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(54) Title: A GROUNDING CONNECTOR

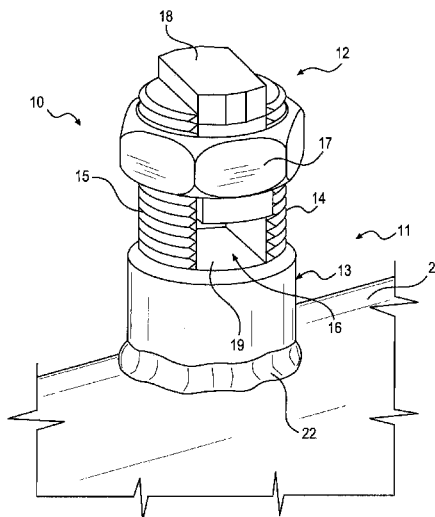


FIG. 4

(57) Abstract: Embodiments of the present disclosure include a connector. The connector may include a connection body and an engagement structure. The connection body may include a first support member, a second support member, a base from which the first support member and the second support member extend, wherein the base includes a beveled portion for connecting the connection body to the structure, and a slot defined between the first support member and the second support member and configured to receive a ground line. The engagement structure may be configured to engage the first support member and the second support member and move relative to the base along the first support member and the second support member.

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A GROUNDING CONNECTOR

DESCRIPTION

Cross-Reference to Related Application

[001] This application claims the benefit of priority under 35 U.S.C. § 119 to U.S. Provisional Patent Application No. 61/513,282, filed on July 29, 2011, which is incorporated herein by reference in its entirety.

Field of the Disclosure

[002] Embodiments of the present disclosure include a grounding connector, and more particularly, a weldable grounding connector.

Background of the Disclosure

[001] Generally, certain structures and equipment that are isolated from the ground may be electrically grounded to prevent damage caused by, for example, electrical surges, electric faults, and static charge build-up. Typically, a ground wire may be coupled to the structure to ground the structure. For example, a ground wire may be secured to a pipe by a strap, clamp, or similar means. Straps, however, may not provide enough contact surface area to securely couple the grounding wire with the pipe. Moreover, inspections of the ground connection require that the straps be frequently disconnected and reconnected from the pipe, which may damage and weaken the strap. As a result, these damaged and weakened straps may fail when the pipe experiences electric surges.

[002] Alternatively, the ground wire may be welded directly onto the pipe. Such a connection, however, may be cumbersome when testing the ground wire, as the ground wire must be regularly detached to verify the ground quality of the wire, and then rewelded. Furthermore, the weld may not provide enough surface area for connection due to the existence of air pockets within the weld. Welding may also be harmful to the pipe, as the wire may not be a suitable material to weld onto the pipe.

[003] Accordingly, the grounding connector and related methods of the present disclosure are directed to improvements in the existing technology.

Summary of the Disclosure

[004] In accordance with an embodiment, a connector for electrically grounding a structure may include a connection body and an engagement structure. The connection body may include a first support member, a second support member, a base from which the first support member and the second support member extend, wherein the base includes a beveled portion for connecting the connection body to the structure, and a slot defined between the first support member and the second support member and configured to receive a ground line. The engagement structure may be configured to engage the first support member and the second support member and move relative to the base along the first support member and the second support member.

[005] In accordance with another embodiment, a connector for electrically grounding a structure may include a connection body and an engagement structure. The connection body may include a first support member, a second support member, a base from which the first support member and the second support member extend, wherein the base is configured to be coupled to the structure, and a slot defined between the first support member and the second support member and configured to receive a ground line, wherein the slot includes a substantially flat surface disposed on the base for contacting the ground wire. The engagement structure may be configured to engage the first support member and the second support member and move relative to the base along the first support member and the second support member.

[006] In accordance with yet another embodiment, a connector for electrically grounding a structure may include a connection body and an engagement structure. The connection body may include a first support member, a second support member, a base configured to couple the connection body to the structure, wherein the first support member extends from the base at a first interface, and the second support member extends from the base at a second interface, and a slot defined between the first support member and the second support member and configured to receive a ground line, wherein the slot includes a surface for contacting the ground line, wherein the surface is disposed on a top end of the base and extends between the first interface and the second interface. The engagement structure may be

configured to engage the first support member and the second support member and move relative to the base.

Brief Description of the Drawings

[007] Fig. 1 is a schematic illustration of a facility employing a grounding connector, according to an exemplary disclosed embodiment;

[008] Fig. 2 illustrates a perspective view of a grounding connector, according to an exemplary disclosed embodiment;

[009] Fig. 3 illustrates a perspective view of a connection body of the grounding connector of Fig. 2, according to an exemplary disclosed embodiment; and

[010] Fig. 4 illustrates a perspective view of the grounding connector of Fig. 2 coupled to a pipe, according to an exemplary disclosed embodiment.

Detailed Description

[011] Reference will now be made in detail to exemplary embodiments of the present disclosure described above and illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[012] The following detailed description illustrates a grounding connector by way of example and not by way of limitation. Although the description below describes an application of a grounding connector for grounding a pipe, and particularly a natural gas pipe, embodiments of the disclosed grounding connector may be applied to electrically couple components in any application, including, without limitation, for grounding purposes. For example, embodiments of the current disclosure may be used to ground electrical components in a building, computer components, and engine and/or motor components.

[013] Fig. 1 is a schematic illustration of a facility 1, according to an exemplary disclosed embodiment. In some embodiments, facility 1 may be a natural gas facility for storing and/or processing natural gas. Natural gas facility 1 may include a system of above-ground pipes 2 for carrying and delivering natural gas and a control center 3 for monitoring and controlling the natural gas within pipes 2. It should be appreciated that natural gas facility 1 may also include any other suitable

structures, such as, for example, one or more generators 4, electrical meters 5, and electric utility lines (not shown).

[014] Natural gas facility 1 may also include a grounding system 6 configured to electrically ground the various structures of natural gas facility 1 and prevent damage caused by, for example, electrical surges, electrical faults, and/or static charge build-up. Grounding system 6 may include one or more conductive rods 7, such as, for example, a copper stake, dug into the ground. Grounding system 6 may also include a conductive grid 8 comprised of a plurality of conductive lines, such as, for example, copper cables, surrounding the structures of natural gas facility 1 and in electrical communication with conductive rods 7 (and thus the ground). In some embodiments, conductive grid 8 may be dug underground. One or more ground lines 9 may be electrically connected to conductive grid 8 and/or conductive rods 7, and may be coupled to the structures of natural gas facility 1 to ground the structures. For example, ground lines 9 may be coupled to pipes 2 and electrically-conductive components of control center 9, generator 4, and meters 5 for grounding purposes. Ground lines 9 may include any suitable conductive material, such as, for example, copper and/or stainless steel wires, cables, rods, or the like.

[015] Ground lines 9 may be coupled to pipes 2 and any other structures via a grounding connector 10. As will be described in more detail below, grounding connector 10 may be suitably connectable to, for example, pipe 2, and may be configured to electrically couple and decouple ground lines 9 to pipe 2 to ground pipe 2.

[016] Fig. 2 is a perspective illustration of grounding connector 10, according to an exemplary disclosed embodiment. As shown in Fig. 2, grounding connector 10 may include a connection body 11 and an engagement structure 12.

[017] Connection body 11 may include a base 13, a first support member 14 extending from base 13, and a second support member 15 extending from base 13. A slot 16 may be defined between first support member 14 and second support member 15 through which ground line 9 may be disposed. First support member 14 and second support member 15 may include a threaded configuration configured to mate with complementary grooves of engagement structure 12. For example, in certain embodiments, engagement structure 12 may include a nut 17 and a contact member 18. Nut 17 may engage first and second support members 14, 15, and contact member 18 may be movably disposed within slot 16. Nut 17 may be

screwed towards base 13 to secure ground line 9 between contact member 18 and base 13, and may be screwed away from base 13 to disengage ground line 9 from contact member 18 and base 13. Nut 17 and contact member 18 may be formed of any suitable malleable and conductive material, including, as examples, copper and bronze. Accordingly, if connection body 11 is exposed to excessive stress on or near engagement structure 12, engagement structure 12 may prevent damage to base 13 and first and second support members 14, 15 by absorbing the stress before such stress damages base 13 and first and second support members 14, 15. Although engagement structure 12 may engage first and second support members 14, 15 via a screw-like arrangement, it should be appreciated that any other suitable configuration may be employed to removably couple engagement structure 12 to first and second support members 14, 15. Such configurations may include, as examples, a friction fit arrangement and removable fasteners. In certain embodiments, first and second support members 14, 15 may each include a height of approximately one inch, and slot 16 may include a width of approximately 0.44 inches. It should be appreciated, however, that first and second support members 14, 15 and slot 16 may include any suitable dimensions to provide appropriate grounding of a structure and may depend on, for example, the size of ground line 9 and/or pipe 2.

[018] Slot 16 may also include a substantially flat surface 19. Ground line 9 may be electrically coupled to grounding connector 10 by contacting flat surface 19. Flat surface 19 may also provide improved contact and compression of ground line 9 to grounding connector 10. For example, in certain applications, ground line 9 may be composed of multiple conductive structures, such as multiple conductive wires, cables, rods, and the like, and may be disposed through slot 16. As engagement structure 12 is moved towards base 13, contact member 18 may contact and compress the multiple conductive structures of ground line 9 against flat surface 19. The conductive structures may spread apart across flat surface 19. The flat configuration of surface 19 may provide a level surface area for the conductive structures to spread out, which may provide increased contact with base 13 and improved compression and connection of the conductive structures by engagement structure 12. Flat surface 19 may also provide more versatility for supporting and connecting other flat-shaped materials, such as, for example, flange guards, to grounding connector 10.

[019] Flat surface 19 may also be positioned at a top end of base 13 and may be substantially perpendicular to first and second support members 14, 15. That is, flat surface 19 may extend across a first interface between first support member 14 and base 13 and a second interface between second support member 15 and base 13. The entire exterior surface of base 13 may also extend up to the first interface and the second interface. As such, base 13 may be a solid, substantially cylinder-shaped structure, which may provide a stronger connection to pipe 2.

[020] Connection body 11 may also be formed of any suitable material that is electrically conductive and compatible with the material of pipe 2, or any other structure, for welding and/or fastening purposes. The material may be, for example, stainless steel (generally the same material as pipe 2), to provide appropriate grounding of pipe 2 and corrosion resistance, and to allow grounding connector 10 to be directly welded and/or fastened to pipe 2.

[021] Fig. 3 illustrates a perspective illustration of connection body 11, according to an exemplary disclosed embodiment. As show in Fig. 3, base 13 may include a beveled portion 20 configured to facilitate the connection of grounding connector 10 to a structure, such as pipe 2.

[022] Beveled portion 20 may define a recessed space at a bottom end of base 13 to allow a greater amount of fastening material, such as, for example, adhesives, solder, welds, and the like, to be positioned between grounding connector 10 and pipe 2. Beveled portion 20 therefore may promote a stronger bond between grounding connector 10 and pipe 2. In certain embodiments, beveled portion 20 may include a tapered configuration to define the recessed space. That is, the diameter of base 13 beginning at beveled portion 20 may incrementally decrease towards a terminal end 21 of base 13.

[023] Terminal end 21 may be positioned at the bottom of base 13, and may be configured to complement the surface of the structure onto which grounding connector 10 may be connected. In certain embodiments, for example, terminal end 21 may include a curved shape to complement the curved configuration of pipe 2. Accordingly, terminal end 21 may provide improved mating, and thus bonding, between grounding connector 10 and pipe 2. It should be appreciated, however, that terminal end 21 may include any other suitable shape configured to complement the mating between grounding connector 10 and any other structure. For example, in

some embodiments, terminal end 21 may include a substantially flat surface to complement a flat surface of a structure onto which grounding connector 10 may be connected.

[024] Grounding connector 10 is a separate unit that may be retrofitted to existing structures, such as pipe 2. In other words, grounding connector 10 is not integrally formed with a structure, such as pipe 2, and may be connected to any suitable structure by fastening and/or welding base 13 to the structure. Accordingly, the non-integral feature of grounding connector 10 may provide increased versatility and applicability for positioning and installing grounding connector 10 to a variety of structures.

[025] Fig. 4 is a perspective illustration of grounding connector 10 connected to pipe 2, according to an exemplary disclosed embodiment. As alluded to above, a fastening material 22 may bond base 13 to pipe 2. Due to the non-integral nature of grounding connector 10, grounding connector 10 may be quickly coupled to pipe 2 by simply applying fastening material 22 between base 13 and pipe 2. Moreover, grounding connector 10 may be coupled to pipe 2 at any location of pipe 2 and at any orientation. For example, and as shown in Fig. 4, grounding connector 10 may be coupled to pipe 2 such that slot 16 substantially intersects a longitudinal axis of pipe 2. It should be appreciated, however, that grounding connector 10 may be coupled to pipe 2 such that slot 16 may be orientated in any other suitable direction, such as, for example, substantially parallel with the longitudinal axis of pipe 2. As such, grounding connector 10 may provide a versatile grounding structure to connect and accommodate ground lines 9 traveling in any direction.

[026] Any aspect set forth in any embodiment may be used with any other embodiment set forth herein. It will be apparent to those skilled in the art that various modifications and variations can be made in the disclosed devices and processes without departing from the scope of the disclosure. Other embodiments of the disclosure will be apparent to those skilled in the art from consideration of the specification and practice of the disclosure disclosed herein. It is intended that the specification and examples be considered as exemplary only.

What is claimed is:

1. A connector for electrically grounding a structure, the connector comprising:
a connection body including:
a first support member;
a second support member;
a base from which the first support member and the second support member extend, wherein the base includes a beveled portion for connecting the connection body to the structure; and
a slot defined between the first support member and the second support member and configured to receive a ground line; and
an engagement structure configured to engage the first support member and the second support member and move relative to the base along the first support member and the second support member.
2. The connector of claim 1, wherein the beveled portion defines a recessed space at a bottom end of the base.
3. The connector of claim 2, wherein a diameter of the base at the beveled portion tapers towards the bottom end of the base.
4. The connector of claim 1, wherein the base includes a terminal end having a shape configured to complement a surface of the structure onto which the connector is connected.
5. The connector of claim 4, wherein the terminal end includes a curved shape.
6. The connector of claim 1, wherein the slot includes a substantially flat surface disposed on a top end of the base for contacting the ground wire.
7. The connector of claim 6, wherein the first support member extends from the base at a first interface, and the second support member extends from the base at a

second interface, and the flat surface extends between the first interface and the second interface.

8. The connector of claim 6, wherein an entire exterior surface of the base extends up to the first and second interfaces.
9. The connector of claim 1, wherein the base is substantially cylinder-shaped.
10. The connector of claim 1, wherein the connection body is formed of an electrically conductive material.
11. A connector for electrically grounding a structure, the connector comprising:
 - a connection body including:
 - a first support member;
 - a second support member;
 - a base from which the first support member and the second support member extend, wherein the base is configured to be coupled to the structure; and
 - a slot defined between the first support member and the second support member and configured to receive a ground line, wherein the slot includes a substantially flat surface disposed on the base for contacting the ground wire; and
 - an engagement structure configured to engage the first support member and the second support member and move relative to the base along the first support member and the second support member.
12. The connector of claim 11, wherein the flat surface is disposed on a top end of the base.
13. The connector of claim 11, wherein the flat surface is substantially perpendicular to the first and second support members.
14. The connector of claim 11, wherein the base includes a beveled portion for connecting the connection body to the structure.

15. The connector of claim 14, wherein the beveled portion defines a recessed space at a bottom end of the base.
16. A connector for electrically grounding a structure, the connector comprising:
 - a connection body including:
 - a first support member;
 - a second support member;
 - a base configured to couple the connection body to the structure,wherein the first support member extends from the base at a first interface, and the second support member extends from the base at a second interface; and
 - a slot defined between the first support member and the second support member and configured to receive a ground line, wherein the slot includes a surface for contacting the ground line, wherein the surface is disposed on a top end of the base and extends between the first interface and the second interface; and
 - an engagement structure configured to engage the first support member and the second support member and move relative to the base.
17. The connector of claim 16, wherein the surface is substantially flat.
18. The connector of claim 17, wherein the surface is substantially perpendicular to the first and second support members.
19. The connector of claim 16, wherein the base includes a beveled portion for connecting the connection body to the structure.
20. The connector of claim 17, wherein the engagement structure is configured to move relative to the flat surface along the first support member and the second support member.

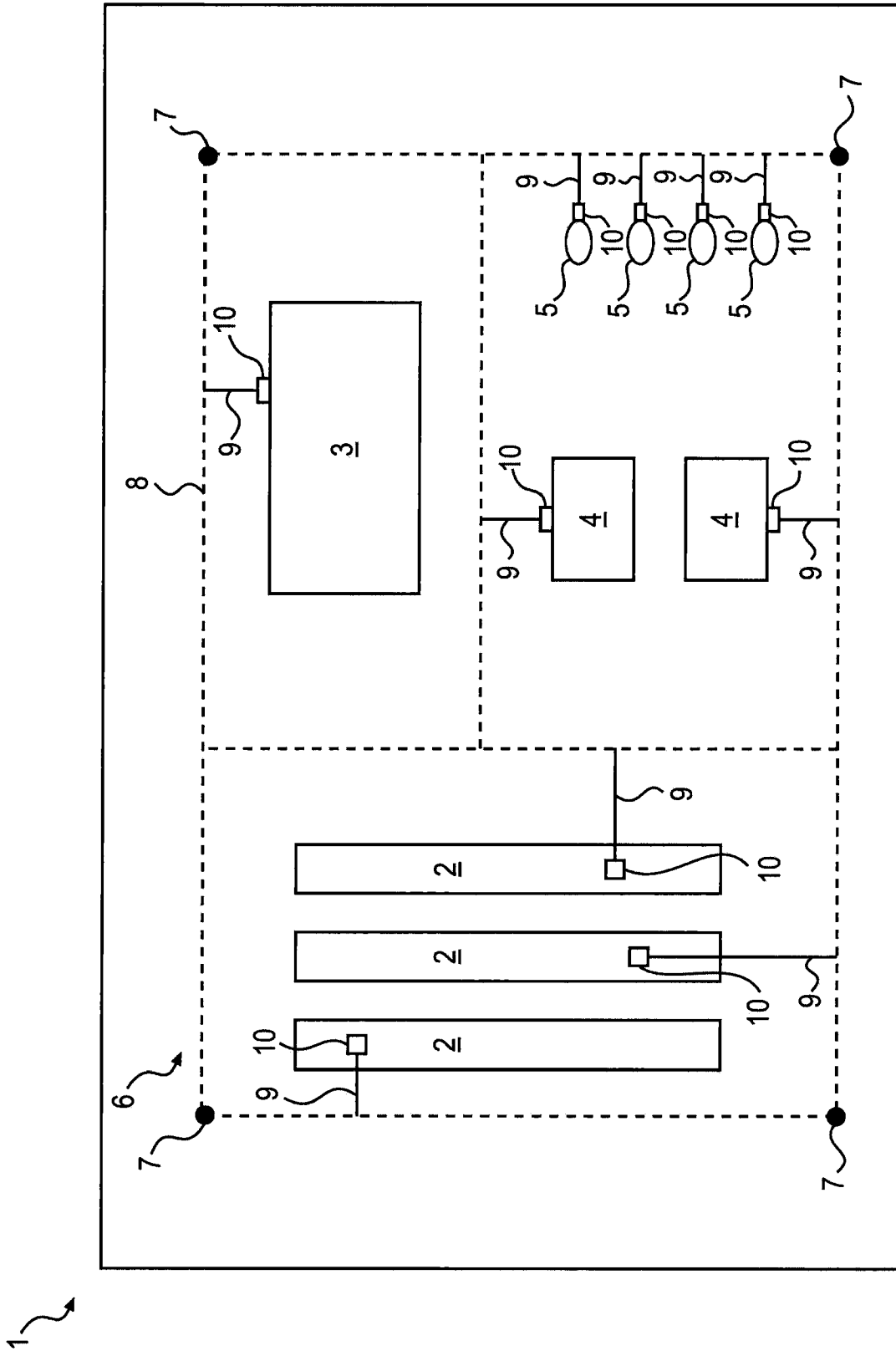
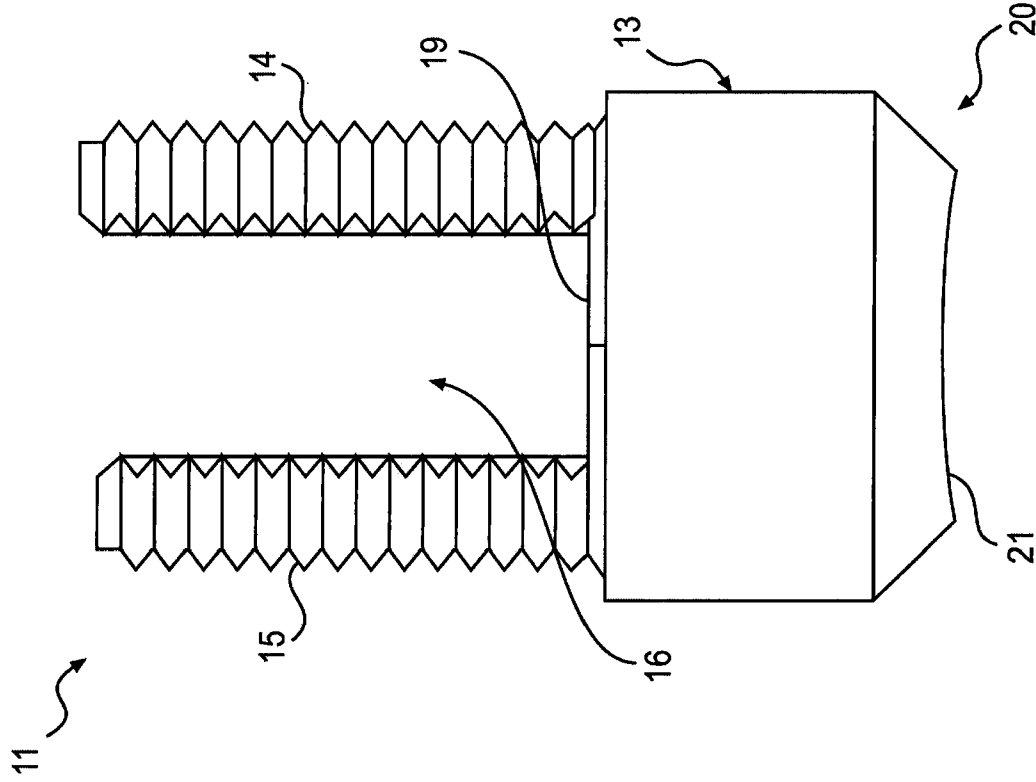
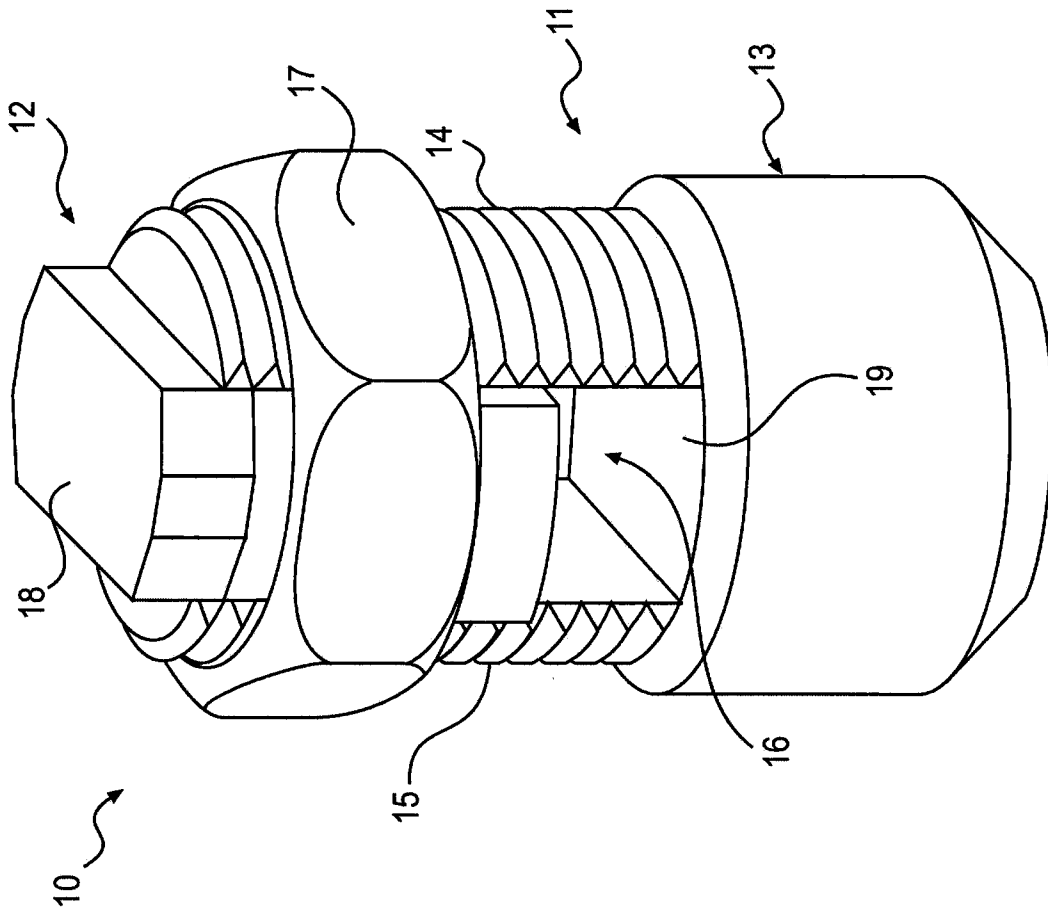


FIG. 1



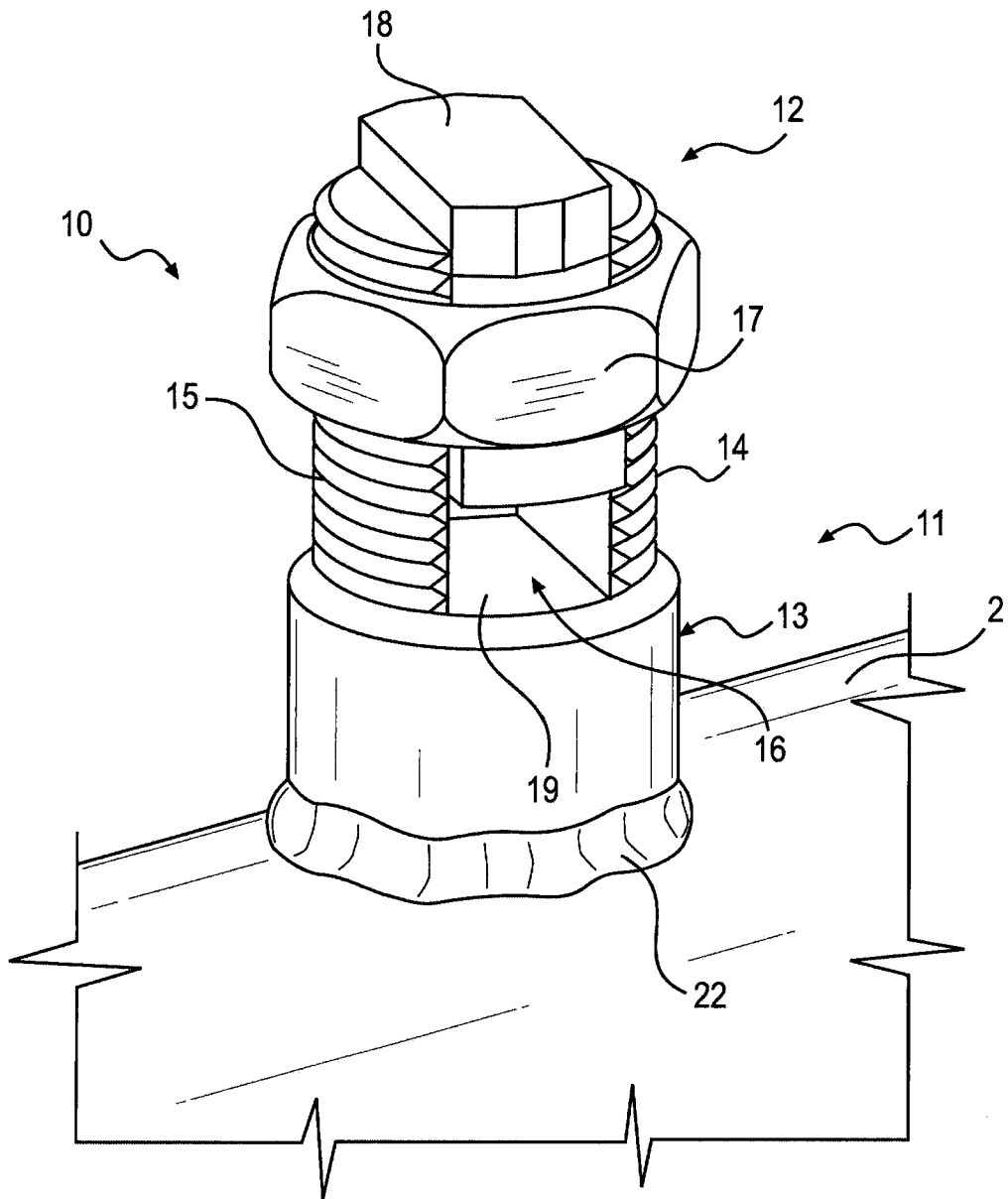


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/048287

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R4/32
ADD.
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)
H01R

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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 7 566 250 B1 (GOOD ROBERT SCOTT [US]) 28 July 2009 (2009-07-28) abstract; figure 1	1,11,16, 20
A	FR 1 587 247 A (JACQUET FRANCIS) 13 March 1970 (1970-03-13) figure 1	1
X	US 2 187 166 A (MADDEN JOHN B) 16 January 1940 (1940-01-16) figures 1,9	1,10
X	CH 106 640 A (KALBERER O E DR [CH]; MEZGER W [CH]) 1 September 1924 (1924-09-01) the whole document	1,6,7, 11-13, 17,18

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
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- "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
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- "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 11 October 2012	Date of mailing of the international search report 18/10/2012
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Corrales, Daniel
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2012/048287

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 7566250	B1	28-07-2009	CA 2669632 A1 27-12-2009
			EP 2139072 A2 30-12-2009
			US 7566250 B1 28-07-2009

FR 1587247	A	13-03-1970	NONE

US 2187166	A	16-01-1940	NONE

CH 106640	A	01-09-1924	NONE
