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(54) Title: SAFETY CLIMB ATTENUATION APPARATUS

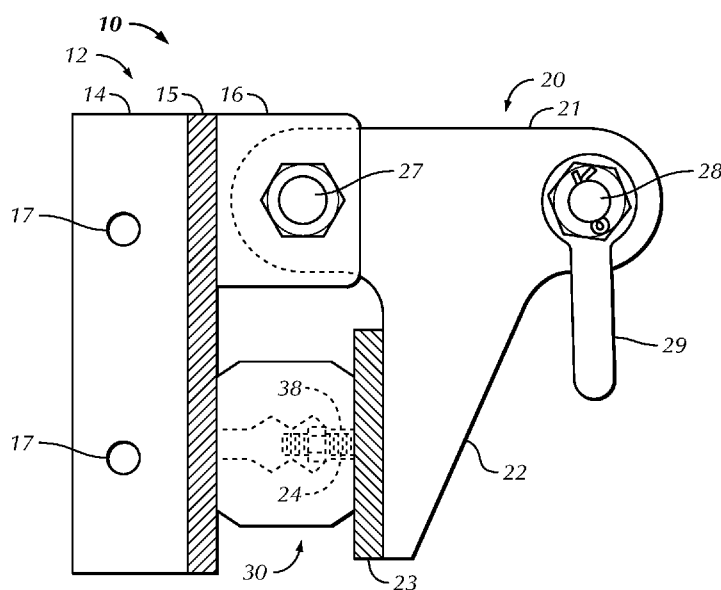


FIG. 3

(57) Abstract: A safety climb attenuation apparatus provides a more robust and visually inspectable apparatus for climbing safety. In an upper bracket, a pivot arm is attached to a base that is disposed upon a structure. The upper bracket includes an attenuation member such as an elastic bushing, mounted on the pivot arm or the base, that resists pivoting of the pivot arm relative to the base when a safety cable attached to the pivot arm causes the pivot arm to pivot. In a lower bracket, a similar attenuation member is attached to a base disposed on the structure, with an anchor bolt connecting the cable to the attenuation member so that the attenuation member resists upward movement of the cable.



MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

- *with international search report (Art. 21(3))*

SAFETY CLIMB ATTENUATION APPARATUS

TECHNICAL FIELD

[0001] The present invention relates to the field of safety climbs, and in particular to a safety climb for use on structures such as communication towers.

BACKGROUND ART

[0002] Safety climbs are conventionally used with communication towers and other structures to provide resilience to safety lines when they are used to prevent a worker from falling. A conventional safety climb fixture is illustrated in FIG. 1. Such fixtures include an upper closed housing with an internal spring or elastic bushing engaged with a vertically moveable rod having a ring at a bottom end thereof. As illustrated in FIG. 1, a safety cable is supported by the ring, and conventional safety equipment may be secured to the safety cable.

[0003] Although safety climb fixtures as illustrated in FIG. 1 can provide effective attenuation in case of a fall, they suffer from several problems. For example, the attenuation spring is hidden inside the closed housing, requiring an inspector to physically use a crane or climb a tower or other structure in order to open the housing and visually inspect the attenuation spring to determine whether the fixture is in working order. Another problem associated with safety climb fixtures as illustrated in FIG. 1 is the close proximity of the safety rod and attached safety cable to the tower and/or equipment mounted on the tower. In such arrangements, the close proximity of the safety cable to the tower or equipment can damage the tower and/or equipment, and viewing of the safety climb fixture from the ground is often blocked or obstructed by the tower and/or equipment mounted thereon. A further problem associated with safety climb fixtures as illustrated in FIG. 1 is that they tend to degrade or fail after extended periods of time due to water retention or missing caps to protect the internal components thus requiring frequent inspections during their lifespans, and requiring more frequent repairs or replacements. In addition, certain types of conventional safety climb fixtures having coil springs are susceptible to incorrect installation and corrosion.

SUMMARY OF INVENTION

[0004] In one aspect, a safety climb attenuation apparatus comprises a safety climb attenuation bracket, comprising: a base member, configured for mounting to a structure; a pivot arm member, pivotably disposed on the base member; and an attenuation member, disposed on one or both of the pivot arm member and the base member, wherein the attenuation member resists pivoting of the pivot arm member relative to the base member.

BRIEF DESCRIPTION OF DRAWINGS

[0005] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate an implementation of apparatus and methods consistent with the present invention and, together with the detailed description, serve to explain advantages and principles consistent with the invention. In the drawings,

[0006] Figure 1 is prior art example of a safety climb attenuation bracket.

[0007] Figures 2 is a side view of a safety climb attenuation bracket according to one embodiment, connected to a safety cable.

[0008] Figure 3 is another side view of the safety climb attenuation bracket according to one embodiment.

[0009] Figure 4 is a side view and a top view of a base of the safety climb attenuation bracket according to one embodiment.

[0010] Figure 5 is a side view of a pivot arm of the safety climb attenuation bracket according to one embodiment.

[0011] Figure 6 is a top view of an elastic compression bushing for use in a safety climb attenuation bracket according to one embodiment.

[0012] Figure 7 is a cutaway of an elastic compression bushing for use in a safety climb attenuation bracket according to one embodiment.

[0013] Figure 8 is a front and a side view of a lower safety cable anchoring system according to one embodiment.

DESCRIPTION OF EMBODIMENTS

[0014] In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the invention. It will be apparent, however, to one skilled in the art that the invention may be practiced without these specific details. In other instances, structure and devices are illustrated in block diagram form in order to avoid obscuring the invention. References to numbers without subscripts are understood to reference all instance of subscripts corresponding to the referenced number. Moreover, the language used in this disclosure has been principally selected for readability and instructional purposes, and may not have been selected to delineate or circumscribe the inventive subject matter, resort to the claims being necessary to determine such inventive subject matter. Reference in the specification to “one embodiment” or to “an embodiment” means that a particular feature, structure, or characteristic described in connection with the embodiments is included in at least one embodiment of the invention, and multiple references to “one embodiment” or “an embodiment” should not be understood as necessarily all referring to the same embodiment.

[0015] The terms “a,” “an,” and “the” are not intended to refer to a singular entity unless explicitly so defined, but include the general class of which a specific example may be used for illustration. The use of the terms “a” or “an” may therefore mean any number that is at least one, including “one,” “one or more,” “at least one,” and “one or more than one.”

[0016] The term “or” means any of the alternatives and any combination of the alternatives, including all of the alternatives, unless the alternatives are explicitly indicated as mutually exclusive.

[0017] The phrase “at least one of” when combined with a list of items, means a single item from the list or any combination of items in the list. The phrase does not require all of the listed items unless explicitly so defined.

[0018] Any numerical range recited herein is intended to include all sub-ranges subsumed therein. For example, a range of “1 to 10” is intended to include all sub-ranges between (and including) the recited minimum value of 1 and the recited maximum value of 10, that is, having a minimum value equal to or greater than 1 and a maximum value of equal to or less than 10.

[0019] In this description, the term “connect” or “connected” means either an indirect or direct connection. Thus, if a first device is connected to a second device, that connection may be through a direct connection or through an indirect connection via other devices and connections.

[0020] Safety climb attenuation brackets and apparatuses are described below that address the above-noted problems of conventional safety climb fixtures.

[0021] An embodiment of a safety climb attenuation bracket is illustrated in FIGs. 2-5.

[0022] FIGs. 6 and 7 illustrate details of an elastic compression bushing for use in an attenuation bracket according to one embodiment.

[0023] FIG. 8 includes front and side views of a lower safety cable anchoring apparatus in accordance with one embodiment.

[0024] Side views of safety climb attenuation apparatuses in accordance with various embodiments are illustrated in FIGs. 2 and 3. The safety climb attenuation bracket 10 includes a base member 12, pivot arm 20, and an attenuation member, in one embodiment in the form of an elastic attenuation bushing 30. Side and top views of the base member 12 according to one embodiment are illustrated in FIGs. 4 and 5. A side view of the pivot arm 20 is illustrated in FIG. 5. An end view and a partial side sectional view of the elastic attenuation bushing 30 are illustrated in FIGs. 6 and 7, respectively.

[0025] As illustrated in FIG. 3, the pivot arm 20 is pivotally mounted on the base member 12, and the elastic attenuation bushing 30 is secured to the pivot arm 20. In one embodiment, the base member 12 includes a mounting bracket 14, a back plate 15, a pair of support tabs 16, mounting holes 17, and a pivot hole 18 through the support tabs 16, as illustrated in FIGs. 3 and 4. The mounting bracket 14 uses the mounting holes 17 for attaching the mounting bracket

14 of the base member 12 to a structure (not shown in FIG. 3). In other embodiments, the mounting bracket 14 may be omitted, and the back plate 15 may be configured for mounting the base member 12 to the structure. In some embodiments, a single support tab 16 may be used instead of a pair of support tabs 16.

[0026] As illustrated in FIGs. 3 and 5, the pivot arm 20 includes a horizontal arm extension 21 and a vertical arm extension 22 that extends downward from the horizontal arm extension 21. Although illustrated in FIGs. 3 and 5 as extending perpendicular to the horizontal arm extension 21, the vertical arm extension 22 may be formed at other angles than perpendicular. The details of the shape of the pivot arm 20, as well as the placement of the vertical arm extension 22 relative to the horizontal arm extension 21 are illustrative and by way of example only, and other shapes and arrangements may be used. A back plate 23 may be connected to the vertical arm extension 22, and a threaded stud 24 extends from the back plate 23 in one embodiment. In some embodiments, the stud 24 is welded to the back plate 23, while in other embodiments, other means for attaching the stud 24 may be used, such as inserting the stud 24 through a hole formed in the back plate 23. Other techniques for attaching the elastic attenuation bushing 30 may be used as desired, such as glue, a strap, etc. In some embodiments, the back plate 23 may be formed integral with the vertical arm extension 22. In some embodiments, the elastic attenuation bushing 30 may be mounted on the back plate 15 instead of on the back plate 23, so that the elastic attenuation bushing 30 may be mounted on the base member 12 instead of the pivot arm 20, and if a stud 24 is used, the stud 24 may be disposed on the base member 12 with the attenuation bushing 30. A pivot hole 25 is provided at one end of the horizontal arm extension 21, and a safety cable-mounting hole 26 is provided at another end of the horizontal arm extension 21. As illustrated in FIG. 3, a pivot bolt 27 is used to pivotally mount the pivot arm 20 on the support tabs 16 of the base member 12. The pivot bolt 27 extends through the pivot holes 18 of the support tabs 16 of the base member 12, and extends through the pivot hole 25 of the pivot arm 20. As further illustrated in FIG. 3, a shackle 29 is secured to the horizontal arm extension 21 of the pivot arm 20 through the cable-mounting hole 26 (illustrated in FIG. 5). A mounting bolt 28 extends through the cable-mounting hole 26 to secure the shackle 29 to the pivot arm 20.

[0027] As illustrated in FIGs. 6 and 7, the elastic attenuation bushing 30 includes a generally cylindrical body 32. In some embodiments, one or both ends of the cylindrical body may be tapered, as illustrated in FIG. 7 with an upper taper 33 and a lower taper 34. Such

attenuation bushings may be adapted for use in disclosed embodiments from commercially available sources, such as hollow rubber springs sold by Timbren Industries under the designation Aeon. A central contoured hole 35 extends through the center of the cylindrical body 32. A central opening 36 is provided at one end of the elastic attenuation bushing 30, and a threaded hole 38 is provided centrally in the other end of the bushing 30. The bushing 30 is elastically compressible along its central longitudinal axis in order to provide controlled deflection when a load is applied to the horizontal arm extension 21 through the shackle 29 of a safety cable (not shown). The elastic attenuation bushing 30 may be made of any suitable materials, dimensions and shapes in order to achieve the desired deflection characteristics. For example, cylindrical rubber bump stops conventionally used on truck suspensions may be adapted for use as the elastic attenuation bushing 30 of one embodiment. Although as illustrated the attenuation member is an elastic attenuation bushing 30, in other embodiments controlled deflection may be provided by an attenuation member that comprises a compression spring, hydraulic cylinder, or any other suitable means known to those skilled in the art. In some embodiments, the attenuation member may be formed in a way that pivoting of the pivot arm 20 causes the attenuation member to resist expansion, such as an expansion spring connected between the pivot arm 20 and the base member 12.

[0028] The safety climb attenuation bracket apparatus 10 operates as follows. During a safety incident such as a worker fall, a sudden downward load applied through the safety cable shackle 29 to the right side of the horizontal arm extension 21 illustrated in FIGs. 3 and 5 causes the pivot arm 20 to pivot around the pivot hole 25 within the support tabs 16 of the base member 12. Clockwise rotation of the pivot arm 20 around the pivot bolt 27 causes the back plate 23 and elastic attenuation bushing 30 to move toward the back plate 15 of the base member 12. The elastic qualities of the attenuation bushing 30 are such that a desired amount of deflection is achieved based upon the load applied to the bushing 30.

[0029] As understood by those skilled in the art, the size, shape, material and deflection curve of the attenuation bushing 30 may be varied in order to control its deflection characteristics. In certain embodiments, for a load applied during typical fall situations, the elastic attenuation bushing deflection may typically range from 0.5 to 5 inches, for example, from 0.1 to 2 inches, or from 0.2 to 1.5 inches. During a fall situation in which safety equipment is used to apply a load to the safety cable, a typical load applied to the elastic attenuation

bushing 30 may range from 1,000 to 10,000 pounds, for example, from 2,000 to 7,000 pounds, or from 2,500 to 5,500 or 6,000 pounds.

[0030] As understood by those skilled in the art, the dimensions of the pivot arm 20 may be selected in order to provide the desired deflection and attenuation characteristics. For example, the distance along the horizontal arm extension 21 between the pivot hole 25 and cable-mounting hole 26 may be selected in combination with the horizontal distance between the pivot hole 25 and the threaded stud 24 upon which the elastic attenuation bushing 30 is mounted. For example, the ratio of the distance between the pivot hole 25 and cable-mounting hole 26 along the horizontal arm extension 21 to the distance between the pivot hole 25 and the threaded stud 24 may typically range from 0.2:1 to 5:1, for example, from 0.3:1 to 3:1, or from 0.5:1 to 2:1, or from 0.75:1 to 1.5:1, or from 0.8:1 to 1.2:1. In certain embodiments, the ratio may be about 1:1. The specific distances may be selected as desired, and may typically range from 2 to 20 inches, or from 3 to 10 inches, or from 4 to 8 inches.

[0031] FIG. 8 illustrates a lower cable anchoring apparatus 40 including attenuation member such as an elastic attenuation bushing 48, which may be of the same or similar design to the elastic attenuation bushing 30 illustrated in FIGs. 6 and 7. The cable anchoring apparatus 40 includes an anchor base 41 that may be mounted at or near the bottom or base of a communication tower or other structure (not shown in FIG. 8). In the embodiment illustrated, two anchor-mounting holes 42 are provided for attachment of the anchor base 41 at or near the base of the tower. An anchor bracket 43 extends from the anchor base 41. A threaded anchor bolt 44 includes an upper attachment ring 45 for attachment of a safety cable and shackle S. The anchor bolt 44 is threaded into a threaded hole 49 of the elastic attenuation bushing 48, and may be secured thereto by a nut and washer 46. The lower cable anchoring apparatus 40 may be used to relieve tension placed on the cable S due to the “sunflower effect” in which thermal expansion of a tower on one side causes the structure to bend or curve slightly.

[0032] The elastic attenuation bushing 48 illustrated in FIG. 8 may be selected in order to provide the same or similar deflection distances as described above for the elastic attenuation bushing 30 of FIGs. 6 and 7. Typically, the elastic attenuation bushing 48 may be subjected to a cable tension of from 3 to 400 pounds, and its deflection or elastic characteristics may be selected accordingly. As with the upper safety attenuation bracket, other embodiments may use

an attenuation member other than an elastic attenuation bushing, or may use an attenuation member that resists expansion instead of resisting compression.

[0033] The various components of the present safety climb apparatus may be made from any suitable materials known to those skilled in the art. For example, the bracket components may be made from metal such as plate steel that is cut into different shaped pieces and then welded together, mechanically fastened, etc. In certain embodiments, the bracket components may be hot dipped galvanized steel. An assortment of nuts, bolts, pins and locking devices known to those skilled in the art may be used in the assemblies. In certain embodiments, the upper elastic attenuation bushing and the lower elastic bushing may be a rubberized product such as a bump stop used on a truck suspension. The wire rope may be a 7x19 stainless steel cable with a thimble and swaged connection secured to the top assembly using a shackle.

[0034] The present safety climb and attenuation system has many advantages over conventional safety climb apparatuses. The attenuation member is removed from the cable load path and placed in another location on the assembly, which provides more dependability and re-usability. The attenuation member and bracket are more robust than other products available on the market, requiring less maintenance and associated costs. The system also allows the user to visually inspect the components from the ground prior to use.

[0035] The above description is intended to be illustrative, and not restrictive. For example, the above-described embodiments may be used in combination with each other. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention therefore should be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled.

CLAIMS

We claim:

1. A safety climb attenuation apparatus, comprising:
a safety climb attenuation bracket, comprising:
a base member, configured for mounting to a structure;
a pivot arm member, pivotably disposed on the base member; and
an attenuation member, disposed on one or both of the pivot arm member and the base member,
wherein the attenuation member resists pivoting of the pivot arm member relative to the base member.
2. The safety climb attenuation apparatus of claim 1, wherein the attenuation member is an elastic bushing that resists compression between the pivot arm member and the base member.
3. The safety climb attenuation apparatus of claim 1,
wherein the pivot arm member comprises
a horizontal arm extension, pivotably attached to the base member; and
a vertical arm extension, formed with the horizontal arm extension,
extending from the horizontal arm extension.
4. The safety climb attenuation apparatus of claim 3, further comprising:
a stud extending from the vertical arm extension toward the base member,
wherein the attenuation member is disposed on the stud.
5. The safety climb attenuation apparatus of claim 4,
wherein the stud is a threaded stud, and
wherein the attenuation member is threadedly connected to the threaded stud.
6. The safety climb attenuation apparatus of claim 4, wherein the stud is disposed on a back plate that is affixed to the vertical arm extension.
7. The safety climb attenuation apparatus of claim 1, further comprising:

a stud extending from the base member,
wherein the attenuation member is disposed on the stud.

8. The safety climb attenuation apparatus of claim 1, further comprising:
a shackle secured to the pivot arm member, configured for attachment of a safety cable.
9. The safety climb attenuation apparatus of claim 1, wherein the attenuation member is visible while the safety climb attenuation bracket is mounted to the structure.
10. The safety climb attenuation apparatus of claim 1, wherein the attenuation member is a spring.
11. The safety climb attenuation apparatus of claim 1, wherein the base member comprises:
a mounting bracket, configured for mounting to the structure; and
a first back plate disposed on the mounting bracket and configured to engage the attenuation member between the base member and the pivot arm member.
12. The safety climb attenuation apparatus of claim 1, where in the base member comprises a first back plate configured for mounting to the structure and for engaging the attenuation member.
13. The safety climb attenuation apparatus of claim 1, further comprising a second back plate disposed on the pivot arm member configured to engage the attenuation member between the base member and the pivot arm member.
14. The safety climb attenuation apparatus of claim 1, further comprising:
a cable anchoring apparatus, comprising:
an anchor base member, configured for disposition on the structure near a base of the structure;
an anchor bracket, disposed with the anchor base member; and

an anchor attenuation member, disposed on the anchor base member, the anchor attenuation member resists upward movement by a cable connected to the anchor attenuation member.

15. The safety climb attenuation apparatus of claim 14, wherein the anchor attenuation member is an elastic bushing.

16. The safety climb attenuation apparatus of claim 14, wherein the anchor attenuation member resists compression against the anchor bracket caused by upward movement of the cable.

17. The safety climb attenuation apparatus of claim 14, wherein the anchor attenuation member resists expansion relative to the anchor bracket caused by upward movement of the cable.

18. The safety climb attenuation apparatus of claim 14, wherein the anchor attenuation member is mounted below the anchor base member, so that upward movement of the cable compresses the anchor attenuation member against the anchor base member.

19. The safety climb attenuation apparatus of claim 14, wherein tension on the cable connected to the anchor attenuation member caused by thermal expansion of the structure is relieved by deformation of the anchor attenuation member.

20. The safety climb attenuation apparatus of claim 1,
wherein the attenuation member is disposed on both the base member and the pivot arm member, and
wherein the attenuation member resists expansion between the base member and the pivot arm member.

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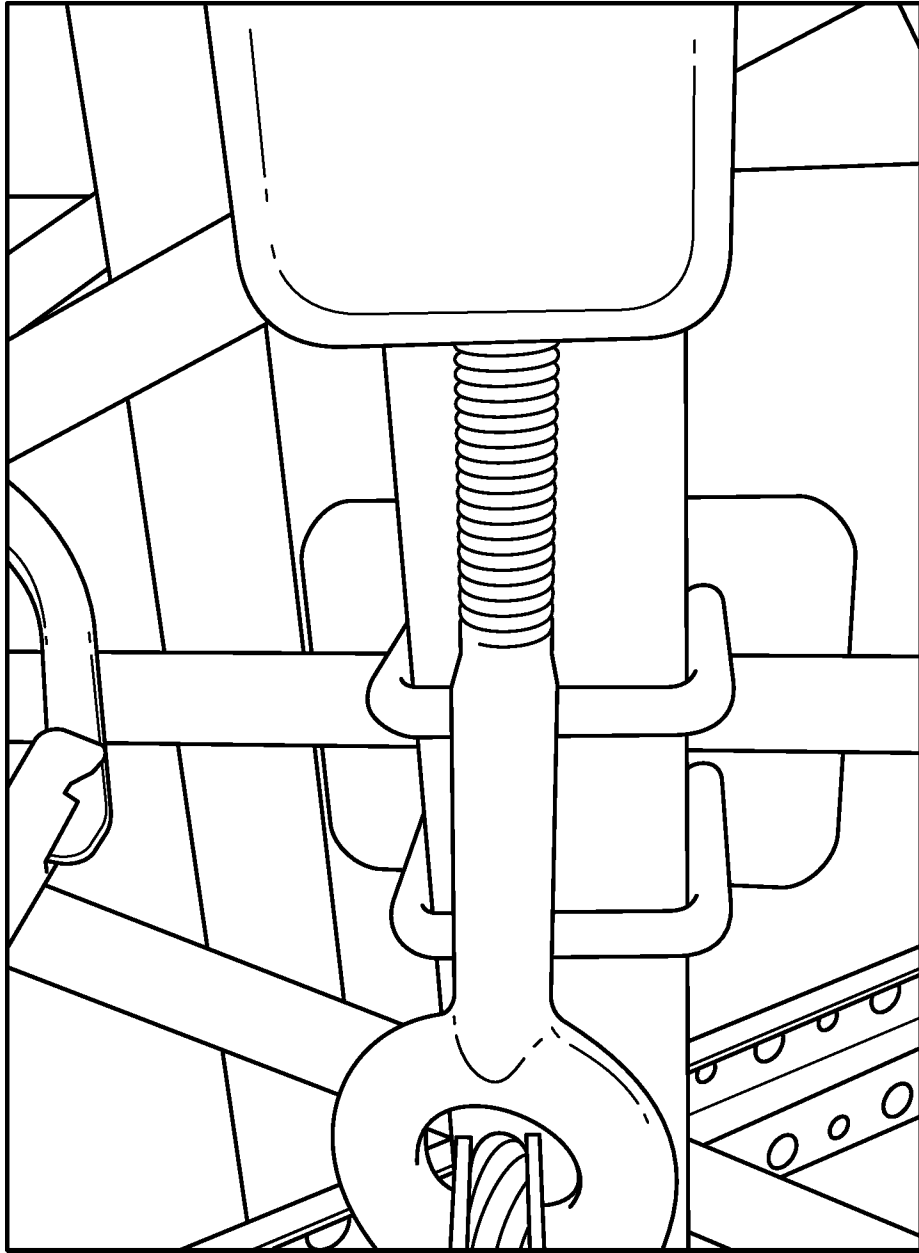


FIG. 1
(Prior Art)

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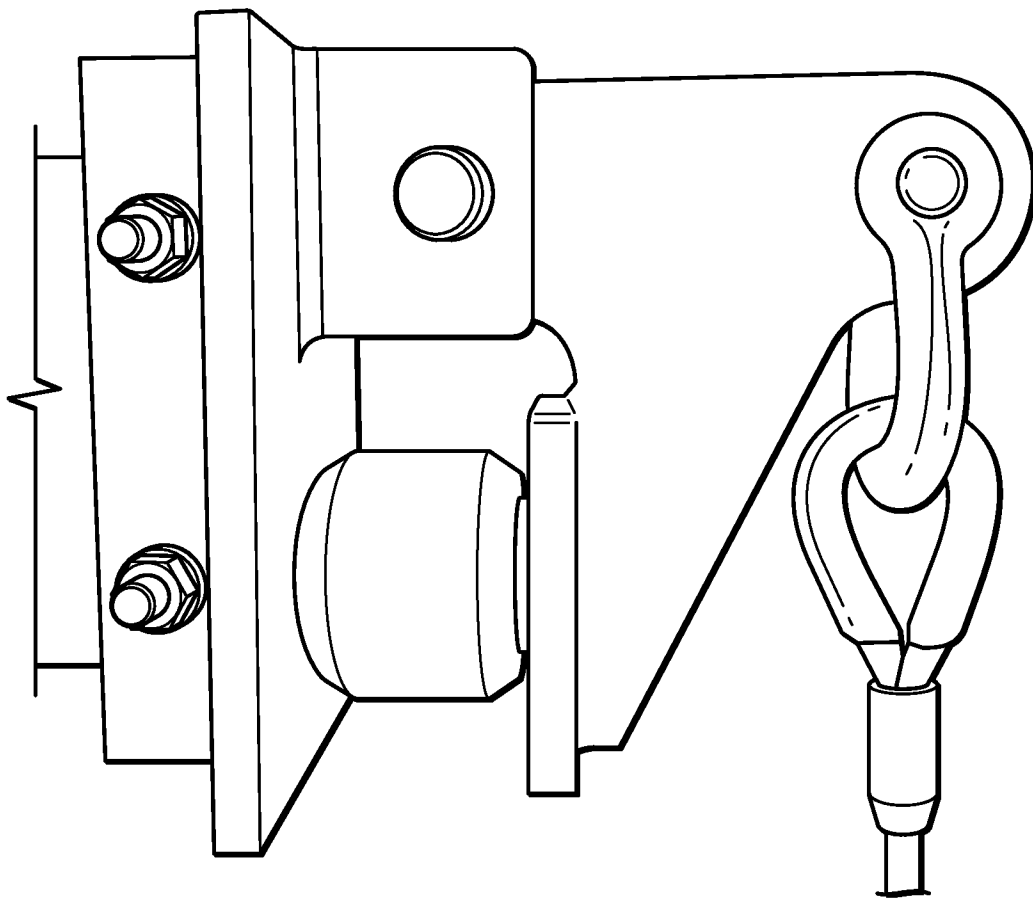


FIG. 2

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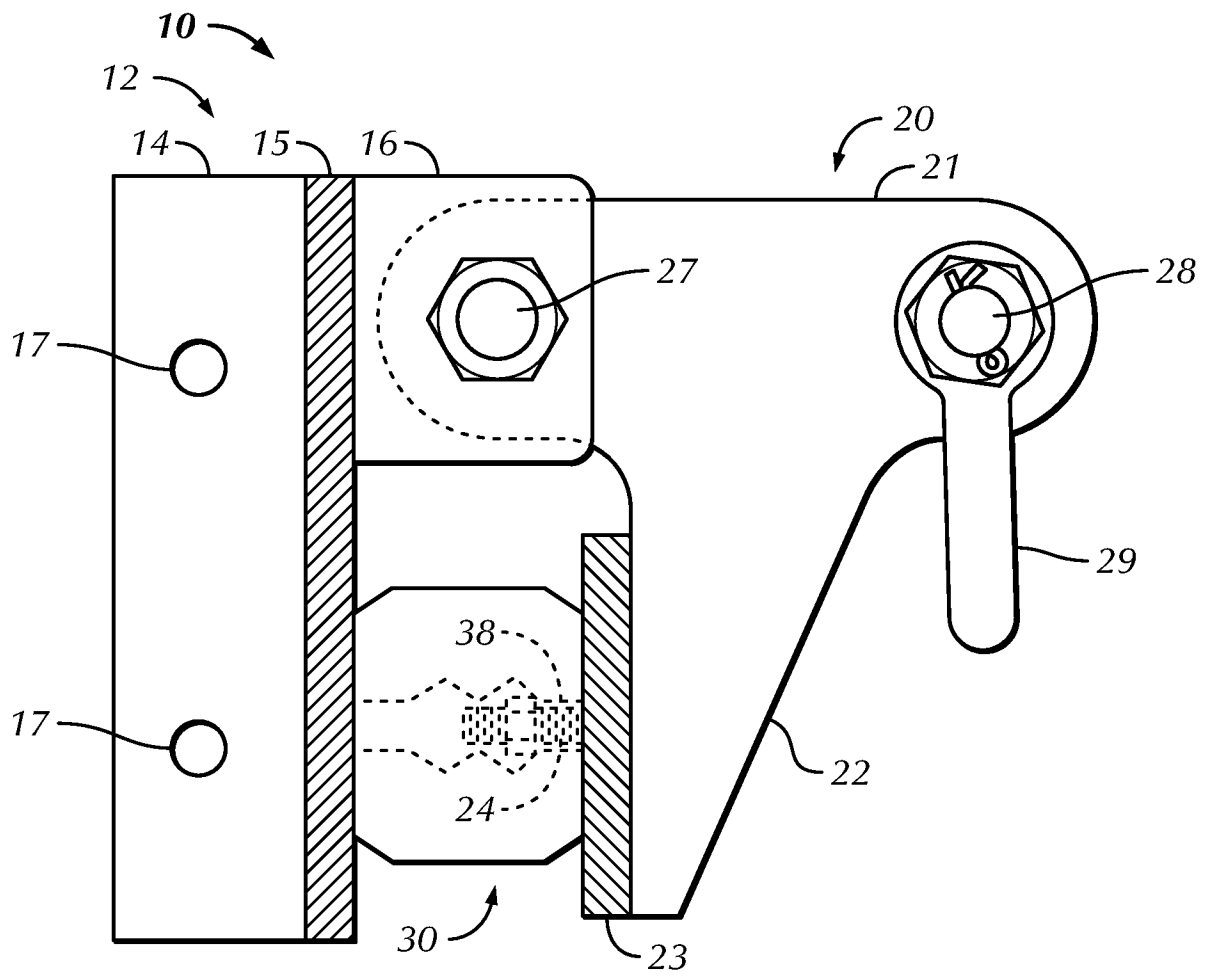


FIG. 3

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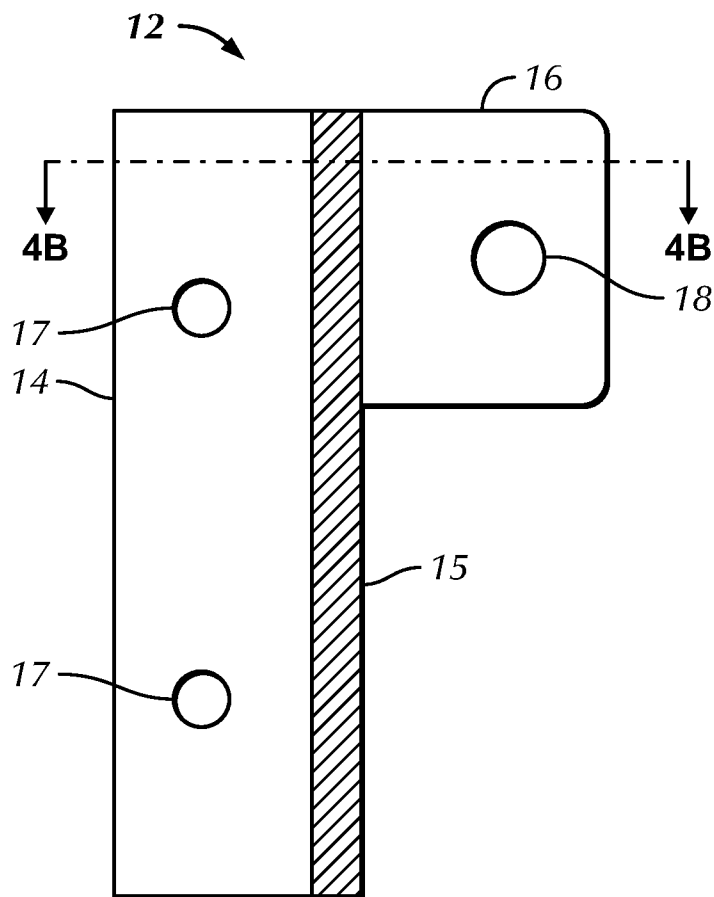


FIG. 4A

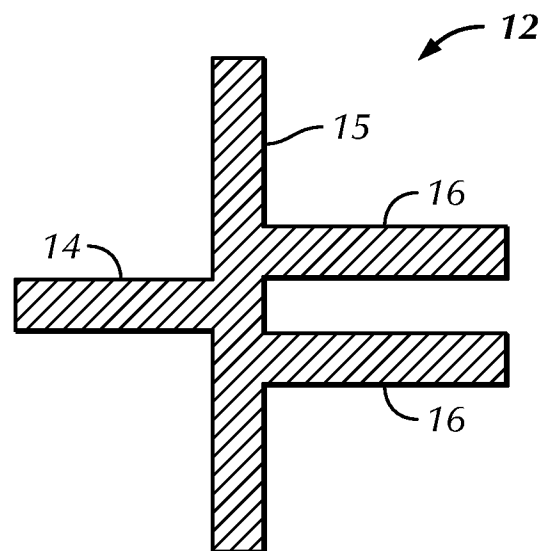
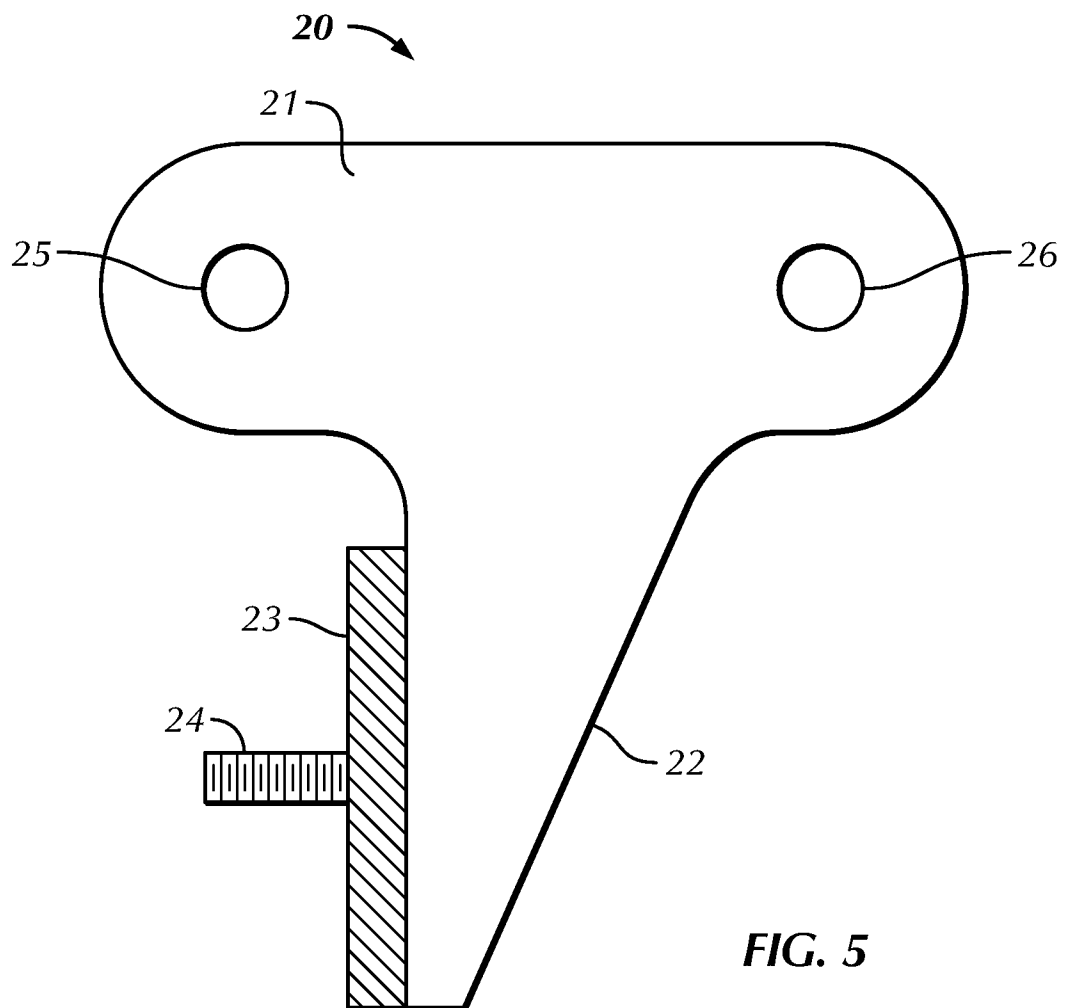


FIG. 4B

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6/7

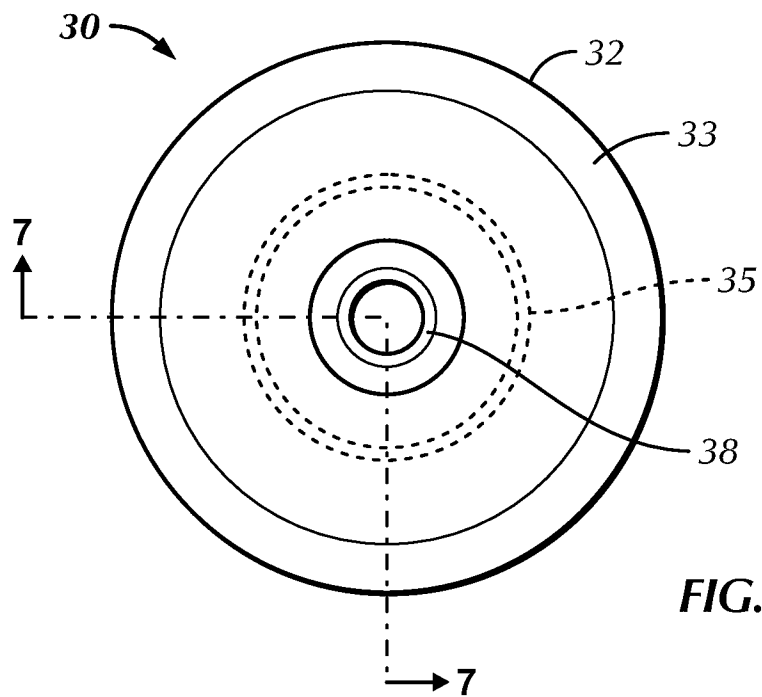


FIG. 6

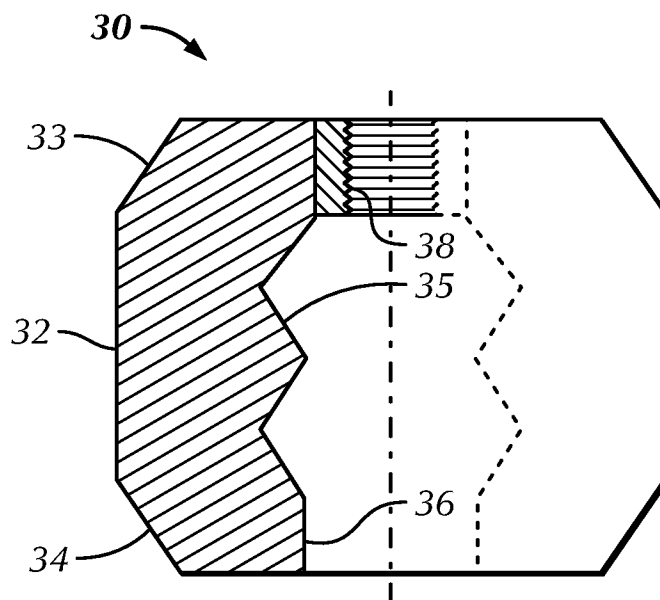


FIG. 7

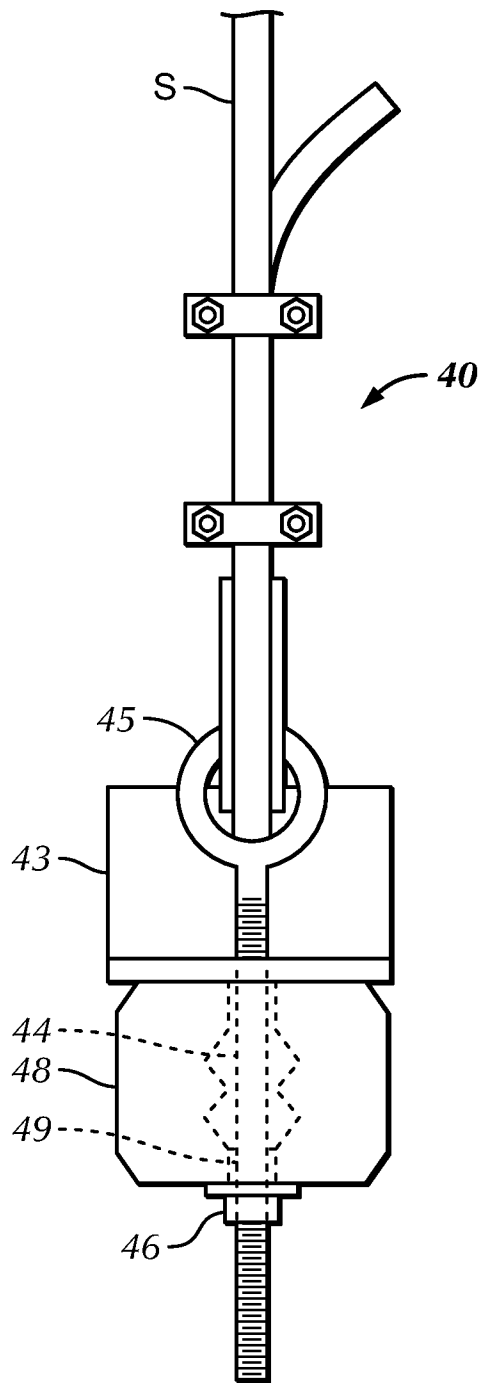


FIG. 8A

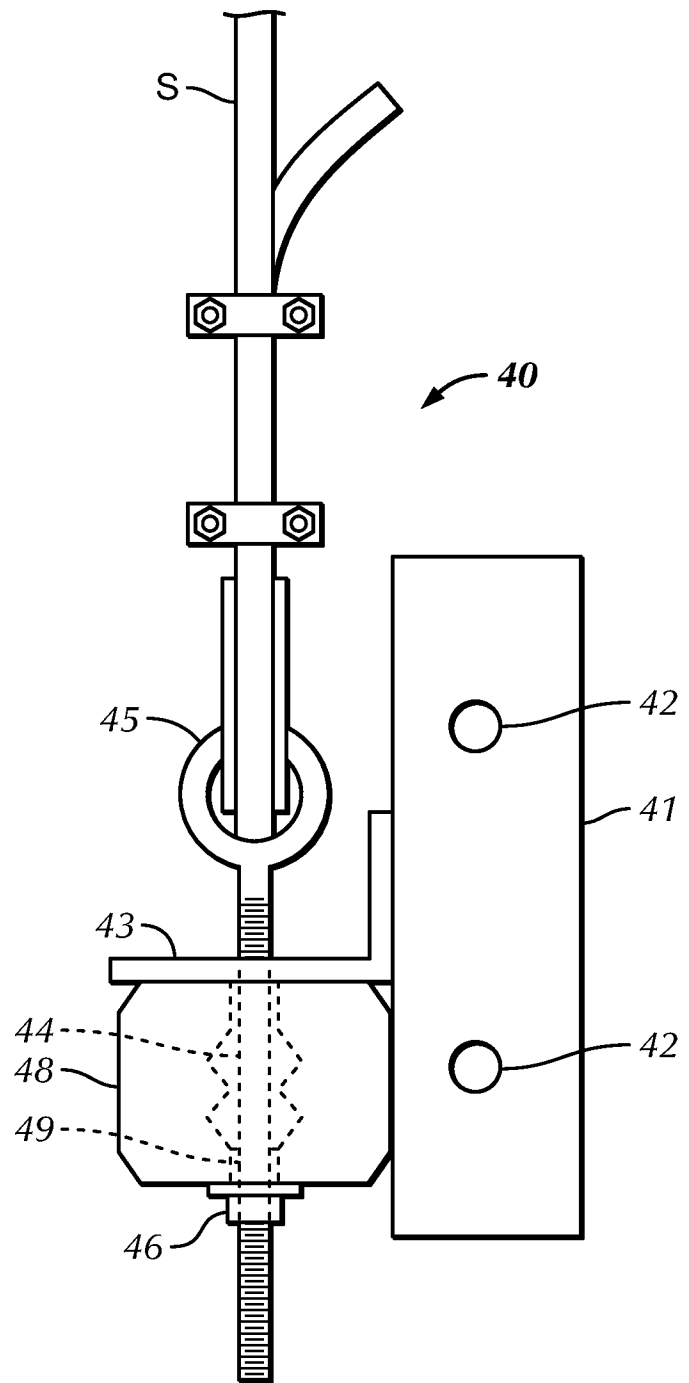


FIG. 8B

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2018/066591

A. CLASSIFICATION OF SUBJECT MATTER

INV. A62B35/00 A62B35/04
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)

A62B E04G

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 A	WO 2005/044384 A1 (UNILINE SAFETY SYSTEMS LTD [GB]; STRATTON LUKE [GB]) 19 May 2005 (2005-05-19) figures 1-6 page 6, line 29 - page 7, line 11 page 7, line 23 - page 12, line 2 -----	1,3,4, 6-9, 11-13,20 2,5,10, 14-19
X A	JP 2000 107305 A (FUJII DENKO; NIPPON TELEGRAPH & TELEPHONE) 18 April 2000 (2000-04-18) figures 1-6 -----	1,3-9, 11-20 2,10
X A	WO 98/01639 A1 (FULLAM PETER J [US]; COWIN LOUIS J [US]) 15 January 1998 (1998-01-15) figures 1-5 page 7, lines 6-10 page 8, lines 7-10 -----	1-13,20 14-19



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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

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Date of the actual completion of the international search

1 March 2019

Date of mailing of the international search report

04/04/2019

Name and mailing address of the ISA/

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Paul, Adeline

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2018/066591

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2005044384	A1	19-05-2005	NONE
JP 2000107305	A	18-04-2000	JP 3769392 B2 26-04-2006
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