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(54) Title: FRICTION LOCK BOLT

(57) Abstract: A fastening device is provided and includes an elongated fastener, a head, and an elastomeric element. The head is coupled to an end of the elongated fastener, and the elastomeric element is coupled to a surface of the head substantially opposite to the elongated fastener. Furthermore, a method of securing a device to a support structure is provided.

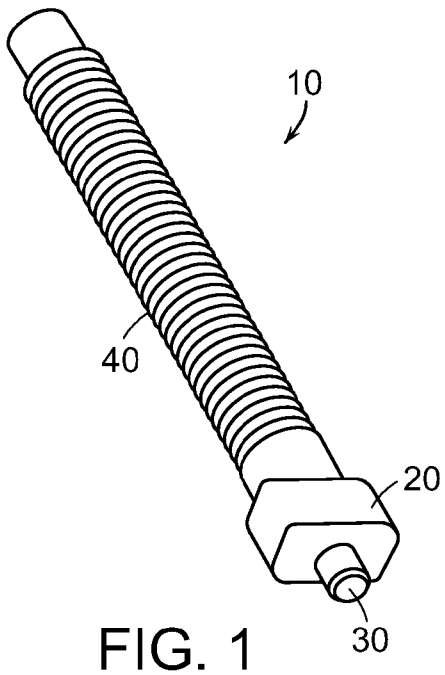

FIG. 1

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FRICTION LOCK BOLT

CROSS-REFERENCE TO RELATED APPLICATION

This application claims benefit of U.S. Provisional Application No. 61/034,822 filed March 7, 2008, which is incorporated herein by reference for all purposes.

FIELD OF TECHNOLOGY

Exemplary embodiments of the invention generally relate to a fastener, such as a bolt, and methods of using the bolt. In a non-limiting implementation, the bolts are used in systems to securely mount a panel to a rail.

BACKGROUND OF EXEMPLARY EMBODIMENTS OF THE INVENTION

Fasteners, such as bolts, are used to secure two objects together. In one example, a bolt may be used to mount a panel to a support structure, such as mounting a solar panel onto a rail. In such cases, the rail may be, in turn, mounted to a secure surface, such as roof footings, footing grids, roofs, poles, frames, surfaces, or other objects.

Over time, the bolt may loosen, particularly when it is exposed to varying forces induced or caused by wind, snow, rain, and other elements of weather. The loose bolt is problematic because the panel may no longer be securely held to the rail or support structure.

Furthermore, the current design of the bolts tends to allow the bolts to fall out, slip or move when inserted into a slot of a rail for the purpose of securing a panel or other device. As such, an installer may need to use both hands to steadily position a bolt after

placing the bolt in the slot and before placing the panel on the rail and securing the assembly by tightening a nut around the bolt. This is due, in part, because there is no compressing force between the interior surfaces of the slot and the head of the bolt to initially hold the bolt in place. Accordingly, the bolts complicate the installation of the panels and other devices and make the installation more time consuming.

As the use of solar panels to generate all or part of the electrical needs for home and industry increases, demand has escalated for a solar panel mounting system that not only is structurally rigid, weather resistant, and easy to install, but also is easy to maintain and is structurally secure for an extended period of time. Therefore, a new and useful bolt that is capable of easily and securely mounting solar panels onto a rail is needed.

SUMMARY OF EXEMPLARY EMBODIMENTS OF THE INVENTION

An object of an illustrative, non-limiting embodiment of the present invention is to overcome the above and other problems and disadvantages associated with the current design of bolts and other fasteners. Also, the present invention is not required to overcome the disadvantages described above, and exemplary embodiments of the present invention may overcome other disadvantages or may not overcome any disadvantages.

In one embodiment, the present invention relates to a bolt that facilitates a more secure and easy mounting of a panel onto a support structure. In this embodiment, an elastomeric element is provided on a head of the bolt so that the elastomeric element is compressed against an opposing surface of the support structure during an assembly or installation process. The support structure has upper and lower portions that define a slot that can accept the head of the bolt. The bolt is inverted and inserted into the slot so that

the elastomeric element compresses against the lower portion of the support structure and presses the head of the bolt against the upper portion. This results in creating friction between the bolt, which holds the bolt steady during assembly or installation and prevents the bolt from loosening after the panel is mounted.

In one example, after securing the bolt to the support structure at a desirable location on the structure, the panel may be mounted onto the support structure. A clamp is placed over at least a portion of the panel and the bolt so that the bolt extends through the clamp. A flange nut may be used to tighten the clamp down towards the support structure and secure the panel.

In another embodiment, the bolt has a dog-point on the end of the bolt to facilitate placement of a nut on the bolt.

In some embodiments, the bolt includes a head with a spring that compresses during installation of the bolt.

In still another embodiment, the bolt includes a mechanism that prevents the bolt from turning in a direction, which loosens the bolt, after installation.

Embodiments of the invention also provide a method of installing a solar panel onto a rail. In one implementation, the bolt engages the panel and the rail and secures the panel to the rail.

Other embodiments may relate to a nut or other fastener having the same elastomeric spring material to create the same functionality.

While several embodiments of the bolt and nut are explained in connection with securing a solar panel to a rail, they may be used in other applications where an opposing

surface would compress the elastomeric element and provide for a more secure and easy installation process.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects and advantages of illustrative, non-limiting embodiments of the present invention will become more apparent by describing them in detail with reference to the attached drawings in which:

Figure 1 shows a perspective view of an embodiment of a bolt.

Figure 2 shows a cross-sectional view of the bolt of Figure 1 in an embodiment of a support structure.

Figures 3A to 3C, respectively, show a bottom, side, and top views of an embodiment of the bolt.

Figures 4A to 4D, respectively, show two side views, a top view, and a bottom view of another embodiment of the bolt.

Figures 5A to 5C, respectively, show top, side, and bottom views of a further embodiment of the bolt.

Figures 6A to 6C, respectively, show top and two side views of yet another embodiment of the bolt.

Figures 7A and 7B, respectively, show side views of still another embodiment of the bolt.

Figure 8 shows a perspective view of another embodiment of the bolt.

Figure 9 shows a perspective view of an embodiment of the solar panel clamping system.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

The following description of the illustrative, non-limiting embodiments discloses specific dimensions, configurations, components, and processes. However, the embodiments are merely examples of the present invention, and thus, the specific features described below are merely used to more easily describe such embodiments and to provide an overall understanding of the present invention. Accordingly, one skilled in the art will readily recognize that the present invention is not limited to the specific embodiments described below. Furthermore, the descriptions of various dimensions, configurations, components, and processes of the embodiments that would have been known to one skilled in the art are omitted for the sake of clarity and brevity.

Figure 1 shows one embodiment of a fastener (*e.g.*, a bolt) 10 that has a head 20 with an elastomeric element 30. The head 20 of the bolt 10 is located on top of an elongated fastener 40 that engages another device (*e.g.*, a nut) to perform a fastening operation. In Figure 1, the fastener 40 is threaded to accept the nut so that twisting the nut in a certain direction (e.g., a clockwise direction) moves the nut from a distal end of the fastener 40 towards the head 20.

As described in the more detailed examples below, when the elastomeric element 30 is compressed against a surface of a support structure, friction is created between the element 30 and the surface due to, in part, the resiliency of the element 30. The compressed elastomeric element 30 may also urge the head 20 of the bolt 10 against one or more other surfaces of the support structure to increase the friction. As a result of the friction, the bolt 10 may be securely held in position during an installation or assembly

process. Also, the friction may prevent the bolt 10 from turning and loosening after assembly to keep the assembly more structurally secure.

Figure 2 shows an example of a top mounting clamping system that is used to position and hold a panel 45 firmly against a support structure 50. As shown in the embodiment, the support structure 50 includes a space 65 adapted to accept the head 20 of the bolt 10 and hold the bolt 10 in an inverted position. The support structure 50 includes an upper portion 70 and a lower portion 80 that hold the head 20 of the bolt 10 within the space 65 between the portions 70 and 80, and the fastener 40 of the bolt 10 projects from the support structure 50 through an opening (e.g., slot 60) in the upper portion 70. After placing a panel 45 on the support structure 50 such that the fastener 40 projects through a hole in the panel 45, a nut (not shown) may be tightened around fastener 40 of the bolt 10 and secure the panel 45 onto the support structure 50.

When the head 20 of the bolt 10 is located in the space 65, it contacts the upper portion 70 of the structure 50, and the elastomeric element 30 contacts the lower portion 80 of the structure 50. Since the elastomeric element 30 is compressed in the space 65, it exerts pressure against the lower portion 80 and pushes the head 20 against the upper portion 70. As such, there is friction between (1) the head 20 and the element 30 and (2) the support structure 50, which prevents the bolt 10 from rotating within the structure 50 and loosening the connection between the panel 45 and the structure 50.

Figure 9 shows an example of a solar panel clamping system that uses the bolt 10 described above. In the system, the bolt 10 secures a solar panel 120 onto a support structure 50 (e.g., a solarmount rail 130). The rail 130 is elongated and has upper opposing jaws 170, which form an upper portion 70 and a lower portion 80 that form the

contours of a slot 60. Also, as described above, a space 65 is formed between the upper and lower portions 70 and 80.

To secure the panel 120 to the rail 130, the bolt 10 is inverted, the head 20 of the bolt 10 is inserted in the space 65, and the fastener 40 protrudes through the slot 60. Specifically, the bolt 10 is positioned in the rail 130 by inserting the head 20 at the end of the rail 130 and sliding the bolt 10 along the slot 60 of the rail 130 to the desired position while the head 20 is in the space 65. Since the compressed element 30 creates friction between the bolt 10 and the rail 130, the bolt 10 remains in the desired position during the installation process, even prior to securing the panel 120 to the assembly.

After inserting the bolt 10 into the space 65 and moving it to the desired position, an end clamp 140 or a mid-point clamp 150 may be placed on top of the bolt 10 so that at least one portion of the clamp 140 or 150 covers the solar panel 120. This clamp system may be made from aluminum, or from other metallic or non metallic materials. A flange nut 160 may engage the bolt 10 and secure the solar panel 120 to the solarmount rail 130 via the clamp 140 or 150. Also, the clamp 140 or 150 may be omitted from the system, and the bolt 10 and nut 160 may directly secure the solar panel 120 to the rail 130. Of course, the system is not limited to securing solar panels 120 to rails 130 and other types of panels or devices may be secured to other types of rails or support surfaces.

Figures 3A to 3C provide different views of the bolt 10 shown in Figure 1. In a non-limiting example, the head 20 of the bolt 10 has a maximum width that is larger than the width of the elongated fastener 40. As shown, the head 20 has a generally rectangular shape in which two opposite angles are rounded. In other embodiments, the head 20 can be shaped like a square, rectangle, circle, ellipse, octagon, a parallelogram, or any other

shape that provides for a width larger than the width of the elongated fastener 40. Furthermore, while the head 20 in Figures 3A to 3C has a flat upper portion, it may also have a dome shape or another appropriate shape depending on the environment in which the bolt 10 is used. The size of the head 20 is sufficient to insert it and the elastomeric element 30 in its compressed form in the space 65 between the upper and lower portion 70 and 80 of the support structure 50.

Also, in the embodiment illustrated in Figures 4A to 4D, the elastomeric element 30 is separate from the head 20. As such, the head 20 has an indented surface, groove or hole 25, which accepts the elastomeric element 30.

Figure 4A is a side view of one example of the bolt 10 in which the shorter width of the generally rectangular head 20 is shown in relation to the width of the fastener 40. In the embodiment, the shorter width of the head 20 is substantially identical to the width of the fastener 40. Figure 4B is another view which shows the longer width of the head 20 in relation to the width of the fastener 40. As illustrated, this width is larger than the width of the fastener 40.

As discussed above, the elongated fastener 40 extends from the head 20 to engage a nut. Figures 3A and 4D show that the elongated fastener 40 has a generally cylindrical shape and contains threads along the outer surface of the cylindrical shape to engage a nut. In other embodiments, the elongated fastener 40 may have different shapes to operate with locking mechanisms other than a nut. While the size and shape of the elongated fastener 40 may depend on the size and shape of the panel or other item to be secured or the application in which the bolt is used, in one example, the elongated fastener 40 may have a length of about 1 inch to about 3 inches and a width 1/8 inch to

about 1 inch. When threaded, the elongated fastener 40 optionally includes a "non-threaded" shoulder 90 above the threads as best shown in Figures 3B, 4A, and 4B.

Depending on the embodiment and the implementation, the elongated fastener 40 and the head 20 may be made from metallic or non-metallic material. In one example, the head 20 and the elongated fastener 40 are made from stainless steel.

In one implementation, the elastomeric element 30 compresses when the bolt 10, for example, is inserted between the upper and lower portion 70 and 80 of a support structure 50. As noted above, when the elastomeric element 30 is compressed, it pushes the head 20 against the upper portion 70 of the support structure 50 and, due to its resiliency, directly presses against the lower portion 80 of the support structure 50. In one example, the elastomeric element 30 is made of rubber, but in other embodiments, it may be made of other materials. For instance, it could be made from various thermoplastics which exhibit a rubber-like behavior, like Santoprene™.

In some embodiments, the elastomeric element 30 holds the position of the bolt 10 relative to the support structure 50 due to the frictional force between the compressed elastomeric element 30 and the lower portion 80. For example, after the head 20 of the bolt 10 is inserted in the space 65, the elastomeric element 30 expands and exerts pressure on the head 20 of the bolt 10 and pushes it against the opposite side of the space 65 to provide sufficient friction to prevent the head 20 (and thus the bolt 10) from falling out of the space 65. In one implementation, an elastomeric element 30 having a coefficient of friction of at least about 1 (and preferably between about 1 to about 4) in its uncompressed form can create sufficient friction to prevent the bolt 10 from falling out of the space 65.

In one example, the size of the elastomeric element 30 should be large enough so that it is compressed when the head 20 of the bolt 10 is inserted between the upper and lower portions 70 and 80 of the support structure 50. In this instance, the height of the elastomeric element 30 should be sufficient to push the head 20, with enough force, against the upper portion 70 of the support structure 50 and to exert enough pressure on the lower portion 80 of the structure 50. Depending on the size of the space 65, such a height may be about 0.1 inch to about 0.4 inches. Also, the element 30 may take various shapes, such as a cylinder, a box, a pyramid, cone, a truncated pyramid, or a truncated cone. The examples in Figures 3A to 4D and other figures show that the elastomeric element 30 has a generally cylindrical shape in which the longitudinal axis of the element 30 aligns with the longitudinal axis of the cylindrical fastener 40. However, the element 30 clearly is not limited to such a shape and orientation, and after reading the present specification, one skilled in the art would know how to adjust the size, shape, and orientation of the element 30 in light of the particular application.

As shown in Figures 3A, 4A, and 4B, the bolt 10 may include a dog point 100. The dog point 100 is an unthreaded elongated tip that has a width less than the diameter of fastener 40. The dog-point 100 aligns and positions, for example, a nut with respect to the threads of the fastener 40 allowing the installer to place the nut on the bolt 10 before the nut initially engages the threads of fastener 40. In one implementation, the dog-point 100 is made from metallic or non-metallic material, such as stainless steel. In a further example, the dog point 100 may include a chamfer 110 to connect the dog point 100 to the fastener 40, and the chamfer 110 may be angled at about 45° to allow an easy transition for the nut onto the threaded portion of the fastener 40.

In other embodiments, the bolt 10 also includes one or more devices for preventing the bolt 10 from turning in a direction (*e.g.*, counter-clockwise) in which it loosens its connection with the nut. For example, as shown in Figures 4A and 4B, the bolt 10 may include nibs 35 to prevent it from turning counter-clockwise. The nibs 35 may be provided on the surface of the head 20 opposite to the surface on which the elastomeric element 30 is present. Although Figures 4A and 4B show the nibs 35 at the circumferential end of head 20, other embodiments of the bolt 10 may have the nibs 35 off-set towards the center of the bolt 10. Moreover, the nibs 35 may additionally or alternatively be placed on the surface of the head 20 where element 30 is present or on the side surfaces of the head 20. In some of the embodiments that include nibs 35, the elongated fastener 40 may include threads that would tighten the bolt 10 when turned in a clockwise direction.

Table 1 below includes examples of specific dimensions of the embodiments of the bolts 10 illustrated in Figures 3A to 4D.

Table 1

Figure 3	Dimension
Length of head 20	about 0.435 inches
Width of head 20	about 0.25 inches
Length of fastener 40 (including shoulder 90 and dog point 100)	about 2 inches
Length of dog point 100	about 0.186 inches
Length of threaded portion of fastener 40	about 1.590 inches
Height of head 20	about 0.165 inches
Height of exposed portion of elastomeric	about 0.125 inches

element 30	

Figures 5A to 5C shows another embodiment of the bolt 10 in which the head 20 also possesses the generally rectangular shape with rounded opposing angles. The bolt 10 in this example does not include a dog-point 110. Table 2 below includes examples of specific dimensions of the bolt 10 illustrated in Figures 5A to 5C.

Table 2

Figure 5	Dimension
Length of head 20	about 0.435 inches
Width of head 20	about 0.25 inches
Height of head 20	about 0.165 inches
Length of fastener 40	about 1.125 inches
Length of dog point 100	about 0.186 inches
Height of exposed portion of elastomeric element 30	about 0.125 inches

Figures 6A to 6C illustrate yet a further embodiment of the bolt 10 in which the head 20 has a shape of a parallelogram and in which the elastomeric element 30 has the shape of a truncated cone. As shown in Figures 6B to 6C, the fastener 40 of the bolt 10 is threaded up to the head. Figures 7A and 7B show another example of the bolt 10 having a "non-threaded" shoulder 90 above the threaded portion of the fastener 40. Table 3 below includes examples of specific dimensions of the bolts 10 illustrated in Figures 6A to 7B.

Table 3

Figure 6	Dimension
Length of one side of head 20	about 0.503 inches
Width of head 20	about 0.25 inches
Length of fastener 40 (including shoulder 90 and dog point 100)	about 2 inches
Diameter of dog point 100	about 0.186 inches
Length of dog point 100	about 0.186 inches
Length of threaded portion of fastener 40	about 1.590 inches
Height of head 20	about 0.165 inches
Height of exposed portion of elastomeric element 30	about 0.125 inches
Diameter of elastomeric element 30 at its base	about 0.197 inches
Diameter of elastomeric element at its upper portion	about 0.118 inches
Degree of chamfer 110	45°

Figure 8 shows another embodiment of the bolt 10. In this example, the elastomeric element 30 comprises a spring that presses the head 20 against the upper portion 70 of a support structure 50 and that presses against a lower portion 80 of the support structure 50, as described above.

While the various embodiments above contain different components and features, upon reading the specification, one skilled in the art readily will realize that such components

and features in one embodiment may be incorporated into or combined with components and features of another embodiment. Also, the previous description of the embodiments is provided to enable a person skilled in the art to make and use the present invention. Moreover, various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles and specific examples defined herein may be applied to other embodiments without the use of inventive faculty. Therefore, the present invention is not intended to be limited to the embodiments described herein but is to be accorded the widest scope as defined by the limitations of the claims and equivalents thereof.

CLAIMS

What is claimed is:

1. A fastening device comprising:

an elongated fastener,

a head coupled to an end of the elongated fastener, and

an elastomeric element coupled to a surface of the head substantially opposite to the elongated fastener.

2. A method of securing a device onto a support structure, the method comprising:

providing a bolt that comprises

a elongated fastener,

a head coupled to a first end of the elongated fastener, and

an elastomeric element coupled to a surface of the head substantially opposite to the elongated fastener, and

inserting the bolt in a space of the support structure such that the elastomeric element compresses and exerts a force against a surface of the support structure.

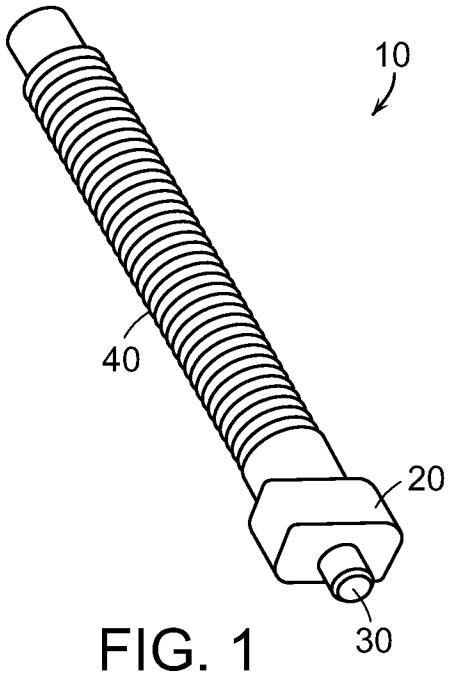

FIG. 1

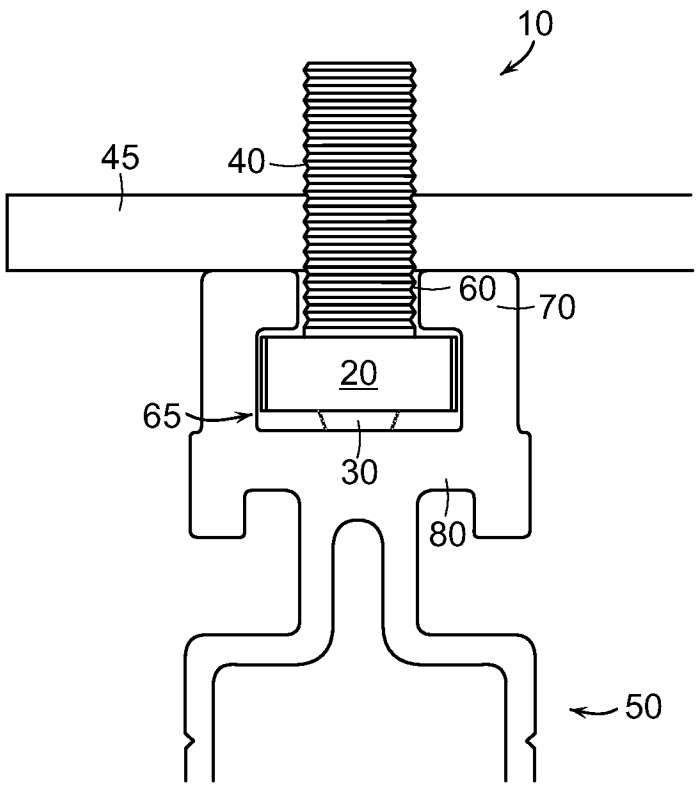

FIG. 2

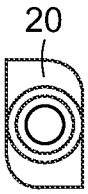

FIG. 3A

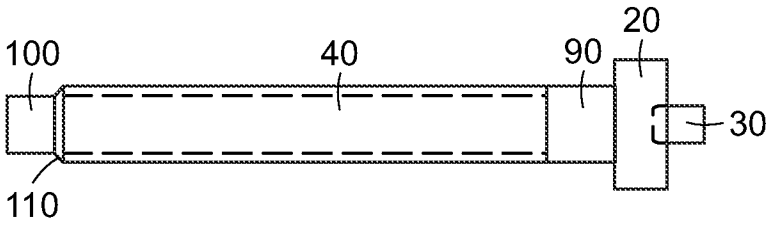

FIG. 3B

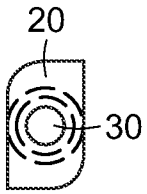

FIG. 3C

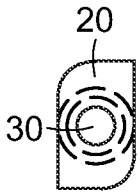

FIG. 4C

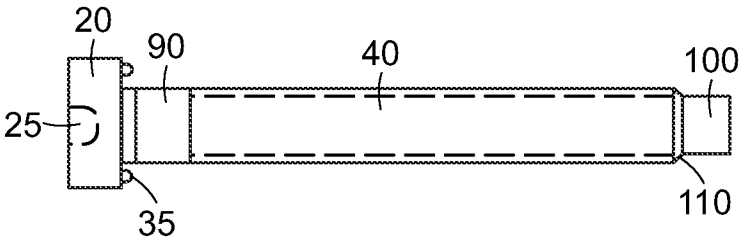

FIG. 4B

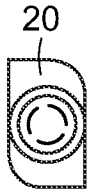

FIG. 4D

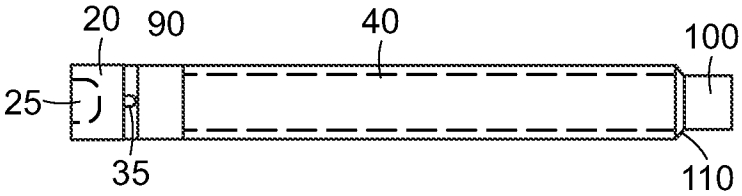

FIG. 4A

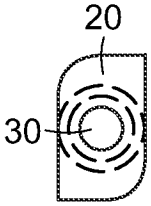

FIG. 5A

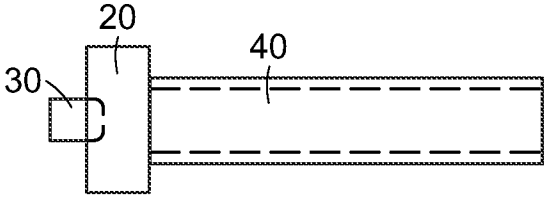

FIG. 5B

FIG. 5C

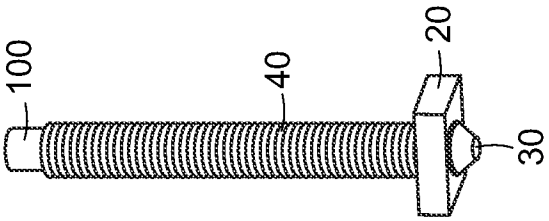

FIG. 6C

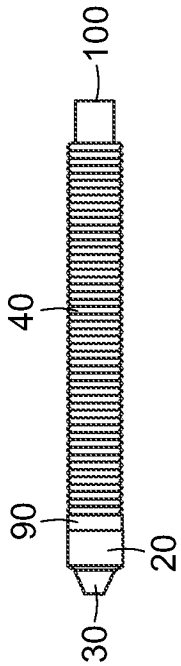

FIG. 7A

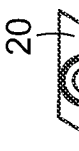

FIG. 6A

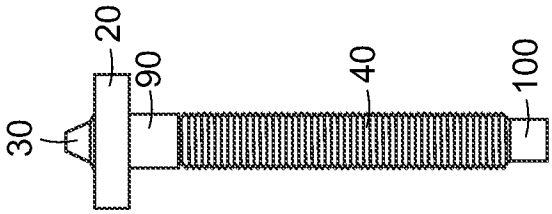

FIG. 7B

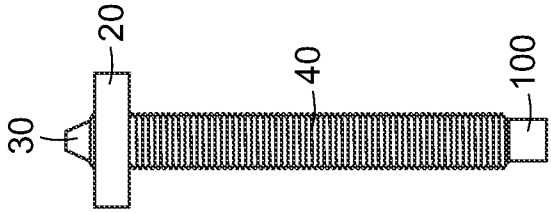

FIG. 6B

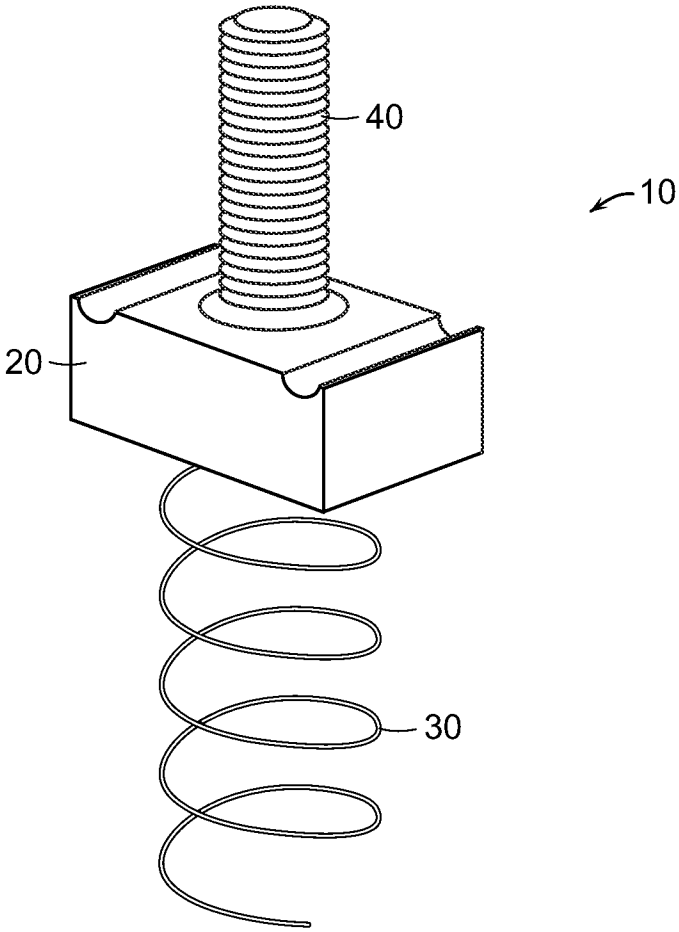

FIG. 8

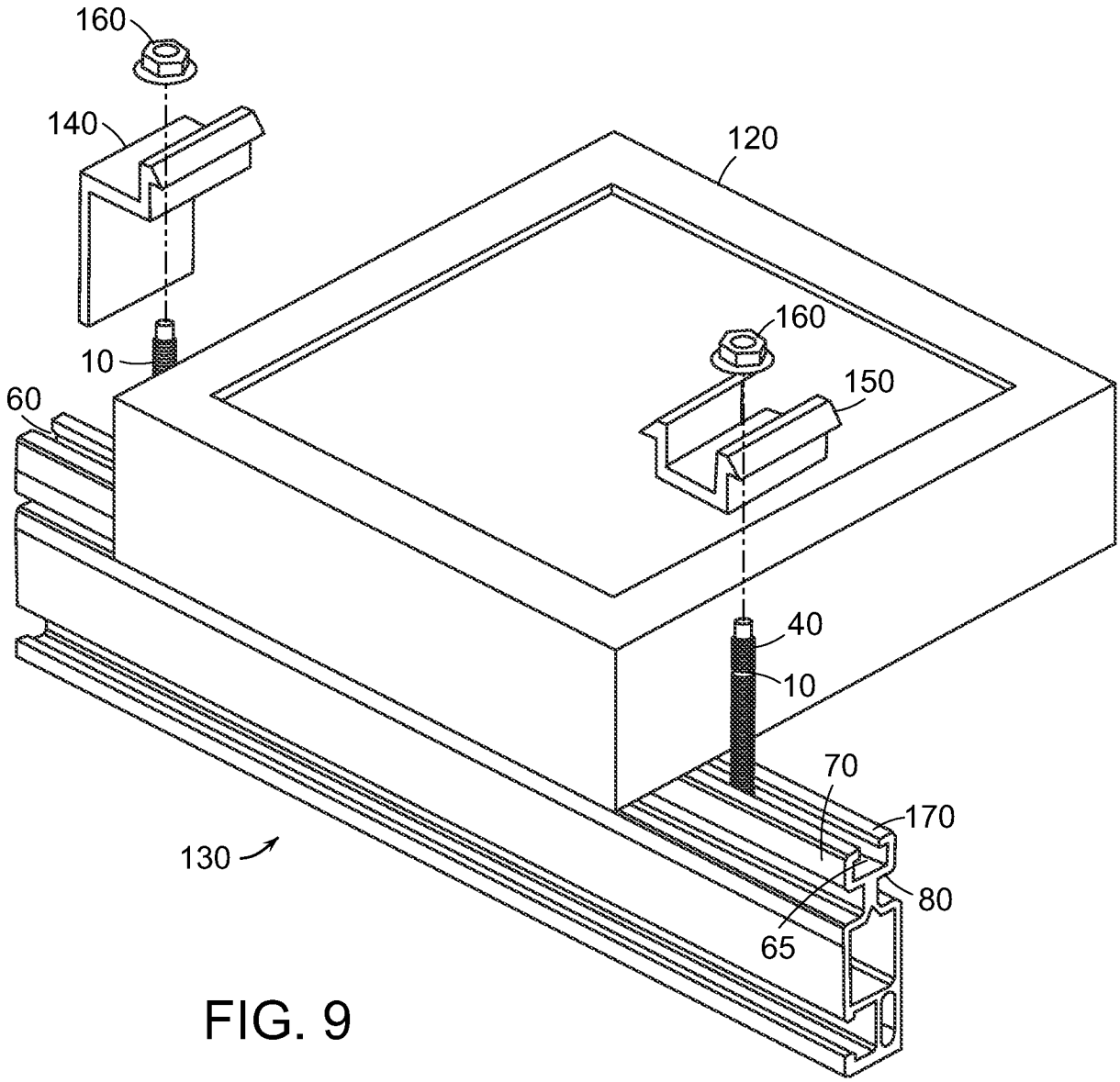

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 09/36565

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - F16B 23/00 (2009.01)
USPC - 411/22, 341, 360, 512
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) - F16B 23/00 (2009.01)
USPC - 411/22, 341, 360, 512

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 411/340, 342, 343, 344, 345, 347, 552, 392, 501, 516 (text search - see terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST(USPT,PGPB,EPAB,JPAB); Google Scholar; Google Patents
Search Terms: bolt, head, attached, mounted, coupled, to, on, elastomeric, elongated, fastener, device, fastening, element, rubber, polymer, end, tail

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,520,704 B1 (Vidmar et al.) 18 February 2003 (18.04.2003), Fig 1 and 2, col 1, ln 23-34	1 and 2

☐ Further documents are listed in the continuation of Box C. ☐

* 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	Date of mailing of the international search report
02 April 2009 (02.04.2009)	14 APR 2009
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (April 2007)