

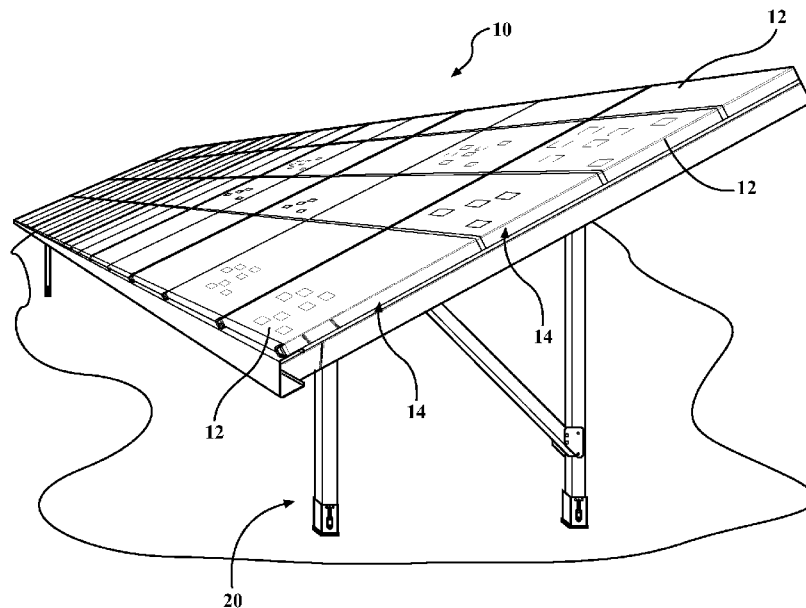


- (51) **International Patent Classification:**
H01L 31/042 (2006.01)
- (21) **International Application Number:**
PCT/US2013/030797
- (22) **International Filing Date:**
13 March 2013 (13.03.2013)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
61/611,217 15 March 2012 (15.03.2012) US
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- (81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) **Designated States (unless otherwise indicated, for every kind of regional protection available):** ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) **Title:** SOLAR PANEL MOUNTING STRUCTURE



(57) **Abstract:** A mounting structure for a solar panel assembly, having a plurality of solar panels, includes a plurality of vertical support legs and a grid assembly. The grid assembly includes a plurality of north-south members and the east-west members. The plurality of north-south members include a plurality of elongated slots to allow attachment to the vertical support legs despite any manufacturing tolerances that may exist in the components. The plurality of east-west members include a plurality of elongated slots to allow attachment to the north-south members despite any manufacturing tolerances that may exist in the components.

WO 2013/138444 A1

SOLAR PANEL MOUNTING STRUCTURE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This PCT Patent Application claims the benefit of U.S. Provisional Patent Application Serial No. 61/611,217, entitled “Solar Panel Mounting Structure”, filed March 15, 2012, the entire disclosure of the application being considered part of the disclosure of this application, and hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The subject invention is related to a solar panel assembly, and more precisely, to a solar panel assembly including a mounting structure for receiving and retaining solar panels.

2. Description of the Prior Art

[0003] Renewable resources are becoming an increasingly popular alternative to non-renewable resources for generating electricity. One renewable resource that can be converted into electricity is solar energy through the use of solar power generators, which harness the potential energy of solar rays from the sun and convert that potential energy into electricity. One type of solar power generator is a photovoltaic (PV) cell, which converts solar radiation into electricity.

[0004] PV cells are typically arranged in an array on a solar panel. For maximum effectiveness, the PV panels must remain outdoors, and therefore, they must be resistant to a wide range of environmental factors. Such environmental factors could include high winds, rain, hail and large snow falls. For cost savings purposes, PV panels are typically mounted on a stationary mounting structure which angles the PV panels to receive maximum solar rays throughout the year. Due to seasonal changes of the earth's axis relative to the sun, the optimal angle at which the PV panels should be operated changes continuously.

Accordingly, a large amount of potential energy is inherently lost by the stationary PV panels.

[0005] Typical solar panels are intended to be mounted in predetermined locations and include mounting structures having a plurality of north-south members and a plurality of east-west members that interconnect with the north-south members to form a rack for receiving and retaining the PV panels. This mounting structure is maintained at an angle by a plurality of front and rear legs that serve to support the mounting structure. These mounting structures are typically installed on one or more predetermined foundation structures. Because of manufacturing tolerances that exist in the various components that make up the mounting structure as well as variances that can exist in the foundation structures, it can be extremely time consuming and laborious to accurately assemble and align the mounting structure and thus the solar panel assembly in the field.

[0006] It would therefore be desirable to have a mounting structure that can be easily and securely installed and allows for manufacturing tolerances and other variances to be compensated for during the installation process in the field.

SUMMARY OF THE INVENTION

[0007] It is therefore an aspect of the present disclosure to provide a solar panel array assembly that can be readily installed in the field.

[0008] It is another aspect of the present disclosure to provide a mounting structure for a solar assembly that allows for the compensation of manufacturing tolerances or variances as part of the manufacturing process.

[0009] In accordance with the above and the other aspects, a solar assembly is provided which includes a plurality of solar panels disposed on a mounting structure. The mounting structure includes a plurality of north-south members and a plurality of east-west members secured thereto. The plurality of east-west members have a plurality of elongated

slots formed therein such that a fastening member can pass through a respective one of the slots to connect and secure the north-south members to the east-west members despite any manufacturing tolerances that may exist in the components. The mounting structure also includes a plurality of front leg members and a plurality of rear leg members that connect at respective upper ends to the north-south members and connect at lower ends to a plurality of pre-installed foundation structures. A leg mounting bracket is disposed at the connection between each of the foundation structures and the leg members. The leg mounting brackets each include an elongated vertical slot that insures the placement of fastening members utilized to connect the leg members to the foundation structures despite the existence of any manufacturing tolerances and grade variations or slope of the ground at the site location.

[0010] In accordance with another aspect, each of the leg mounting brackets includes an elongated horizontal slot that compensates for any manufacturing tolerances as part of the connection of the leg members to the foundation structures by ensuring alignment of the connection openings.

[0011] In accordance with still another aspect, the mounting structure includes a plurality of structures that extend between the rear legs and the north-south members. The plurality of structures each have an elongated slot disposed adjacent the connection to the north-south members that allows for flexibility in the placement of the fastening members to also accommodate for manufacturing tolerances.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Other aspects of the present invention will be readily appreciated, as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[0013] Figure 1 is a perspective view of a solar array assembly in accordance with an aspect of the disclosure;

[0014] Figure 2 is a side view of a mounting structure for a solar panel assembly in accordance with an aspect of the disclosure;

[0015] Figure 3 is a perspective view of a mounting structure for a solar panel assembly in accordance with an aspect of the disclosure;

[0016] Figure 4 is a cross-sectional view of the mounting structure of Figure 3 in the direction of the arrows 4-4;

[0017] Figure 5 is a schematic illustration of a connection of a leg member to a foundation structure in accordance with an aspect of the disclosure;

[0018] Figure 6 is a schematic illustration of a connection of a rear leg member to a foundation structure as well as a diagonal reinforcement to a rear leg member in accordance with an aspect of the disclosure;

[0019] Figure 7 is a schematic illustration of a connection of a leg member to a north-south member in accordance with an aspect of the disclosure;

[0020] Figure 8 is a schematic illustration of a connection of a north-south member to an east-west member in accordance with an aspect of the disclosure;

[0021] Figure 9A is a schematic illustration a connection of one end of a rear support brace to a rear leg member in accordance with an aspect of the disclosure;

[0022] Figure 9B is a schematic illustration a connection of another end of a rear support brace to a rear leg member in accordance with an aspect of the disclosure;

[0023] Figure 10 is a schematic illustration of an interconnection of sections of an east-west member in accordance with an aspect of the disclosure; and

[0024] Figure 11 illustrates a completed solar assembly in accordance with an aspect of the disclosure.

DETAILED DESCRIPTION OF THE ENABLING EMBODIMENTS

[0025] Referring to the Figures, wherein like numerals indicate corresponding parts throughout the several views, a solar assembly **10** is generally shown. As best shown in Figure 1, the solar assembly **10** may include a plurality of panels **12** arranged in a plurality of solar arrays **14**. In the exemplary embodiment, each panel **12** can include at least one photovoltaic (PV) cell for receiving sun rays and converting them into electricity.

However, it should be appreciated that the solar panels **12** could be any other type of panel for converting sun rays into electricity or any other form of useable energy. It should be appreciated that the solar assembly **10** could include any number of solar arrays **14** and those arrays **14** could be disposed at any desirable angle relative to one another. According to an aspect, the solar arrays **14** are supported and oriented in a predetermined direction and at a predetermined angle by a mounting structure **20**. According to an aspect, the solar arrays **14** are installed and maintained at an orientation that maximizes the solar rays captured by the PV panels **12** throughout the year. It is thus important that the mounting structure **20** can be installed and assembled properly so that the solar arrays **14** are properly aligned. However, because of ground unevenness, manufacturing tolerances, and other variables, alignment of the components and their attachment openings can be very difficult thus making installation of the solar assembly **10** a laborious and time consuming process.

[0026] According to an aspect of the disclosure and with reference specifically to Figures 2-4, the mounting structure **20** can include a plurality of north-south members **22**, a plurality of east-west members **24**, a plurality of front leg members **26**, a plurality of rear leg members **28**, a plurality of diagonal reinforcements **30**, and a plurality of rear support braces **32**. The mounting structure **20** may include more or less components as desired. As shown in the Figures, the north-south members **22** may have a forward end **40** and rearward end **42** with a body extending generally therebetween. The body may be angled upward in

the direction from the forward end **40** to the rearward end **42** such that the solar panels are positioned at the desired angle. As shown, the mounting structure **20** can have any number of north-south members **22** and they can extend at a variety of different upward angles.

[0027] The components that make the mounting system **20** may be formed of a variety of different materials and may have a variety of different configurations. According to an aspect, as shown in Figures 5 and 6, the front leg members **26** and the rear leg members **28** may each employ generally lipped c-shapes. Additionally, as shown in Figure 7, according to another aspect, the north-south members **22** may have a generally lipped c-shape. According to a further aspect, as shown in Figure 4, the east-west members **24** can have an open parallelogram shape. According to another aspect shown in Figure 6, the diagonal reinforcements **30** may have a lipped c-shape. According to a still further aspect, as shown in Figures 9A and 9B, the rear support braces **90** may have an l-shape. It will be understood that the illustrated shapes of these structures are merely exemplary and these structures can be formed in a multitude of other shapes and configurations as desired. Also, according to an aspect, the components may be formed of suitable metal material. However, a variety of other suitable materials may be employed.

[0028] Figure 5 through 10 illustrate the various connections that exist to assemble the various individual components of the mounting structure **20** according to an aspect of the disclosure. It will be understood that the structures effectuating the connections are intended to be friction-type bolted connections. However, other suitable connecting structures may be employed. According to an aspect, the fasteners may be M10 bolts with appropriate backing plates. According to another aspect, the M10 bolts can be torqued to 65 Nm. It will be appreciated that other suitable attachment structures may also be employed having a variety of different characteristics and specifications.

[0029] Referring now to Figures 5 and 6, the connection of the leg members **26**, **28** to the foundation structure **50** is schematically illustrated. While the connection is described in connection with the front leg members **26**, however, the description applies equally to the connection of the rear leg members **28**, as shown in Figure 6. According to an aspect, the connection may be effectuated by a mounting bracket **52** that allows for the connection of the front leg member **26** at a lower end to the foundation structure **50**. According to another aspect, the mounting bracket **52** may be generally c-shaped and fit around the exterior perimeter of the front leg member **26**. According to a further aspect, a fastening structure **54** may pass through a back portion **56** of the mounting bracket **52** to secure it to the front leg member **26**. The back portion **56** may include an elongated vertical slot **58** that allows a fastening structure **54** to couple the mounting bracket **52** to the front leg member **26**. The fastening structure **54** may consist of a bolt and a backing plate with nuts. The vertical slot **58** can help compensate for any tolerances that may result from the manufacture of the components that make up the mounting structure **20** by allowing the opening or openings in the front leg member **26** to align with the vertical slot **58** for receipt of the bolt therethrough. Instead of a slot **58**, another suitable opening configured to allow for the compensation of tolerances may be employed. According to a further aspect, the slot **58** allows for up-down adjustment as well as some angular adjustment of the front leg member **26**.

[0030] The mounting bracket **52** may also include a base portion **60** for abutting the foundation structure **50**. Another fastening device **60** may pass through an opening **62** in the base portion **60** to securely connect the front leg **26** to the foundation structure **50**. According to an aspect, the foundation structure **50** can consist of helical pilings. However, other suitable structures may also be utilized. The opening **62** can consist of an elongated horizontal slot that again allows easier alignment with an opening in the foundation

structure **50** such that any manufacturing tolerances or other variances are taken into account and do not interfere with the proper assembly of the components. Instead of a slot **62**, another suitable opening configured to allow for the compensation of tolerances by side adjustment may be employed.

[0031] Figure 6 also illustrates the connection of the diagonal reinforcement **30** to the rear leg member **28**. According to an aspect, as shown, a bracket **100** can be employed to secure the rear leg member **28** to the diagonal reinforcement **30**. The bracket **100** may include one or more openings **102** that are intended to align with openings **104** in the lower end of the rear leg member **28**. One or more fastening devices **106** can be utilized to secure the bracket **100** to the rear leg member **28**. According to an aspect, the openings **102** or openings **104** may consist of an elongated slot or be otherwise enlarged to allow for the compensation of tolerances. According to another aspect, the bracket **100** may also include one or more openings **108** that are intended to align with openings **112** in a lower end **110** of the diagonal reinforcement **30**. One or more fastening devices **114** can be utilized to secure the bracket **100** to the diagonal reinforcement **30**. According to a further aspect, the openings **108**, **112** may consist of an elongated slot or be otherwise enlarged to allow for the compensation of tolerances.

[0032] Figure 7 illustrates the connection of each of the front leg members **26** and the rear leg members **28** to the north-south members **22**. The connection is described with respect to the front leg members **26**, however the description applies equally to the attachment of the rear leg members **28** to the north-south member **22**. As shown, one or more openings **70** may exist in each of the front leg members **26** and the north-south members **22** to allow a fastening device **72** to effectuate a connection therebetween and secure the front leg members **26** to the north-south members **22**. The fastening device **72** can include a pair of bolts **74** and a backing plate **76**. Instead of openings, one or more slots

could be employed. It will be appreciated that the fastening device **72** could have a variety of different configurations. According to an aspect, the upper end **116** of the diagonal reinforcements **30** can be secured to the north-south members **22** in the same fashion as the front and rear leg members **26, 28**.

[0033] Referring now to Figure 8 which depicts the connection of the north-south members **22** to the east-west members **24**. According to an aspect, the east-west members **24** may include a plurality of slots **80** formed therein. According to another aspect, as the mounting structure **20** is assembled, one of the slots **80** may overlie an opening formed in the north-south members **24** to allow for easy attachment of the members **22, 24** to one another despite any tolerance variations that may exist as a result of the individual manufacture of the components that make up the mounting structure **20** or other variations. The securing of these structures is effectuated by a fastening device **82** that may consist of a nut **84**, a bolt **86** and a backing plate **88**. However, other suitable structures may be employed. The slot **80** that is utilized to receive the fastening device can vary depending upon the degree of tolerance build up. However, according to an aspect, the assembly of the mounting structure **20** will not be affected by the tolerances. Instead of slots **80** other suitable openings configured to allow for the attachment of the north-south members **22** to the east-west members **24** may be employed. Additionally, more or less slots or openings may be employed.

[0034] Figures 9A and 9B illustrate the connection of the rear support brace **90** to the rear leg members **28**. As shown, each end of the rear support brace **90** includes an opening **92** that is intended to align with corresponding openings in adjacent rear leg member **28**. According to an aspect, the openings **92** are elongated slots formed therein that provide some play such that once the rear support brace **90** is aligned with the rear leg member **28**, the opening in the rear leg member **28** is accessible through the slot **92** to allow

utilization of a fastening device **94**, thereby in this case a bolt and nut, to secure the rear support braces **90** to each of the rear leg members **28**. It will be appreciated that various different types of fastening devices may be employed to secure these structures.

[0035] As shown in Figure 10, each east-west member **24** can consist of multiple sections. While three sections are disclosed, it will be appreciated that more or less sections can be utilized. The sections are preferably connected by a plurality of bolts and a bracket, as generally indicated by reference number **98**. These sections are connected at their ends by the fastening structures that assist in integrating the sections into a single unitary east-west member **24**.

[0036] Figure 11 generally illustrates the attachment mechanism **120** that can be employed to secure the solar panels **12** to the mounting structure **20**.

[0037] Obviously, many modifications and variations of the present invention are possible in light of the above teachings and may be practiced otherwise than as specifically described while within the scope of the appended claims.

In the Claims:

Claim 1. A mounting structure for a solar panel assembly, comprising:

a plurality of front support legs having a first height, each front support leg having an upper end for communicating with a solar array and a lower end configured for communicating with ground;

a plurality of rear support legs having a second height, wherein the second height is greater than the first height, each of the plurality of rear support legs having an upper end for communicating with the solar array and a lower end configured for communicating with ground;

a grid pattern for receiving a plurality of solar arrays, the grid pattern being generally planar and supported by the front support legs and the rear support legs at an angle with respect to ground, including:

a plurality of north-south members with each of the plurality of north-south members extending between one of the plurality of front support legs and one of the plurality of rear support legs such that each north-south member is oriented at an angle with respect to ground; a plurality of enlarged openings formed in each of the north-south members that are each configured to at least partially align with a first throughhole formed in the upper end of each of the front support legs and a second throughhole formed in the upper end of the rear support legs;

a plurality of east-west segments that overlie and connect to each of the plurality of north-south members, each of the plurality of east-west segments having a plurality of enlarged apertures spaced along their lengths that are configured to at least partially align with corresponding voids formed in each of the plurality of north-south members;

wherein the plurality of enlarged openings are each larger than the first throughholes and the second throughholes;

wherein the plurality of enlarged apertures are each larger than the voids.

Claim 2. The assembly of claim 1, further comprising:

a plurality of first retention mechanism passed through the enlarged openings in the north-south members and the first throughhole in each of the front support legs; and

a plurality of second retention mechanism passed through the enlarged openings in the north-south members and the second throughhole in each of the rear support legs.

Claim 3. The assembly of claim 2, further comprising:

a plurality of fastening mechanism extending through the enlarged apertures in each of the plurality of east-west segments and the voids in the plurality of north-south members to secure the plurality of east-west segments to the plurality of north-south strips.

Claim 4. The assembly of claim 3, wherein the front support legs are arranged generally in a first parallel row.

Claim 5. The assembly of claim 4, wherein the rear support legs are arranged generally in a second parallel row with the first parallel row being substantially parallel to the second parallel row.

Claim 6. The assembly of claim 5, wherein the plurality of enlarged openings are elongated slots.

Claim 7. The assembly of claim 5, wherein the plurality of enlarged apertures are elongated slots.

Claim 8. The assembly of claim 1, further comprising:
a plurality of diagonal supports that each extend between one of the plurality of rear support legs and one of the plurality of north-south members.

Claim 9. The assembly of claim 8, wherein the plurality of diagonal supports include a first oversized slot formed therein that is configured to at least partially align with a support leg opening in one of the plurality of rear support legs.

Claim 10. The assembly of claim 9, wherein the plurality of diagonal supports include a second oversized slot formed therein that is configured to at least partially align with a north-south member slot to allow attachment therefore.

Claim 11. The assembly of claim 1, further comprising:
a front leg aperture formed adjacent a lower end of each of the front support legs to effectuate securement to a foundation structure in ground.

Claim 12. The assembly of claim 11, further comprising:
a rear leg aperture formed adjacent a lower end of each of the rear support legs to effectuate securement to a foundation structure in ground.

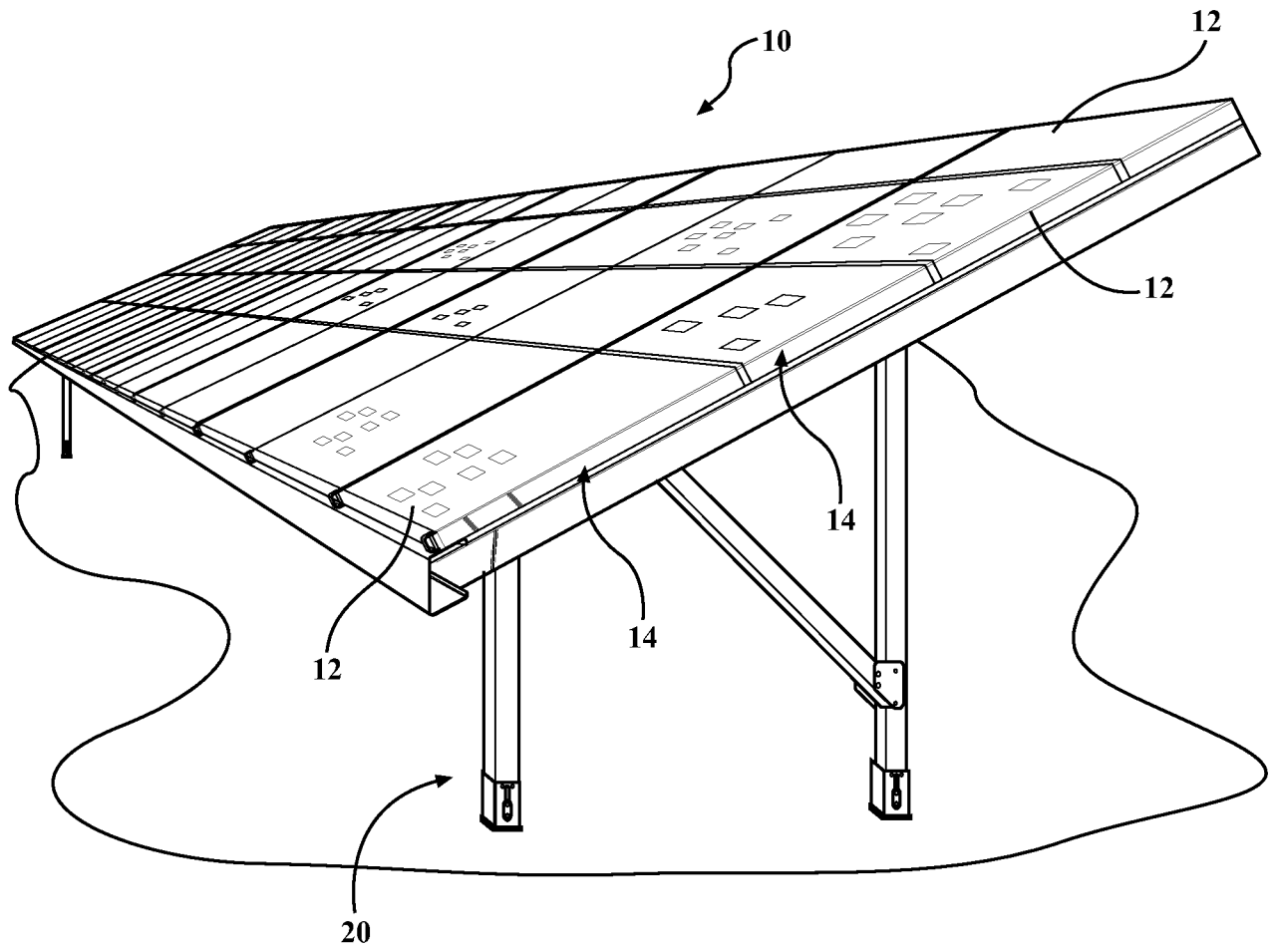


FIG. 1

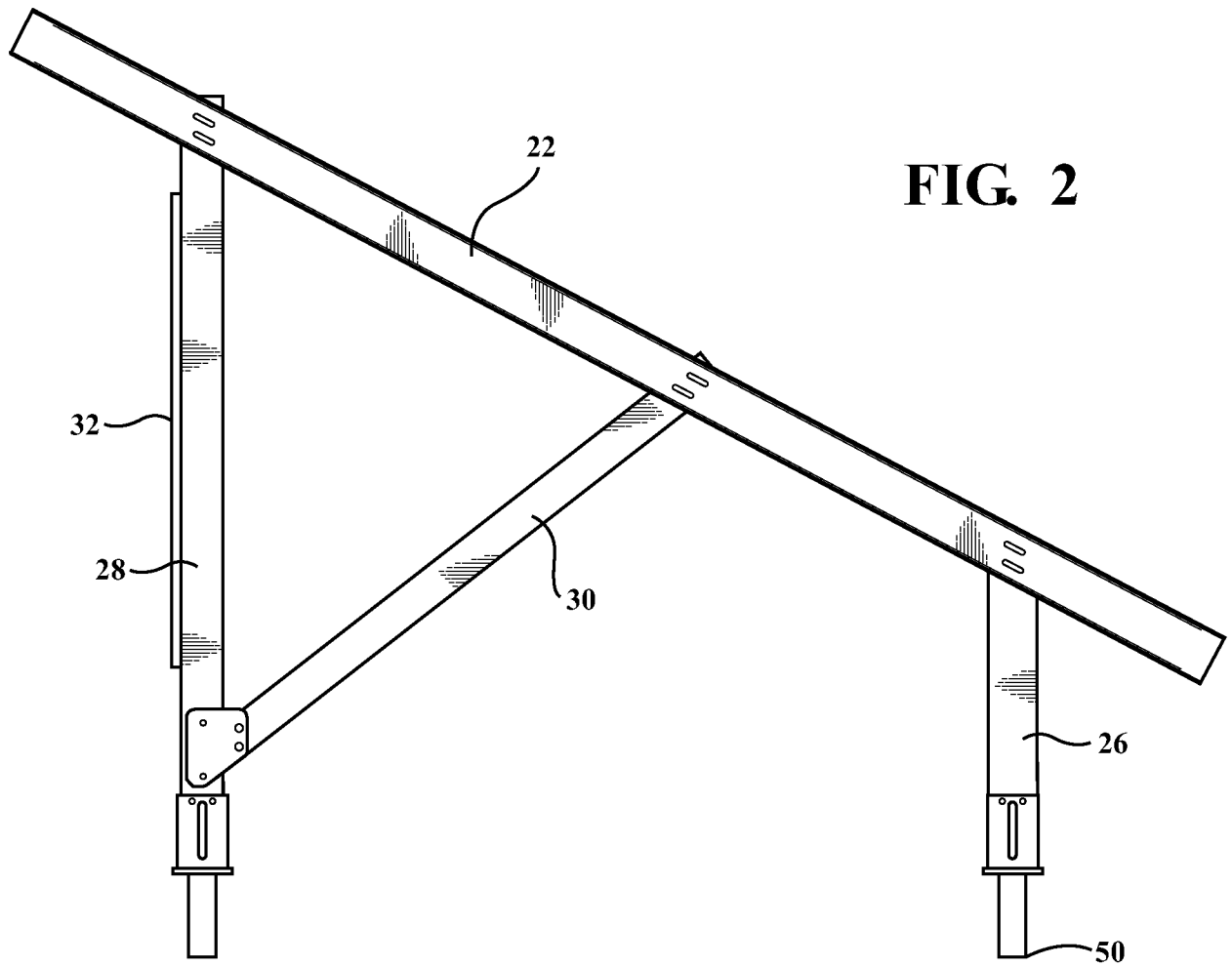


FIG. 2

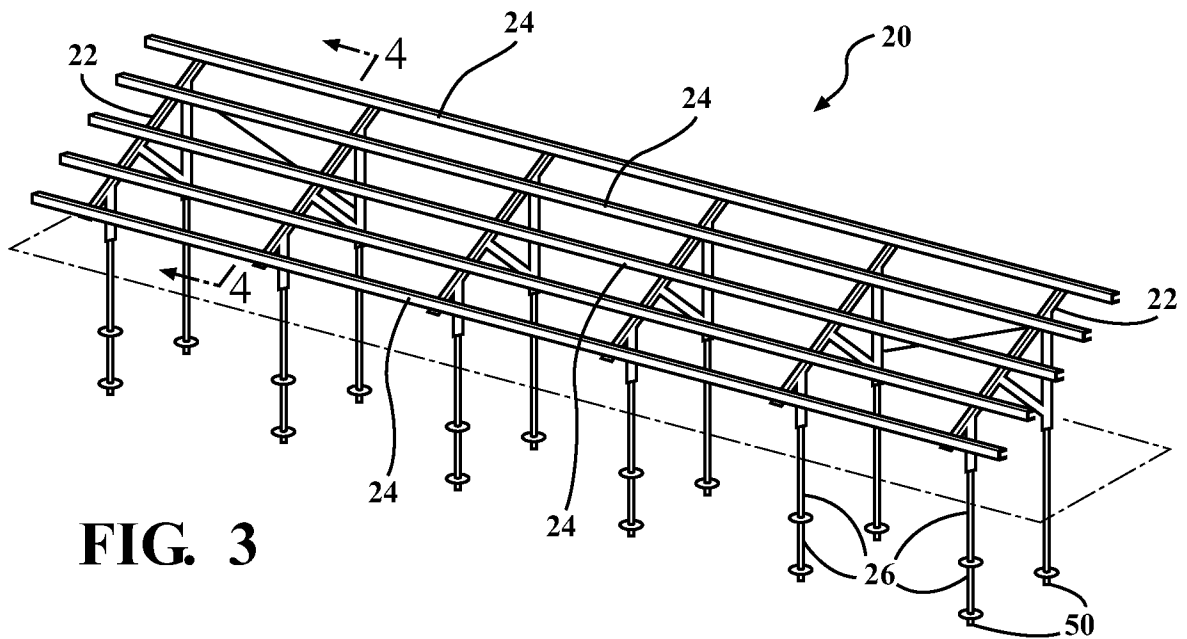


FIG. 3

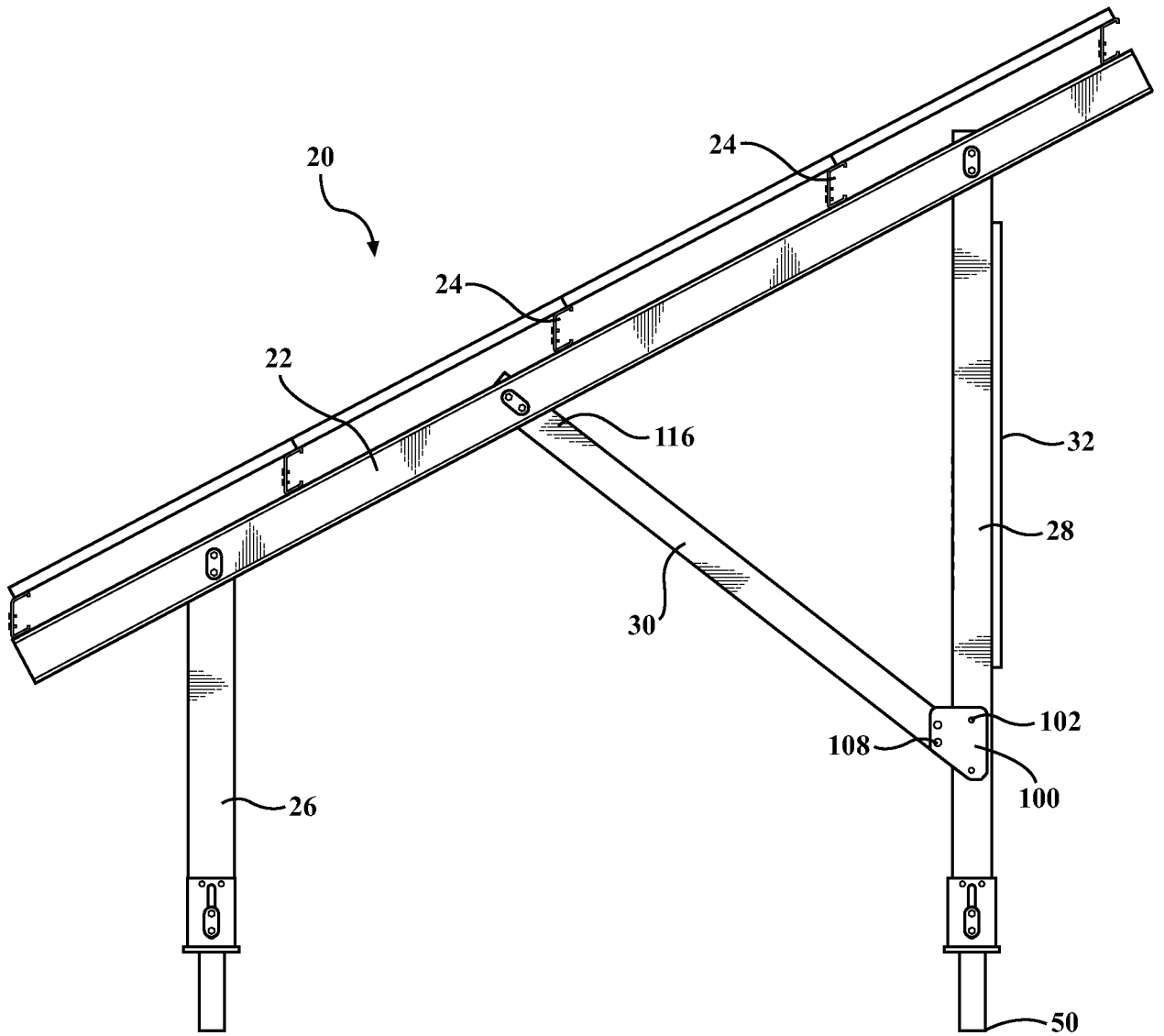


FIG. 4

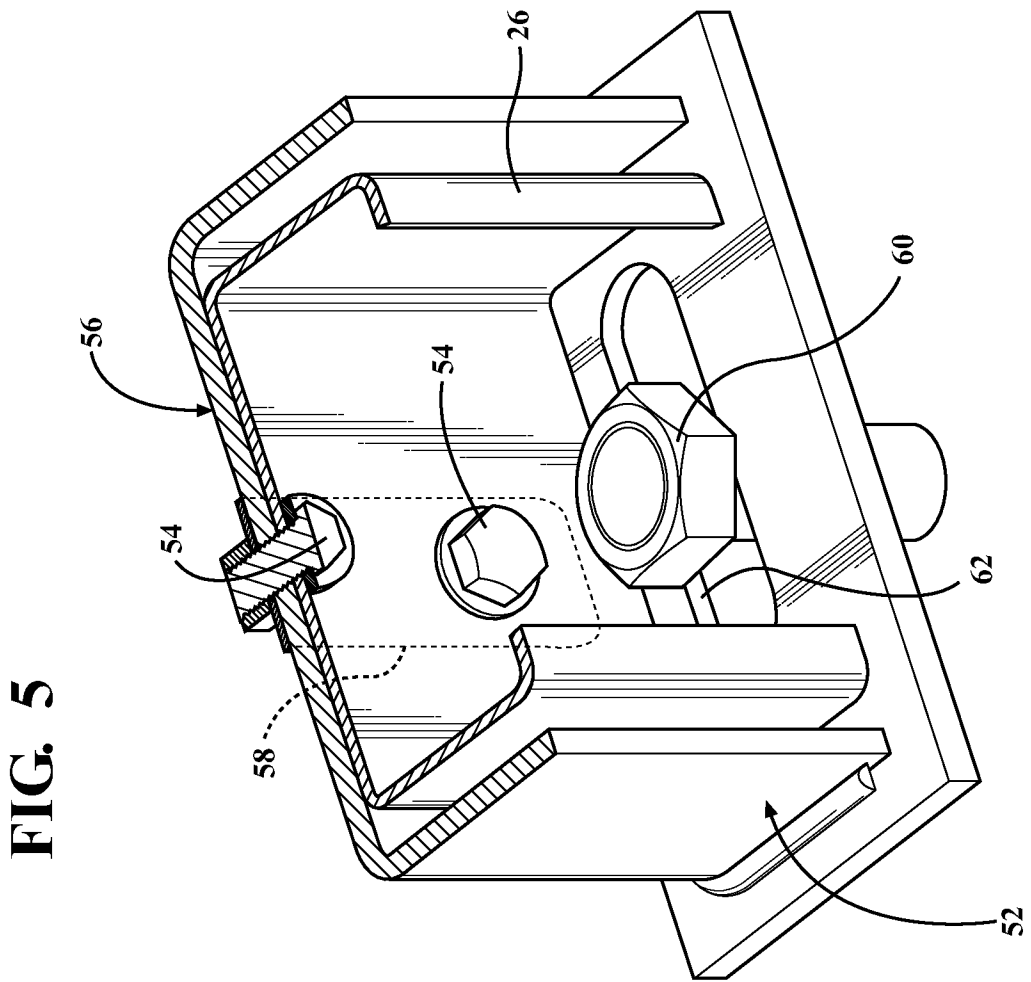
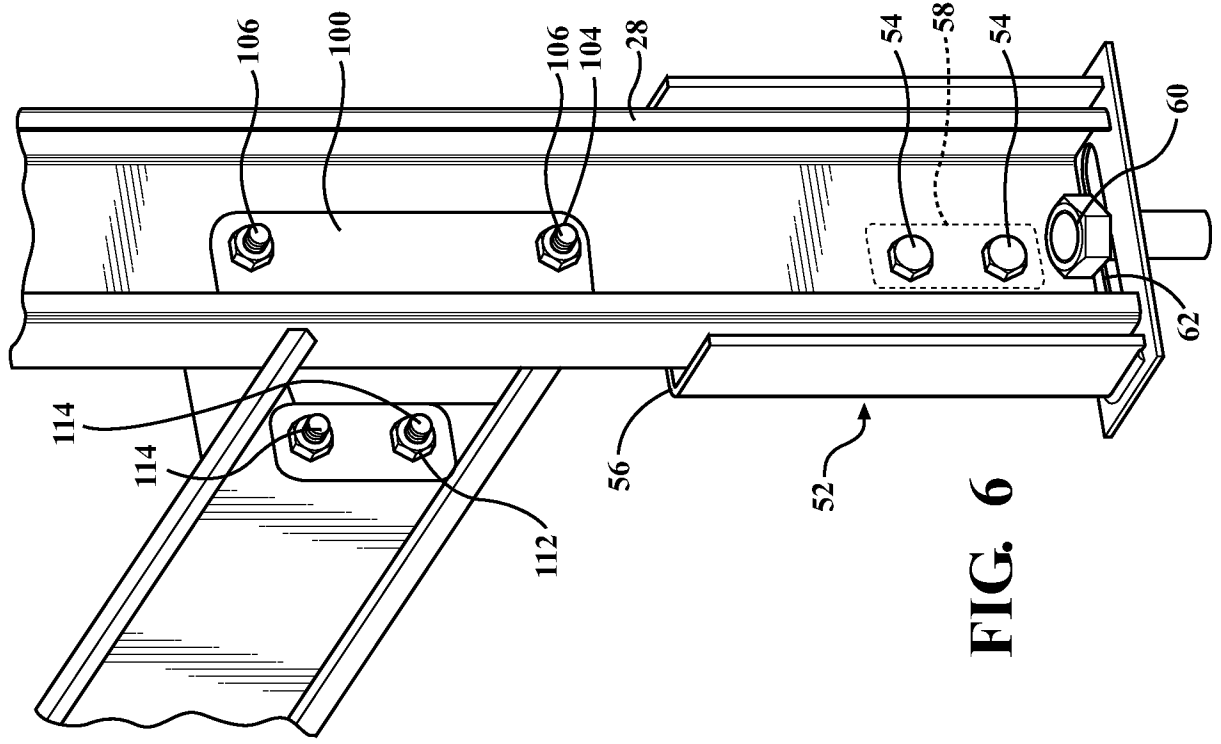


FIG. 7

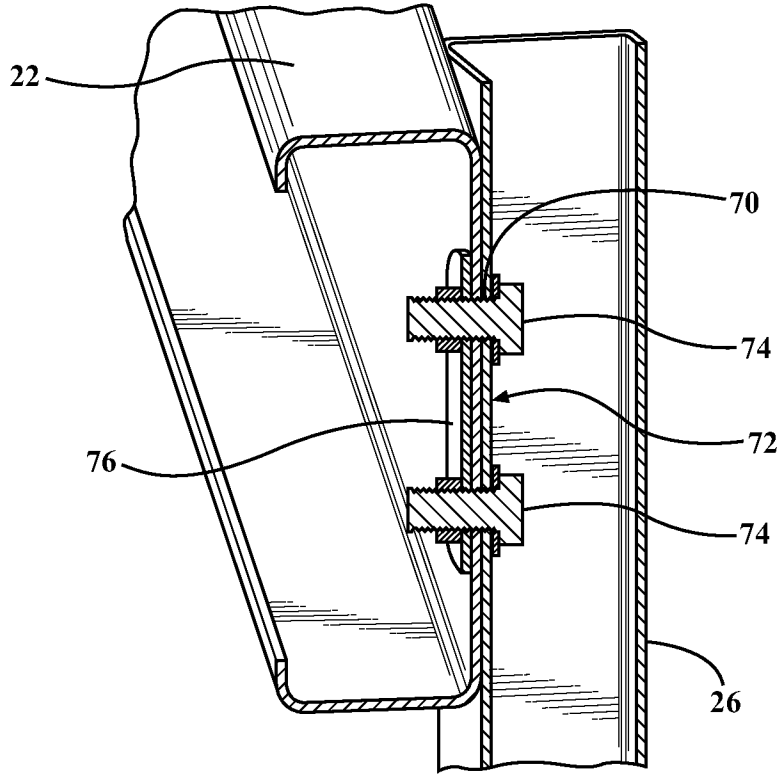
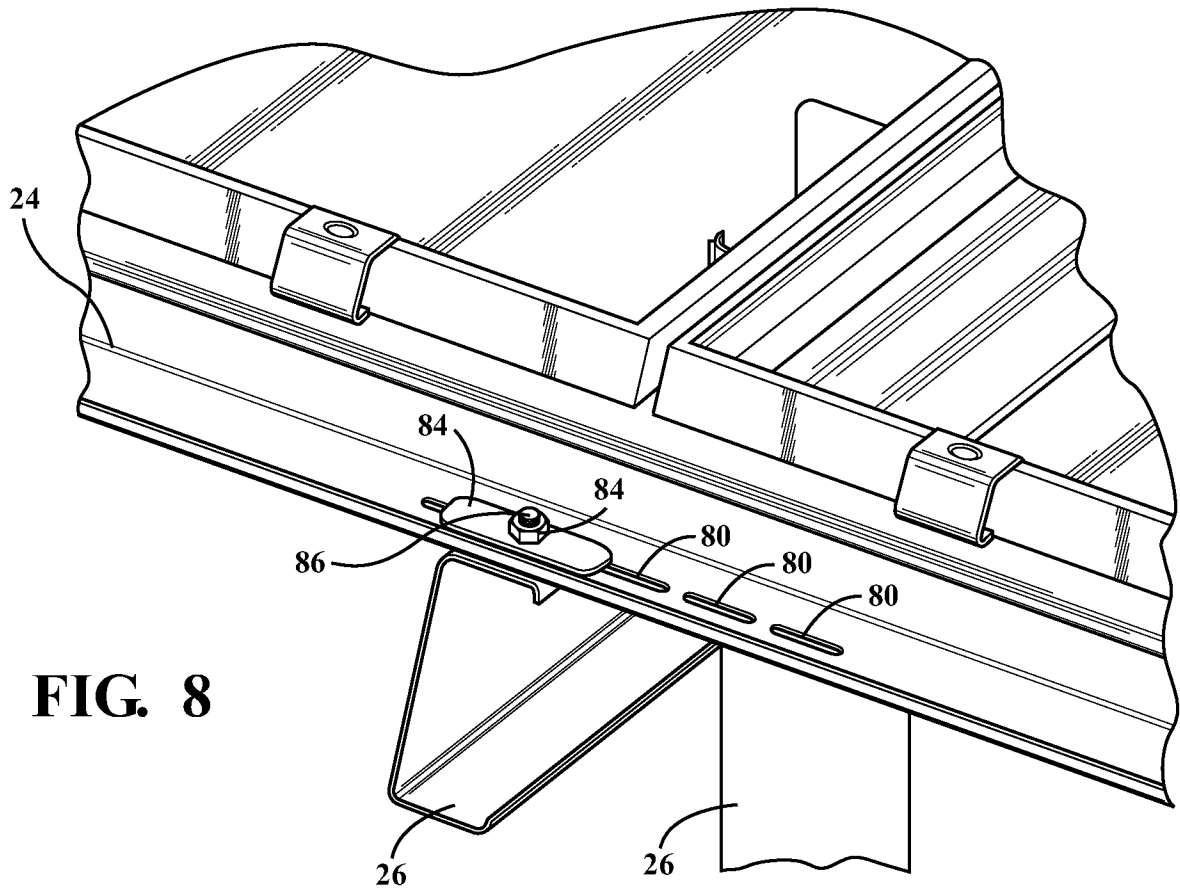
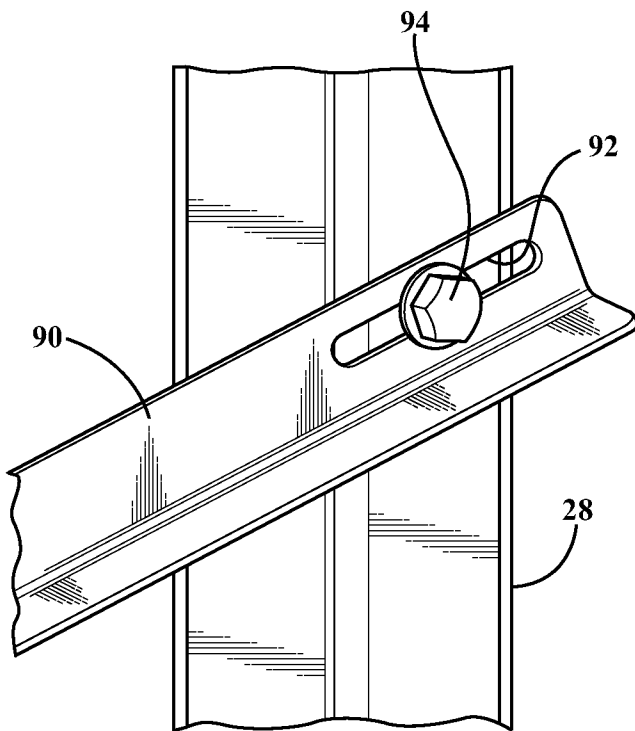
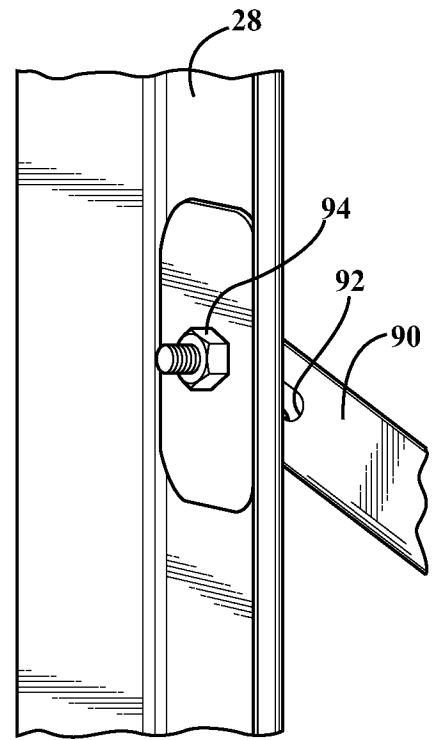
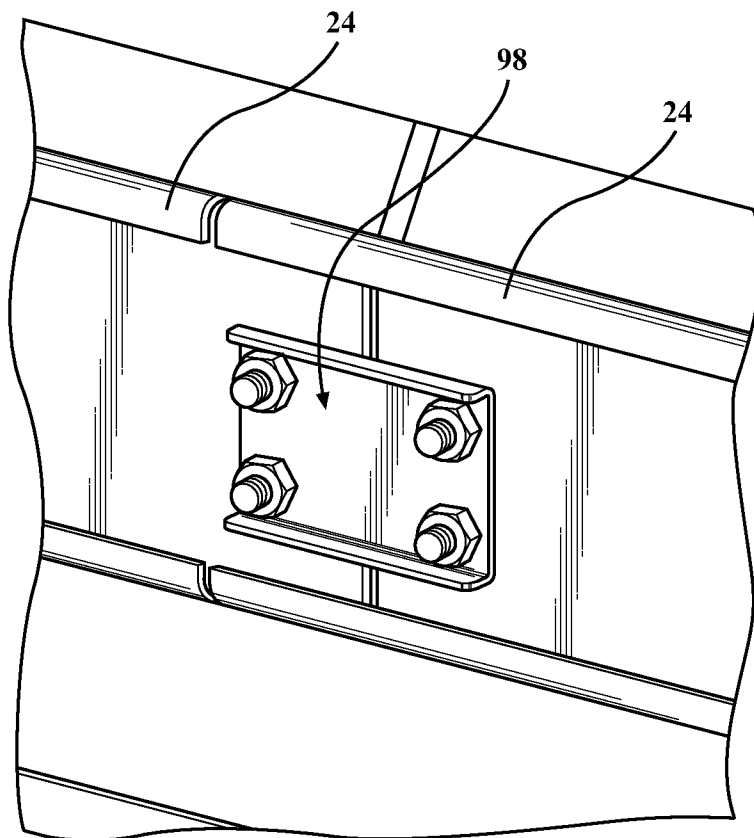


FIG. 8



**FIG. 9A****FIG. 9B****FIG. 10**

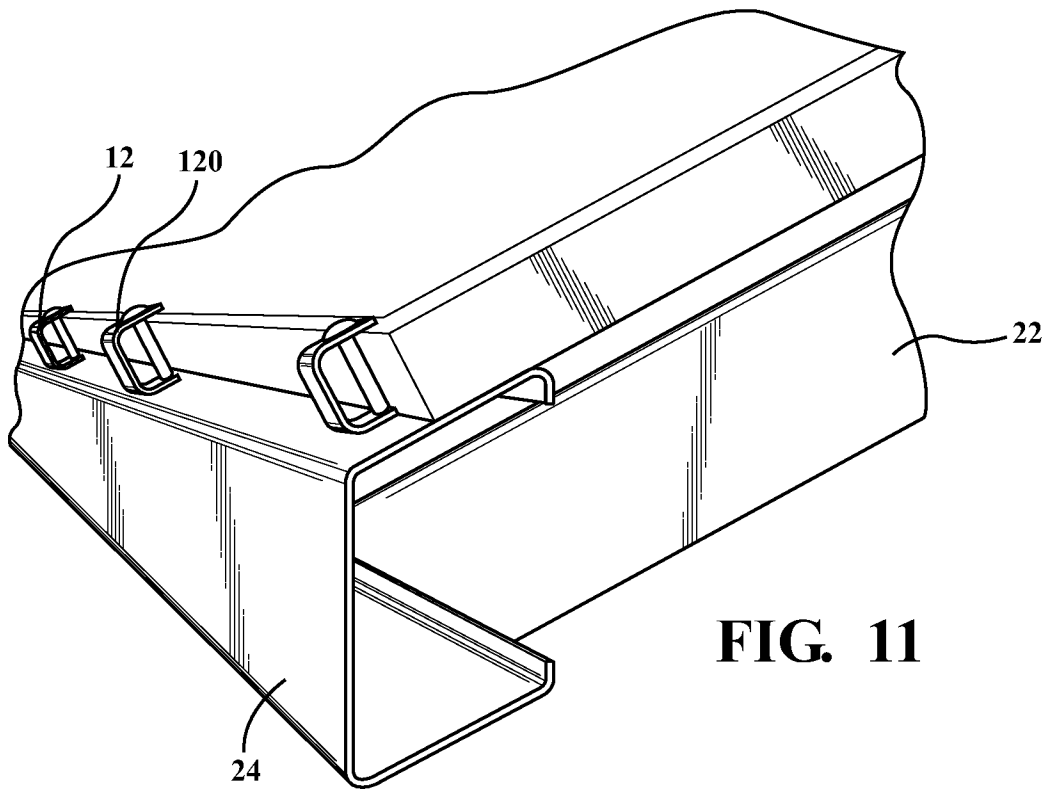


FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2013/030797

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H01L 31/042 (2013.01)

USPC - 52/173.3

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - E04D 13/00, 13/18; F24J 2/00, 2/46, 2/52; H01L 31/042 (2013.01)

USPC - 52/173.3, 633; 126/569, 704; 136/243, 244, 246, 251

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

CPC - F24J 2/46, 2/52; H01L 31/042 (2013.01)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Minesoft Patbase, Google Patent Search

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,269,173 A (KRUEGER et al) 26 May 1981 (26.05.1981) entire document	1-8, 11-12
Y		9-10
Y	US 2011/0309215 A1 (LU et al) 22 December 2011 (22.12.2011) entire document	9-10
A	US 5,125,608 A (MCMASTER et al) 30 June 1992 (30.06.1992) entire document	1-12
A	US 2011/0067749 A1 (ZURITIS) 24 March 2011 (24.03.2011) entire document	1-12

 Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

14 May 2013

Date of mailing of the international search report

30 MAY 2013

Name and mailing address of the ISA/US

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