US Patent & Trademark Office
Patent Public Search | Text View

United States Patent	12392366
Kind Code	B2
Date of Patent	August 19, 2025
Inventor(s)	Katz; David

Solar panel mounting configuration

Abstract

Mounting clamps may be utilized to quickly and easily secure solar panel modules relative to mounting rails, which may in turn be secured relative to a mounting surface (e.g., a roof). The mounting clamps may be configured to quickly secure the solar pane modules relative to the mounting rails by tightening a tightening element to pull a clamp element toward the surface of a mounting rail, thereby clamping a portion (e.g., a frame) of a solar panel module between the clamping element and an outer surface of the mounting rail.

Inventors: **Katz; David (Arcata, CA)**

Applicant: **Tamarack Solar Products, Inc.** (Eureka, CA)

Family ID: **1000008767010**

Assignee: **Tamarack Solar Products, Inc. (Eureka, CA)**

Appl. No.: **18/961142**

Filed: **November 26, 2024**

Prior Publication Data

Document Identifier	Publication Date
US 20250084881 A1	Mar. 13, 2025

Related U.S. Application Data

continuation parent-doc US 18777918 20240719 PENDING child-doc US 18961142
continuation parent-doc US 17806692 20220613 US 12044268 20240723 child-doc US 18777918
continuation parent-doc US 16215266 20181210 US 11384780 20220712 child-doc US 17806692
us-provisional-application US 62660438 20180420
us-provisional-application US 62598249 20171213

Publication Classification

Int. Cl.: **F16B5/06** (20060101); **F16B2/04** (20060101); **F16B2/06** (20060101); **F16B2/10** (20060101); **F16B7/04** (20060101); **F16B7/18** (20060101); **F24S25/37** (20180101); **H02S20/20** (20140101); **H02S30/00** (20140101); F24S25/00 (20180101); F24S25/60 (20180101)

U.S. Cl.:

CPC **F16B5/0685** (20130101); **F16B2/04** (20130101); **F16B2/065** (20130101); **F16B2/10** (20130101); **F16B7/0413** (20130101); **F16B7/0473** (20130101); **F16B7/187** (20130101); **F24S25/37** (20180501); **H02S20/20** (20141201); **H02S30/00** (20130101); F24S2025/6003 (20180501); F24S2025/801 (20180501)

Field of Classification Search

CPC: F16B (5/0685); F16B (7/0473); F16B (2/10); F16B (7/0413); F16B (7/187); F16B (2/04); F16B (2/065); H02S (20/20); H02S (30/00); F24S (25/37); F24S (2025/6003); F24S (2025/801); F24S (25/30); F24S (2025/6007); F24S (2025/804); F24S (25/636); F24S (25/65); F24S (25/632); Y02E (10/47); Y02E (10/50); Y02B (10/20)

USPC: 248/274.1

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
4953820	12/1989	Yoder	N/A	N/A
8181926	12/2011	Magno, Jr. et al.	N/A	N/A
9097443	12/2014	Liu	N/A	N/A
9249813	12/2015	Kalman	N/A	N/A
9825581	12/2016	Wildes	N/A	N/A
9893677	12/2017	Liu	N/A	N/A
10330249	12/2018	Polen	N/A	N/A
10605282	12/2019	Young	N/A	F16B 5/0685
10727780	12/2019	Kobayashi	N/A	F24S 25/33
10749459	12/2019	Liu	N/A	F16B 5/0685
11221034	12/2021	Katz	N/A	N/A
11384780	12/2021	Katz	N/A	N/A
12044268	12/2023	Katz	N/A	N/A
2005/0095062	12/2004	Iverson et al.	N/A	N/A
2008/0250614	12/2007	Zante	24/542	F16B 5/0657
2014/0255090	12/2013	Oravits et al.	N/A	N/A
2015/0040967	12/2014	West et al.	N/A	N/A
2015/0068010	12/2014	Klingler	N/A	N/A
2016/0069592	12/2015	Giraudo	248/220.21	F24S 25/00
2018/0238359	12/2017	Cross	N/A	N/A
2018/0342974	12/2017	Jasmin	N/A	F24S 25/636
2019/0013772	12/2018	Bamat	N/A	F24S 25/636

2019/0178274	12/2018	Katz	N/A	F16B 7/0473

OTHER PUBLICATIONS

United States Patent and Trademark Office, Office Action received for U.S. Appl. No. 16/215,266, dated Sep. 3, 2020, 9 pages, U.S. cited by applicant
U.S. Appl. No. 16/117,813, “Solar Panel Mounting Configuration”, Unpublished (filing date Aug. 30, 2018), (David Katz, Inventor) (Tamarack Solar Products, Inc., assignee). cited by applicant
United States Patent and Trademark Office, Office Action received for U.S. Appl. No. 16/215,266, dated Sep. 2, 2021, 8 pages, U.S. cited by applicant
United States Patent and Trademark Office, Office Action received for U.S. Appl. No. 17/226,895, dated Sep. 14, 2021, 18 pages, U.S. cited by applicant

---

Primary Examiner: Ijaz; Muhammad

Attorney, Agent or Firm: Alston & Bird LLP

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This patent application is a continuation of U.S. patent application Ser. No. 18/777,918, filed Jul. 19, 2024, which is a continuation of U.S. patent application Ser. No. 17/806,692, filed Jun. 13, 2022, now U.S. Pat. No. 12,044,268, which is a continuation of U.S. patent application Ser. No. 16/215,266, filed Dec. 10, 2018, now U.S. Pat. No. 11,384,780, which claims priority from U.S. Provisional Appl. Ser. No. 62/598,249 filed Dec. 13, 2017 and U.S. Provisional Appl. Ser. No. 62/660,438, filed Apr. 20, 2018, each of which is incorporated herein by reference in its entirety.

BACKGROUND
(1) Solar panels, which typically comprise large sheets of glass surrounded by a rigid frame (e.g., aluminum) and two electrical leads extending from each panel that are electrically connected to an electrical storage device (e.g., a battery or inverter). Due to the very nature of solar panels and the mechanism through which they generate electricity, solar panels are often secured to building roofs or other supportive structures where the solar panels are exposed to direct sunlight for a maximum amount of time during each day.
(2) As solar energy becomes an increasingly popular source of electrical power both on and off traditional power grids, the need for installation systems that can be quickly and easily utilized to secure solar panels to respective supportive structures has become increasingly important.
BRIEF SUMMARY
(3) Various embodiments are directed to a mounting clamp for mounting a solar panel onto a mounting rail. In certain embodiments, the mounting clamp comprises: a clamp component configured to frictionally engage a top surface of a solar panel; a channel nut configured to engage an interior portion of the mounting rail; and a fastening member adjustably securing the clamp component relative to the channel nut and configured to, when tightened, pull the clamp component toward the channel nut and the mounting rail to clamp the solar panel against an exterior portion of the mounting rail.
(4) In various embodiments, the clamp component comprises: a vertical body portion aligned parallel with the fastening member, a top horizontal leg extending from an upper end of the vertical body portion, wherein the top horizontal leg is configured to engage the top surface of the solar panel; and a bottom horizontal leg extending from a lower end of the vertical body portion, wherein the bottom horizontal leg is configured to engage a side surface of the solar panel, wherein the side

surface is perpendicular to the top surface. Moreover, the fastening member may extend through an aperture in the top horizontal leg and a slot in the bottom horizontal leg. In certain embodiments, the top horizontal leg has a length longer than the bottom horizontal leg. In various embodiments, the solar panel is a first solar panel of a plurality of solar panels, and the clamp component defines opposite horizontal clamp surfaces, wherein a first horizontal clamp surface is configured to engage the first solar panel and a second horizontal clamp surface is configured to engage a second solar panel; and wherein the mounting clamp further comprises a compressible resilient member configured to support the clamp component a distance away from the channel nut. In certain embodiments, the compressible resilient member defines interference fit components to engage corresponding features of the clamp component.

(5) In various embodiments, the solar panel is a first solar panel of a plurality of solar panels, and wherein the clamp component comprises: a vertical body portion aligned parallel with the fastening member, a first top horizontal leg extending from an upper end of the vertical body portion in a first direction, wherein the first top horizontal leg is configured to engage the top surface of the first solar panel; a second top horizontal leg extending from the upper end of the vertical body portion in a second direction, opposite the first direction, wherein the second top horizontal leg is configured to engage the top surface of a second solar panel; and a bottom horizontal leg extending from a lower end of the vertical body portion, wherein the bottom horizontal leg is configured to engage a side surface of the solar panel, wherein the side surface is perpendicular to the top surface. In certain embodiments, the fastening member extends through an aperture in the first top horizontal leg and a slot in the bottom horizontal leg. Moreover, in certain embodiments, the first top horizontal leg is longer than the second top horizontal leg. In various embodiments, the first top horizontal leg is longer than the bottom horizontal leg. In certain embodiments, the mounting clamp further comprises a compressible resilient member configured to support the clamp component a distance away from the channel nut.

(6) Certain embodiments are directed to a mounting clamp for mounting a solar panel onto a mounting rail. In various embodiments, the mounting clamp comprising: a top engagement feature configured to engage a frame portion of a solar panel; a bottom engagement feature pivotably secured relative to the top engagement feature and configured to engage an interior portion of the mounting rail; and a tightening element configured to, when tightened, cause the bottom engagement feature to pivot relative to the top engagement feature and to close a gap between a portion of the top engagement feature and a portion of the bottom engagement feature to clamp the frame portion of the solar panel against an exterior portion of the mounting rail.

(7) In various embodiments, the tightening element is a bolt rotatable about a bolt axis, and wherein tightening the bolt causes the gap to close in a direction perpendicular to the bolt axis. Moreover, the bolt may loosely extend through the bottom engagement feature and thread into the top engagement feature. In certain embodiments, the bottom engagement feature is pivotably secured relative to the top engagement feature about a pivot axis perpendicular to the bolt axis. Moreover, the mounting clamp may further comprise a pivot pin, and wherein the top engagement feature and the bottom engagement feature are secured relative to the pivot pin.

Description

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

(1) Reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

(2) FIG. **1** is a perspective view of an internal rail splice utilized to join two rails according to one embodiment;

(3) FIG. **2** is an end-on view of an internal rail splice within a rail according to one embodiment;

(4) FIG. **3** is an inverted perspective view of a rail splice having a key feature according to one embodiment;
(5) FIGS. **4**A-**4**B are side views of rails being assembled relative to an internal rail splice having a key feature according to one embodiment;
(6) FIG. **5** is a perspective view of an end clamp according to one embodiment;
(7) FIG. **6** is a perspective view of an end clamp within a rail according to one embodiment;
(8) FIG. **7** is an end view of an end clamp within a rail according to one embodiment;
(9) FIGS. **8**A-**8**B are side views of an end clamp in an open and closed configuration, respectively, according to one embodiment;
(10) FIGS. **9**A-**9**B are views of an end clamp securing a module relative to a rail according to one embodiment;
(11) FIGS. **10**A-**10**D are various views of an alternative configuration of an end clamp according to one embodiment;
(12) FIGS. **11**A-**11**B are perspective views of an outer end clamp according to one embodiment;
(13) FIG. **12** is a perspective view of an outer end clamp within a rail according to one embodiment;
(14) FIGS. **13**A-**13**B are side views of an outer end clamp securing a module relative to a rail according to one embodiment;
(15) FIGS. **14**A-**14**D are various views of a mid-clamp according to one embodiment;
(16) FIG. **15** is a perspective view of a mid-clamp secured relative to adjacent modules according to one embodiment;
(17) FIGS. **16**A-**16**B are side views of a mid-clamp securing adjacent modules relative to a rail according to one embodiment;
(18) FIGS. **17**A-**17**D are various views of a mid-clamp having a spacer according to one embodiment;
(19) FIGS. **18**A-**18**B are views of a convertible clamp according to one embodiment;
(20) FIG. **19** is a side view of convertible clamps securing modules relative to a rail according to one embodiment;
(21) FIGS. **20**A-**20**C are perspective views of a convertible clamp according to one embodiment;
(22) FIG. **21** is an isolated perspective view of a resilient member of a convertible clamp according to one embodiment;
(23) FIG. **22** is a side view of a convertible clamp securing modules relative to a rail according to one embodiment;
(24) FIG. **23** is a side view of a convertible clamp securing a skirt and a module relative to a rail according to one embodiment;
(25) FIG. **24** is a side view of a convertible clamp securing a module relative to a rail according to one embodiment;
(26) FIGS. **25**A-**26**B are perspective views of module arrays according to various embodiments;
(27) FIGS. **27-28** are perspective views of a surface mount secured relative to a rail according to one embodiment;
(28) FIGS. **29**A-**29**B are end views of a rail secured relative to a surface mount according to one embodiment; and
(29) FIGS. **30**A-**30**F are end views of various rail configurations according to various embodiments.

DETAILED DESCRIPTION

(30) The present disclosure more fully describes various embodiments with reference to the accompanying drawings. It should be understood that some, but not all embodiments are shown and described herein. Indeed, the embodiments may take many different forms, and accordingly this disclosure should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like

numbers refer to like elements throughout.

(31) It should be understood that the terms of direction provided within this disclosure are provided merely for purposes of convenience relative to the orientation of the configurations shown in the attached figures. Accordingly, while the terms “vertical” and “horizontal” are provided in reference to the orientation of the various configurations shown in the figures, it should be understood that these directions are provided merely to ease the discussion of the functionality of the described configurations, however it should be understood that the described configurations may be provided in any orientation. Indeed, the described solar panel mounting configurations may be utilized to mount solar panels relative to supportive structures configured at any angle relative to horizontal. For example, the described configurations may be secured relative to entirely horizontal building roofs, pitched building roofs between 0-90 degrees, or entirely vertical building walls, as non-limiting examples.

(32) Various embodiments are directed to rail-based mounting systems for securing solar panels relative to supportive structures (e.g., roofs). As shown in the attached figures, rails **10** may be utilized to secure solar panels to a support surface. The rails **10** may be aluminum extruded rails having a mill finish (e.g., no coating), an anodized finish, a painted finish, and/or the like. In certain embodiments, the rails **10**, various components of the mounting mechanism, and/or the rail splices discussed herein may comprise an electrically conductive material that may be used to connect the components relative to electrical ground. However it should be understood that any of a variety of materials may be utilized, including, for example, stainless steel, carbon steel, titanium, and/or the like. Moreover, the rails may be formed by any of a variety of manufacturing mechanisms, such as extrusion, forging, casting, milling, and/or the like.

(33) Rails **10** may be spliced together to provide additional length to a particular rail mounting portion (e.g., to accommodate a large number of solar panels arranged in a single line). Rail splicing (e.g., securing multiple rails **10** relative to one another in an end-to-end configuration) may be provided via rail splice members configured to be secured relative to a plurality of rails **10**. The rail splices may be configured of aluminum or another electrically conductive material having sufficient structural support to secure multiple rails **10** relative to one another.

(34) The rail splice may be embodied as an internal rail splice **60** as shown in FIG. **1**. The internal rail splice **60** may be configured to engage corresponding mounting features (e.g., mounting features positioned at a top portion of the rail **10**, in a sidewall of the rail **10**, and/or the like). Accordingly, in certain embodiments the internal rail splices **60** may be configured for use with a specific size (e.g., height) rail **10**, as shown in the attached figures. In various embodiments, internal rail splices **60** having sidewall heights corresponding to specific rail sizes may more naturally match the rail strength. Moreover, the internal rail splice **60** does not extend to the exterior of the attached rails **10**, and accordingly the internal rail splices **60** do not interfere with the described features for securing a rail relative to a mounting mechanism.

(35) In certain embodiments, the sidewalls of the internal rail splices **60** may be biased (preloaded) away from an interior of the rail splice, such that the sidewalls impart a compressive force onto rails **10** when inserted therein. To install the preloaded internal rail splice **60** within the rail **10**, an installer may flex the sidewalls of the internal rail splice **60** toward the interior of the rail splice and may insert the internal rail splice **60** within the interior of the rail **10**. Once the internal rail splice **60** is inserted into the rail **10**, the preloaded sidewalls expand outward, thereby providing a compressive force on the rails **10**. The compressive force may create a stronger frictional bond between the internal rail splice **60** and the rails **10** to securely mount the multiple rails **10** relative to one another.

(36) Because the internal rail splices **60** are located within the interior portion of the rails **10**, the internal rail splices **60** may be utilized with a plurality of different rail configurations having one or more different rail profiles (e.g., corresponding to different engagement features **11** as discussed herein). Moreover, because the internal rail splices **60** are located within the interior portion of the

rails **10**, specially configured channel nuts **12** (as shown in FIG. **2**) may be provided to be secured relative to the rails **10** at a location adjacent the internal rail splices **60**.

(37) In certain embodiments, the internal rail splices **60** may comprise a key feature **61** on an exterior surface of the internal rail splice **60** (as shown in FIG. **3**). The key feature **61** may be positioned at least substantially centrally along the length of the internal rail splice **60**, such that the key feature **61** facilitates centering of the internal rail splice **60** relative to a plurality of rails **10**. As the rails **10** are pressed onto the internal rail splice **60**, the rails **10** are prevented from moving relative to the internal rail splice **60** once a portion of the rail **10** contacts the key feature **61**. Thus, rails **10** may be pressed onto the internal rail splice **60** (as shown in FIGS. **4**A-**4**B) until each rail **10** contacts the key feature **61** to center the internal rail splice **60** relative to the rails **10**. In certain embodiments, the key feature **61** may be integrally formed with the internal rail splice **60** (e.g., the thickness of the rail splice may be milled around the key feature **61**; the internal rail splice **60** may be forged with an integrated key feature **61**; the key feature **61** may be punched into the internal rail splice **60**; and/or the like) or the key feature **61** may be secured relative to the internal rail splice **60**.

(38) Although described in relation to internal rail splices **60**, it should be understood that the key feature **61** may be integrated into an external rail splice by placing the key feature **61** on an interior surface of the external rail splice **60**, such that rails **10** contact the key feature **61** as they are pressed onto the rail splice.

(39) End Clamp

(40) Certain embodiments are directed to clamps configured to be implemented with rails **10** according to various embodiments, to secure components (e.g., solar panels) relative to the rails **10**.

(41) FIG. **5** illustrates an end clamp **110** configured to secure a module **200** relative to an end of a rail **10**. The unique shape of the end clamp **110** allows it to be slid into the rail **10**, with a tightening element **113** (e.g., a bolt) set inside the rail **10** and accessible from the end of the rail **10** to tighten the end clamp **110** and secure modules **200** relative to the rail **10**. In certain embodiments, components of the end clamp **110** may be made by a low cost extrusion, casting, forging, or molding process. The clamping force is created by the component closest to the bolt head, which is under flanges defining the rail channel, and the portion of the clamp directly above it.

(42) In the illustrated embodiment, the end clamp **110** comprises a top engagement component **111**, a bottom engagement component **112**, and a tightening element securing the top engagement component **111** and bottom engagement component **112**. As shown, the top engagement component **111** comprises a wide bottom portion defining shoulders configured to engage a bottom surface of flanges defining a rail channel, and a thin top portion configured to fit within the rail channel (as shown in FIGS. **6-7**). The thin top portion extends in a first direction (e.g., in a horizontal direction toward the bottom engagement component **112**) configured to engage a portion of a module **200** (e.g., solar panel). Overall, the top engagement component **111** may define an at least substantially inverted “L” shape, with the tightening element **113** extending parallel to a leg of the “L” along a tightening element axis. The bottom engagement component **112** is pivotably secured relative to the top engagement component **111** at a pivot portion and about a pivot axis. The pivot portion may be configured to provide a single degree of freedom (rotational about a single horizontal pivot axis perpendicular to a longitudinal tightening element axis of the tightening element **113**). The bottom engagement component **112** may also be at least substantially “L” shaped, and collectively, the top engagement component **111** and bottom engagement component **112** may define an at least substantially rectangular shape, with a first corner defining the pivot portion, and the opposite corner (diagonally across the rectangle) defining clamp jaws that may be tightened (e.g., such that a gap between the clamp jaws may be closed in a direction perpendicular to both the tightening element axis and the pivot axis) to secure a module **200** therein.

(43) As shown in FIGS. **8**A-**8**B, the tightening element **113** may slidably extend through the bottom engagement component **112**, and may be threaded into the top engagement component **111**. Accordingly, tightening the tightening element **113** may draw a portion of the bottom engagement

component **112** toward the top engagement component **111** (thereby pivoting the bottom engagement component **112** relative to the top engagement component **111** at the pivot portion). The clamp jaws may thereby close (as shown in FIG. **8**B) onto a module **200** as shown in FIGS. **9**A-**9**B, and simultaneously, the shoulder portion of the top engagement component **111** may engage the underside of the rail channel to secure the end clamp **110** in place relative to the rail **10**.

(44) FIGS. **10**A-**10**D illustrate an alternative embodiment of an end clamp **110***a* according to various embodiments. As shown therein, the bottom engagement component **112***a* may be defined as a channel member that may be inserted within the rail channel. In such embodiments, the bottom engagement component **112***a* engages the flanges of the rail channel to secure the end clamp **110***a* relative to the rail **10**, while the top engagement component **111***a* (which may not define the shoulder portions) pivots relative to a pivot point (e.g., a separate pin **114***a*, a pin integrally formed within the bottom engagement component **112***a*, and/or the like) to close the clamp jaws of the end clamp **110***a*. As shown specifically in FIGS. **10**C-**10**D, the clamp jaws operate in a manner as described above in relation to FIGS. **8**A-**8**B.

(45) Outer End Clamp

(46) FIGS. **11**A-**11**B and **12** illustrate an outer end clamp **120** according to various embodiments. The outer end clamp **120** provides an upward facing fastening member **123** that may provide for quicker and/or easier installation. The illustrated outer end clamp **120** is configured to fit a range of module frame sizes, since there are no established standards for module frames.

(47) The outer end clamp **120** shown in FIGS. **11**A-**11**B and **12** comprises a channel nut **121** configured to engage a bottom surface of flanges of a rail channel, a clamp component **122**, and a fastening member **123**. The fastening member **123** is slidably engaged with the clamp component **122** and is threaded into a threaded aperture of the channel nut **121**. As shown, the channel nut **121** height is configured such that it does not extend beyond the top surface of a rail **10** in which it is secured, such that tightening the fastening member **123** to secure a module **200** relative to the rail **10** causes the clamp component **122** to clamp the module **200** relative to the top surface of the rail **10**.

(48) As shown in FIGS. **11**A-**11**B and **12**, the clamp component **122** defines an at least substantially “C” shape, having a horizontal top leg having a first length, a vertical body portion, and a horizontal bottom leg having a second length shorter than the first length. The top leg has an aperture therein aligned with a slot within the bottom leg for the fastening member **123** to extend therethrough (e.g., at least substantially parallel to the vertical body portion). The top leg is configured to engage a horizontal surface of a module **200** (e.g., solar panel) pressed against the bottom leg, such that the module **200** is clamped against the top surface of the rail **10** as the fastening member **123** is tightened as shown in FIGS. **13**A-**13**B. As shown in FIGS. **13**A-**13**B, the fastening member **123** may be placed close to the module frame (e.g., in contact with the module frame) to impede rotation of the clamp component **122** relative to the module **200**.

(49) Moreover, as shown in FIG. **11**B, the bottom surface of the top leg defines one or more puncture elements **124** (e.g., sharp pins) configured to puncture and/or dent the surface of the module **200** as the fastening element **123** is tightened to impede sliding and or rotation of the module **200** relative to the outer end clamp **120**. The puncture elements **124** may also serve to provide a reliable electrical connection between the module frame and the rail **10**. These puncture elements **124** may be integrally formed with the clamp component **122**, may be formed by punching or securing pins relative to the clamp component **122**, and/or the like.

(50) Mid-Clamp

(51) FIGS. **14**A-**14**D illustrate a mid-clamp **130** configured to be secured between adjacent modules **200** (e.g., solar panels) to simultaneously clamp both adjacent modules **200** relative to a rail **10**. As illustrated, the mid-clamp **130** comprises an integrated resilient member **134** (e.g., spring) to ease the installation process by ensuring the clamp component **132** remains above the top surface of the modules **200** (as shown in FIG. **15**) until tightened. The integrated resilient member

134 also ensures the channel nut **131** of the mid-clamp **130** remains engaged with the rail channel. Like the outer end clamp **120** disclosed herein, the mid-clamp comprises a channel nut **131**, a clamp component **132** (which may comprise puncture elements **136**, visible in FIG. **17**C, discussed below), and a fastening member **133**. The integrated resilient member **134** surrounds the fastening member **133** to support the clamp component **132** at a distance relative to the channel nut **131**. As illustrated in FIGS. **16**A-**16**B (which show the mid-clamp **130** in a raised position and a clamped position, respectively, relative to adjacent modules **200**), the resilient member **134** compresses as the fastening member **133** is tightened. Moreover, the resilient member **134** may have a width (measured between adjacent modules **200**) corresponding to (e.g., at least substantially the same as) or thinner than the width of the clamp component **132**, such that adjacent modules **200** may be pressed against opposite surfaces of the clamp component **132** when secured therein.

(52) In certain embodiments, the clamp component **132** may have a hollow interior portion configured to accept a portion of the resilient member **134** therein to prevent the resilient member **134** from rotating relative to the clamp component **132**. In certain embodiments, the resilient member **134** may comprise a plastic material, a metal material, and/or the like. Moreover, the resilient member **134** may define at least substantially vertical side edges (e.g., edges positioned adjacent modules **200**). The resilient member **134** may be configured such that the width of the resilient member **134** (measured between vertical edges) does not change as the resilient member **134** is compressed and/or expanded. As shown in FIGS. **14**A-**14**D, the resilient member defines an at least substantially horizontal base surface configured to extend across a rail channel, two oscillating vertical members, and a top portion configured to be secured within the clamp component **132**. The oscillating vertical members comprise thin resilient sheets having a sinusoidal or other curved shape that, when compressed, form at least substantially stacked sheet portions such that the perimeter dimensions of the resilient member **134** remain at least substantially unchanged as the resilient member **134** is compressed.

(53) As shown in the figures, the top portion comprises resilient clips configured to be clipped into corresponding channels of the clamp component **132** such that the resilient member **134** remains secured relative to the clamp component **132**. This detachable securing of the resilient member **134** relative to the clamp component **132** may facilitate assembly of the mid-clamp **130**, and may ensure that the clamp component **132** is not rotatable relative to the resilient member **134** to create an interference between the clamp component **132** and modules **200** to be secured by the mid-clamp **130** that may impede the modules **200** from being securely positioned fully under the horizontal clamp portions of the clamp component **132**.

(54) The mid-clamp **130** may operate similarly to the outer end clamp **120** discussed herein. The channel nut **131** is configured to engage bottom surfaces of flanges defining a rail channel. The channel nut **131** may be configured to remain below a top surface of the rail **10**, such that the module **200** is clamped against a top surface of the rail **10** when secured thereon. Moreover, the channel nut **131** comprises a threaded aperture extending therethrough configured to accept the fastening member **133** therein, such that the fastening member **133** is tightened relative to the channel nut **131**. The clamp component **132** has elongated horizontal clamp surfaces proximate a top portion of the clamp component **132**. The clamp surfaces are configured to engage top horizontal surfaces of a module **200** as the fastening component **133** is tightened, to clamp the modules **200** relative to the rail **10**. Moreover, as shown in the figures, the clamp component **132** comprises at least substantially vertical body surfaces below the horizontal clamp surfaces. The body surfaces are configured such that vertical edges of adjacent modules **200** may be pressed against the body surfaces of the clamp component **132** to ensure the adjacent modules **200** are securely positioned below the horizontal clamp surfaces of clamp component **132**. The clamp component **132** further defines an aperture therein configured to slidably accept the fastening member **133** therein. The aperture extends vertically through the body portion of the clamp component **132**, such that the clamp component **132** may be clamped against modules **200** secured

therein.
(55) Moreover, the mid-clamps **130** may be utilized proximate an end of a module **200** installation, such that only a single module **200** is secured by the mid-clamp **130**. As shown in FIGS. **17**A-**17**D, the mid-clamp **130** may be utilized with an edge spacer **135** configured to be secured within one side of the mid-clamp **130**. Spacers **135** may be formed of a rigid plastic material, a metal material (e.g., a material identical to the frame material of module **200**, such as aluminum, steel, and/or the like). By utilizing a material identical to that included within a module **200**, the spacer **135** may thermally expand and/or contract at a rate identical to the module **200**, such that the spacer **135** and module **200** provide identical forces on the mid-clamp **130** as the temperature of the components change. In certain embodiments, spacers **135** may be provided in various lengths corresponding to different heights of modules **200** to be utilized with the mid-clamps **130**. However in certain embodiments, the spacers **135** may be provided in a single length, and may be cut (e.g., at an installation site) to be custom sized to correspond to the height of the modules **200**.
(56) In certain embodiments, the spacer **135** may have a width configured to extend from a first body surface (to be secured adjacent the module **200**, along the width of the body portion, and to an edge of a horizontal clamp member opposite the first body surface (e.g., spaced a distance away from the first body surface). Accordingly, the spacer may be configured to provide a smooth, finished surface visible at an edge of the module **200**, such that the resilient member **134** and/or clamp component **132** are not visible within the spacer **135**. As shown in FIGS. **17**B-**17**C, the spacer **135** may comprise standoffs **137** molded within the spacer **135**. The standoffs **137** may be configured to engage the body portion of the clamp component **132** (e.g., an exterior surface of the clamp component **132** and/or an interior surface of the clamp component **132**). In certain embodiments, the standoffs **137** may be configured to snap onto the clamp component **132**, such that the spacer **135** is detachably secured relative to the clamp component **132**. This configuration may ease installation of the module **200** and spacer **135** relative to the mid-clamp **130**, because the spacer **135** and mid-clamp **130** are provided as a self-contained component that may be secured relative to the rail **10** and module **200**.
(57) Convertible Clamp
(58) Solar panel modules **200** may be secured relative to rails **10** via one or more convertible clamps **300**. Example convertible clamps **300** according to certain embodiments are shown in FIGS. **18**A-**18**B. The convertible clamps **300** shown in FIGS. **18**A-**18**B may be configured to secure a single module **200** (e.g., solar panel module) relative to a rail **10** or to secure a plurality (e.g., two) modules **200** relative to the rail **10**, as shown in FIG. **19**.
(59) With reference again to the isolated views of FIGS. **18**A-**18**B, a convertible clamp **300** configured according to certain embodiments provides an upward facing fastening member **323** (e.g., having a tool engagement portion/head, such as a bolt head, accessible at a top end of the convertible clamp **300**) that may provide for quicker and/or easier installation. The illustrated convertible clamp **300** is configured to fit a range of module frame sizes, since there are no established standards for module frames.
(60) The convertible clamp **300** shown in FIGS. **18**A-**18**B comprises a channel nut **321** configured to engage a rail **10** (e.g., a bottom surface of flanges of a rail channel), a clamp component **322**, and a fastening member **323**. The fastening member **323** is slidably engaged with the clamp component **322** and is threaded into a threaded aperture of the channel nut **321**. In certain embodiments, the channel nut **321** height is configured such that it does not extend beyond the top surface of a rail **10** in which it is secured, such that tightening the fastening member **323** to secure a module **200** relative to the rail **10** causes the clamp component **322** to clamp the module **200** relative to the top surface of the rail **10**.
(61) As shown in FIGS. **18**A-**18**B, the clamp component **322** defines a modified "C" shape, having a vertical body portion **322***a*, a horizontal bottom leg **322***b* having a first length and extending away from the vertical body portion **322***a* in a first direction, and a horizontal top leg comprising a first

top leg portion **322***c* having a second length and extending away from the vertical body portion **322***a* in the first direction and a second top leg portion **322***d* having a third length and extending away from the vertical body portion **322***a* in a second direction at least substantially opposite the first direction. In the illustrated embodiment of FIGS. **18**A-**18**B, the second length (the length of the first top leg portion **322***c*) is longer than the first length (the length of the bottom leg portion **322***b*). In certain embodiments, the second length (the length of the first top leg portion **322***c*) is longer than the third length (the length of the second top leg portion **322***d*). In certain embodiments, the second length (the length of the first top leg portion **322***c*) is at least substantially equal to or greater than the combination of (1) the diameter of a body portion of the fastening member **323** and (2) the third length (the length of the second top leg portion **322***d*), such that the first top leg portion **322***c* and the second top leg portion **322***d* are configured to engage at least substantially equal lengths of a module **200** secured thereby.

(62) In various embodiments, the end of the bottom leg portion **322***b* is configured to engage a vertical surface of a module **200** secured under the first top leg portion **322***c*, to prevent the clamp component **322** from pivoting relative to the first top leg portion **322***c* when nothing is secured under the second top leg portion **322***d* (or in embodiments in which the first top leg portion **322***c* is thicker than the second top leg portion **322***d*, as discussed herein) and the fastening member **323** is tightened. Thus, as discussed herein, the convertible clamp **300** may be utilized in an end condition, in which only one module **200** is secured under a first side of the convertible clamp **300** or in a mid-condition, in which a first module **200** is secured under the first top leg portion **322***c* and a second module is secured on an opposite side of the convertible clamp **300** under a second top leg portion **322***d*.

(63) In certain embodiments discussed in greater detail herein, the bottom surface of the first top leg portion **322***c* may be lower than the bottom surface of the second top leg portion **322***d*. In such configurations (in other words, the first top leg portion **322***c* may be thicker than the second top leg portion **322***d*), the first top leg portion **322***c* may be configured to secure a first module **200** by engaging a top surface of the first module **200** and clamping the first module **200** against a rail **10**. Thus, once the first module **200** is secured between the rail **10** and the first top leg portion **322***c*, the distance between the top surface of the rail and the bottom surface of the first top leg portion **322***c* is at least substantially equal to the height of the module **200**. In this configuration, the distance between the top surface of the rail **10** and the bottom surface of the second top leg portion **322***d* is slightly larger than the height of the first module **200**, such that a second, matching module **200** may be slid between the second top leg portion **322***d* and the rail **10**.

(64) The top leg portion has an aperture extending therethrough (e.g., within the first top leg portion **322***c*) aligned with a slot within the bottom leg portion **322***b* for the fastening member **323** to extend therethrough (e.g., at least substantially parallel to the vertical body portion **322***a*). As mentioned, the first top leg portion **322***c* is configured to engage a horizontal surface of a first module **200** (e.g., solar panel) pressed against an end of the bottom leg portion **322***b*, such that the module **200** is clamped against the top surface of the rail **10** as the fastening member **323** is tightened as shown in FIG. **2**. Similarly, the second top leg portion **322***d* is configured to engage a horizontal surface of a second module **200** (e.g., solar panel) pressed against a portion of the vertical body portion **322***a* such that the second module **200** is clamped against the top surface of the rail **10** as the fastening member **323** is tightened. As shown in FIG. **2**, the fastening member **323** may be placed close to the first module **200** frame (e.g., in contact with the module frame) to impede rotation of the clamp component **322** relative to the module **200**.

(65) Moreover, as shown in FIGS. **18**A-**18**B, the bottom surface of the top leg (e.g., one or more of the first top leg portion **322***c* and/or the second top leg portion **322***d*) defines one or more puncture elements **324** (e.g., sharp pins) configured to puncture and/or indent the surface of a module **200** as the fastening element **323** is tightened to impede sliding and or rotation of the module **200** relative to the convertible clamp **300**. The puncture elements **324** may also serve to provide a reliable

electrical connection between the module frame and the rail **10**. These puncture elements **324** may be integrally formed with the clamp component **322**, may be formed by punching or securing pins relative to the clamp component **322**, and/or the like.
(66) In certain embodiments, the convertible clamp **300** comprises an integrated resilient member **334** (e.g., spring) as shown in FIGS. **20**A-**20**C to ease the installation process by ensuring the clamp component **322** remains above the top surface of the modules **200** until tightened. The integrated resilient member **334** also ensures the channel nut **321** of the convertible clamp **300** remains engaged with the rail channel. As shown in FIGS. **20**A-**20**C, the integrated resilient member **334** surrounds the fastening member **323** to support the clamp component **322** at a distance relative to the channel nut **322**. As illustrated in FIGS. **20**A-**20**B (which show the mid-clamp **330** in a raised position and a clamped position, respectively), the resilient member **334** compresses as the fastening member **323** is tightened.
(67) FIG. **21** is an isolated view of a resilient member **334** according to one embodiment. The resilient member **334** shown in FIG. **21** comprises a plurality (e.g., two) resilient arms **334***a* extending away from a body portion **334***b*. The resilient arms **334***a* define a zig-zag pattern between a bottom end (integrated with a top edge of the body portion **334***b*) and a top end (defining a portion of a fastening member axis through a central portion of the resilient member **334**. The resilient member **334** may comprise a plastic material, a metal material, a rubber material, or any other resilient material enabling the resilient arms **334***a* to be deformed via compression (to compress the plurality of resilient arm portions against one another) and to return to an uncompressed configuration once the compressive force is released. For example, the resilient arms **334***a* are configured to change between the configurations shown in FIG. **20**A (uncompressed) and FIG. **20**B (compressed) based on the compressive force applied via fastening member **323**.
(68) With reference again to FIG. **21**, the body portion **334***b* defines a partially enclosed portion (having an open side) configured to fit around a portion of the clamp component **322**. A closed vertical back wall of the body portion **334***a* is spaced laterally relative to the resilient arms **334***a* to define a gap **334***c* through which the vertical portion **322***a* of the clamp component **333** slidably extends. Specifically, a front side of the resilient arms **334***a* is aligned with an open side of the body portion **334***b*, such that a front edge of each of the resilient arms **334***a* and the body portion **334***b* are aligned. The resilient arms **334***a* have a width (measured between the front edge and a back edge of the resilient arms **334***a*) that is less than a width of the body portion (measured between the front edge and a front surface of the back wall), such that the front surface of the back wall is laterally spaced away from the back edge of the resilient arms **334***a* (visible in FIG. **20**C). Thus, when secured onto a convertible clamp **300**, the vertical portion **322***a* of the clamp component **322** slides through the gap **334***c*, and adjacent to the back edge of the resilient arms **334***a* as the convertible clamp **300** is compressed (e.g., by tightening fastener member **323**).
(69) Moreover, the resilient member **334** defines openings aligned with a central axis **334***d* of the resilient member **334** to accept the fastening member **323** extending therethough. As shown in FIG. **21**, the openings are defined between opposing top ends of the resilient arms **334***a* (the top end of each resilient arm defining a concave, curved end having a radius of curvature matching an outer diameter of the fastening member **323**) and an opening in a bottom wall of the body portion **334***b*. As visible in FIGS. **20**A-**20**B, when installed on a convertible clamp **300**, the fastening member **323** extends along the axis **334***d* to secure the resilient member **334** onto the convertible clamp **300**. Moreover, at least one of the top and bottom openings (e.g., both the top and bottom openings) may have open sides to enable the fastening member **323** to be clipped into the openings to align the fastening member **323** with the axis **334***d*.
(70) As shown in FIG. **22**, the back wall of the body portion **334***b* is thin such that, when installed on a convertible clamp **300**, the second top leg portion **322***d* extends laterally away from the vertical portion **322***a* by a distance greater than the distance between the vertical portion **322***a* and the back surface of the back wall of the body portion **334***b*. Accordingly, the second top leg portion

322*d* may be utilized to secure a module **200** thereunder with the resilient member **334** secured around the convertible clamp **300**.
(71) FIG. **22** illustrates a side view of a convertible clamp **300** installed on a rail **10** and securing a single module **200** relative to the rail **10**. As shown therein, the convertible clamp **300** remains stable (e.g., vertical relative to the rail **10** and module **200**) such that the convertible clamp **300** may be utilized to secure single modules **200** to rails **10** without needing additional objects (e.g., second modules **200**) placed on an opposite side of the convertible clamp **300** to balance the convertible clamp **300**.
(72) FIG. **23** illustrates a side view of a convertible clamp **300** installed on a rail **10** and securing a module **200** and a skirt **210** relative to the rail **10** (FIG. **24** shows a similar configuration, securing a module **200** relative to the rail **10**, without a skirt **210**). The skirt **210** may be embodied as an elongated member (e.g., a hollow member) that may be utilized to define a bottom edge of a module **200** installation array to provide a desirable aesthetic for the module **200** installation array that may be installed on a pitched roof. The skirt **210** may comprise an extruded aluminum rail having a mill finish (e.g., no coating), an anodized finish, a painted finish, and/or the like. In certain embodiments, the skirt **210** may comprise an electrically conductive material that may be used to connect various module components relative to electrical ground. However, it should be understood that any of a variety of materials may be utilized, including, for example, stainless steel, carbon steel, titanium, carbon fiber, wood, plastic, and/or the like. Moreover, the skirts **210** may be formed by any of a variety of manufacturing mechanisms, such as extrusion, forging, casting, milling, and/or the like.
(73) The skirt **210** may define a substantially planar, vertical back wall configured to be secured against a convertible clamp **300** and a substantially planar, horizontal (perpendicular to the back wall) bottom surface configured to be secured against a top surface of a rail **10**. Moreover, the skirt **210** may comprise a short, horizontal top surface configured to be secured under a top leg portion (e.g., first top leg portion **322***c* or second top leg portion **322***d*) of the clamp component **322**. The skirt **210** may further define an aesthetic surface extending from the top horizontal surface to (and/or past) the bottom horizontal surface). In the illustrated embodiment of FIG. **23**, the aesthetic surface is curved, however the aesthetic surface may have any of a variety of configurations, including angled, slanted, defining one or more ridges or corners therein, and/or the like.
(74) FIGS. **25**A-**26**B illustrates various views of module **200** array installations according to various embodiments. Portions of the modules **200**, specifically the solar panel portion of the modules **200** have been omitted in FIGS. **25**A and **26**A for purposes of illustration. Moreover, it should be understood that the modules **200** and/or skirt **210** may extend between adjacent rails **10** to provide an at least substantially continuous installation aesthetic. As shown in each of FIGS. **25**A-**26**B, the clamps **300** configured as discussed herein may be utilized to secure skirts **210** relative to rails **10**, to secure a single module **200** relative to the rails **10** and/or to secure two modules **200** relative to the rails **10**. Specifically, as shown in FIGS. **25**A-**25**B, a first convertible clamp **300** (e.g., bottom-most clamps **300** on each rail assembly shown in FIGS. **25**A-**25**B) may be configured to secure a skirt **210** on a first side of the convertible clamp **300** (e.g., under first top leg portion **322***c*) and a module **200** under a second side of the convertible clamp **300** (e.g., under second top leg portion **322***d*). A second convertible clamp **300** (e.g., middle clamps **300** on each rail assembly shown in FIGS. **25**A-**25**B) may be configured to secure a first module **200** under a first side of the clamp and a second module **200** under a second side of the clamp. Finally, a third convertible clamp **300** may be configured to secure a module **200** under a first side of the convertible clamp **300** while nothing is secured under the second side of the convertible clamp **300**. Each of the clamps shown (first, second, and third clamps on each rail assembly) may be identical, thereby illustrating the various uses of the clamps **300** for installation of modules **200** relative to rails.
(75) FIGS. **26**A-**26**B illustrate a similar module **200** array installation, however the module **200**

array installation shown therein omits the front skirt **210**. In such embodiments, the bottom-most convertible clamp **300** may be reversed, such that the first top leg portion **322***c* secures only the first module **200** and nothing is secured under the second top leg portion **322***d*, and the second top leg portion **322***d* faces downward in the illustrated configurations. However, all of the clamps **300** illustrated in FIGS. **26**A-**26**B may have identical configurations to those illustrated and described with respect to FIGS. **25**A-**25**B.

(76) To install the modules **200** and/or skirts **210** relative to the rails **10** via clamps **300**, the rails **10** are first secured relative to a support surface (e.g., a roof). The rails may be continuous rails, or short rail sections (as shown in the configurations of FIGS. **25**A-**26**B) positioned proximate gaps between adjacent modules **200**.

(77) A first convertible clamp **300** is slid into a rail **10** such that channel nut **321** is positioned within rail **10** to engage flanges of the rail **10** and the clamp component **322** is positioned above the top surface of the rail **10**. If a skirt **210** is to be utilized, the first top leg portion **322***c* is facing down the roof. The skirt **210**, having a height at least substantially equal to the height of modules **200** to be installed in the array, is inserted under the first top leg portion **322***c* such that the flat back surface is pressed against an end of the bottom leg portion **322***b*, and the flat bottom surface is pressed against the top surface of the rail **10**. In embodiments in which the convertible clamp **300** comprises resilient member **334**, the top leg portions **322***c-d* remain above the height of the skirt **210** while the fastening member **323** remains loose.

(78) In certain embodiments (e.g., embodiments in which the thickness of the first top leg portion **322***c* is greater than the thickness of the second top leg portion **322***d*), the fastener member **323** is tightened to secure the skirt **210** onto the rail **10**. This process may be repeated along the length of the skirt **210** at adjacently positioned rails **10** (as shown in FIG. **25**A). A first module **200** may then be slid under the second top leg portion **322***d*. As mentioned, the second top leg portion **322***d* may have a thickness less than the thickness of the first top leg portion **322***c*, such that the module **200** may be slide under the second top leg portion **322***d* after the convertible clamp **300** has been tightened. However, in certain embodiments in which the thickness of the first top leg portion **322***c* and second top leg portion **322***d* are equal, the convertible clamp **300** is not tightened until the module **200** and the skirt **210** are positioned under respective top leg portions. Again, the process of securing the lower end of the first module **200** under the second top leg portions **322***d* of respective clamps **300** is repeated across the bottom edge of the module **200**, at each of the adjacent rails **10**.

(79) In embodiments such as those shown in FIGS. **26**A-**26**B, in which no skirt **210** is utilized, the clamps **300** are placed within rails **10** such that the first top leg portion **322***c* faces up the support surface (in the perspective illustrated) such that a bottom edge of module **200** is secured under the first top leg portion **322***c*. The second top leg portion **322***d* faces down the support surface, and in embodiments as shown in FIGS. **26**A-**26**B, nothing is secured thereunder.

(80) The middle and upper clamps **300** illustrated in all of FIGS. **25**A-**26**B are installed similarly. The middle clamp is secured such that an upper end of the first module **200** is secured under the first top leg portion **322***c*, and the bottom edge of a second module **200** may be secured under the second top leg portion **322***d* of the convertible clamp **300**. Like the bottom convertible clamp **300** the fastening member **323** is tightened to secure the convertible clamp **300** relative to the modules. It should be understood that a plurality of clamps **300** secured in this configuration may be provided in embodiments in which the module array comprises greater than two modules **200** (such that there are a plurality of interfaces between adjacent modules **200**).

(81) Finally, the top most convertible clamp **300** in the illustrated embodiments of FIGS. **25**A-**26**B is secured relative to a top edge of the top-most module **200**. The first top leg portion **322***c* is secured over the top edge of the module **200** (e.g., by tightening the fastener member **323**) to secure the module **200** relative to the rail **10**. In the illustrated embodiment of FIGS. **25**A-**26**B, nothing is secured under the second top leg portion **322***d* of the clamp component **322**.

(82) Rail-Mounting Configurations

(83) FIGS. **27-28** illustrate a rail securing mechanism configured to secure a rail **10** relative to surface mounts **20**. In certain embodiments, the rails **10** may have a configuration as described in co-pending patent application Ser. No. 16/117,813 filed Aug. 30, 2018 the contents of which are incorporated herein by reference in their entirety.
(84) As shown in FIG. **27-28**, the surface mounts **20** may comprise at least substantially linear mount plates having a horizontal base surface **21** that may be placed against a support surface (e.g., a roof). The base surface **21** defines a plurality of fastener holes **22** therein configured to accept fasteners to secure the surface mounts **20** relative to the support surface. The surface mounts **20** additionally comprise vertical snap plates **23** extending perpendicularly away from the base surface **21**. The vertical snap plates **23** are resilient plates having interference-fit members proximate an end thereof. In use, the vertical snap plates **23** are displayed outwardly as a rail **10** is pressed against the surface mounts **20** and snap around engagement features **11** of the rails **10** to secure the rails **10** relative to the surface mounts **20**.
(85) As shown in FIGS. **27-28**, the surface mounts **20** additionally comprise a central support portion **24** between the vertical snap plates **23**. The central support portion **24** is configured to engage a bottom surface of a rail **10** (e.g., between engagement members **11** of the rail **10**) to support the rail **10** thereon. Thus, the central support portion **24** provides a retaining surface against the rail **10**, such that the engagement features **11** of the rails **10** remain in contact with the engagement fit aspects of the vertical snap plates **23**. Moreover, the central support portion **24** may be configured to engage interior side portions of the engagement features **11** (as shown in the end-views of FIGS. **29**A-**29**B) to provide lateral support against sheer forces acting on the interface between the rail **10** and the surface mounts **20**.
(86) Although not shown, the surface mounts **20** may be configured for securing relative to a plurality of rail configurations, such as the rails **10***a*-**10***f* shown in FIGS. **30**A-**30**F. The engagement features **11***a*-**11***e* may be configured to be secured relative to vertical snap plates **23** of the surface mounts **20**.
CONCLUSION
(87) Many modifications and other embodiments will come to mind to one skilled in the art to which this disclosure pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the disclosure is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

Claims

1. A solar panel mounting system comprising: at least one mounting rail; and at least one mounting clamp for securing one or more modules to the at least one mounting rail, the at least one mounting clamp comprising: a clamp component defining a first horizontal clamp surface; a fastening member adjustably securing the clamp component to a channel nut, the fastening member having an adjustment head extending above a clamp top surface of the clamp component, wherein the fastening member is configured to, when tightened by rotating the adjustment head, move the clamp component toward the channel nut; and a compressible resilient member positioned between the clamp component and the channel nut, and wherein the compressible resilient member is configured to support the clamp component a distance away from the channel nut; wherein the compressible resilient member comprises one or more side members, each of the one or more side members having a height measured between a base of the compressible resilient member and a top end of the respective side member of said one or more side members; wherein the compressible resilient member comprises a compressible resilient member aperture configured to receive at least

a portion of the fastening member therein, wherein the compressible resilient member aperture is defined at least in part by an outer perimeter that at least partially surrounds the at least a portion of the fastening member; and wherein each side member of the compressible resilient member defines a vertical arm portion that, when compressed, forms substantially stacked sheet portions.

2. The solar panel mounting system of claim 1, wherein the clamp component comprises: a vertical body portion aligned parallel with the fastening member; and a top horizontal leg extending at least substantially perpendicular from an upper end of the vertical body portion and defining the clamp top surface of the clamp component and an opposite lower surface, wherein the opposite lower surface defines the first horizontal clamp surface and a second horizontal clamp surface.

3. The solar panel mounting system of claim 1, wherein at least a portion of the clamp component contacts a first portion of the compressible resilient member.

4. The solar panel mounting system of claim 1, wherein each vertical arm portion is defined by a plurality of thin resilient sheets having an at least partially curved shape defined at least in part by a respective radius of curvature.

5. The solar panel mounting system of claim 1, wherein the compressible resilient member aperture is disposed between a first side member and a second side member.

6. The solar panel mounting system of claim 5, wherein the outer perimeter of the compressible resilient member aperture is at a central position of the compressible resilient member.

7. The solar panel mounting system of claim 5, wherein the first side member and the second side member are disposed on opposite sides of the fastening member such that at least a first member portion of the fastening member extends between the first side member and the second side member.

8. The solar panel mounting system of claim 1, wherein the channel nut is configured to engage an interior portion of the at least one mounting rail so as to secure the at least one mounting clamp relative to the at least one mounting rail in one or more directions.

9. The solar panel mounting system of claim 1, wherein the channel nut comprises a threaded aperture configured to receive at least a portion of the fastening member so as to secure the fastening member relative to the channel nut.

10. The solar panel mounting system of claim 1, wherein the compressible resilient member comprises a second compressible resilient member aperture configured to receive at least a second portion of the fastening member therein.

11. The solar panel mounting system of claim 10, wherein the compressible resilient member aperture and the second compressible resilient member aperture are coaxially arranged.

12. The solar panel mounting system of claim 1, wherein the base is configured to engage a top surface of the channel nut.

13. The solar panel mounting system of claim 1, wherein the clamp component defines one or more puncture elements configured to engage a panel top surface of a first solar panel.

14. The solar panel mounting system of claim 1, wherein the first horizontal clamp surface of the clamp component is on a first side of the fastening member and the clamp component further defines a second horizontal clamp surface on an opposite, second side of the fastening member.

15. The solar panel mounting system of claim 14, wherein the first horizontal clamp surface is configured to engage a first solar panel and the second horizontal clamp surface is configured to engage a second solar panel.

16. The solar panel mounting system of claim 1, wherein the compressible resilient member aperture defines an outer perimeter partially surrounding the at least a portion of the fastening member such that the portion of the fastening member is exposed through a side of the compressible resilient member.

17. The solar panel mounting system of claim 1, wherein the one or more modules comprises at least a solar panel.

18. The solar panel mounting system of claim 1, wherein the at least one mounting rail defines an

interior and a rail channel along a length of the at least one mounting rail.

19. The solar panel mounting system of claim 18, wherein the channel nut engages the rail channel when the channel nut is positioned within the interior of the at least one mounting rail.

20. A solar panel mounting system comprising: at least one mounting rail; and at least one mounting clamp for securing one or more solar panels to the at least one mounting rail, the at least one mounting clamp comprising: a clamp component configured to engage a panel top surface of at least a first solar panel; a channel nut configured to engage an interior portion of the at least one mounting rail, wherein the channel nut has a nut width and a nut length measured perpendicular to the nut width; a fastening member adjustably securing the clamp component to the channel nut and having an adjustment head extending above a clamp top surface of the clamp component, wherein the fastening member is configured to, when tightened by rotating the adjustment head, move the clamp component toward the channel nut and the at least one mounting rail to clamp the first solar panel against an exterior portion of the at least one mounting rail; and a compressible resilient member positioned between the clamp component and the channel nut, wherein the compressible resilient member is configured to support the clamp component a distance away from the channel nut; wherein the clamp component defines a first horizontal clamp surface on a first side of the fastening member and a second horizontal clamp surface on an opposite, second side of the fastening member, wherein the first horizontal clamp surface is configured to engage the first solar panel and the second horizontal clamp surface is configured to engage a second solar panel; wherein the compressible resilient member comprises one or more vertical arm members, each of the one or more vertical arm members having a height measured between a bottom horizontal base of the compressible resilient member and a top end of the respective vertical arm member of said one or more vertical arm members; wherein the one or more vertical arm members comprises a first vertical arm member and a second vertical arm member; and wherein the first vertical arm member defines at least a portion of a first vertical side edge of the compressible resilient member and the second vertical arm member defines at least a portion of a second vertical side edge of the compressible resilient member; and wherein the compressible resilient member further comprises a cover plate that extends between the first vertical side edge and the second vertical side edge.