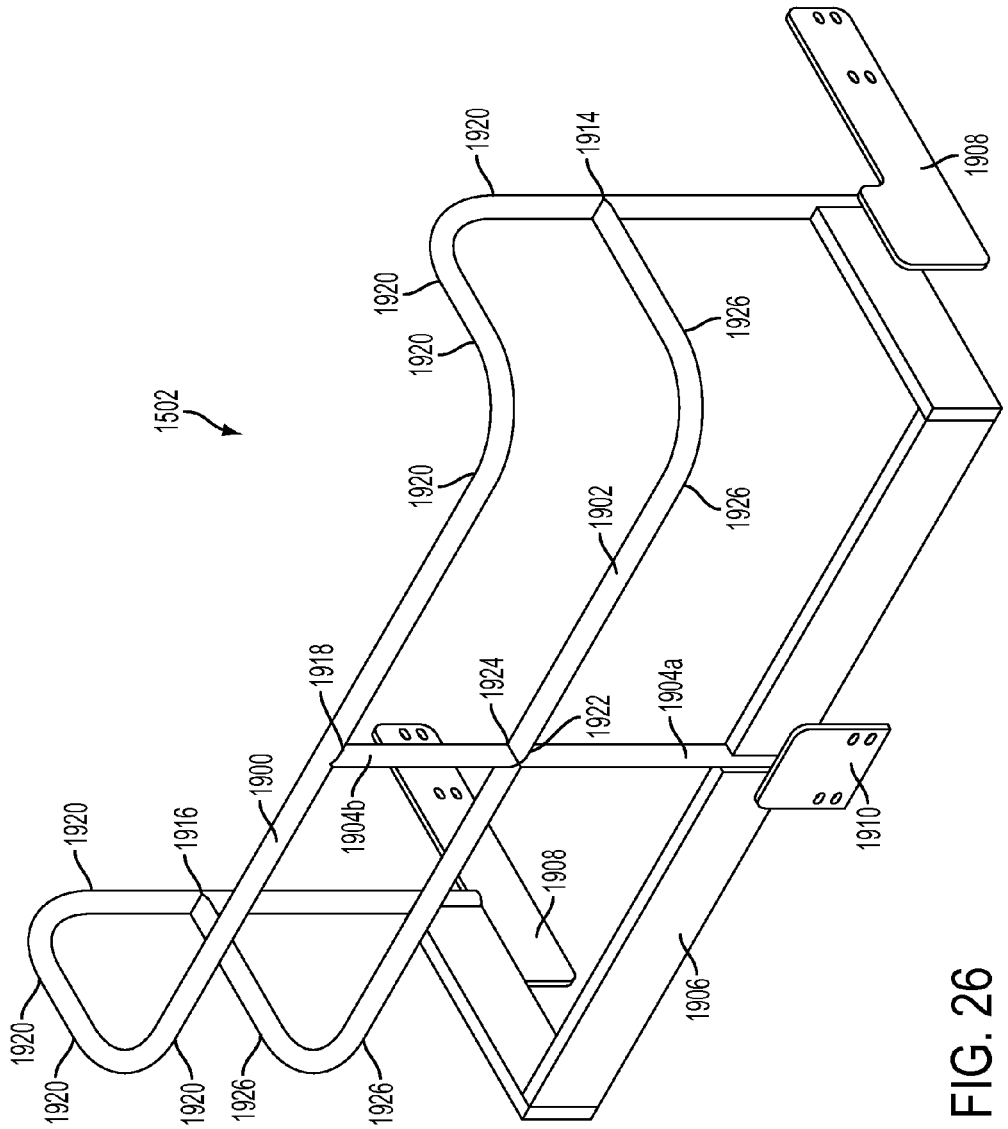
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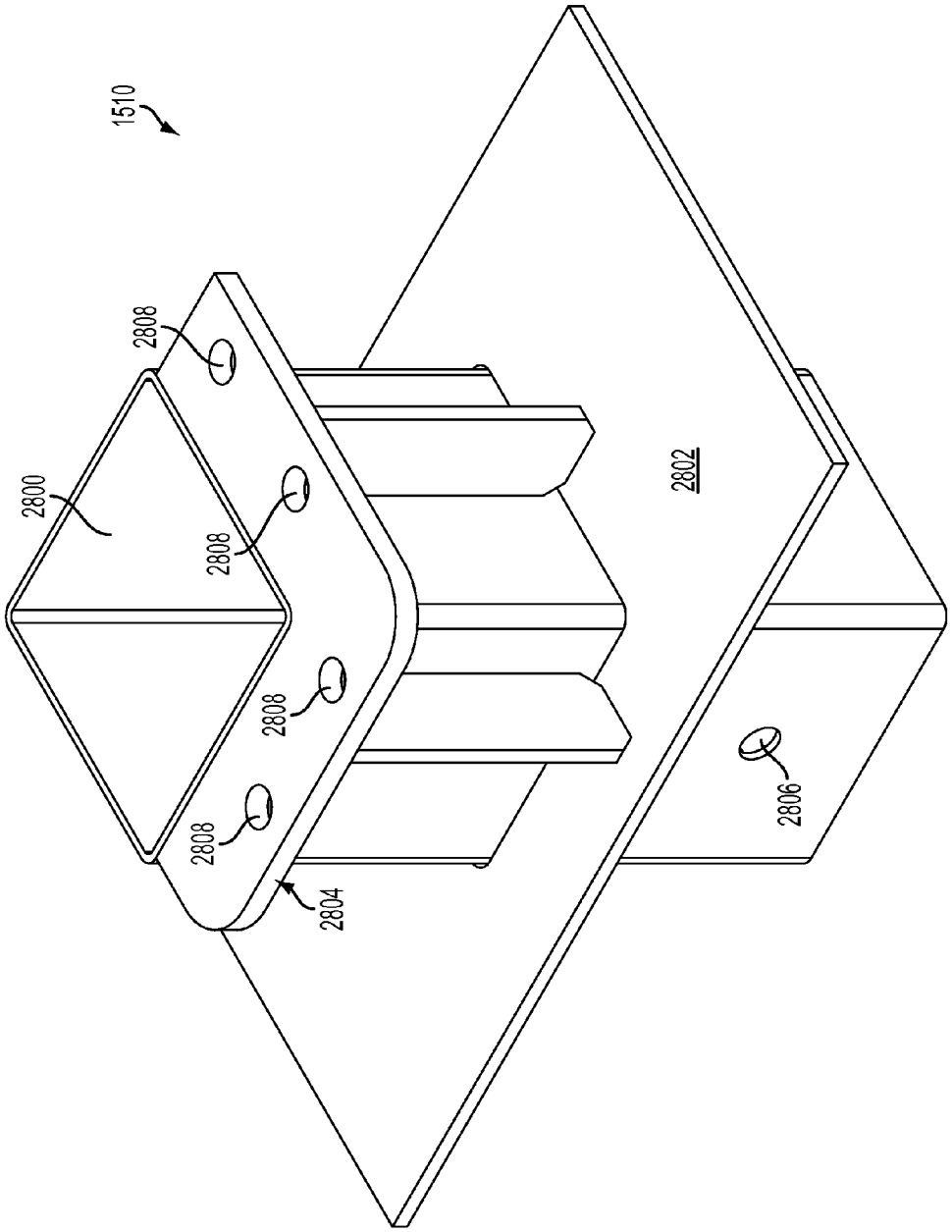
FIG. 26



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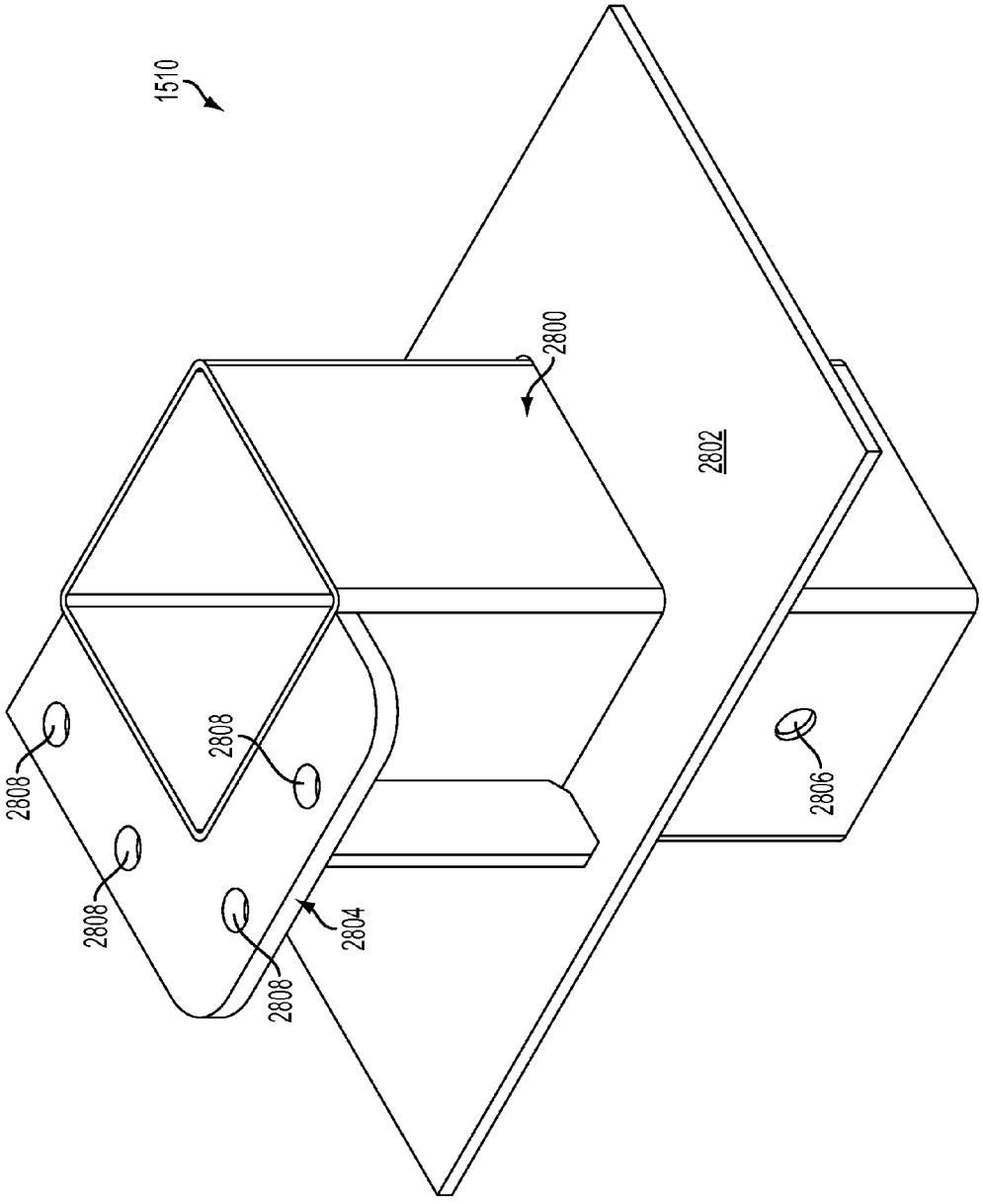

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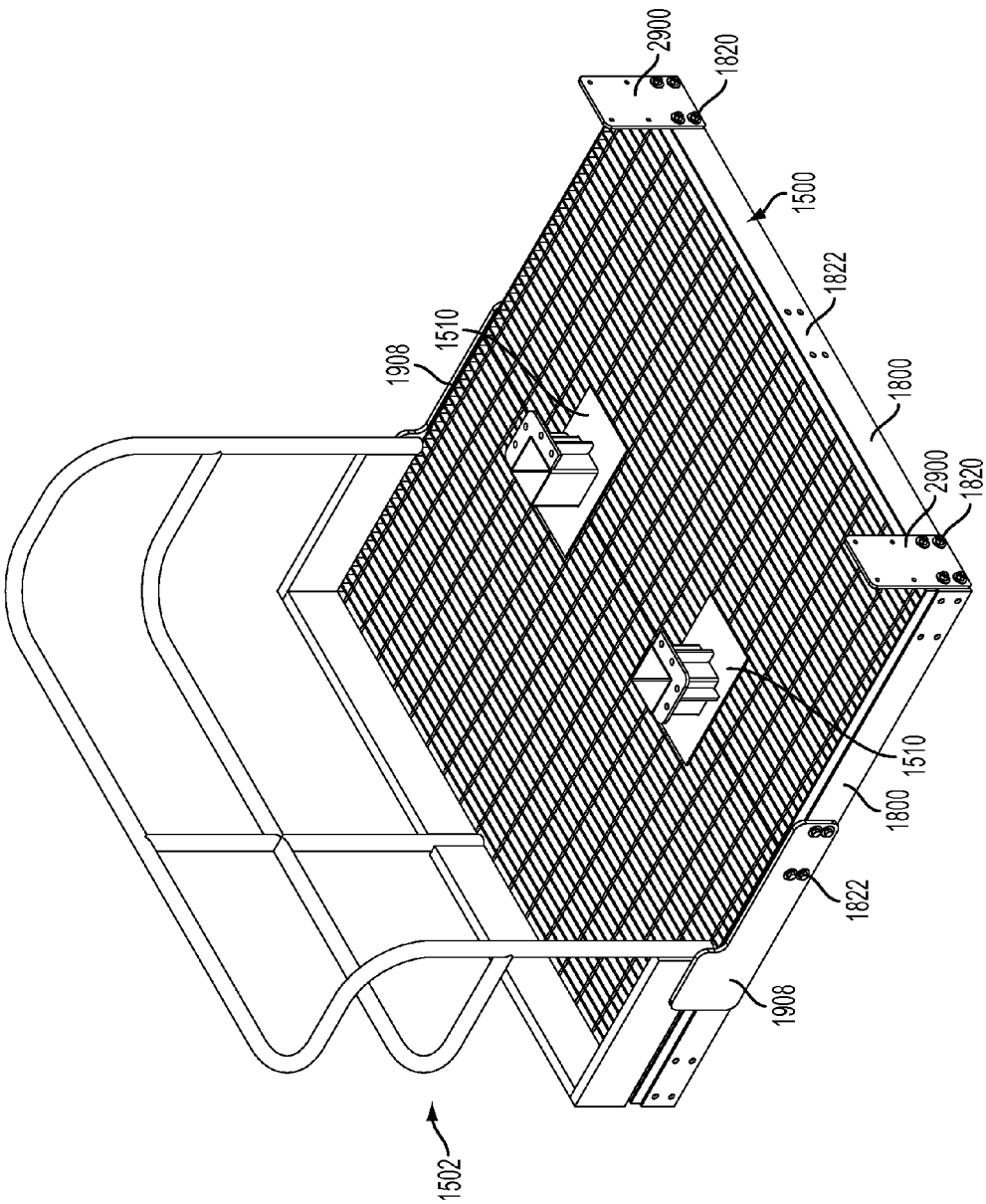
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FIG. 29a

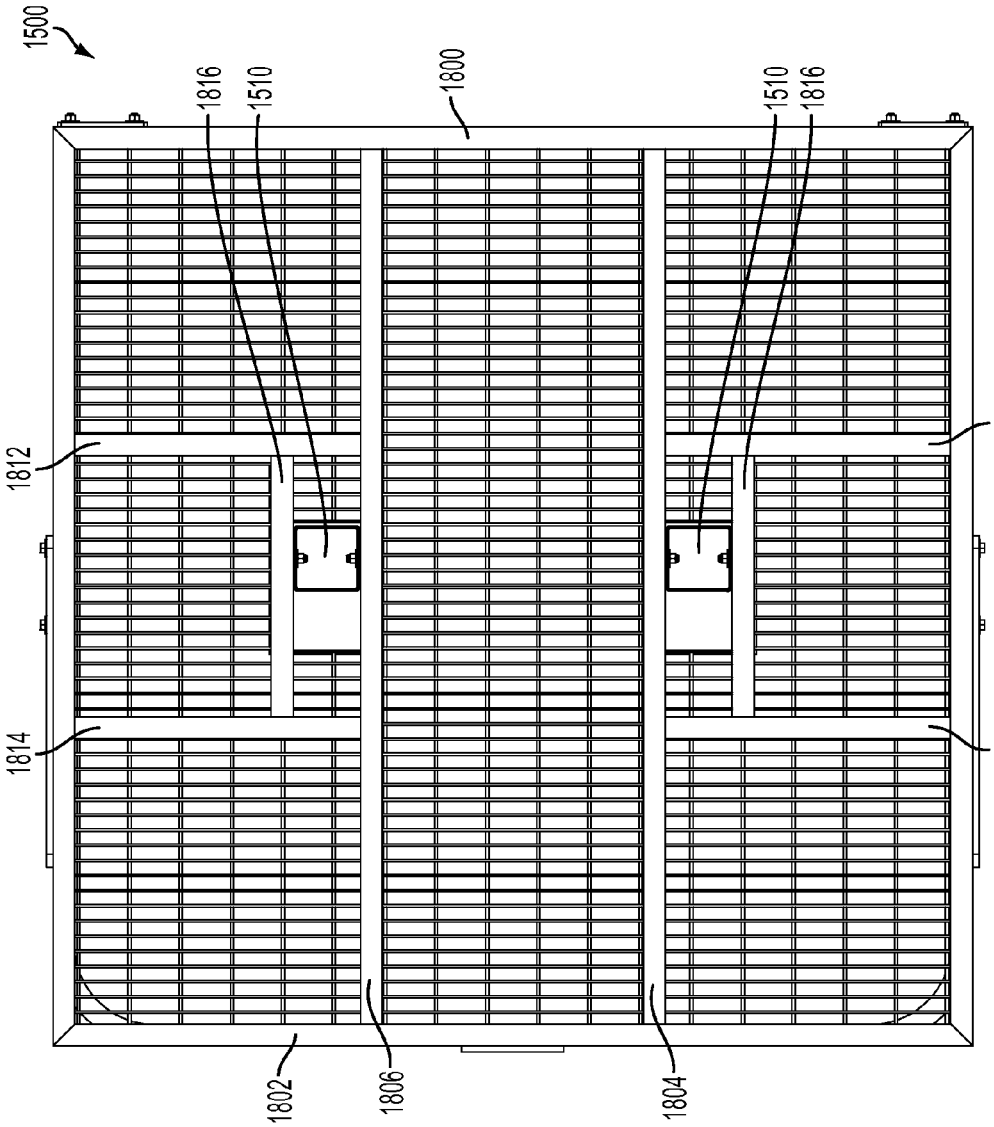
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FIG. 29b

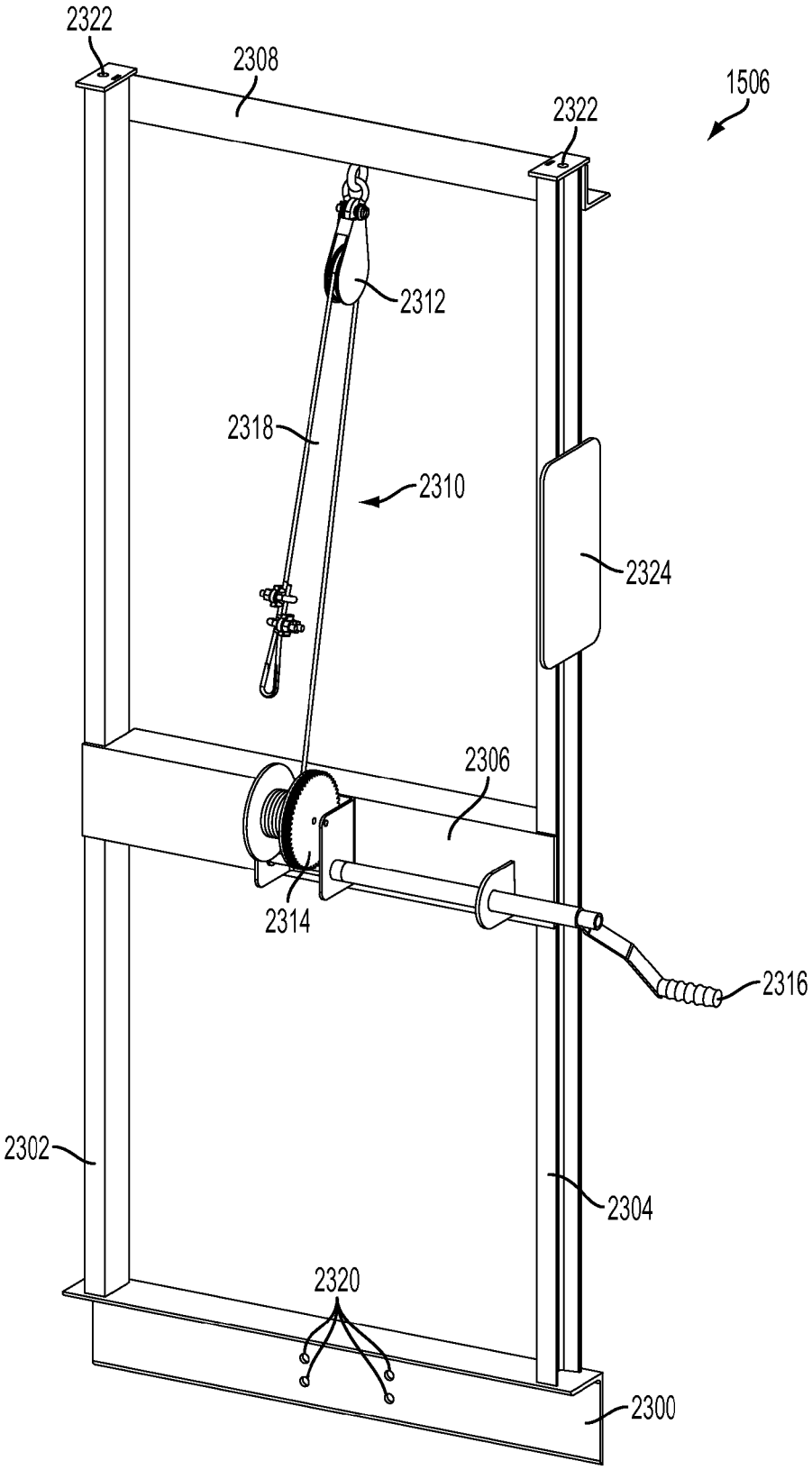
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FIG. 30

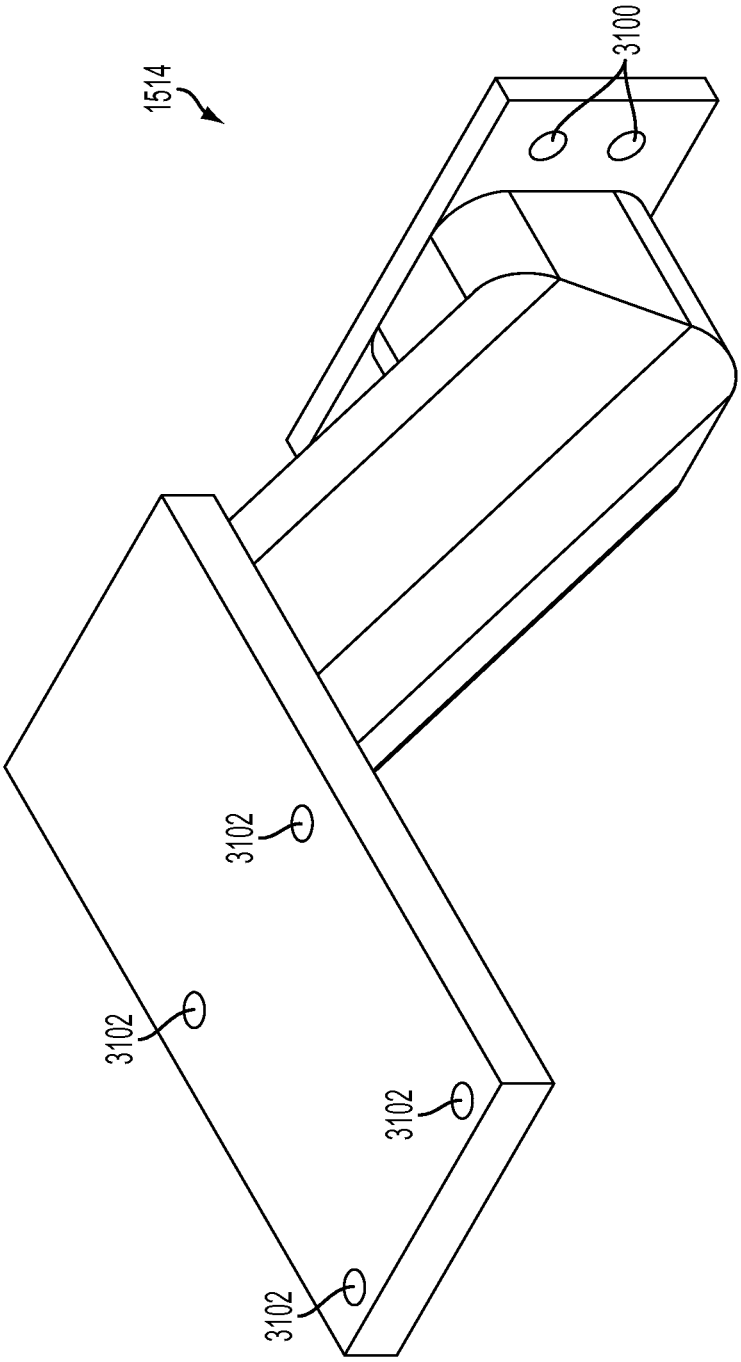

FIG. 31

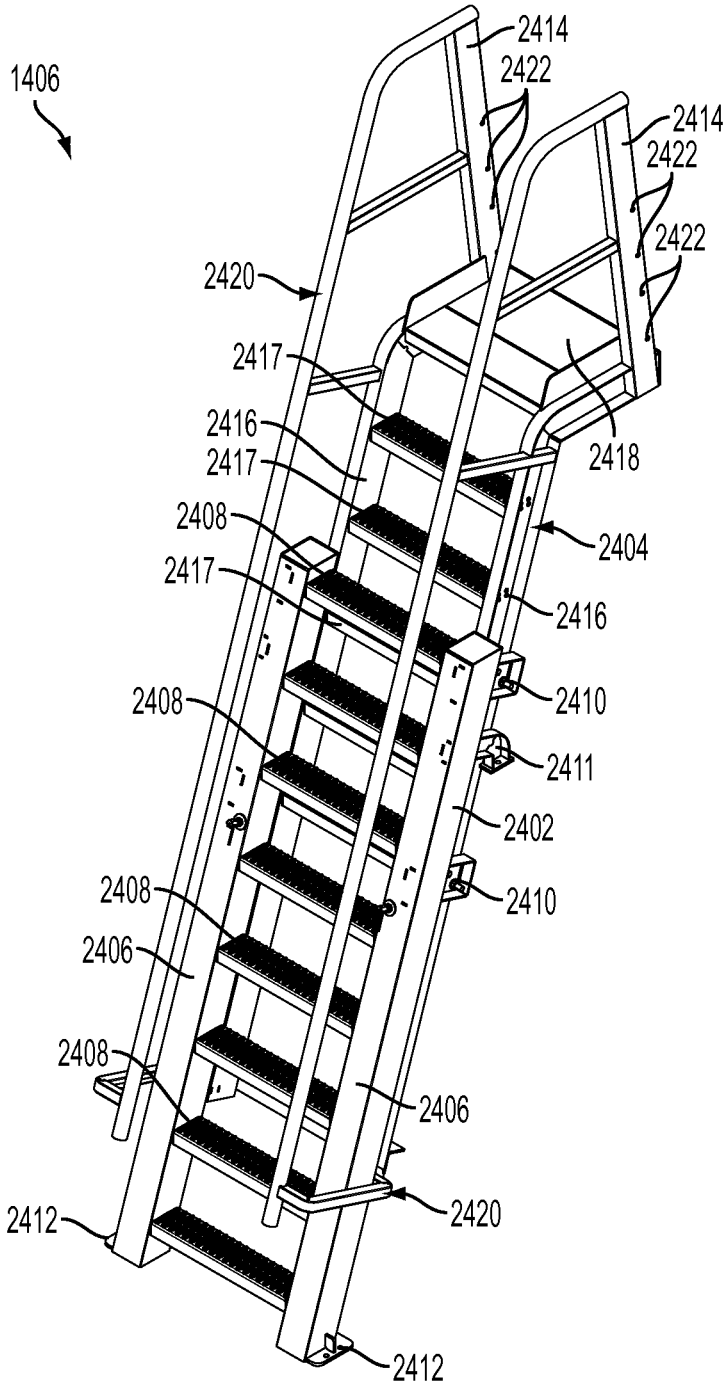
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FIG. 32

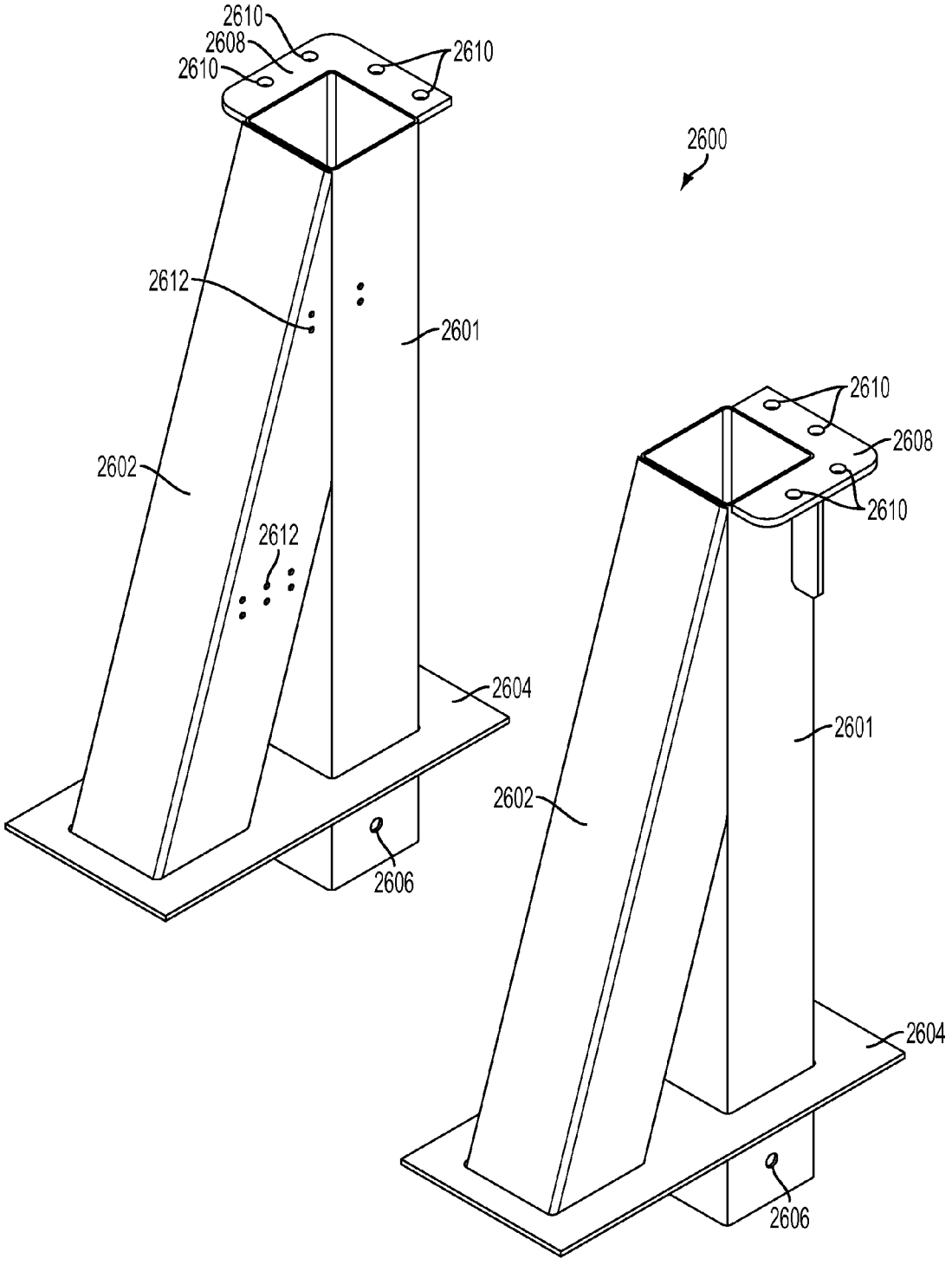
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FIG. 33

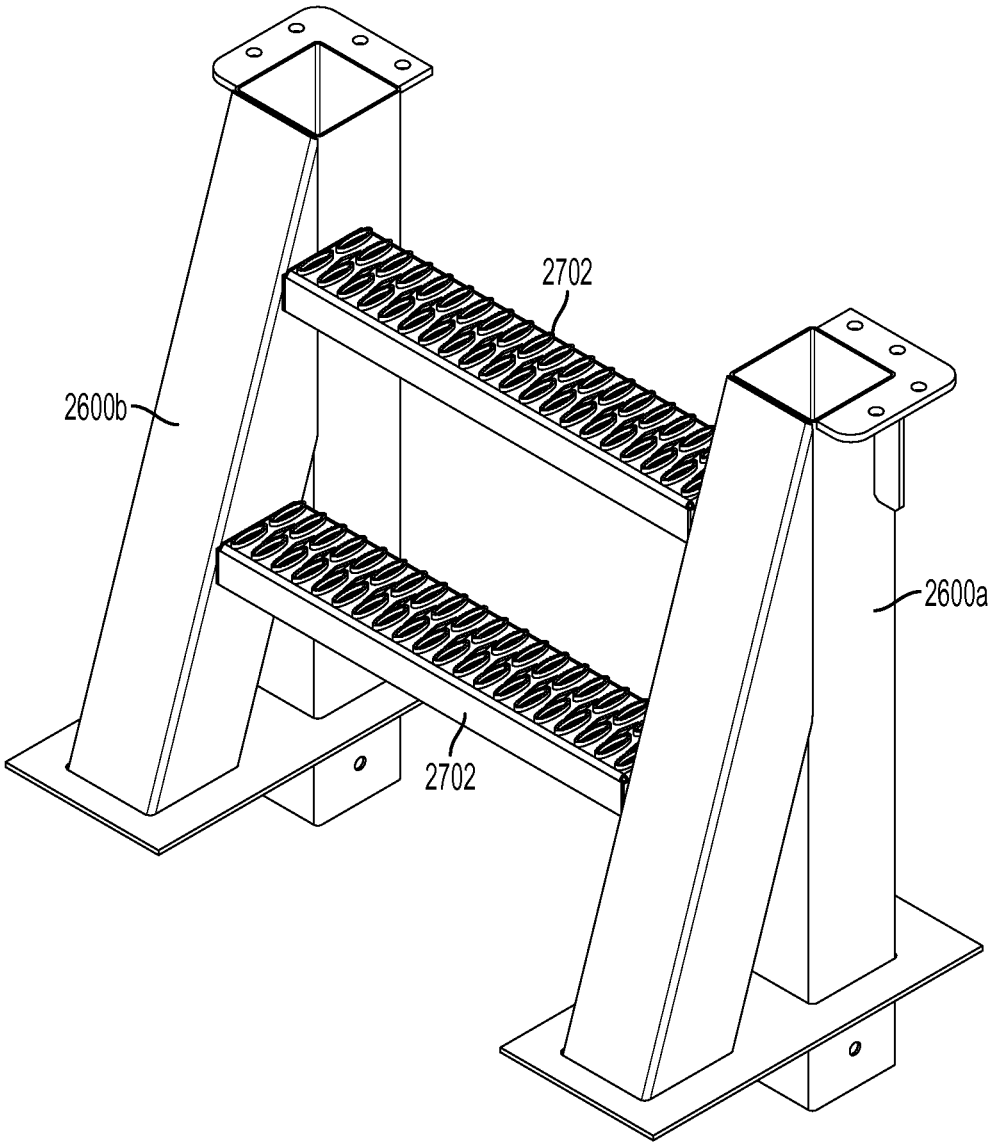

FIG. 34

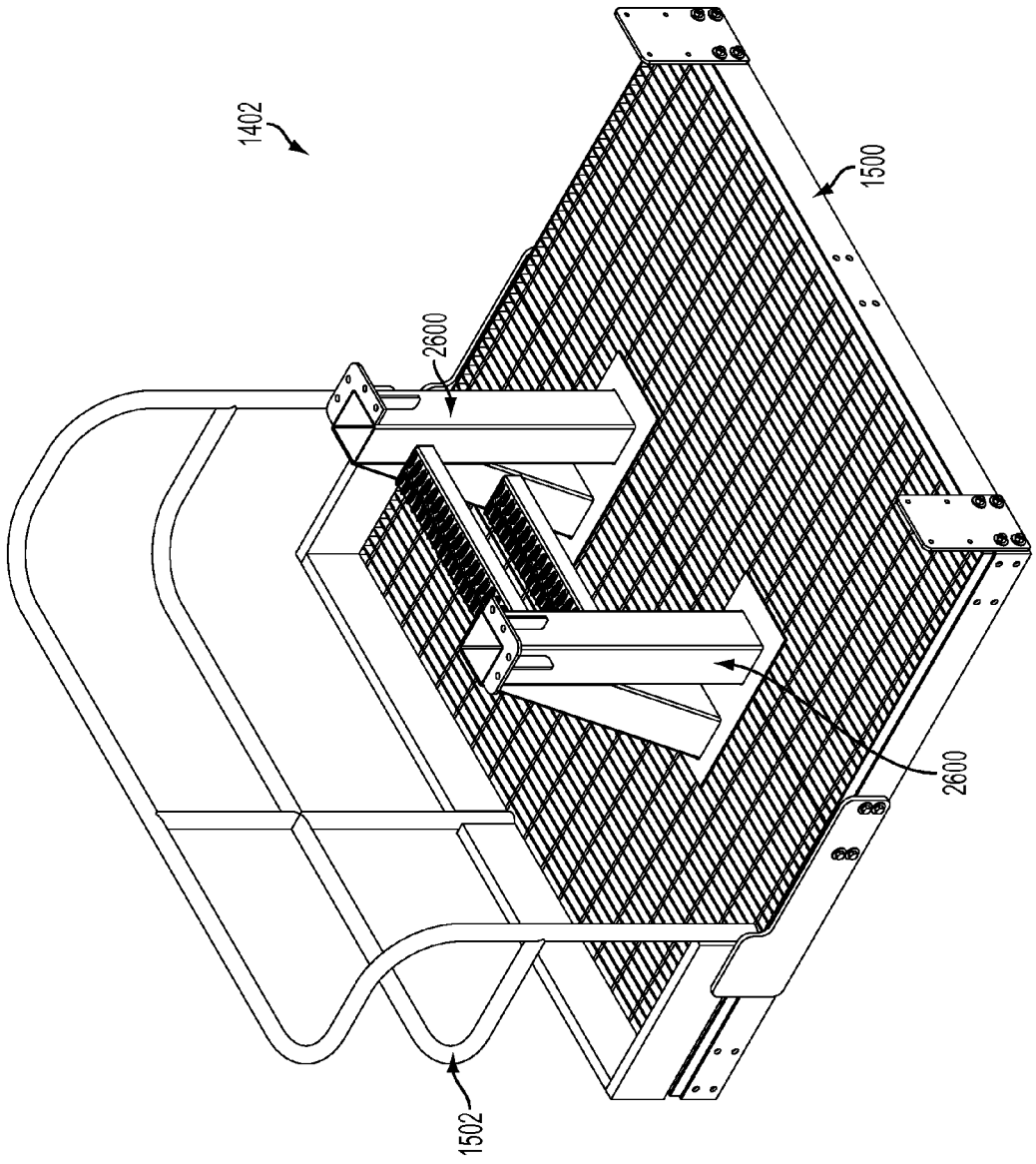

FIG. 35

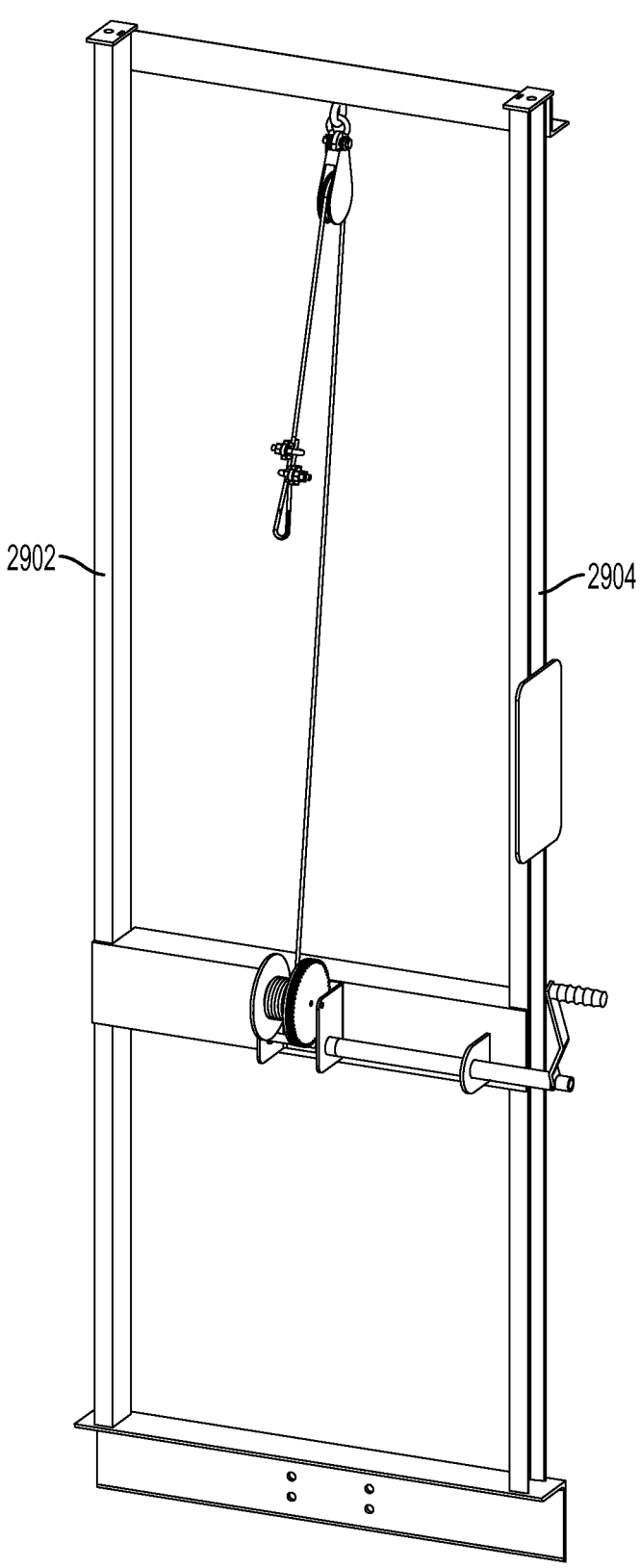

FIG. 36

MOBILE ACCESS UNIT AND CAGE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a divisional of U.S. application Ser. No. 12/837,480, filed Jul. 15, 2010, which claims the benefit of U.S. Provisional Application No. 61/244,016, entitled "Cage" and filed on Sep. 18, 2009. These applications are hereby incorporated by reference as if set forth verbatim herein and relied upon for all purposes.

FIELD OF THE INVENTION

The present invention relates generally to fall restraint equipment components. More particularly, the present invention relates to a mobile access unit configured to aid in the unloading of material from containers. The present invention also relates to cages configured to be used with the mobile access unit or with other fall restraint equipment.

BACKGROUND OF THE INVENTION

Typically, fall restraint equipment and its components are manufactured by cutting and welding stock pieces of material together. The stock material commonly exhibits a predefined configuration, size, and arrangement. As a result, the stock material must be plasma cut to the desired shape and/or size. The resulting pieces are then welded together to form a component. To accomplish this, a surface of one piece is placed flat against a surface of another, and the connection between the two is then welded. As a result, the strength of the formed component is limited at least in part by the weld holding the two pieces together. Once the component is formed, it is attached to other components that have been formed in the same manner by welding the two components together. Similarly, the strength of the resulting equipment is limited at least in part by the weld holding its components together.

Additionally, manufacturing equipment in this manner is both time-consuming and costly. Moreover, the drilling and cutting of the stock materials must be accomplished with precision in order to create a stable end product. Variances greater than an acceptable level render the smaller pieces unusable, which are typically discarded as it is often unfeasible to use them in another product once they have been drilled or cut. Moreover, if other parts cannot be cut or drilled from the remaining portions of the stock materials, they too are discarded. Further, different types and sizes of the metal stock material must be kept on hand in order to form the components to be welded together. The inefficient yet inescapable use of stock material also increases the costs associated with manufacturing fall restraint equipment.

SUMMARY OF THE INVENTION

The present invention recognizes and addresses the foregoing considerations, and others, of prior art construction and methods.

In this regard, one aspect of the invention provides a cage for fall restraint equipment. The cage comprises a top rail formed from a continuous piece of tubular metal, a bottom rail formed from a continuous piece of circular, tubular metal, and an upright formed from a continuous piece of tubular metal. The upright defines a first aperture configured to receive a first end of the top rail and defines a second aperture configured to receive a first end of the bottom rail.

According to another aspect, the present invention provides a method for manufacturing a cage for fall restraint equipment. The method comprises the steps of bending a first continuous piece of tubular metal at a plurality of first predefined locations to form a relatively rectangular top rail, where the top rail defines at least one top rail end; bending a second continuous piece of tubular metal at a plurality of second predefined locations to form a relatively rectangular bottom rail, wherein the bottom rail defines at least one bottom rail end; cutting a third continuous piece of tubular metal to define a first aperture and a second aperture, wherein the first aperture is configured to receive the at least one top rail end and the second aperture is configured to receive the at least one bottom rail end; inserting the at least one top rail end into the first aperture; and inserting the at least one bottom rail end into the second aperture.

Yet another aspect of the present invention provides a mobile access unit comprising a ladder portion including a ladder and a mobile platform. The mobile platform is configured to receive a first pair and a second pair of adapters. The first and second pair of adapters are configured to connect to the ladder portion. The second pair of adapters is greater in height than the first pair of adapters so that the mobile access unit exhibits a greater height when the mobile platform receives the second pair of adapters than when the mobile platform receives the first pair of adapters.

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate one or more embodiments of the invention and, together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

A full and enabling disclosure of the present invention, including the best mode thereof directed to one of ordinary skill in the art, is set forth in the specification, which makes reference to the appended drawings, in which:

FIG. **1** is a perspective view of fall restraint equipment in accordance with an embodiment of the present invention;

FIG. **2** is a perspective view of a cage of the fall restraint equipment of FIG. **1**;

FIG. **3** is a partially exploded perspective view of the cage of FIG. **2**;

FIGS. **4**, **5**, **6**, **7**, and **8** are perspective views of various components of a cage bumpout weldment of the cage of FIG. **2**;

FIGS. **9** and **10** are perspective views of bumpout weldments of the cage of FIG. **2**;

FIG. **11** is a bottom planar view of a top rail of the cage of FIG. **2**;

FIG. **12** is a side elevation view of the top rail of FIG. **11**;

FIG. **13** is a top planar view of the top rail or FIG. **11**;

FIG. **14** is a perspective view of fall restraint equipment in accordance with an embodiment of the present invention;

FIG. **15** is a perspective view of a cage of the fall restraint equipment of FIG. **14**;

FIG. **16** is a perspective view of a vertical support tube of the cage of FIG. **15**;

FIG. **17** is a top planar view of a rail of the cage of FIG. **15**;

FIG. **18** is a side elevation view of the rail of FIG. **17**;

FIG. **19** is a bottom planar view of the rail of FIG. **17**;

FIG. **20** is a perspective view of a bumpout weldment of the cage of FIG. **15**;

FIG. **21** is a perspective view of the bumpout weldment upright of FIG. **20**;

FIG. **22** is a perspective view of a mobile access unit and attached cage of the fall restraint equipment of FIG. **14**;

FIG. **23** is an exploded view of the mobile access unit and attached cage of FIG. **22**;

FIG. **24** is a perspective view of a base support of the mobile access unit of FIG. **22**;

FIG. **25** is a perspective view of a support structure of the mobile access unit of FIG. **22**;

FIG. **26** is a perspective view of a handrail assembly of the mobile access unit of FIG. **22**;

FIGS. **27** and **28** are perspective views of ladder adapters of the mobile access unit of FIG. **22**;

FIG. **29***a* is a perspective view of a base portion of the mobile access unit of FIG. **22**;

FIG. **29***b* is a top planar view of the base portion of FIG. **29***a*;

FIG. **30** is a perspective view of an h-frame assembly of the mobile access unit of FIG. **22**;

FIG. **31** is a perspective view of a goose neck connector of the mobile access unit of FIG. **22**;

FIG. **32** is a perspective view of a ladder of the mobile access unit of FIG. **22**;

FIG. **33** is a perspective view of a pair of ladder adapters in accordance with an embodiment of the present invention;

FIG. **34** is a perspective view of the pair of ladder adapters of FIG. **33** interconnected by a pair of supports;

FIG. **35** is a perspective of a base portion of a mobile access unit in accordance with an embodiment of the present invention; and

FIG. **36** is a perspective view of an h-frame in accordance with an embodiment of the present invention.

Repeat use of reference characters in the present specification and drawings is intended to represent same or analogous features or elements of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Reference will now be made in detail to presently preferred embodiments of the invention, one or more examples of which are illustrated in the accompanying drawings. Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that modifications and variations can be made in the present invention without departing from the scope or spirit thereof. For instance, features illustrated or described as part of one embodiment may be used on another embodiment to yield a still further embodiment. Thus, it is intended that the present invention covers such modifications and variations as come within the scope of the appended claims and their equivalents.

Fall restraint equipment may be used to unload material from a railcar or other storage container. Examples of fall restraint equipment may be found in U.S. Pat. No. 7,950,095, entitled "Gangway and Method of Manufacturing Same" and granted on May 31, 2011; U.S. Pat. No. 8,261,393, entitled "Fall Restraint Equipment Component and Method for Manufacturing the Same" and granted on Sep. 11, 2012; U.S. Publication No. 2010/0031455, entitled "Fall Restraint Equipment Component and Method for Manufacturing the Same" and published on Feb. 11, 2010; U.S. Pat. No. 8,341,821, entitled "Fall Restraint Equipment Components and Method for Manufacturing the Same" and granted on Jan. 1, 2013; and U.S. Pat. No. 8,046,858, entitled "Gangway Handrail and Method for Manufacturing the Same" and granted on Nov. 1, 2011, the entire of disclosure of each of which is hereby incorporated by reference as if set forth verbatim herein and relied upon for all purposes.

FIG. **1** illustrates fall restraint equipment comprising a stairwell **100**, a platform **102**, a gangway **104**, and a cage **106**. In this example, platform **102** is part of a canopy system **108** comprising a canopy **110**. Stairwell **100** is connected to and provides access to platform **102**. Gangway **104** is pivotally connected to platform **102** on one side of the gangway and to cage **106** on the other. It should be understood that the fall restraint equipment illustrated in FIG. **1** may include other components, such as handrails **112**.

In operation, the fall restraint equipment is located adjacent to railroad tracks, thereby allowing railcars, such as railcar **114**, to pass by and be positioned adjacent the fall restraint equipment in order to unload the material from the railcar. In this manner, a locomotive operatively connected to railcar **114** positions the railcar in a manner such that an access point **116** of the railcar is directly in front of gangway **104**. Gangway **104** is then pivoted or lowered toward railcar **114** until cage **106** encircles access point **116** as should be understood by those in the art. Access point **116** may include a platform **118** and its own guardrails **120**.

After pivoting and lowering gangway **104** so that cage **106** encircles the area defined by access point **116**, platform **118**, and guardrails **120**, a user reaches the access point by crossing gangway **104**. After opening access point **116**, the materials contained within railcar **114** may be unloaded and transported back down gangway **104**, platform **102**, and stairwell **100**, if desired. Canopy system **108** and canopy **110** shields the user from the elements, such as precipitation or heat from the sun.

FIG. **2** is a perspective view of cage **106** comprising a top rail **202** connected to a bottom rail **204** via vertical supports **206**. Top rail **202** and bottom rail **204** are comprised of two upper mirror image rail portions and two lower mirror image rail portions, respectively. The two mirror image rail portions are interconnected by a pair of splice plates **208**. Cage **106** further comprises bumpout weldments **200** that connect the cage to another structure such as gangway **104** (FIG. **1**). Cage **106** may optionally include a sign plate **210** to which a label or other instructions may be attached.

FIG. **3** is a partially exploded perspective view of cage **106**. Bumpout weldments **200***a* and **200***b* are mirror images of one another. Each of bumpout weldments **200** comprises a bump up component **300**, a bump top brace **302**, a bump bottom brace **304**, and a bump angle plate **306**. The formation of bumpout weldments **200** is described in more detail below. Bump angle plate **306** connects cage **106** and, more specifically, bumpout weldments **200**, to another structure, such as gangway **104** (FIG. **1**).

FIG. **4** is a perspective view of bump up component **300***a*, which is formed from an integral, continuous piece **402** of tubular metal. The continuous piece **402** is drilled, lasered, or otherwise cut to define apertures **404**, **406**, **408**, and **410** and tab **412**. This may be accomplished through the use of a tube laser, cutting drill, or plasma torch. Continuous piece **402** is also cut at the areas denoted at **413** in order to define tab **414**.

FIG. **5** is a perspective view of bump bottom brace **304***a*, which is formed from an integral, continuous piece **500** of tubular metal. Continuous piece **500** is drilled, lasered, or otherwise cut to define a pair of tabs **502**. This may be accomplished through the use of a tube laser, cutting drill, or plasma torch. Each tab **502** is identical to the other tab and located on opposite sides of one end of the bump bottom brace **304***a* with respect to one another.

FIG. **6** is a perspective view of bump top brace **302***a*, which is also formed from an integral, continuous piece **600** of tubular metal. Continuous piece **600** is drilled, lasered, or otherwise cut to define tab aperture **602** (including the indentation denoted at **604**), a pair of tabs **606**, and area **608**. This

may be accomplished through the use of a tube laser, cutting drill, or plasma torch. Each tab **606** is identical to the other tab and located on opposites sides of one end of the bump top brace **302***a*.

FIGS. **7** and **8** are perspective views of bump angle braces **306***a* and **306***b*, respectively, which are formed from respective continuous pieces **700** and **800** of sheet metal. Bump angle braces **306***a* and **306***b* are mirror images of one another. Accordingly, the following discussion is directed to bump angle brace **306***a*, although it should be understood to apply to bump angle brace **306***b* as well. Continuous piece **700** is drilled, lasered, or otherwise cut to define apertures **702**, area **704**, and indentations **706**. Continuous piece **700** of sheet metal is folded along fold line **708** in order to form bump angle brace **302***a*.

FIGS. **9** and **10** are perspective views of bumpout weldments **200***a* and **200***b*, respectively, which are mirror images of one another. Accordingly, the following discussion is directed to bumpout weldment **200***a*, although it should be understood to apply to bumpout weldment **200***b*. Referring to FIGS. **3**, **4**, **5**, **6**, **7**, and **9**, bumpout weldment **200***b* is formed by bending tab **414** outward (in the direction opposite of aperture **410**). This provides a sufficient amount of clearance so that area **608** may be inserted into aperture **406**. Pressure is then applied to bump up component **300***a* and bump top brace **302***a* so that the bottom edge of the area defining aperture **406** is received into area **604**. Pressure is then applied to bump up component **300***a* and bump top brace **302***a* in order to lock the bump top brace into place with respect to component **300***a*. Pressure is also applied to tab **414** in order to push the tab back into contact with bump top brace **302***a*.

Tabs **606** of bump top brace **302***a* and tabs **502** of bump bottom brace **304***a* are inserted into corresponding apertures **706** of bump angle brace **306***a*. The opposite end of bump bottom brace **304***a* is inserted into aperture **404**. The areas of components **300**, **302**, **304**, and **306** that come into contact with one another are welded together for additional stability. It should be understood that the internal area defined by bump up component **300***a* receives respective portions of bump top brace **302***a* and of bump bottom brace **304***a*. Accordingly, the welds where these components come into contact with one another are not the only structural support holding bumpout weldments **300** together. Rather, the edges of bump up component **300** defining apertures **404** and **406** rest on the surfaces of bump bottom brace **304** and bump top brace **306**, respectively, which have been inserted fully into component **300**.

FIG. **11** is a bottom planar view of portion **202***a* of top rail **202** (FIG. **2**), which is formed from a continuous piece **1100** of circular, tubular metal. Continuous piece **1100** is drilled, lasered, or otherwise cut to define tab apertures **1104**. This may be accomplished through the use of a tube laser, cutting drill, or plasma torch. Continuous piece **1100** of circular, tubular metal is then bent at approximately a 45° angle at the locations denoted by bend lines **1102** in order to form portion **202***a* of upper rail **202** (FIG. **2**). FIGS. **12** and **13** are side elevation and top planar views, respectively, of portion **202***a* prior to being bent at bend lines **1102** (FIG. **11**). It should be understood that bottom rail **204** is formed in a similar manner to that described above with respect to top rail **202**.

Referring also to FIGS. **2** and **3**, cage **106** is formed by inserting vertical supports bars **206** into the apertures defined by upper rail **202** and lower rail **204**, such as apertures **1104**. Opposite side ends of sign plate **210** may be inserted into a vertical aperture defined by two of the vertical supports bars **206** as illustrated in FIG. **3**. Vertical support bars **206** are described in more detail below. A label **211** having an adhesive backing may be affixed to sign plate **210**. It should be understood that the apertures defined by top rail **202** and bottom rail **204** are configured to receive a portion of each relevant vertical support bar **206**. The connections between rails **202** and **204** and vertical support bars are then welded. It should be appreciated that the strength of the connection between these components is not based solely on a weld.

Once portions a and b of cage **106** have been formed in the manner described above, one end of rail portions **202***a* and **204***a* are welded to cage splice plate **208***a*. One end of rail portions **202***b* and **204***b* are likewise welded to cage splice plate **208***b*. Cage splice plates **208***a* and **208***b* are then welded together. The other end of rail portions **202***a* and **204***a* are inserted into bumpout weldment **200***a*. Specifically, the end of upper rail portion **202***a* is inserted into aperture **410** of bump up component **300***a* (FIGS. **4** and **9**). The end of lower rail portion **204***a* is inserted into aperture **408** of bump up component **300***a* (FIGS. **4** and **9**). The connections between the rails **202***a* and **204***a* and bump up component **300***a* are then welded. Upper rail portion **202***b* and lower rail portion **204***b* are similarly connected and welded to bumpout weldment **300***b*.

FIG. **14** illustrates the use of fall restraint equipment to unload material from a tractor-trailer **1402**. In this embodiment, the fall restraint equipment comprises a mobile access unit **1400** that includes a base portion **1404** and a ladder portion **1406**. A cage **1408** is attached to the end of ladder portion **1406**. Tractor-trailer **1402** comprises a tractor portion **1410** and a trailer portion **1412**. Access points **1414** are located on the top surface of trailer portion **1412** similar to that described above with respect to railcar **114** of FIG. **1**.

In operation, mobile access unit **1400** is positioned so that it is located adjacent an access point **1414** of trailer **1412**. Cage **1408** is positioned to encircle the access point. A user climbs ladder portion **1406** in order to gain access to access point **1414**.

FIG. **15** is a perspective view of cage **1408** comprising an upper rail **3002**, a first mid rail **3004**, a second mid rail **3006**, and a bottom rail **3008**. Rails **3002**, **3004**, **3006**, and **3008** are interconnected by vertical support bars **3010** in a manner similar to that described above with reference to FIGS. **2** and **3**. Likewise, the end of rails **3002**, **3004**, **3006**, and **3008** are connected to bumpout weldments **3000**.

FIG. **16** is a side elevation view of vertical support bar **3010**, but may also be used as vertical support bar **206** (FIG. **2**). Vertical support bar **3010** is formed from a continuous piece of circular, tubular metal. The continuous piece is drilled, lasered, or otherwise cut to cut the bar to size and to define the indentations on both ends of the bar. This may be accomplished through the use of a tube laser, cutting drill, or plasma torch.

FIGS. **17**, **18**, and **19** are bottom planar, side elevation, and top planar views, respectively, of first mid rail **3004**, which is formed from a continuous piece **3200** of circular, tubular metal. Continuous piece **3200** is drilled, lasered, or otherwise cut to cut the bar to define apertures **3206** and **3208**. This may be accomplished through the use of a tube laser, cutting drill, or plasma torch. Continuous piece **3200** of circular, tubular metal is then bent at approximately 45° angles at bend lines commonly denoted at **3204** in FIG. **17** in order to form first mid rail **3004**. Referring again to FIG. **15**, upper rail **3002**, second mid rail **3006**, and bottom rail **3008** are formed in a similar manner to that described above with respect to FIGS. **17**, **18**, and **19**, and with respect to FIGS. **2**, **3**, **11**, **12**, and **13**. It should be understood, however, that the location of apertures **3206** and/or **3208** for each rail may vary in order to allow vertical support bars to be interspersed as illustrated in FIG.

15. Thus, it should be further understood that a surface of one rail defines apertures that correspond to apertures defined by the surface of another rail that faces the first rail to allow a vertical support bar to connect the two.

FIG. **20** is a perspective view of bumpout weldment **3000** formed in a similar manner to that described above with respect to FIG. **9** except incorporating a bump up component **3500**. Otherwise, weldment **3000** is similar in construction, operation, and use as that of weldment **200**.

FIG. **21** is a perspective view of bump up component **3500** comprising a continuous piece of tubular metal. The continuous piece is drilled, lasered, or otherwise cut to cut the bar to define apertures **3600** and **3602** and a tab **3604** in a manner similar to that described above with respect to FIG. **4**. It should be understood, however, that component **3500** comprises four apertures **3600** in order to receive each of the rails described above.

It should be understood that the above description discloses a cage for fall restraint equipment that has increased stability at the locations where its components connect and is more efficient to manufacture.

FIG. **22** illustrates mobile access unit **1400** connected to cage **1408**, both of FIG. **14**, but removed from tractor-trailer **1402** (FIG. **14**). FIG. **23** is an exploded view of mobile access unit **1400** and cage **1408**. The construction and operation of cage **1408** are described above and are, therefore, not described in more detail below.

Referring to FIGS. **22** and **23**, mobile access unit **1400** comprises base portion **1404** connected to and supporting ladder assembly **1406**. Base portion **1404** comprises a platform **1500**, a chariot portion **1502**, a plurality of wheels **1504**, an h-frame **1506**, a pair of jack stands **1508**, a pair of ladder adapters **1510**, a handle **1512**, and a gooseneck weldment **1514**.

FIG. **24** is a perspective view of a top surface of platform **1500**. Platform **1500** comprises a side rail **1800** and two support surfaces **2400**, both of which are described in more detail below. Support surfaces **2400** are preferably formed from continuous pieces of sheet metal that have been butterflied and/or lasered and stamped to result in surfaces **2400***a* and **2400***b*. Support surfaces **2400** are also cut in order to define apertures **2401** configured to receive ladder adapters, as described in more detail below. FIG. **25** is a perspective view of the underside of platform **1500** exhibiting a support structure **2500**. Support surfaces **2400** have been removed from FIG. **25** for purposes of explanation.

Referring to FIG. **25**, support structure **2500** comprises side rail **1800**, a pair of crossbeams **1804** and **1806**, a plurality of crossbeam supports **1808**, **1810**, **1812**, and **1814**, and adapter supports **1816**. Side rail **1800** is a continuous piece of tubular metal that has been notched and folded at 90° in three places to form a rectangular support, as illustrated, in a manner similar to that described above with respect to top rail **202** (FIGS. **3**, **11**, and **12**). Side rail **1800** is also lasered or otherwise cut to define apertures for receiving the ends of crossbeams **1804** and **1806** and crossbeam supports **1808**, **1810**, **1812**, and **1814** that connect to the side rail. Side rail **1800** is also lasered or cut to define other apertures configured to receive bolts, rivets, or other suitable fasteners in order to connect to other components of base portion **1404** (FIG. **23**), as described below. For simplicity, apertures defined near the corners of side rail **1800** are denoted by reference numerals **1820**, while apertures defined near the middle of each section of the side rail are denoted by reference numerals **1822**. The crossbeams are lasered or otherwise cut to define apertures for receiving the ends of the crossbeam supports that connect to the crossbeams. Likewise, the crossbeam supports are lasered or otherwise cut to define apertures for receiving the ends of adapter supports **1816**. Preferably, the crossbeams, crossbeam supports, and adapter supports are each constructed from a singular piece of tubular metal.

Each end of one adapter support **1816** is inserted into crossbeam supports **1808** and **1810**, while each end of the other adapter support is inserted into crossbeam supports **1812** and **1814**. One end of each of crossbeam supports **1808** and **1810** is inserted into portion **1800***d* of the side rail, while the other end of each crossbeam support is inserted into crossbeam **1804**. Likewise, one end of each of crossbeam supports **1812** and **1814** is inserted into portion **1800***c* of the side rail, while the other end of each crossbeam support is inserted into crossbeam **1806**. Side rail **1800** is then folded at the corner between portion **1800***b* and **1800***c* and the corner between portion **1800***b* and **1800***d* so that one end of each of crossbeams **1804** and **1806** is inserted into portion **1800***b* of the side rail. Side rail is folded at the corner between portions **1800***a* and **1800***d* so that the other end of each of crossbeams **1804** and **1806** are inserted into the apertures defined in portion **1800***a* of the side rail and so that the end of portions **1800***a* and **1800***c* form a corner. The connections made between two components may then be welded for additional strength and support, such as the connections made by the crossbeams and the crossbeam supports. Support surfaces **2400** are fastened to support structure **2500** by any suitable method, such as welding, bolting, riveting, or a combination thereof.

FIG. **26** is a perspective view of chariot portion **1502** of mobile access unit **1400** (FIG. **22**) comprising a top rail **1900**, a midrail **1902**, a pair of midbeams **1904**, a toeboard **1906**, and brackets **1908** and **1910**. Top rail **1900** and midrail **1902** are formed in a manner similar to that described above with respect to top rail **202** (FIGS. **3**, **11**, and **12**). That is, rails **1900** and **1902** are formed from respective continuous pieces of circular, tubular metal, lasered or otherwise cut to define apertures to receive ends of other components, and curved at 45° angles at certain locations. For instance, top rail **1900** is lasered or otherwise cut to define apertures configured to receive both ends of midrail **1902** at opposite sides of the top rail denoted at points **1914** and **1916** and to define an aperture configured to receive an end of midbeam **1904***b* denoted at point **1918**. Top rail **1900** is curved at a 45° at the locations denoted by numerals **1920**. Midrail **1902** is lasered or otherwise cut to define apertures configured to receive midbeams **1904***a* and **1904***b* on opposite sides of the midrail as denoted at points **1922** and **1924**, respectively. Midrail **1902** is curved at a 45° at the locations denoted by numerals **1926**.

The portions of toeboard **1906** are formed from continuous pieces of tubular metal. In one embodiment, the ends of midbeam **1904***a* and top rail **1900** are lasered or otherwise cut to define areas to receive the portions of toeboard **1906**. The portions of toeboard **1906** may also be connected to ends of midbeam **1904***a* and top rail **1900** by other suitable fastening methods, such as welding. Likewise, brackets **1908** and **1910** are fastened to toeboard **1906** by any suitable method, including welding, bolting, and/or riveting.

FIGS. **27** and **28** are perspective views of ladder adapters **1510** of base portion **1404** (FIGS. **22** and **23**) in accordance with one embodiment of the present invention. Ladder adapters **1510** comprise a tubular portion **2800**, a flat portion **2802**, and a lip portion **2804**. Tubular portion **2800** is formed from a continuous piece of tubular metal that has been lasered or otherwise cut to define a pair of opposing apertures **2806**. Apertures **2806** of ladder adapters **1510** are configured to align with apertures **1824** defined by crossbeams **1804** and **1806** and ladder adapters **1816** (all of FIG. **25**). Lip portion is

lasered or otherwise cut to define apertures **2808**, which are configured to align with apertures of ladder portion **1406** (FIGS. **22** and **23**), as described in more detail below.

Referring to FIGS. **29***a* and **29***b*, chariot portion **1502** is connected to platform **1500** by bolts or other suitable fasteners connecting brackets **1908** to side rail **1800**. An additional pair of brackets **2900** configured to connect to jack stands **1508** (FIGS. **22** and **23**), as described below, are bolted or otherwise connected to platform **1500**. Ladder adapters **1510** are bolted to respective crossbeams **1804** and **1806** and to adapter supports **1816**.

FIG. **30** is a perspective view of an h-frame **1506** comprising a bottom support **2300**, a pair of uprights **2302** and **2304**, a midbeam **2306**, and a top support **2308**. A pulley system **2310** comprising a pulley **2312**, a wench **2314**, a crank **2316**, and a cable **2318** is attached to top support **2308** and midbeam **2306**. That is, pulley **2312** is connected to top support **2308**, while wench **2314** and crank **2316** are connected to midbeam **2306**. The operation and use of h-frame **1506** including pulley system **2310** is described in more detail below. Bottom support **2300** is cut to define a set of apertures denoted at **2320** that are used to connect h-frame **1506** to platform **1500** as described in more detail below. Each of uprights **2302** and **2304** is lasered or otherwise cut to define a set of apertures **2322** configured to align with apertures defined by uprights **2414** of ladder portion **1406** (described below with respect to FIG. **32**) in order to connect h-frame **1506** to the ladder portion. H-frame **1506** may comprise additional components as desired, such as a sign placard **2324** to which a label or other information may be adhered.

FIG. **31** is a perspective view of gooseneck weldment **1514**, which is cut to define two sets of apertures **3100** and **3102** that allow the weldment to be connected to handle **1512** (FIG. **23**) and to bracket **1910** (FIG. **26**) of chariot portion **1502**, as described in more detail below.

Most components of base portion **1404** are connected to platform **1500**. Referring to FIGS. **23** through **31**, for instance, brackets **1908** of chariot portion **1502** are bolted or otherwise connected, such as by rivets, to respective portions of side rail **1800** of platform **1500** via two sets of respective middle apertures **1822**. A portion of handle **1512** is connected to front wheel **1504***a*, while another portion of the handle is connected to gooseneck weldment **1514** via apertures **3102**. The gooseneck weldment is then connected to bracket **1910** of chariot portion **1502** via apertures **3100**. Ladder adapters **1510** are bolted or otherwise connect, such as by rivets, to respective portions of crossbeams **1806** and **1804** and adapter supports **1816**. Wheels **1504***b* are connected to platform **1500**, as are jack stands **1508**. H-frame **1506** is connected to platform **1500** by aligning apertures **2320** of the h-frame with a set of middle apertures **1822** of the platform and supplying fasteners, such as bolts or rivets, through the aligned apertures.

FIG. **32** is a perspective view of ladder portion **1406** comprising a fixed portion **2402** and a moveable portion **2404**. Fixed portion **2402** comprises a pair of uprights **2406** and a plurality of steps **2408**. Moveable portion **2404** comprises a pair of uprights **2414**, a pair of channeled supports **2416**, a platform **2418**, a plurality of steps **2417**, and may include other components, such as a pair of handrail systems **2420**.

Each of uprights **2406** is formed from a continuous piece of metal lasered or otherwise cut to define apertures to receive an end portion of each of steps **2408**, similar in the manner side panel **1800** is lasered or otherwise cut to receive an end portion of each of crossbeams **1804** and **1806** as described above with respect to FIG. **25**. Similarly, each of steps **2408** is formed from a continuous piece of tubular metal that is lasered or otherwise cut and then stamped to form the resulting step.

Each of uprights **2406** are also lasered or otherwise cut to define areas to receive a plurality of brackets **2410**, **2411**, and **2412**. Brackets **2410** are configured to receive portions of moveable portion **2404** that allow the moveable portion to move up and down with respect to fixed portion **2402**. Brackets **2411** are configured to connect to h-frame **1506** (FIG. **30**), as described in more detail below. Brackets **2412** are lasered or otherwise cut to define apertures that align with apertures **2808** of ladder adapters **1510** as described above with respect to FIGS. **27** and **28**.

Each of uprights **2414** is formed from a continuous piece of metal lasered or otherwise cut to define areas configured to receive portions of channel supports **2416** and handrail systems **2420** in a manner similar to that described above with respect to bump up component **300** of FIG. **10**. Uprights **2414** are also lasered or otherwise cut to define a plurality apertures denoted at **2422** that are configured to align with apertures defined by angle braces **306** of bumpout weldments **200** described above with respect to FIG. **10** in order to connect ladder portion **1406** to cage **1408** (FIG. **22**).

Each of channeled supports **2416** is formed from a continuous piece of channeled tubular metal, which is folded in a manner similar to that described above with respect to top rail **202** of FIG. **11**. Platform **2418** is lasered and/or butterflied from a flat, continuous piece of sheet metal and stamped to form the resulting platform. It should be understood that channeled uprights **2416**, brackets **2410** and handrail systems **2420** are configured to work together to enable moveable portion **2404** to move up and down with respect to fixed portion **2402** of ladder portion **1406**. It should be understood, however, that movable portion **2404** may be bolted or otherwise fixed into place once it is configured at the desired height as described in more detail below. Steps **2417** are formed and connected to channel supports **2416** in ways similar to those described above with respect to steps **2408** and uprights **2406**.

Referring to FIGS. **22**, **23**, **27**, **28**, **30**, and **32**, mobile access unit **1400** is formed by connecting ladder portion **1406** to base portion **1404**. That is, brackets **2412** are fastened by one or more bolts or other suitable fasteners, such as rivets, to ladder adapters **1510** via apertures **2808** and those defined by brackets **2412**. Brackets **2411** are fasted by a bolt or other suitable fastener to h-frame **1506** via apertures **2322** and those defined by brackets **2411**. Additionally, the lose end of cable **2318** is connected to a portion of one of steps **2417**.

Referring to FIGS. **14**, **22**, **23**, and **30**, cage **1408** and moveable portion **2404** may be raised to a desired height by using pulley system **2310**. That is, rotation of crank **2316** causes wench **2314** to retract cable **2318** via pulley **2312**, thereby asserting a pulling force on the step of steps **2417** to which the lose end of the cable is attached. Once cage **1408** and moveable portion **2404** reach a desired height, the moveable portion may be fixed into place by bolting or otherwise fastening it to fixed portion **2402**. Mobile access unit **1400** may then be wheeled to a desired position using handle **1512** and wheels **1504**. Once positioned as desired, jack stands **1508** may be used to fix mobile access unit **1400** in place. A user may then access a storage container such as via access point **1414** of tractor-trailer **1402** by climbing ladder portion **1406** of mobile access unit **1400**.

It should be understood from the above description that the components of mobile access unit **1400** described above are modular and may be relocated with respect to platform **1500** and/or ladder portion **1406**. Referring to FIGS. **23** and **24**, for instance, chariot portion **1502**, gooseneck weldment **1514**,

wheels **1504**, and jack stands **1508** may be disconnected from platform **1500** and relocated at a position on the platform as desired using apertures **1820** and **1822**. For example, chariot portion **1502**, wheels **1504***b*, and jack stands **1508** may be disconnected from platform **1500**, rotated about the platform in a clockwise manner, and reconnected to the platform at the relevant apertures. As a result, the direction of movement of mobile access unit **1400** may be changed by 90° with respect to ladder portion **1406**.

FIG. **33** is a perspective view of a pair of ladder adapters **2600** that may be used to replace ladder adapters **1510** (FIGS. **22**, **23**, **27**, **28**, **29***a*) in order to increase the height of ladder portion **1406** in accordance with another embodiment of the present invention. Each of ladder adapters **2600** is comprised of tubular portions **2601** and **2602** and flat portion **2604**. A lip portion **2608** similar to lip portion **2804** (FIGS. **27** and **28**) is attached to each of ladder adapters **2600**. Lip portions **2608** are cut to define a plurality of apertures **2610** similar to apertures **2808** (FIGS. **27** and **28**).

Each of tubular portions **2601** are formed from a continuous piece of tubular metal and lasered or otherwise cut to define areas to receive respective tubular portions **2602** in a manner similar to that described above with respect to bump up component **300** and bump top braces **302** of FIG. **9**, respectively. Similarly, each of tubular portions **2602** are formed from lasering or otherwise cutting a continuous piece of tubular metal. Each of tubular portions **2601** are lasered to define apertures **2606**, which are similar to apertures **2806** of ladder adapters **1510** (FIGS. **27** and **28**). Additionally, each of tubular portions **2601** and **2602** are lasered or otherwise cut to define sets of apertures **2612** configured to receive a pair of steps. Referring additionally to FIG. **34**, for instance, a pair of steps **2702** is connected between ladder adapters **2600** in the presently-described embodiment. That is, ends of steps **2702** are inserted into apertures **2612**. Steps **2702** are formed by lasering and/or butterflying and stamping a continuous piece of tubular metal in a manner similar to that described above with respect to steps **2408** and **2417** (FIG. **32**).

FIG. **35** illustrates lower portion **1402** of mobile access unit **1400** (FIG. **14**) where ladder adapters **2600** have replaced ladder adapters **1510** (FIGS. **23** and **29***a*). That is, ladder adapters **2600** are connected to platform **1500** in a manner similar to that described above with regard to the connection between ladder adapters **1510** and platform **1500** (FIGS. **25**, **29***a*, and **29***b*). Ladder portion **1406** (FIG. **32**) is connected to ladder adapters **2600** in a manner similar to that described above with respect to the connection between ladder adapters **1510** and ladder portion **1406** (FIGS. **22** and **23**).

It should be understood that, because ladder adapters **2600** extend ladder portion **1406** to a greater height, an h-frame that is also greater in height a corresponding amount must be used. FIG. **36**, for instance, illustrates an h-frame **2900** similar in construction and operation to h-frame **1506** (FIG. **30**). However, uprights **2902** and **2904** are longer in length that uprights **2302** and **2304** (FIG. **30**), respectively, in order to coincide with the greater height provided by ladder adapters **2600**.

It should be understood that an embodiment utilizing ladder adapters **2600** provides a mobile access unit that extends to a height greater than that a mobile access unit utilizing ladder adapters **1510**. The greater height is approximately equal to the difference in height between ladder adapters **1510** and ladder adapters **2600**, or approximately two feet. It should also be understood that because ladder adapters **1510** and ladder adapters **2600** are exchangeable, the user of mobile access unit **1400** may configure the unit to the desired height for a task and may change it for another task by swapping out the ladder adapters.

While one or more preferred embodiments of the invention have been described above, it should be understood that any and all equivalent realizations of the present invention are included within the scope and spirit thereof. The embodiments depicted are presented by way of example only and are not intended as limitations upon the present invention. Thus, it should be understood by those of ordinary skill in this art that the present invention is not limited to these embodiments since modifications can be made. Therefore, it is contemplated that any and all such embodiments are included in the present invention as may fall within the scope and spirit thereof.

What is claimed is:

1. A mobile access unit comprising:

a base portion having first and second apertures;

a plurality of wheels connected to said base portion to allow said base portion to be moved toward and away from a selected location;

a ladder adapter arrangement having a first pair of ladder adapters and a second pair of ladder adapters, said first and second pairs of ladder adapters configured to be inserted and secured into said first and second apertures, the first pair of ladder adapters having at least one adapter step extending therebetween to support a user, the first pair of ladder adapters having a first height configured to extend to a first location above a surface of said base portion, the second pair of ladder adapters having a second height configured to extend to a second location above said surface of said base portion, said first height being greater than said second height, wherein said ladder adapter arrangement is configured to allow a user to alternate between securing said first pair of ladder adapters and said second pairs of ladder adapters into the apertures; and

a ladder assembly having a first pair of uprights directly connected by ladder steps, the ladder assembly connected to said base portion by way of resting on top of a selected one of said pairs of ladder adapters, the ladder assembly configured to extend to multiple heights as a direct result of switching between the first and second pairs of ladder adapters.

2. A mobile access unit as set forth in claim **1**, wherein said ladder assembly has a fixed portion and an extensible movable portion, said fixed portion being attached to said ladder adapter arrangement.

3. A mobile access unit as set forth in claim **2**, further comprising a crank arrangement for moving said extensible movable portion of said ladder assembly.

4. A mobile access unit as set forth in claim **1**, wherein said ladder assembly is mounted in a slant with respect to said base portion.

5. A mobile access unit as set forth in claim **4**, further comprising a cage mounted to a distal end of said ladder assembly.

6. A mobile access unit as set forth in claim **5**, wherein said cage comprises at least two horizontal rails formed of tubular material spaced apart by vertical supports.

7. A mobile access unit as set forth in claim **2**, further comprising at least one jack stand connected to said base portion, said at least one jack stand being operative to prevent rolling movement of said base portion at said selected location.

8. A mobile access unit as set forth in claim **2**, wherein each of said ladder adapters comprises a first tubular portion having a proximal end and a distal end, said proximal end is configured to extend below said surface of said base portion as said distal end is attached to said ladder assembly.

9. A mobile access unit as set forth in claim **8**, wherein each of said ladder adapters of said first pair of ladder adapters comprises a second tubular portion attached obliquely to said first tubular portion of each of said ladder adapters of said first pair of ladder adapters.

10. A mobile access unit as set forth in claim **8**, wherein each of said ladder adapters comprises a flat portion spaced apart from said proximal end of said first tubular portion so as to rest on said surface of said base portion.

11. A mobile access unit as set forth in claim **10**, wherein each of said ladder adapters comprises a lip portion at said distal end of said first tubular portion, said lip portion defining at least one aperture for attachment of said ladder assembly.

12. A mobile access unit as set forth in claim **2**, wherein said wheels are attached to said base portion such that said base portion is configured to move towards and away from said selected location along a direction of orientation of said ladder assembly.

13. A mobile access unit as set forth in claim **2**, wherein said wheels are attached to said base portion such that said base portion is configured to move towards and away from said selected location along a direction lateral to a direction of orientation of said ladder assembly.

14. A mobile access unit as set forth in claim **1**, wherein each of said ladder adapters comprises a first tubular portion having a proximal end and a distal end, said proximal end is configured to extend below said surface of said base portion as said distal end is attached to said ladder assembly.

15. A mobile access unit as set forth in claim **14**, wherein each of said ladder adapters of said first pair of ladder adapters comprises a second tubular portion attached obliquely to said first tubular portion of each of said ladder adapters of said first pair of ladder adapters.

16. A mobile access unit as set forth in claim **14**, wherein each of said ladder adapters comprises:

a flat portion spaced apart from said proximal end of said first tubular portion so as to rest on said surface of said base portion; and

a lip portion at said distal end of said first tubular portion, said lip portion defining at least one aperture for attachment of said ladder assembly.

17. A mobile access unit as set forth in claim **1**, further comprising a cage mounted to a distal end of said ladder assembly.

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