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(71) Applicant: **HUBBELL INCORPORATED** [US/US]; 40
Waterview Drive, Shelton, CT 06484 (US).

(72) Inventor: **MARTIN, Evan, Ronald**; 7 Colman Path, Mer-
rimack, NH 03054 .

(74) Agent: **WISSING, Gerard, M.**; Wissing Miller LLP, 1325
Avenue of the Americas, 27th Floor, New York, NY 10019
(US).

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(54) Title: CLAMP ON BONDING JUMPER

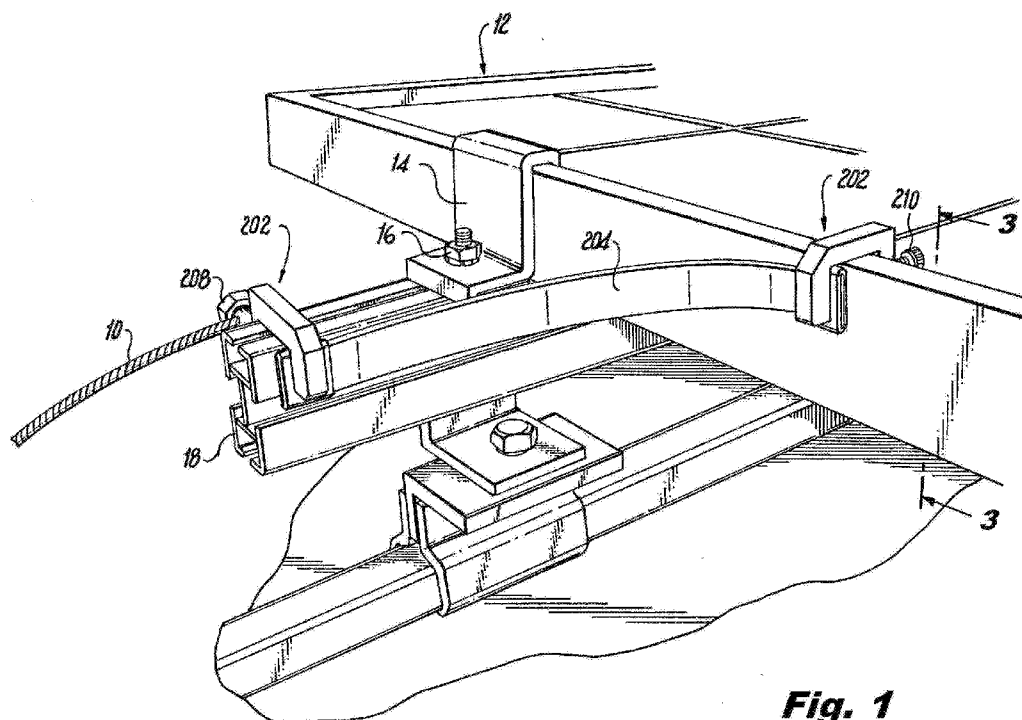


Fig. 1

(57) Abstract: A bonding jumper system includes a clamp capable of clamping a bonding jumper to a structure and a clamp bolt operationally associated with the clamp, the clamp bolt further including a ground post for attaching a ground cable.



*Patent Application for***CLAMP ON BONDING JUMPER****CROSS REFERENCE TO RELATED APPLICATIONS**

[0001] The present application is based on and claims benefit from co-pending U.S. Provisional Application Serial No. 62/398,729 filed September 23, 2016 entitled “Clamp on Bonding Jumper” the entire contents of which are incorporated herein by reference.

BACKGROUNDField

[0002] The present disclosure relates generally to bonding jumpers, and more particularly to clamp on bonding jumpers.

Description of the Related Art

[0003] In recent years, the use of photovoltaic arrays to provide electrical power in commercial, residential, and other environments has become popular. Photovoltaic arrays are generally composed of a number of photovoltaic modules set within a metallic frame and a rail system that supports the photovoltaic modules. The rail system may be attached to a fixed support structure such as a roof or the ground or to a movable structure such as a solar tracker. When installing a photovoltaic array, a number of photovoltaic modules are assembled onto the rail system. The metallic frames of the individual photovoltaic modules, and the structural pieces, e.g., the rails, on which the modules are mounted are generally made out of aluminum. Depending upon the size of the photovoltaic array, the rail system may include multiple metallic rails coupled or connected together in a grid-like pattern. Although the metallic frames of the photovoltaic modules and the metallic rails are not intended to be energized, in order to avoid any appreciable potential difference between these metallic parts, bonding is generally performed. Bonding is a method by which all electrically conductive portions of a structure are

effectively interconnected via a low impedance conductive path. For example, in the present example, the photovoltaic modules may be connected to each other and/or to the rail system utilizing bonding wires or straps. Attaching bonding wires or straps to the array generally involves drilling holes in the modules and rail and attaching the bonding wires or straps utilizing nuts and bolts. The photovoltaic modules and the rail system may also be connected to ground utilizing one or more ground wires or straps which may also involve drilling holes in the modules and/or rails.

SUMMARY

[0004] The present disclosure provides a bonding jumper system including a clamp capable of clamping a bonding jumper to a structure and a clamp bolt operationally associated with the clamp, the clamp bolt further including a ground post for attaching a ground cable.

[0005] A bonding jumper system includes a bonding jumper cable, a pair of clamps, each clamp capable of clamping the bonding jumper to a structure and a pair of clamp bolts, each clamp bolt operationally associated with one of the pair of clamps, at least one of the pair of clamp bolts including a ground post for attaching a ground cable.

[0006] A bonding jumper clamp includes three parallel members extending from a connecting member, a bonding jumper permanently affixed between at least two of the three parallel members and a clamp bolt operationally associated with one of the three parallel members, the clamp bolt including a ground post for attaching a ground cable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] A more complete appreciation of the present disclosure and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

[0008] Fig. 1 is a perspective view of a photovoltaic module attached to a rail of a solar tracking frame and bonded utilizing a bonding jumper system according to an illustrative embodiment of the present disclosure;

[0009] Fig. 2 is a perspective view of a bonding jumper system according to an illustrative embodiment of the present disclosure;

[0010] Fig. 3 is a view of a portion of the bonding jumper system illustrated in Fig. 1, taken along line 3-3, according to an illustrative embodiment of the present disclosure;

[0011] Fig. 4 is a perspective view of a bonding jumper clamp according to an illustrative embodiment of the present disclosure;

[0012] Fig. 5 is a perspective view of a clamping bolt according to an illustrative embodiment of the present disclosure; and

[0013] Fig. 6 is a perspective view of a clamping bolt according to another illustrative embodiment of the present disclosure.

DETAILED DESCRIPTION

[0014] Illustrative embodiments of the present disclosure may be provided as improvements to bonding jumpers. For example, a bonding jumper may be attached to a structure utilizing clamps. The bonding jumper may also include a ground terminal to which a ground wire may be attached.

[0015] Illustrative embodiments of the present disclosure provide a bonding jumper system in which a bonding jumper includes at least one C-shaped clamp allowing the bonding jumper to be clamped to a structure. The C-shaped clamp may include a ground terminal allowing a ground wire to be attached to the bonding jumper system.

[0016] Illustrative embodiments of the present disclosure include at least one clamp permanently attached to a bonding jumper. The bonding jumper may be crimped between a pair of members forming a portion of the clamp. The bonding jumper may be a flat braided strap.

[0017] In certain illustrative embodiments described herein, the tightening bolt of the C-shaped clamp also serves as a ground terminal. According to an illustrative embodiment, the tightening bolt may be a SERVIT POST™ manufactured by Burndy LLC.

[0018] As shown in Fig. 1, a bracket system including brackets 14 and nuts and bolts 16 may be utilized to attach the frame 12 of a photovoltaic module to a rail 18 of a solar tracking frame. However, such bracket systems may not provide a sufficiently low impedance conductive path to avoid any appreciable potential difference between these metallic parts. Accordingly, a bonding jumper system according to an illustrative embodiment of the present disclosure may be used for bonding frame 12 of a photovoltaic module to rail 18 of the solar tracking frame. In the present embodiment, strap 204 is attached to rail 18 by positioning a distal end of strap 204 between clamp 202 and the rail 18 and tightening bolt 208. A ground wire 10 may be attached to bolt 208 utilizing, for example, one of the appropriate clamping bolts to be described in the present disclosure. As shown in greater detail in Fig. 3, the other end of strap 204 is attached to frame 12 by positioning strap 204 (and cap 206) between member 207 of clamp 202 and frame 12 and tightening bolt 210 against frame 12. The bonding jumper systems as described herein provide a reliable low impedance conductive path for electrically bonding the metallic parts.

[0019] A clamp on bonding jumper system according to an embodiment of the present disclosure will be described in more detail below by reference to Fig. 2 and is referred to generally as bonding jumper system 200. Bonding jumper system 200 includes a bonding cable or strap 204. According to an illustrative embodiment of the present disclosure, bonding cable or strap 204 is a flat braided strap which may be, for example, aluminum, brass, copper, steel, etc. The ends of strap 204 may include metal caps 206 which may also be, for example, aluminum, brass, copper, steel, etc. Caps 206 may be attached to strap 204 in any suitable manner including, for example, by crimping, welding, soldering, etc. According to another illustrative embodiment of the present disclosure, caps 206 may be positioned on the ends of strap 204 just prior to them being positioned and clamped in place, with clamping bolt 208 or clamping bolt 210 providing the force for maintaining the strap 204 and cap 206 in position. Strap 204 may vary in length depending on a particular application. For example, strap 204 may be provided in 6", 1', 3', 5', 6' lengths or any other suitable length. Bonding jumper system 200 also includes C-shaped clamps 202, formed by substantially parallel members 205 and 207 separated by

connecting member 209. As shown, parallel member 205 includes a threaded hole 203 for receiving a clamping bolt 208, 210. The C-shaped clamps 202 may be provided in various sizes. For example, the distance between parallel members 205, 207 may vary depending on a particular application. That is, if the C-shaped clamp 202 is to be used to clamp a relatively thin frame, the distance between parallel members 205, 207 may be a first distance. If the C-shaped clamp 202 is to be used to clamp a relatively thick rail, the distance between members 205, 207 may be greater than the first distance. Clamping bolts 208 and 210 may be the same or different types of bolt. For example, as shown in Fig. 2, bolt 208 may be a SERVIT POST™ by Burndy LLC. The SERVIT POST™ includes a threaded post 220, fixed nut 222 and slot 224. Movable wire clamping member 227 moves up and down in slot 224 by rotation of nut 226 in the counterclockwise or clockwise direction. Utilizing the SERVIT POST™, a ground cable 20 may be attached to the bonding jumper system 200. For example, fixed nut 222 is utilized to tighten bolt 208 to clamp 202. A ground cable 20 is then positioned in the SERVIT POST™ below clamping member 227. Nut 226 is rotated in the clockwise direction to urge clamping member 227 down against ground cable 20 securing it in position. Bolt 210 may be a basic clamping bolt having a threaded post 230 and head portion 228. Head portion 228 may be any suitable type of head allowing the end user to tighten the bolt 210. In the exemplary embodiment shown in Fig. 2, head portion 228 of bolt 210 includes a hexagonal socket 232 for receiving a hexagonal wrench. C-shaped clamps 202 may be, for example, aluminum, brass, copper, steel, etc. Strap 204 may be positioned in clamps 202 just prior to the clamp being attached to a structure. Alternatively, straps 204 may be permanently attached to clamps 202 by welding, soldering, crimping, etc.

[0020] A clamp according to another illustrative embodiment of the present disclosure is shown in Fig. 4. According to this embodiment, a substantially E-shaped clamp 400 is formed by substantially parallel members 405, 408 and 410 separated by connecting member 409. As shown, parallel member 405 includes a threaded hole 402 for receiving a clamping bolt (not shown). Depending on a particular application, any suitable type of clamping bolt may be utilized, including those described herein. A braided bonding cable or strap 406 is positioned and crimped between parallel members 408 and 410 to provide a permanent connection between strap 406 and clamp 400. The opposite end of strap 406 may have a similar clamp 400 crimped

and permanently attached thereto. Alternatively, the opposite end of strap 406 may be attached to a structure utilizing a removable C-shaped clamp 202 such as that described above with respect to Figs. 1-3. Clamp 400 and strap 406 may be, for example, aluminum, brass, copper, steel, etc.

[0021] According to various embodiments of the present disclosure, other types of clamp bolts may be utilized for clamping the clamps to a structure and providing a ground post for attaching a ground wire. A clamp bolt according to another embodiment of the present disclosure is shown in Fig. 5 and is referred to generally as jack screw bolt 500. Jack screw bolt 500 includes a threaded shaft 502. According to an embodiment of the present disclosure, threaded shaft 502 includes a “cupped” distal end 504, which allows bolt 500 to bite into a surface of the structure, cutting through surface coatings naturally occurring (e.g., oxidation) or intentionally added (e.g., anodized) to the surface of the structure providing electrical continuity to the structure. It should be noted that the “cupped” shaped distal end of bolt 500 may be provided on any of the clamp bolts described herein. Threaded shaft 502 is integral with hexagonal head 506. A sliding member 510 has an inner dimension such that it is capable of sliding up and down on threaded shaft 502. A hole 512 passes through a side of sliding member 510 and through threaded shaft 502 and a nut 508 is provided for tightening sliding member 510. After bolt 500 is secured to one of the clamps described above, a ground wire (not shown) is passed through holes 512 in sliding member 510 and shaft 502. Nut 508 is then rotated which urges sliding member 510 against the wire securing the wire in position.

[0022] A clamp bolt according to another embodiment of the present disclosure is shown in Fig. 6 and is referred to generally as screw bolt 600. Screw bolt 600 includes a threaded shaft 602 which is integral with hexagonal head 606. A nut 610 includes an integral ground wire or cable 612 extending therefrom. Cable 612 may be welded or otherwise permanently attached to nut 610. Nut 608 is threaded onto threaded shaft 602. Nut 610 can be moved up and down on shaft 602 by rotating head 606 in the clockwise or counterclockwise directions as desired. When appropriately positioned, nut 608 is rotated until it abuts nut 610 locking it in position.

[0023] While illustrative embodiments of the present disclosure have been described and illustrated above, it should be understood that these are exemplary of the disclosure and are not

to be considered as limiting. Additions, deletions, substitutions, and other modifications can be made without departing from the spirit or scope of the present disclosure. Accordingly, the present disclosure is not to be considered as limited by the foregoing description.

CLAIMS

What is claimed is:

1. A bonding jumper system comprising:
a clamp capable of clamping a bonding jumper to a structure; and
a clamp bolt operationally associated with the clamp, the clamp bolt further comprising a ground post for attaching a ground cable.
2. The bonding jumper system as recited in claim 1, wherein the clamp comprises a substantially C-shaped clamp.
3. The bonding jumper system as recited in claim 1, wherein the clamp comprises a substantially E-shaped clamp.
4. The bonding jumper system as recited in claim 3, further comprising a bonding jumper, wherein the bonding jumper is permanently attached to the clamp.
5. The bonding jumper system as recited in claim 4, wherein the bonding jumper comprises a braided cable.
6. The bonding jumper system as recited in claim 5, wherein the braided cable is flat.
7. The bonding jumper system as recited in claim 1, wherein the clamp bolt comprises a SERVIT POST™.
8. The bonding jumper system as recited in claim 1, wherein the clamp bolt comprises a jack screw bolt.
9. A bonding jumper system comprising:
a bonding jumper cable;
a pair of clamps, each clamp capable of clamping the bonding jumper to a structure; and

a pair of clamp bolts, each clamp bolt operationally associated with one of the pair of clamps, at least one of the pair of clamp bolts including a ground post for attaching a ground cable.

10. The bonding jumper system as recited in claim 9, wherein the bonding jumper cable comprises a flat cable.

11. The bonding jumper system as recited in claim 10, wherein the flat cable comprises a braided flat cable.

12. The bonding jumper system as recited in claim 9, wherein at least one of the pair of clamps comprises a substantially C-shaped clamp.

13. The bonding jumper system as recited in claim 9, wherein at least one of the pair of clamps comprises a substantially E-shaped clamp.

14. The bonding jumper system as recited in claim 13, wherein the bonding jumper cable is permanently attached to the E-shaped clamp.

15. The bonding jumper system as recited in claim 14, wherein the bonding jumper cable is crimped to the E-shaped clamp.

16. A bonding jumper clamp comprising:

three parallel members extending from a connecting member;

a bonding jumper permanently affixed between at least two of the three parallel members; and

a clamp bolt operationally associated with one of the three parallel members, the clamp bolt including a ground post for attaching a ground cable.

17. The bonding jumper clamp as recited in claim 16, wherein the bonding jumper comprises a flat cable.

18. The bonding jumper clamp as recited in claim 17, wherein the flat cable comprises a braided flat cable.

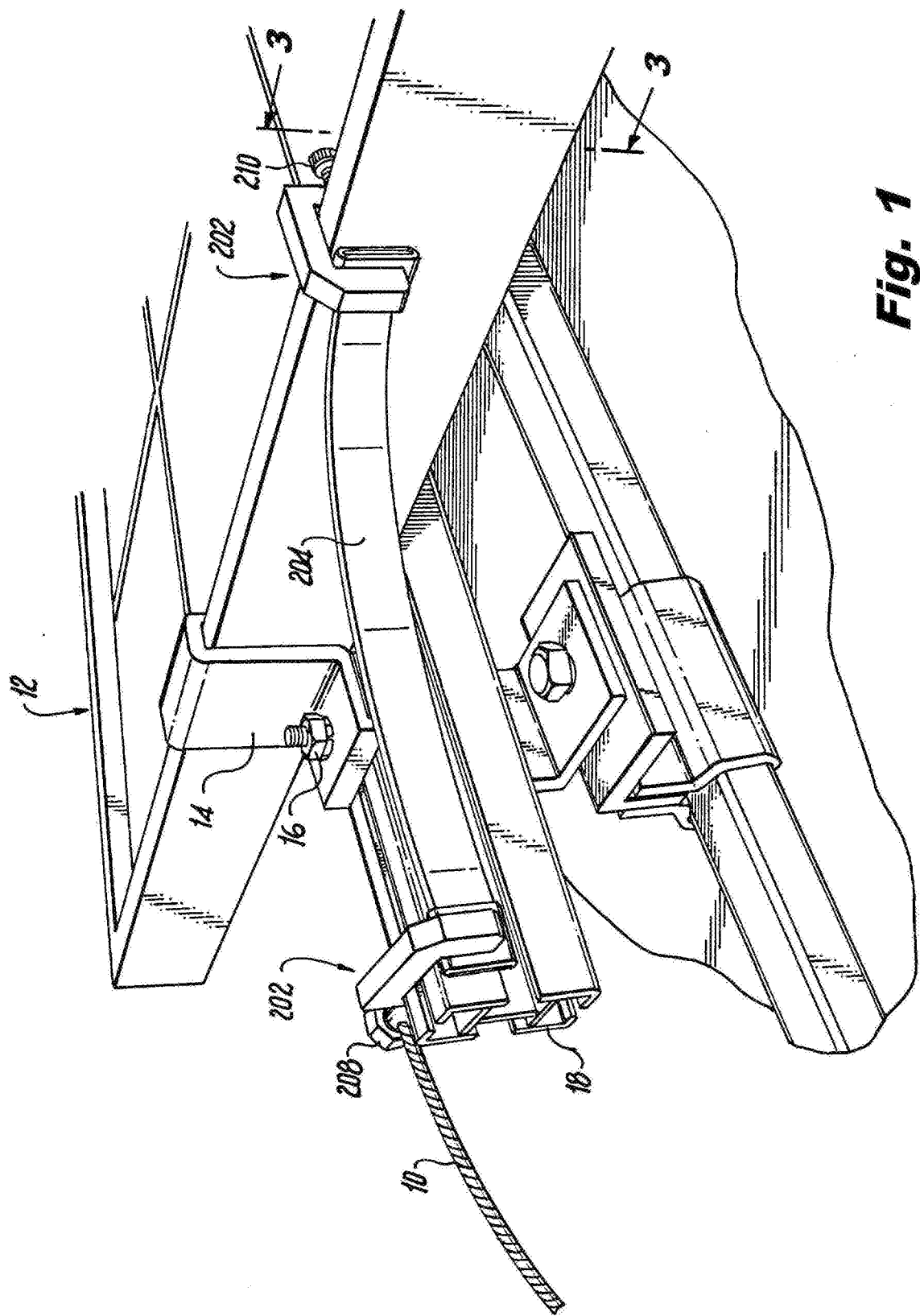


Fig. 1

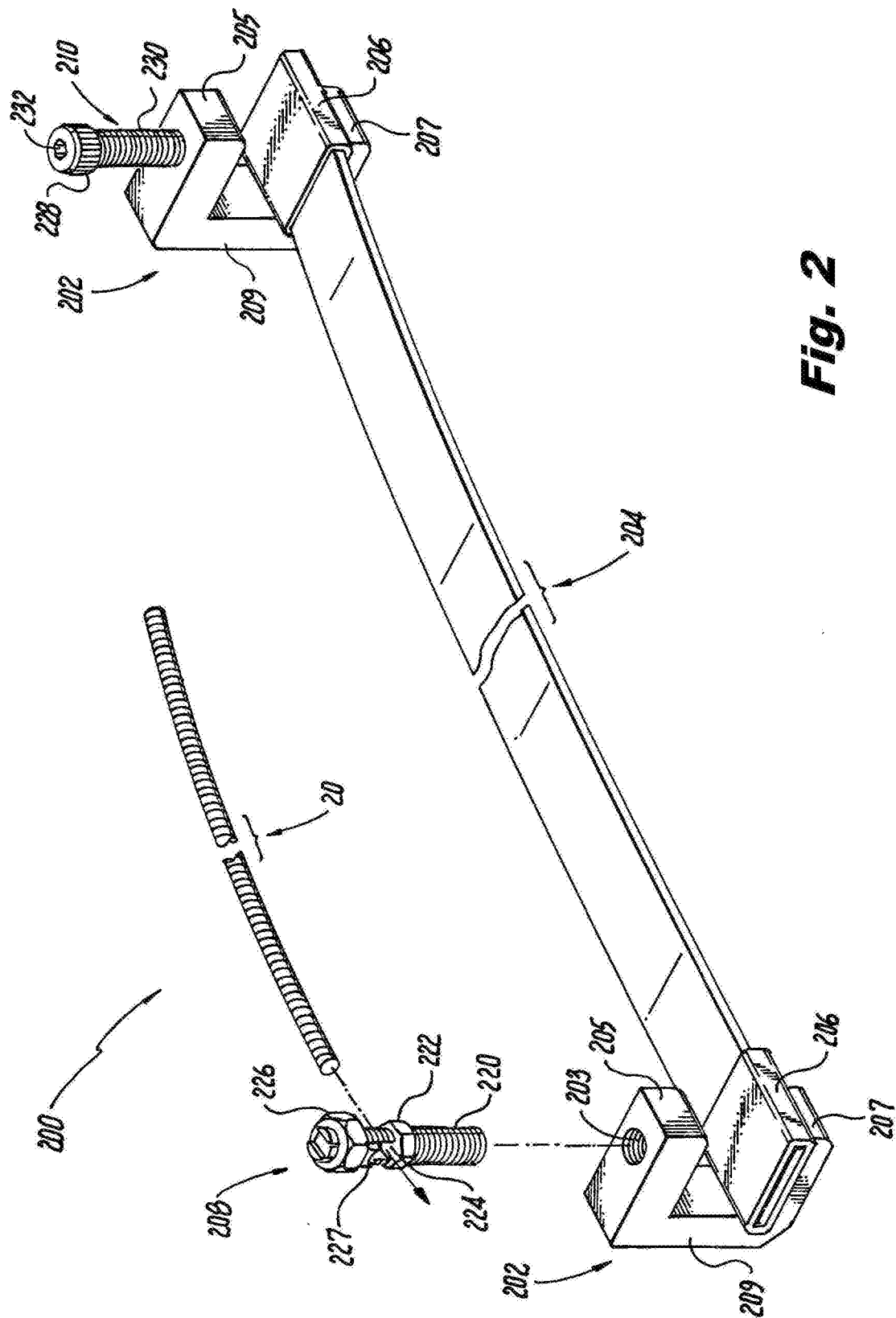


Fig. 2

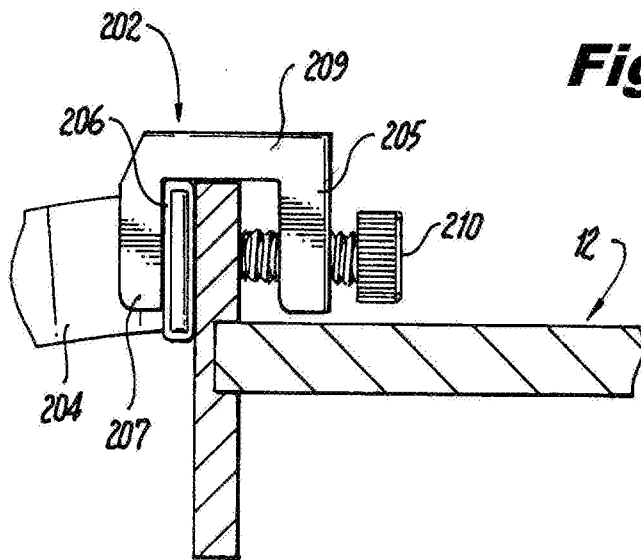


Fig. 3

Fig. 4

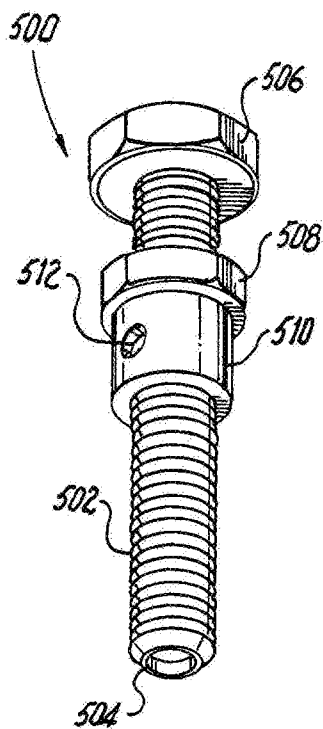
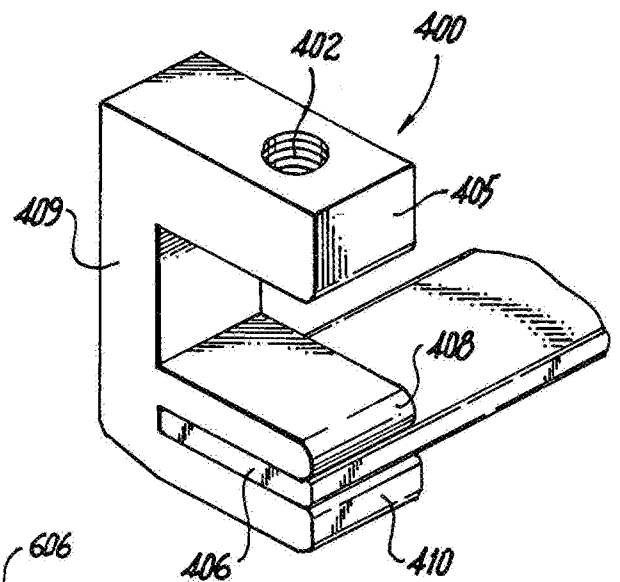


Fig. 5

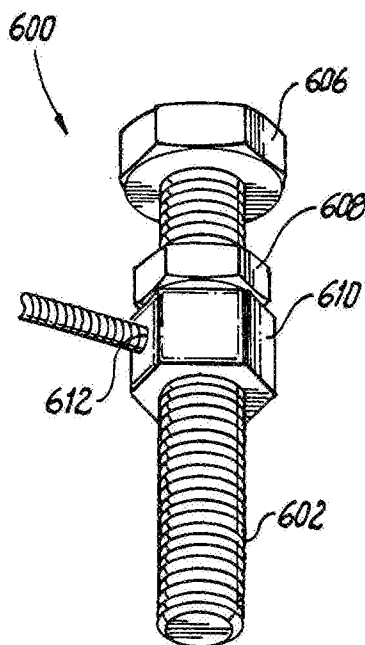


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/47096

A. CLASSIFICATION OF SUBJECT MATTER

IPC - H01R 4/38, 4/32, 4/36, 4/66, 4/64, 4/18 (2017.01)

CPC - H01R 4/38, 4/32, 4/36, 4/66, 4/64, 4/182

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)

See Search History document

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

See Search History document

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

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y --- A	US 4,925,395 A (FRANKS, G) May 15, 1990; figures 1-4, column 3, lines 24-31, column 4, lines 6 to column 5, line 20	1, 2, 7, & 8 --- 9-12 --- 3-6
Y --- A	US 1,910,022 A (LEGG, B) May 23, 1933; figures 1-5, page 2, lines 8-19, 56-63, line 77 to page 3, line 20, claim 3	9-12 --- 13-15
Y --- A	US 4,934,952 A (BANKER, J) June 19, 1990; figures 1, 2, column 2, lines 23-39, 50-55, column 3, lines 27-38, claim 1	10 & 11
A	US 7,993,169 B1 (HOXHA, V) August 9, 2011; abstract, figure 1, column 2, lines 3-28	1-15
A	CN 203939824 U (CHINA FIRST METALLURG GROUP CO) November 12, 2014; see machine translation; abstract, paragraph [0018], figures 1, 3	1-15



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

29 September 2017 (29.09.2017)

Date of mailing of the international search report

05 DEC 2017

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

Shane Thomas

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

-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 1-15 appear to be directed towards a clamp capable of clamping a bonding jumper to a structure.

Group II: Claims 1-8 & 16-18 appear to be directed towards a bonding jumper permanently affixed between parallel members.

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.

The special technical features of Group I are a pair of clamps, each clamp capable of clamping the bonding jumper to a structure; and a pair of clamp bolts, which are not present in Group II.

The special technical features of Group II are three parallel members extending from a connecting member; a bonding jumper permanently affixed between at least two of the three parallel members, which are not present in Group I.

The common technical features are a clamp capable of clamping a bonding jumper to a structure; and a clamp bolt operationally associated with the clamp, the clamp bolt further comprising a ground post for attaching a ground cable.

US 2010/0203748 A1 to Wason, P. et al. (WASON) discloses a clamp capable of clamping a bonding jumper to a structure (frame 18 and set screws 20 (together clamp) for clamping a bonding conductor 4 to a structure 12; figures 1, 3, paragraphs [0026], [0027]); and a clamp bolt operationally associated with the clamp (mounting post assembly 16 (clamp bolt) operationally associated with frame 18 for attaching to structure 12, as shown; figure 1, 3, paragraphs [0027], [0033]), the clamp bolt further comprising a ground post for attaching a ground cable (mounting post assembly 16 comprising post connector 28 for attaching main ground conductor 2; figures 1, 3, paragraphs [0028], [0030], [0034]).

Since these common features are previously disclosed by WASON, they are not special and Groups I-II lack unity.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/47096

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:

Group I: Claims 1-15; Group II: Claims 1-8 & 16-18

-Continued within 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.:
1-15

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.