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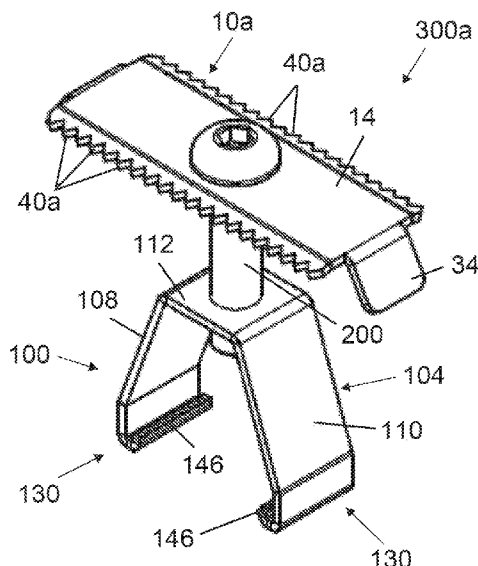


FIG. 14

(57) Abstract: A connector configured to mechanically and electrically couple a first frame to a second frame includes a body, a first clamping member, a second clamping member, and a plurality of projections extending from the body and configured to contact at least one of the first frame and the second frame. The body includes a first end and a second end and defines a longitudinal axis extending between the first end and the second end. The body further includes a feature for engaging a fastener. The first clamping member is positioned adjacent the first end of the body and is configured to engage the first frame. The second clamping member is positioned adjacent the second end of the body and is configured to engage the second frame.

CLAMP AND CLAMP ASSEMBLY

REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of prior-filed, co-pending U.S. Provisional Patent Application No. 62/182,257, filed June 19, 2015, the entire contents of which are hereby incorporated by reference.

BACKGROUND

[0002] The present disclosure relates to a connector that is connectable to a support structure, and particularly a connector for mechanically and electrically coupling a frame to a support structure.

SUMMARY

[0003] In one embodiment, a connector configured to mechanically and electrically couple a first frame to a second frame includes a body, a first clamping member, a second clamping member, and a plurality of projections extending from the body and configured to contact at least one of the first frame and the second frame. The body includes a first end and a second end and defines a longitudinal axis extending between the first end and the second end. The body further includes a feature for engaging a fastener. The first clamping member is positioned adjacent the first end of the body and is configured to engage the first frame. The second clamping member is positioned adjacent the second end of the body and is configured to engage the second frame.

[0004] In another embodiment, a connector configured to mechanically and electrically engage a support structure includes a first portion, a second portion coupled to the first portion, and an intermediate portion positioned between the first portion and the second portion. The first portion includes a distal end having a first plurality of projections. The second portion includes a distal end having a second plurality of projections. The intermediate portion couples the second portion to the first portion.

[0005] In yet another embodiment, a connector assembly configured to mechanically and electrically couple at least one frame to a support structure includes a first connector, a second connector, and a member coupling the first connector to the second connector. The first

connector includes a body, a first clamping member, a second clamping member, and a plurality of projections extending from the body and configured to contact one of the at least one frame. The body includes a first end and a second end and defines a longitudinal axis extending between the first end and the second end. The body further includes a first aperture positioned between the first end and the second end. The first clamping member is positioned adjacent the first end of the body and is configured to engage one of the at least one frame. The second connector includes a first portion, a second portion coupled to the first portion, and an intermediate portion positioned between the first portion and the second portion. The first portion includes a distal end having teeth configured to engage the support structure. The second portion includes a distal end having teeth configured to engage the support structure. The intermediate portion couples the second portion to the first portion and includes a second aperture.

[0006] In still another embodiment, a connector is configured to mechanically and electrically couple a first frame to a second frame and including a body that has a longitudinal axis and an aperture that extends therethrough. The connector also includes a first clamping member that extends from a first end of the body, a second clamping member that extends from a second end of the body, and a plurality of bonding projections that extend from the body. The first clamping member is configured to be coupled to one of the first frame or the second frame and the second clamping member is configured to be coupled to the other of the first frame or the second frame.

[0007] In still another embodiment, a connector is configured to mechanically and electrically couple to a support structure. The connector includes a body that has a longitudinal axis and a first portion that is coupled to a second portion by an intermediate portion therebetween. The intermediate portion includes an aperture extending therethrough and each of the first portion and the second portion include a surface having a plurality of projections extending therefrom.

[0008] In still another embodiment, a connector assembly is configured to mechanically and electrically couple adjacent frames to a support structure. The connector assembly includes a first connector configured to be coupled between a first frame and a second adjacent frame and a second connector configured to be coupled to the support structure. The first connector includes

a body that has a longitudinal axis and an aperture that extends therethrough. The first connector also includes a first clamping member that extends from a first end of the body, a second clamping member that extends from a second end of the body, and a plurality of bonding projections that extend from the body. The first clamping member is configured to be coupled to one of the first frame or the second frame and the second clamping member is configured to be coupled to the other of the first frame or the second frame. The second connector includes a body that has a longitudinal axis and a first portion that is coupled to a second portion by an intermediate portion therebetween. The intermediate portion includes an aperture extending therethrough and each of the first portion and the second portion include a surface having a plurality of projections extending therefrom.

[0009] Other aspects of the disclosure will become apparent by consideration of the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0010] Fig. 1 is a perspective view of a first connector.
- [0011] Fig. 2 is a plan view of the first connector of Fig. 1.
- [0012] Fig. 3 is an end view of the first connector of Fig. 1.
- [0013] Fig. 4 is a side view of the first connector of Fig. 1.
- [0014] Fig. 5 is a perspective view of a first connector according to another embodiment.
- [0015] Fig. 6 is a plan view of the first connector of Fig. 5.
- [0016] Fig. 7 is an end view of the first connector of Fig. 5.
- [0017] Fig. 8 is a side view of the first connector of Fig. 5.
- [0018] Fig. 9 is a perspective view of a second connector.
- [0019] Fig. 10 is a plan view of the second connector of Fig. 9.

[0020] Fig. 11 is an end view of the second connector of Fig. 9.

[0021] Fig. 12 is a side view of the second connector of Fig. 9.

[0022] Fig. 13 is an enlarged perspective view of portion 13--13 of the second connector of Fig. 9.

[0023] Fig. 14 is a perspective view of a connector assembly including the first connector of Figs. 1-4 and the second connector of Figs. 9-13.

[0024] Fig. 15 is a side view of the connector assembly of Fig. 14.

[0025] Fig. 16 is an end view of the connector assembly of Fig. 14.

[0026] Fig. 17 is a plan view of the connector assembly of Fig. 14.

[0027] Fig. 18 is a perspective view of a connector assembly including the first connector of Figs. 5-8 and the second connector of Figs. 9-13.

[0028] Fig. 19 is a side view of the connector assembly of Fig. 18.

[0029] Fig. 20 is an end view of the connector assembly of Fig. 18.

[0030] Fig. 21 is a plan view of the connector assembly of Fig. 18.

DETAILED DESCRIPTION

[0031] Before any embodiments of the disclosure are explained in detail, it is to be understood that the disclosure is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The disclosure is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of “including,” “comprising” or “having” and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. The terms “mounted,” “connected” and “coupled” are used broadly and encompass both direct and

indirect mounting, connecting and coupling. Further, “connected” and “coupled” are not restricted to physical or mechanical connections or couplings, and can include electrical or hydraulic connections or couplings, whether direct or indirect. Also, electronic communications and notifications may be performed using any known means including direct connections, wireless connections, etc.

[0032] Figures 1-4 illustrate a first connector 10a including an elongated body 14. In the illustrated embodiment, the body 14 has a substantially planar or flat portion defining a plane B (Fig. B). The body 14 includes a first end and a second end, and a first longitudinal axis A extends between the first end and the second end. An aperture 18 extends through the body 14 in a direction perpendicular to the axis A (Fig. 2) and the plane B. A first clamping member 30 is positioned adjacent the first end of the body 14 and a second clamping member 34 is positioned adjacent the second end of the body 14. The clamping members 30, 34 extend from the first and the second ends, respectively. In the illustrated embodiment, each clamping member 30, 34 is oriented at an acute angle 36 with respect to the longitudinal axis A. In some embodiments, the angle 36 is between approximately 55 degrees and approximately 85 degrees. In some embodiments, the angle 36 is approximately 59 degrees. In some embodiments, the angle 36 is approximately 80 degrees.

[0033] The first connector 10 includes one or more first bonding projections 40a. In the embodiment of Figs. 1-4, the first bonding projections 40a of the first connector 10a include a plurality of teeth 40a that extend from side edges of the body 14. Stated another way, the body 14 includes side edges extending between the first end and the second end, and the teeth 40a protrude outwardly from the side edges in a direction perpendicular to the axis A. In the illustrated embodiment, each of the teeth 40a protrudes at an acute angle 44 with respect to the plane B (Fig. 3) and relative to the axis A. The angle 44 is smaller than the angle 36 in the illustrated embodiment. In some embodiments, the angle 44 is between approximately 5 degrees and approximately 20 degrees. In some embodiments, the angle 44 is approximately 13 degrees. In some embodiments, there are twenty teeth 40a that extend from each side of the body 14. In other embodiments there may be fewer or more teeth on each side.

[0034] Figures 5-8 illustrate a first connector 10b according to another embodiment. Some aspects of the first connector 10b is similar to the first connector 10a described above with respect to Figs. 1-4. For the sake of brevity, only the differences between the first connector 10b and the first connector 10a are described in detail. Similar features are identified with similar reference numbers and may be identified with a “b” suffix instead of an “a” suffix.

[0035] As shown in Figs. 5-8, the first bonding projections 40 of the first connector 10b include teeth 40b positioned on the ends of the body 14. In the illustrated embodiment, each end includes a pair of teeth 40b, and the teeth 40b of each end are positioned on each side of the clamping members 30, 34. In addition, the teeth 40b on each end of the body 14 protrude from the first and the second ends at an acute angle 48 with respect to the plane B and relative to the axis A. In the illustrated embodiment, the angle 48 is smaller than the angle 36. In some embodiments, the angle 48 is between approximately 5 degrees and approximately 20 degrees. In some embodiments, the angle 48 is approximately 17 degrees.

[0036] In the embodiment of Figs. 1-4 and the embodiment of Figs. 5-8, the first connector 10a, 10b is symmetrical about the axis A. The first connectors 10a, 10b are also symmetric about an axis that is transverse to the axis A and parallel to the plane B. In some embodiments, the first connector 10a, 10b is manufactured from stainless steel. In other embodiments, the first connector 10a, 10b may be manufactured from another suitable material.

[0037] The first connector 10a, 10b of both the embodiment of Figs. 1-4 and the embodiment of Figs. 5-8 are configured to mechanically secure adjacent frames (e.g., photovoltaics (PV) modules – not shown), and also to electrically bond or provide electrical communication between the frames, each of which has a non-conductive coating of aluminum (e.g., oxide, paint, or anodization). In particular, the first clamping member 30 may engage or be coupled to a first PV module and the second clamping member 34 may engage or be coupled to a second PV module, while the first bonding projections (e.g., the teeth 40a, 40b) pierce the non-conductive coating of aluminum. Accordingly, the above-described first connectors 10a, 10b mechanically and electrically couple adjacent frames, such as PV modules, to one another.

[0038] With respect to Figs. 14-21, both of the first connector 10a, 10b described above can also be coupled to a claw member or second connector 100. The components of the second connector 100 are described below.

[0039] Referring now to Figs. 9-13, the second connector 100 includes a body 104. The body 104 has a first end and a second end. A second longitudinal axis C (Fig. 10) extends between the first end and the second end. In the illustrated embodiment, the second axis C is substantially parallel to the first axis A. The second connector 100 further includes a first portion 108 that is coupled to or integrally formed (i.e., formed as one piece) with a second portion 110. In the illustrated embodiment, the first portion 108 and the second portion 110 are both integrally formed with an intermediate portion 112 therebetween. Each of the first portion 108 and the second portion 110 extend at an acute angle 114 relative to the intermediate portion 112. An aperture 116 extends through the intermediate portion 112.

[0040] As best shown in Figs. 12 and 13, each of the first and the second portions 108, 110 includes a distal end with a hooked portion 130 having a leg 134 and a substantially U-shaped portion 138. In the illustrated embodiment, the U-shaped portion 138 is oriented inwardly such that the U-shaped portion 138 of each hooked portion 130 curve toward one another. Each hooked portion 130 includes a terminal surface 142 with second bonding projections 146. In the illustrated embodiment, the second bonding projections 146 include a plurality of teeth protruding from the terminal surface 142. The surface 124 extends perpendicular to the longitudinal axis C (Fig. 10).

[0041] In some embodiments, the second connector 100 is manufactured from stainless steel. In other embodiments, the second connector 100 may be manufactured from another suitable material. The second connector 100 is configured to engage a support structure (not shown) that is manufactured from aluminum, steel, or any other suitable metallic material.

[0042] As shown in Figs. 14-21, a connector assembly 300 is formed by coupling one of the first connectors 10a, 10b to the second connector 100. In the illustrated embodiment, the first connector 10a or 10b is coupled to and spaced apart from the second connector 100 by a fastener 200. In the illustrated embodiment, the first longitudinal axis A of the first connectors 10a, 10b is parallel to the second longitudinal axis C of the second connector 100 when the connectors 10,

100 are coupled together. The fastener passes through the aperture 18 of the first connectors 10a, 10b and the aperture 116 of the second connector 100.

[0043] The fastener 200 may be constructed from steel or another suitable metallic or electrically-conductive material. In some embodiments, the fastener 200 is a threaded fastener that is threadingly coupled to the second connector 100 (i.e., the aperture 116 may be threaded). In other embodiments, the fastener 200 is a rivet that couples the first connector 10 to the second connector 100. In still other embodiments, the fastener 200 may be another type of fastener (e.g., a screw, a bolt, etc.). In still other embodiments, the first connectors 10 and the second connector may be coupled together in a difference manner.

[0044] In use, the connector assembly 300 couples adjacent PV modules to a support structure. For example, the portions 108, 110 of the second connector 100 are positioned in a channel or slot (not shown) on opposite sides of a rail of the support structure, and the bonding projections 146 or teeth pierce the rail. The second connector 100 extends away from the rail, providing a stand-off for the first connector 10. The first connector 10 is spaced apart from the second connectors 100 and aligned with the second connector 100 along an axis X (Figs. 15 and 19). The first connector 10 is coupled between adjacent PV module frames, as discussed above. Once both the first connector 10 and the second connector 100 are appropriately positioned, the fastener 200 secures the first connector 10 to the second connector 100 and couples the PV module frame to the support structure. The connectors 10, 100 provide mechanical and electrical coupling between the adjacent PV modules, and between the PV modules and the support structure.

[0045] Although certain aspects have been described in detail with reference to certain preferred embodiments, variations and modifications exist within the scope and spirit of one or more independent aspects as described. Various features and advantages of the disclosure are set forth in the following claims.

CLAIMS

What is claimed is:

1. A connector configured to mechanically and electrically couple a first frame to a second frame, the connector comprising:

a body including a first end and a second end, the body defining a longitudinal axis extending between the first end and the second end, the body further including a feature for engaging a fastener;

a first clamping member positioned adjacent the first end of the body, the first clamping member configured to engage the first frame;

a second clamping member positioned adjacent the second end of the body, the second clamping member configured to engage the second frame; and

a plurality of projections extending from the body and configured to contact at least one of the first frame and the second frame.

2. The connector of claim 1, wherein the body includes a first side and a second side, the first side and the second end extending between the first end and the second end and substantially parallel to the longitudinal axis, wherein the plurality of projections includes a plurality of first projections and a plurality of second projections, the plurality of first projections extending from the first side, the plurality of second projections extending from the second side, the plurality of first projections configured to contact the first frame, the plurality of second projections configured to contact the second frame.

3. The connector of claim 2, wherein the plurality of first projections are oriented at an acute angle relative to the longitudinal axis, the plurality of second projections oriented at the acute angle relative to the longitudinal axis.

4. The connector claim 1, wherein the plurality of projections includes at least one first projection and at least one second projection, the at least one first projection extending from the first end, the at least one second projection extending from the second end.

5. The connector of claim 4, wherein the at least one first projection includes a pair of first projections, the at least one second projection including a pair of second projections, wherein the first clamping member is positioned between the pair of first projections, wherein the second clamping member is positioned between the pair of second projections.
6. The connector of claim 4, wherein the body further defines a transverse axis oriented perpendicular to the longitudinal axis, wherein the at least one first projection is oriented at an acute angle relative to the transverse axis, the at least one second projection oriented an the acute angle relative to the transverse axis.
7. The connector of claim 1, wherein the body includes a first surface and a second surface opposite the first surface, the first surface extending between the first end and the second end, wherein feature includes an aperture extending through the body between the first surface and the second surface.
8. A connector configured to mechanically and electrically engage a support structure, the connector comprising:
 - a first portion including a distal end, the distal end including a first plurality of projections;
 - a second portion coupled to the first portion, the second portion including a distal end including a second plurality of projections; and
 - an intermediate portion positioned between the first portion and the second portion and coupling the second portion to the first portion.
9. The connector of claim 8, wherein the intermediate portion includes a first surface, a second surface opposite the first surface, and an aperture extending between the first surface and the second surface.
10. The connector of claim 8, wherein the distal end of the first portion includes a hook portion curving toward the distal end of the second portion.

11. The connector of claim 8, wherein the distal end of the first portion includes a U-shaped portion including a terminal edge oriented toward the intermediate portion, the first plurality of projections protruding from the terminal edge.

12. A connector assembly configured to mechanically and electrically couple at least one frame to a support structure, the connector assembly comprising:

a first connector including,

a body including a first end and a second end, the body defining a longitudinal axis extending between the first end and the second end, the body further including a first aperture positioned between the first end and the second end,

a clamping member positioned adjacent the first end of the body, the first clamping member configured to engage one of the at least one frame, and

a plurality of projections extending from the body and configured to contact one of the at least one frame;

a second connector including,

a first portion including a distal end, the distal end including teeth configured to engage the support structure,

a second portion coupled to the first portion, the second portion including a distal end including teeth configured to engage the support structure, and

an intermediate portion positioned between the first portion and the second portion and coupling the second portion to the first portion, the intermediate portion including a second aperture; and

a member coupling the first connector to the second connector.

13. The connector assembly of claim 12, wherein the member is a fastener extending through the first aperture and the second aperture in a direction perpendicular to the longitudinal axis.

14. The connector assembly of claim 12, wherein the body of the first connector includes a first side and a second side, the first side and the second end extending between the first end and the second end and substantially parallel to the longitudinal axis, wherein the plurality of projections includes a plurality of first projections and a plurality of second projections, the plurality of first projections extending from the first side, the plurality of second projections

extending from the second side, the plurality of first projections configured to contact the first frame, the plurality of second projections configured to contact the second frame.

15. The connector assembly of claim 14, wherein the plurality of first projections are oriented at an acute angle relative to the longitudinal axis, the plurality of second projections oriented at the acute angle relative to the longitudinal axis.

16. The connector assembly of claim 12, wherein the plurality of projections includes at least one first projection and at least one second projection, the at least one first projection extending from the first end, the at least one second projection extending from the second end.

17. The connector assembly of claim 16, wherein the at least one first projection includes a pair of first projections, the first clamping member positioned between the pair of first projections.

18. The connector assembly of claim 16, wherein the body further defines a transverse axis oriented perpendicular to the longitudinal axis, wherein the at least one first projection is oriented at an acute angle relative to the transverse axis, the at least one second projection oriented an the acute angle relative to the transverse axis.

19. The connector assembly of claim 12, wherein the distal end of the first portion includes a hook portion curving toward the distal end of the second portion.

20. The connector assembly of claim 12, wherein the distal end of the first portion includes a U-shaped portion including a terminal edge oriented toward the intermediate portion, the first plurality of projections protruding from the terminal edge.

21. The connector assembly of claim 12, wherein the clamping member is a first clamping member, the first connector further including a second clamping member positioned adjacent the second end of the body and configured to engage another frame.

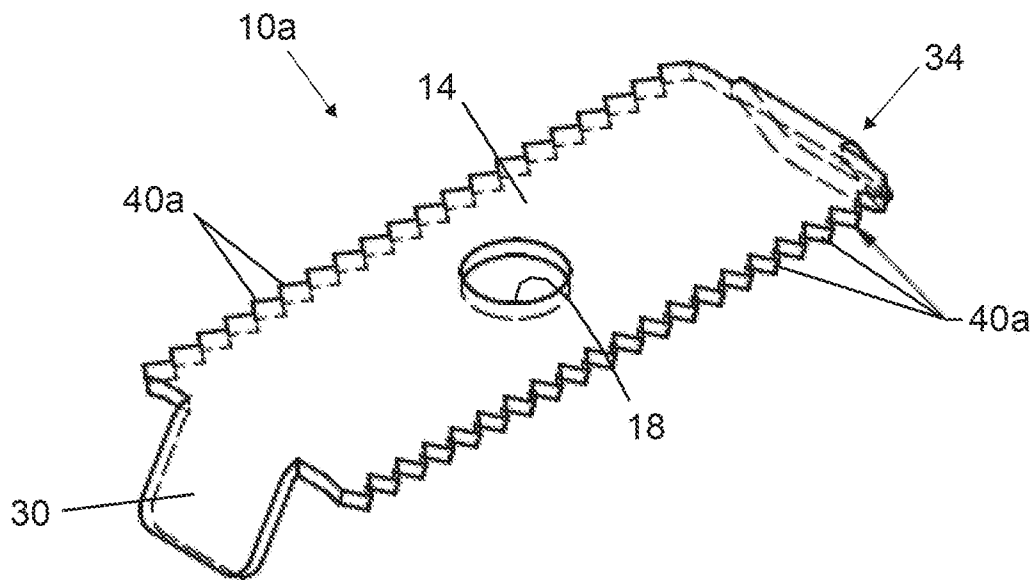


FIG. 1

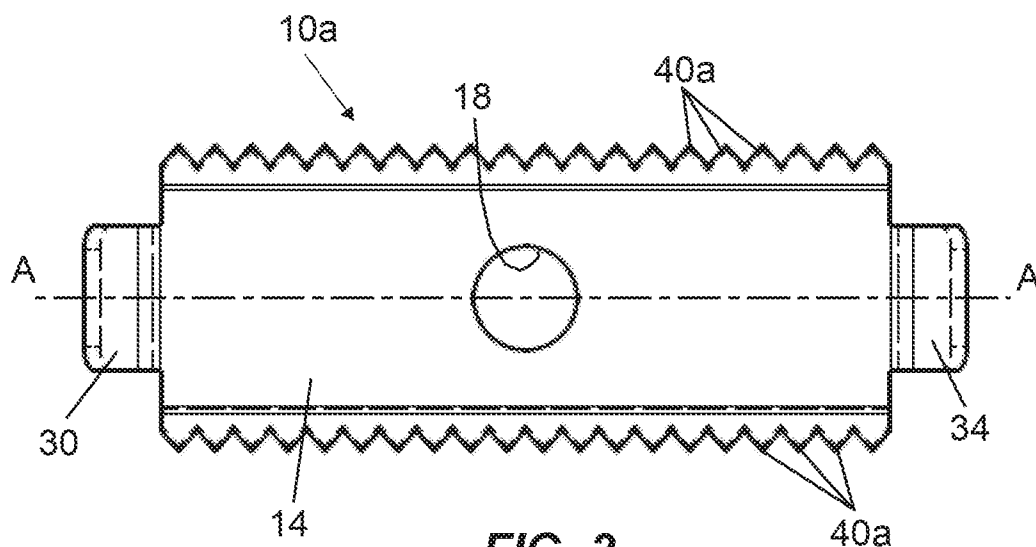


FIG. 2

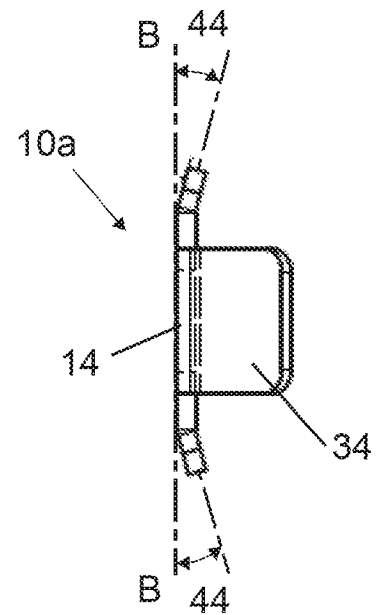


FIG. 3

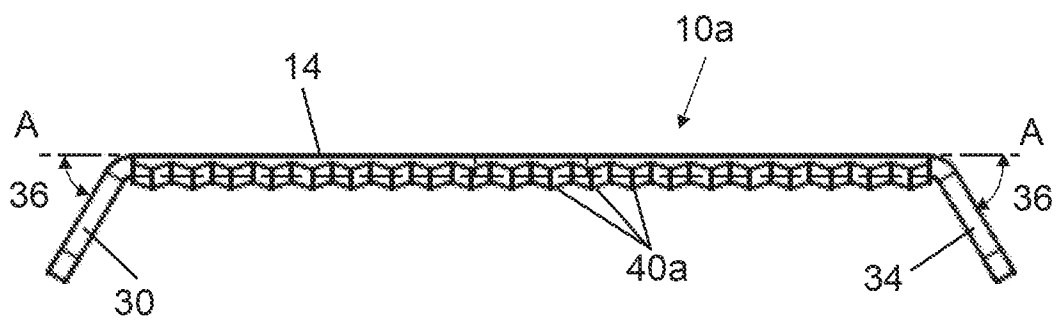


FIG. 4

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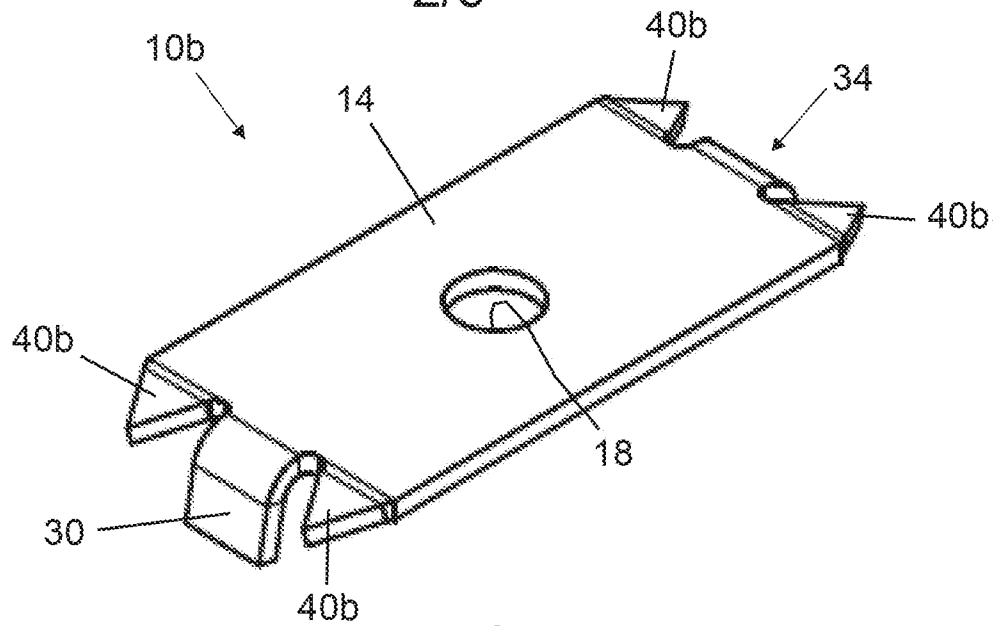


FIG. 5

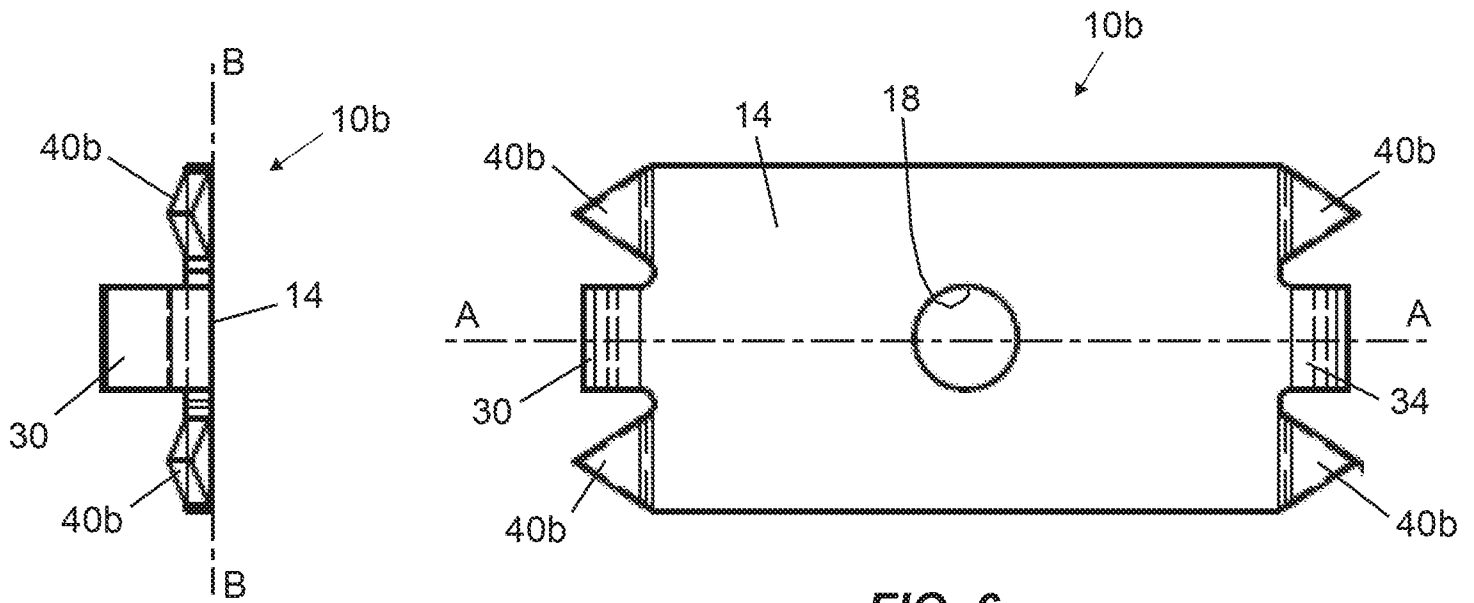


FIG. 6

FIG. 7

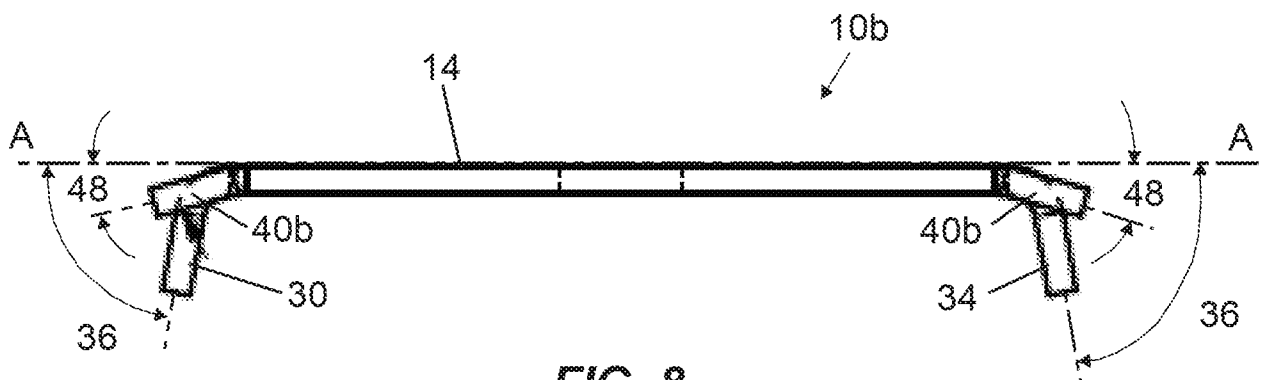


FIG. 8

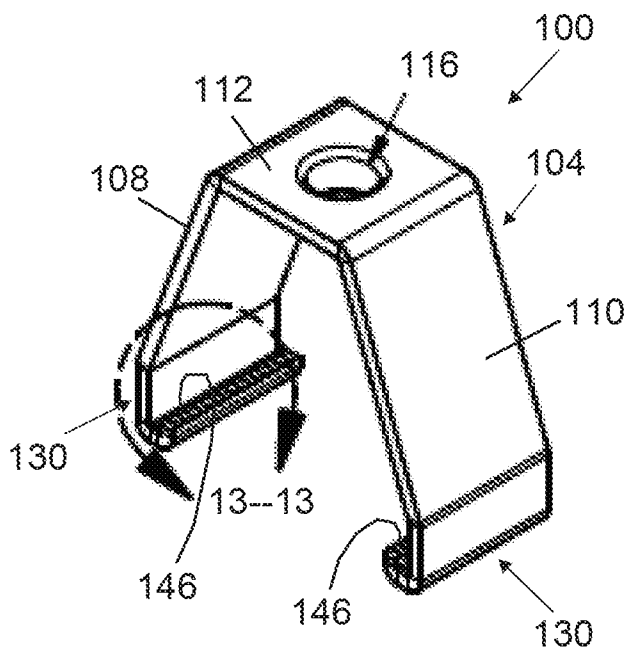


FIG. 9

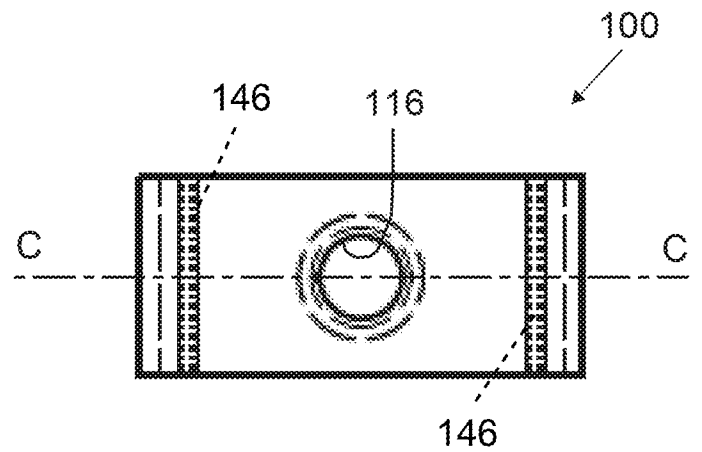


FIG. 10

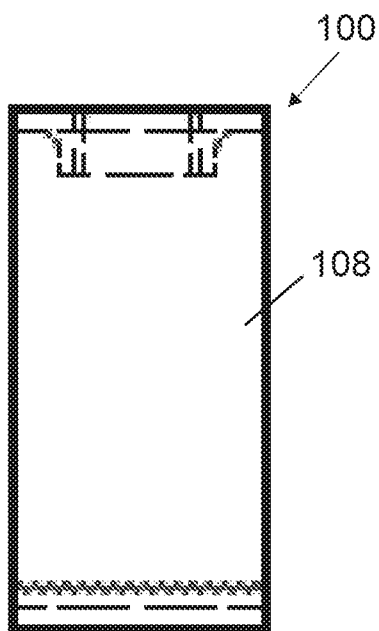


FIG. 11

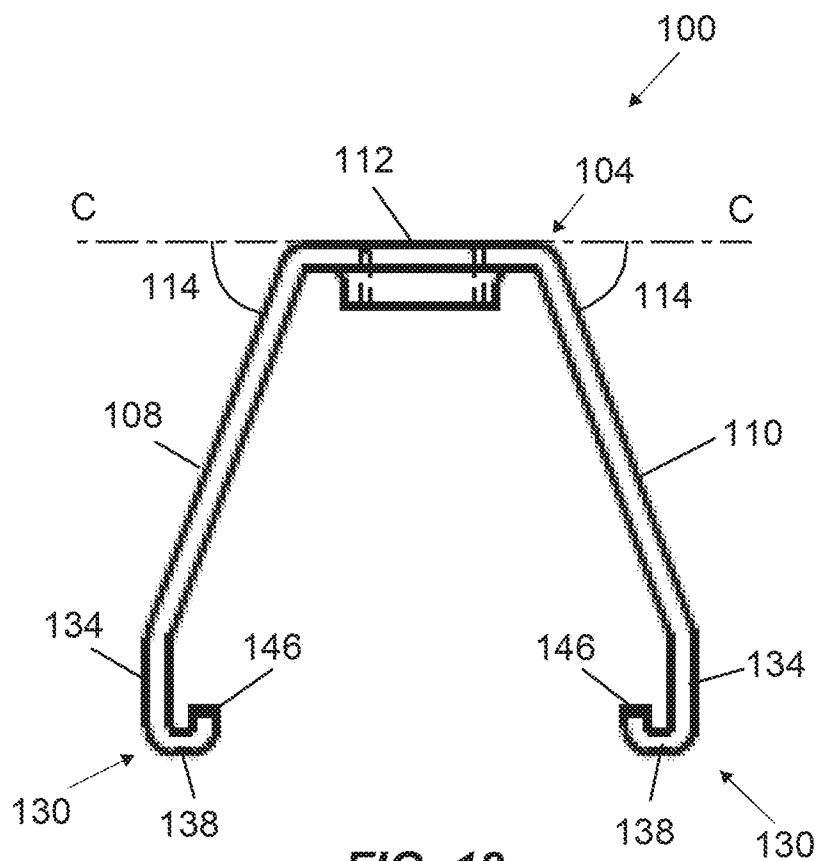


FIG. 12

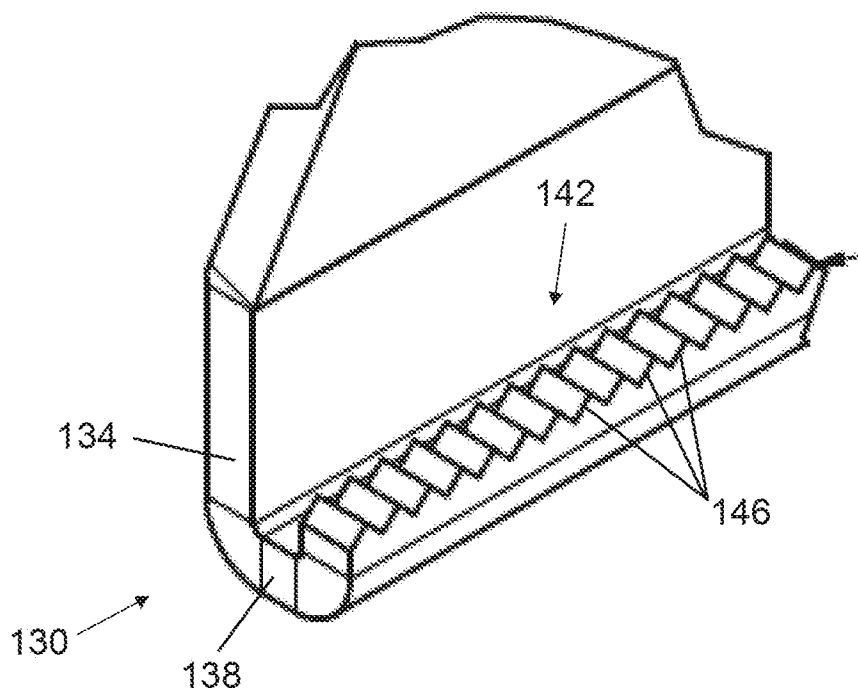


FIG. 13

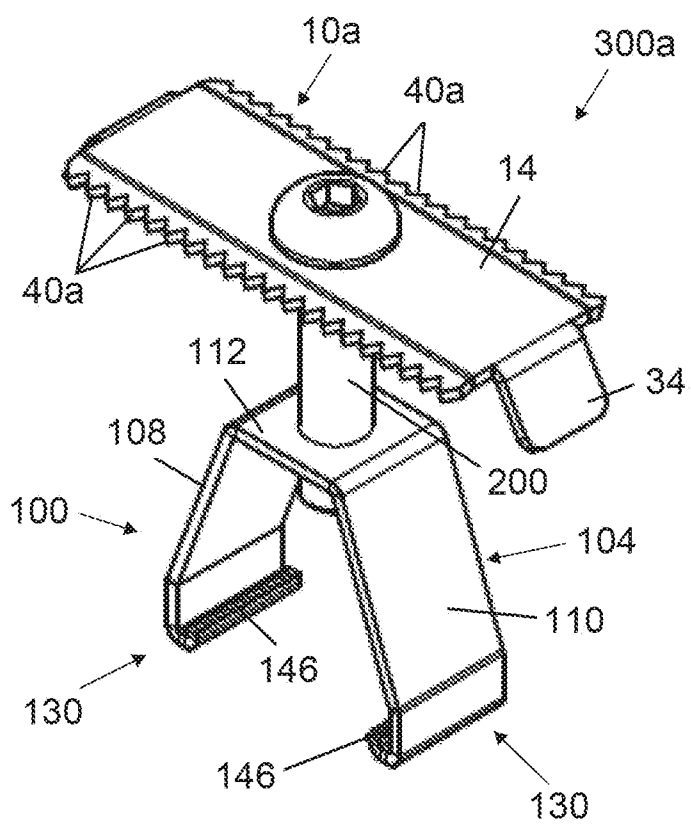


FIG. 14

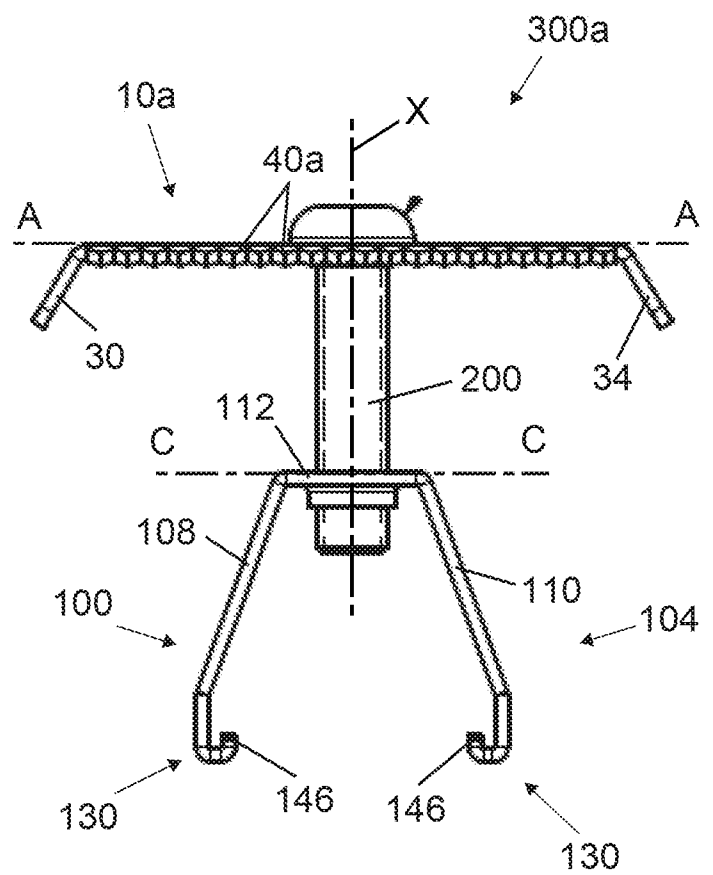


FIG. 15

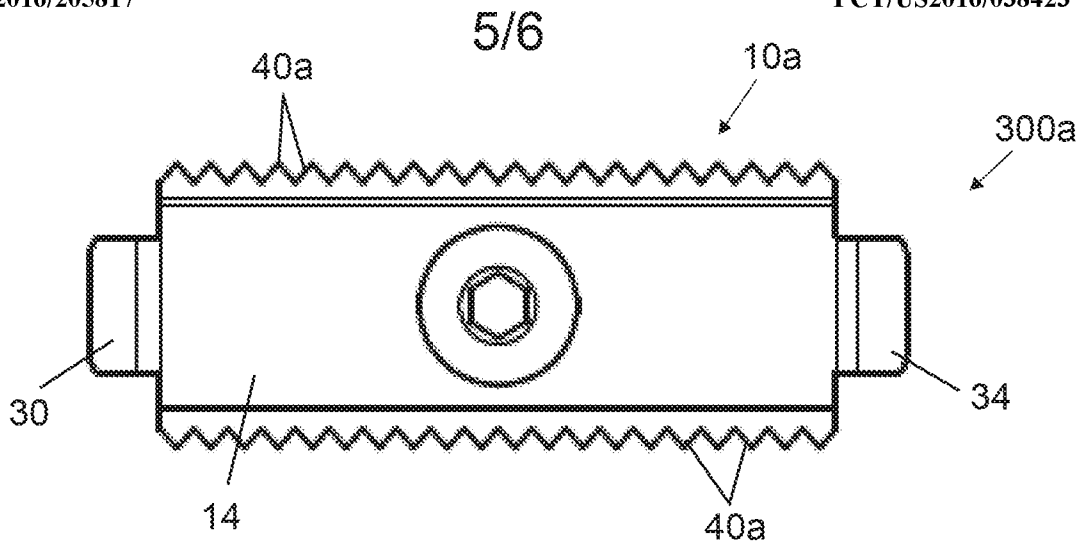


FIG. 17

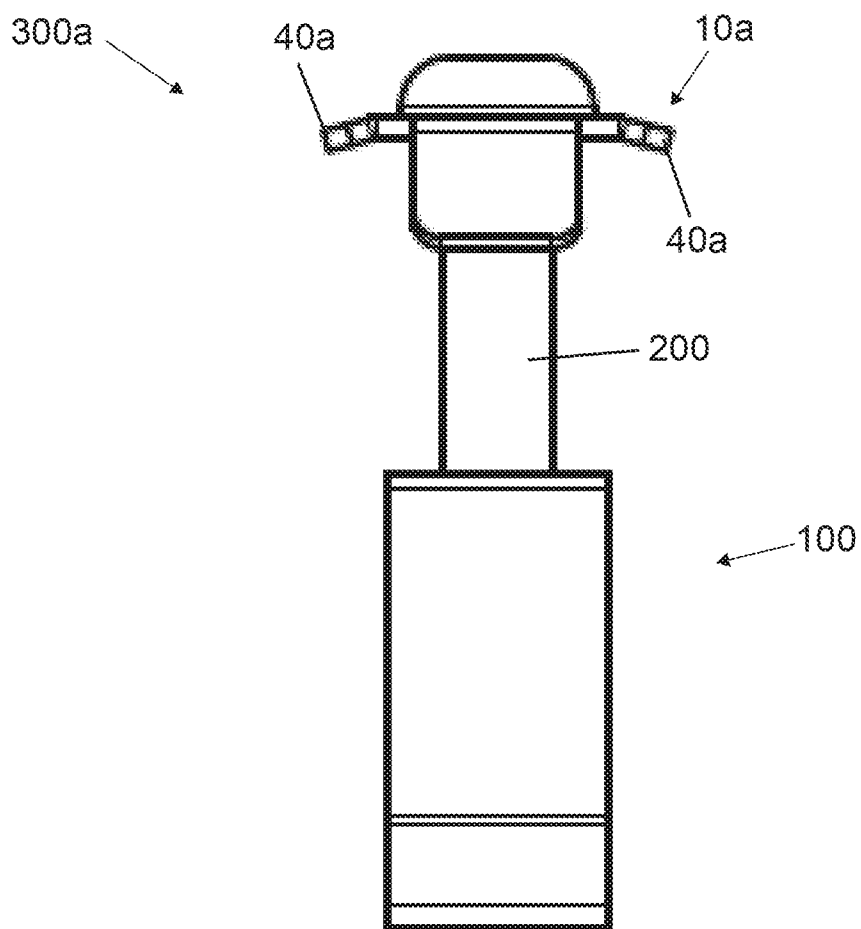


FIG. 16

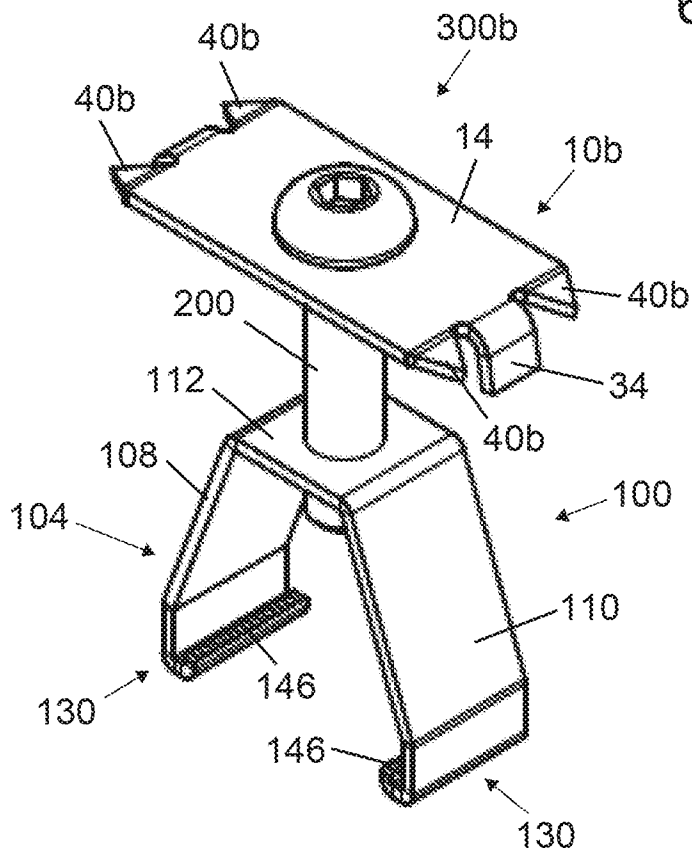


FIG. 18

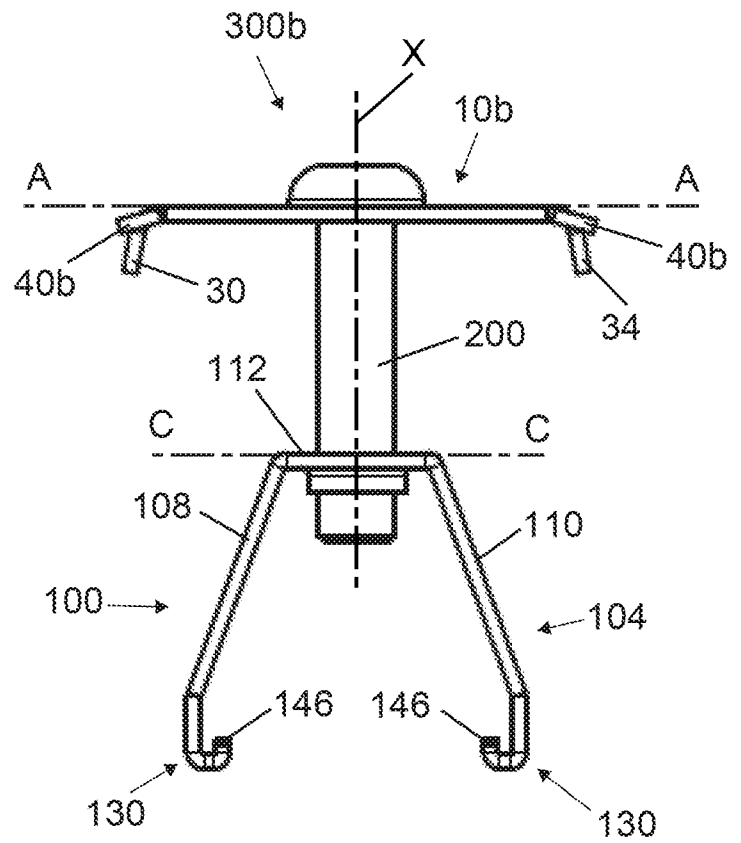


FIG. 19

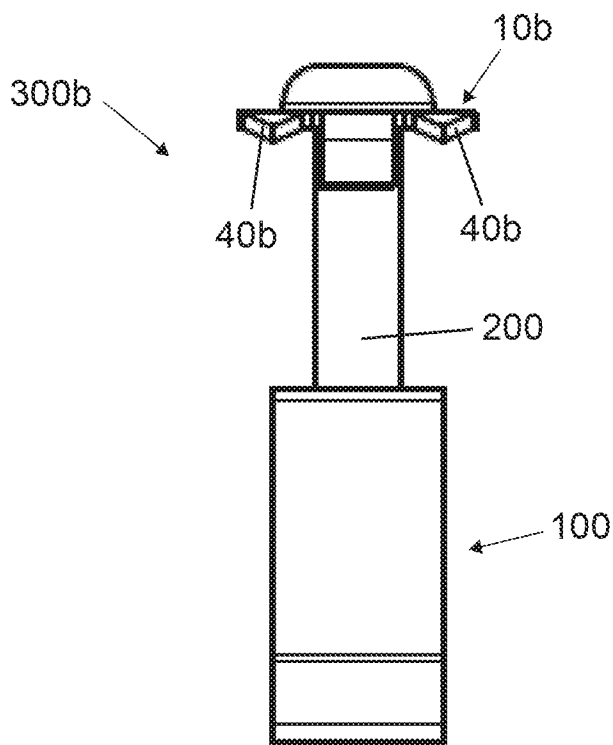


FIG. 20

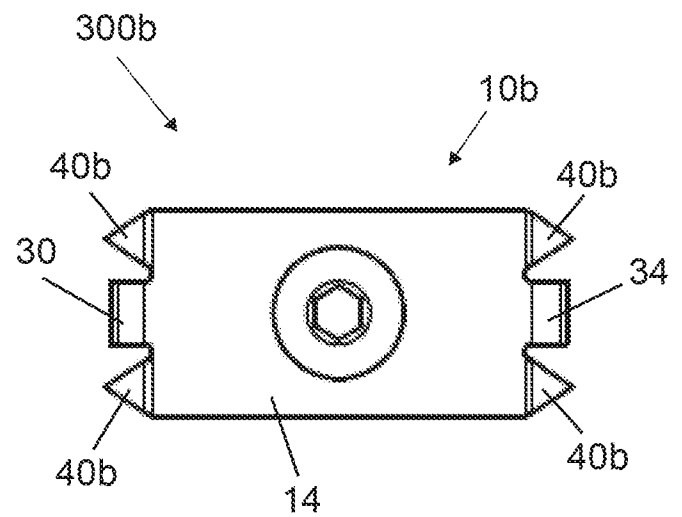


FIG. 21

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US16/38423

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

-See extra sheet-

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-7

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US16/38423

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - F24J 2/52; H01R 13/73, 13/621; F16B 2/02 (2016.01)

CPC - F24J 2/5262; H01R 13/73, 13/621; F16B 2/02

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): A47G 29/00; H02S 40/00, 20/00; H01R 13/62, 13/621, 13/73; F24J 2/46, 2/52; F16B 2/00, 2/02; F16M 13/02 (2016.01)

CPC: H01R 13/62, 13/621, 13/73; F16B 2/00, 2/02; F24J 2/46, 2002/4658, 2002/4669, 2002/4661, 2002/4663, 2/52, 2/526, 2/5262

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

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

PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, Other Countries (INPADOC), RU, AT, CH, TH, BR, PH); Google Patent, Google Scholar, IEEE, Orbit, EBSCO

Keywords: connector, frame, mechanically, electrically, body, longitudinal, axis, clamp, fastener, acute, angle, protrusions, projections

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---	US 8,505,864 B1 (TAYLOR, M et al.) August 13, 2013; abstract, figures 1 & 2, column 1, line 66 to column 2, line 6, lines 27-46, 58-62	1, 4, 6, & 7 ---
Y		2, 3, & 5
Y	CN 204206071 U (CLENERGY XIAMEN TECHNOLOGY CO) March 11, 2015; see machine translation; abstract, paragraphs [0034], [0035], [0038], figures 1 & 8	2 & 3
Y	US 2010/0276558 A1 (FAUST, A et al.) November 4, 2010; figures 4, 5, 9, paragraphs [0041], [0043]	5
P, X	US 2016/006390 A1 (SPICE SOLAR, INC) January 7, 2016; entire document	1
P, X	US 2015/249423 A1 (SUNPOWER CORPORATION) September 3, 2015; entire document	1
A	US 2014/0311552 A1 (GARRETT B) October 23, 2014; entire document	1-7

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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

22 August 2016 (22.08.2016)

Date of mailing of the international search report

28 OCT 2016

Name and mailing address of the ISA/

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-8300

Authorized officer

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PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US16/38423

-Continued from Box No. III Observations where unity of invention is lacking-

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fee must be paid.

Group I: Claims 1-7 are directed towards a connector comprising a second clamping member.

Group II: Claims 8-21 are directed towards a connector and assembly comprising an intermediate portion.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The special technical features of Group I include at least the body further including a feature for engaging a fastener; and a second clamping member positioned adjacent the second end of the body, the second clamping member configured to engage the second frame, which are not present in Group II.

The special technical features of Group II include at least a first portion including a distal end, the distal end including teeth configured to engage the support structure, a second portion coupled to the first portion, the second portion including a distal end including teeth configured to engage the support structure, and an intermediate portion positioned between the first portion and the second portion and coupling the second portion to the first portion, the intermediate portion including a second aperture, which are not present in Group I.

The common technical features shared by Groups I-II are a connector configured to mechanically and electrically couple a first frame, the connector comprising: a body including a first end and a second end, the body defining a longitudinal axis extending between the first end and the second end; a first clamping member positioned adjacent the first end of the body, the first clamping member configured to engage the first frame; and a plurality of projections extending from the body and configured to contact at least one of the first frame.

However, these common features are previously disclosed by US 8,505,864 B1 to TAYLOR, M. et al. (hereinafter "Taylor"). Taylor discloses a connector configured to mechanically and electrically couple a first frame (an attaching arrangement (connector) configured to mechanically, as shown, and electrically couple a first PV panel 23 frame to a second PV panel frame; abstract, figure 2, column 2, lines 58-62), the connector comprising: a body including a first end and a second end (a top connector plate 12 with a body including a first end and a second end, as shown; figure 1, column 2, lines 27-39), the body defining a longitudinal axis extending between the first end and the second end (the body of top connector plate 12 defining a longitudinal axis extending between the first end and the second end, as shown; figure 2); a first clamping member positioned adjacent the first end of the body (a serrated end 12E (first clamping member) positioned adjacent the first end of the body, as shown; figure 1, column 2, lines 27-39), the first clamping member configured to engage the first frame (the serrated end 12E configured to engage the first PV panel 23 frame via side wall 23A, as shown; figures 1 & 2, column 2, lines 27-46); and a plurality of projections extending from the body and configured to contact at least one of the first frame (a plurality of serrations (projections) extending from the body of top connector plate 12 at the serrated ends 12E & 12D, and configured to contact the first PV panel 23 frame and second PV panel frame; abstract, figures 1 & 2, column 2, lines 27-46).

Since the common technical features are previously disclosed by the Taylor reference, these common features are not special and so Groups I-II lack unity.