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(54) Title: TAMPER PROOF FASTENING MECHANISM AND FASTENER

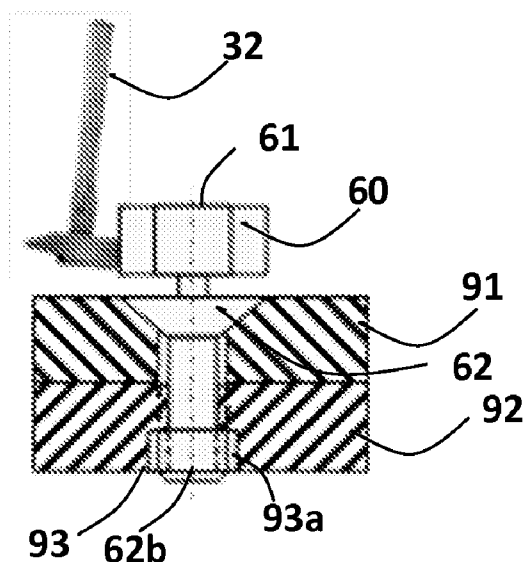


Fig. 7C

(57) Abstract: A tamper-proof fastening mechanism, a fastener and a safety apparatus that allow fastening at least two elements to one another, where the fastener includes a pin portion that has a mechanism for enhancing the pin grip to a socket walls for enhancing the fastening thereto, where the socket is perforated between the elements. According to one embodiment, the mechanism includes an expansion mechanism in which a portion of the pin can expand once inside the socket. According to other embodiments, the mechanism includes a plurality of fasteners each including a pin that is rotatable to a different rotation direction for fastening and removal thereof, where they all appear the same when fastened making it more difficult for an unauthorized person to know in which direction to rotate each for removal thereof.

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TAMPER PROOF FASTENING MECHANISM AND FASTENER

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

[0001] This application claims priority to provisional patent application No. 61/574,054 filed on July 27, 2011, which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present invention generally relates to fastening mechanisms for fastening elements in permanent fixing such as shear bolts.

BACKGROUND OF THE INVENTION

10 [0003] Shear bolts and shear pins are often used for permanent connecting of elements such as plates to one another in a non-removable manner. The shear bolt often includes a cylindrical often threaded pin portion configured for being inserted into a designated socket perforated between the elements held for being connected and a removable head portion configured for being used for inserting (e.g. screwing) the pin
15 portion into the socket using a designated tool such as a screwdriver and then being removed therefrom (sheared) for preventing removing of the pin portion from the socket, thereby providing tamper proof fastening of the elements. The shear bolt head portion is commonly designed as a drive bolt head for allowing a corresponding screwdriver to be used for fastening the shear bolt for securing the designated elements
20 to one another. The drive bolt head is designed to be sheared either by forcefully removing thereof or by unscrewing thereof from the pin portion.

[0004] **Figures 1A-1C** show a known in the art shear bolt **10** having a removable bolt head **11** (also known as drive flange) and pin portion **12** fastening two plate elements **21** and **22** to one another. The bolt head **11** is used for securing the pin
25 portion **12**, which includes a screw-thread thereover, into a designated threaded socket **23** perforated through the two plate elements **21** and **22** by using a suitable tool **30** (e.g. a wrench). Once the pin portion **12** is inside the socket **23**, the bolt head **11** is sheared for preventing the pin portion **12** from being removed of the socket **23**. To allow easy removal of the bolt head **11** the pin portion **12** often includes a widening part **12a** and a
30 pin part **12b**, which may be threaded, where the widening part **12a** has a funnel shape having a polygonal socket for receiving a corresponding polygonal connecting bit **11a**

of the bolt head **11**. The bolt head **11** includes the polygonal connecting bit **11a** as well as a head portion **11b**, in this case having a polygonal design for enabling a corresponding polygonal wrench **30** to be used for securing the shear bolt **10** to the socket **23** by rotating thereof to a predefined rotation direction. Once the pin portion **12** is threaded into the designated threaded socket **23** of the elements **21** and **22**, the interlocking of the polygonal connecting bit **11a** of the bolt head **11** is easily pulled out from the corresponding polygonal socket **12c** of the pin portion **12**. The socket **23** between the plate elements **21** and **22** can include a narrower portion **23a** and a wider portion **23b** for allowing the edge of the pin portion **12** to better fit therein.

[0005] This shear bolt **10** only provides partial protection from disconnection of the elements **21** and **22** as the elements **21** and **22** can be disassembled by using special tools such as a saw, drill or mill tools. A tool having a corresponding polygonal protrusion can be used for interlocking with the remaining polygonal socket **12c** of the pin portion **12**, for example, and then rotated for removing the pin portion **12** from the socket **23** of the elements **21** and **22**.

SUMMARY OF INVENTION

[0006] According to one aspect of the invention, there is provided a tamper-proof fastener for fastening at least two elements to one another that includes: a pin portion; and a head portion connected to the pin portion. The head portion is configured for allowing the fastening mechanism to connect the at least two elements to one another by using a designated fastening tool and for being sheared off from the pin portion once the pin portion is inserted to a socket perforated through the elements for connecting thereof, wherein the pin portion comprises an expansion mechanism allowing at least part of an outer surface thereof to expand once the pin portion is inserted into the socket perforated through the at least two elements.

[0007] Optionally, the pin portion and expansion mechanism thereof comprise a split edge portion comprising multiple pins, each respective pin is made of a material of an elasticity level that allows it to bend inwardly towards a respective main central axis of the fastening mechanism during insertion of the pin portion into the socket and to retract to an open position by moving away from the central axis once already

inserted in said socket, thereby applying pressure upon a receiving inner wall of the socket when the pin portion is inside thereof for securing the pin portion in the socket.

[0008] The pin portion may further comprise an inner channel perforated along a central axis thereof for allowing using a reinforcement member configured for being inserted through the channel for opening the split edge portion. The reinforcement member may be left inside the channel after insertion thereof for maintaining reinforcement.

[0009] Optionally, the socket perforated between the elements is configured in a shape of a longitudinal channel having a bottom part that widens for allowing the split edge portion to open therein. Each pin of the split edge portion may include a protruding part configured for being inserted into the bottom part of the channel of the socket for preventing the pin portion from being removed therefrom.

[0010] According to some embodiments, the expansion mechanism comprises a guiding member made from an elastic material, configured for enveloping a pin of the pin portion, wherein the guiding member is configured for being inserted into the socket separately and the pin is forcefully inserted into the guiding member to strengthen a pressure applied by the pin portion over inner walls of the socket coupled thereto, thereby enhancing a grip of the pin portion to the socket inner walls.

[0011] Optionally, the pin portion includes a threaded portion and the socket has a threaded portion configured to receive and fasten to the threaded portion of the pin portion for securing the pin portion to the elements in the socket by screwing thereof.

[0012] The elements may form a casing when fastened by the at least one fastening mechanism, for casing at least one vital component of a vehicle.

[0013] According to other aspects of the invention, there is provided a tamper-proof fastening mechanism for fastening at least two elements to one another comprising a pin portion that comprises an expansion mechanism allowing at least part of an outer surface thereof to expand once the pin portion is inserted into a socket perforated through the at least two elements.

[0014] Optionally, the pin portion comprises a split edge portion comprising multiple pins, each respective pin of the split portion is made of a material of an elasticity level that allows it to bend inwardly towards a respective main central axis of said fastening mechanism during insertion of the pin portion into the socket and retract to an open position from the central axis once already inserted in the socket.

[0015] The pin portion optionally further comprises an inner channel perforated along its central axis for allowing using a reinforcement member configured for being inserted through the channel for opening the split edge portion.

[0016] The reinforcement member may be left inside the channel after insertion thereof for maintaining the split edge portion in the open position.

[0017] The socket perforated between the elements may be configured in a shape of a longitudinal channel having a bottom part that widens for allowing the split edge portion to open therein. Each pin of the split edge portion optionally includes a protruding part configured for being inserted into the bottom part of the socket channel for preventing the pin portion from being removed therefrom.

[0018] Additionally or alternatively, the elements form a casing when fastened by the at least one fastening mechanism, for casing at least one vital component of a vehicle.

[0019] According to yet another aspect of the present invention, there is provided a tamper-proof fastening mechanism for fastening at least two elements to one another comprising: a pin portion; and a head portion connected to the pin portion, wherein the head portion is configured for allowing the fastening mechanism to connect the at least two elements to one another by using a designated fastening tool and for being sheared off from the pin portion once the pin portion is inserted to a socket perforated through the at least two elements for connecting thereof, wherein at least part of the pin portion is telescopic comprising multiple parts overlapping one another for enabling to slide one into the other for compression of the pin portion.

[0020] According to another aspect of the present invention, there is provided a safety mechanism comprising: at least two elements having a plurality of sockets perforated thereover, each of the sockets is perforated through the at least two elements for receiving a fastener portion therein for connecting the elements to one another; a plurality of fasteners each having a threaded portion and a head portion that allows using a rotating tool for fastening the fastener by rotating thereof to a predefined direction and removing thereof by rotating it to an opposite rotating direction, the plurality of fasteners comprise at least one fastener of a first type and at least one fastener of a second type. The first type fastener is configured to fasten the elements by rotating it to a first rotation direction and removing thereof by rotating it to a second rotating direction opposite to the first rotation direction, wherein the second type

fastener is configured to fasten the elements by rotating it to the second rotation direction and removing thereof by rotating it to the first rotating direction opposite thereto. Each of the plurality of fasteners regardless of its particular type is designed to appear the same from at least one side thereof that is configured for being exposed to a viewer once the respective fastener is secured to the elements for preventing a respective viewer from visually distinguishing the type and therefore the rotation direction of each respective fastener.

[0021] Optionally, each the fastener is a shear bolt having a pin portion and a head portion connected to the pin portion, the head portion is configured for allowing the fastening mechanism to connect said at least two elements to one another by using a designated fastening tool and for being sheared off from the pin portion once the pin portion is inserted to a respective socket perforated through the at least two elements for connecting thereof.

[0022] Additionally or alternatively, the plurality of elements form a casing for at least one vital component of a vehicle when fastened to one another using the plurality of fasteners, encasing the at least one vital component therein.

[0023] According to yet another aspect of the invention, there is provided a safety mechanism comprising: at least two elements having at least one socket perforated therethrough; and at least one shear bolt for fastening the elements to one another. The shear bolt comprises: a pin portion comprising a bottom threaded portion; and a head portion connected to the pin portion, the head portion is configured for allowing the fastening mechanism to connect the at least two elements to one another by using a designated fastening tool and for being sheared off from the pin portion once the pin portion is inserted to a socket perforated through the at least two elements for connecting thereof, wherein the socket comprises a longitudinal section and a widening bottom section, wherein once rotating the pin portion further into the socket, the threaded portion of the pin portion reaches the widening edge section, which is not threaded and therefore the pin portion is unable to be unscrewed therefrom.

BRIEF DESCRIPTION OF DRAWINGS

[0024] **Fig. 1A** shows a prior art hexagonal shear bolt used for connecting two elements before the bolt head is removed.

[0025] **Fig. 1B** shows the prior art shear bolt used for connecting two elements after the bolt has been inserted through the elements and while the bolt head is sheared by using a hexagonal screwdriver.

[0026] **Fig. 1C** shows the shear bolt of the prior art fastening the two elements after the head has been sheared off.

[0027] **Figures 2A, 2B and 2C** schematically illustrate a shear bolt fastener rotatable to one direction, according to a first embodiment of the present invention, where **Fig. 2A** is a side view of the shear bolt; **Fig. 2B** is a bottom view of the shear bolt; and **Fig. 2C** is an elevated view of the shear bolt.

[0028] **Figures 3A, 3B and 3C** schematically illustrate another shear bolt fastener rotatable to an opposite direction to that of the bolt illustrated in **Fig. 2B**, , where **Fig. 3A** is a side view of the shear bolt; **Fig. 3B** is a bottom view of the shear bolt; and **Fig. 3C** is an elevated view of the shear bolt.

[0029] **Figures 4A, 4B, 4C, 4D, 4E and 4F** schematically illustrate a fastener having a hard plate connected thereto for permanent fixing by rotation prevention of the fastener once inside the socket, according to another embodiment of the present invention, where **Fig. 4A** is an exploded side view of the fastener; **Fig. 4B** shows the fastener and socket thereof for connecting two elements, where the fastener is out of the socket; **Fig. 4C** shows the fastener half way through the socket; **Fig. 4D** shows the fastener fully inside the socket; **Fig. 4E** shows a cross section of a pin portion of the fastener showing how before inserted into the socket the hard plate is straight allowing rotation thereof; and **Fig. 4F** shows a cross section of the pin portion of the fastener showing how after inserted into the socket the hard plate is deformed thereby preventing rotation thereof.

[0030] **Fig. 5** shows a shear bolt permanent fix fastener having a widening lower edge, according to another embodiment of the invention.

[0031] **Fig. 6** shows a shear bolt permanent fix fastener having a lower edge covered with adhesive material, according to yet another embodiment of the invention.

[0032] **Fig. 7A** shows a permanent fix shear bolt fastener having a pin portion with a threaded widening bottom part for allowing permanent fixing thereof, according to other embodiments of the invention.

[0033] **Fig. 7B** shows two elements having a socket perforated therethrough configured for receiving the shear bolt of **Fig. 7A**.

[0034] Fig. 7C shows the shear bolt of Fig. 7A inside the designated socket shown in Fig. 7B having the head of the shear bolt being removed by using a hammer.

[0035] Fig. 7D shows the shear bolt inside the socket having the head of the bolt removed (sheared) therefrom.

5 [0036] Fig. 8A shows a permanent fix fastener having a pin portion with a threaded bottom part for allowing permanent fixing thereof, according to other embodiments of the invention.

[0037] Fig. 8B shows a fastening mechanism using the fastener of fig. 8A for connecting two elements having a socket perforated therethrough configured for
10 receiving the fastener of Fig. 8A.

[0038] Fig. 8C shows the fastener of Fig. 8A fully inside the designated socket shown in Fig. 8B.

[0039] Fig. 9 shows a fastening mechanism including a permanent fix fastener, a socket perforated in elements and a multiplicity of stoppers that are configured in
15 material and/or shape for holding the fastener inside the socket for enhancing permanent fixation thereof, according to embodiments of the invention.

[0040] Fig. 10A shows a permanent fix fastener having a split pin portion, according to one embodiment of the invention.

[0041] Fig. 10B shows the permanent fix fastener with the split pin portion inside a
20 designated socket perforated between two elements for fastening thereof.

[0042] Fig. 11A shows a permanent fix fastener having a split pin portion and a separate reinforcing member, according to one embodiment of the invention.

[0043] Fig. 11B shows the permanent fix fastener of Fig. 11A inside the socket, where the reinforcing member is not yet inserted therethrough for reinforcing the hold
25 of the fastener to the walls of the socket.

[0044] Fig. 11C shows the permanent fix fastener of Fig. 11A-11B inside the socket, where the reinforcing member is inserted therethrough for reinforcing the hold of the fastener to the walls of the socket by pushing the split edges of the pin portion of the fastener towards the inner socket walls.

30 [0045] Fig. 12A shows a tamper proof fastener having a split lower edge, according to another embodiment of the present invention.

[0046] Fig. 12B is a cross sectional view of the tamper proof fastener of Fig. 12A being inserted into a socket perforated in two elements for connecting thereof and a

separate reinforcement member for enhancing fastening of the fastener, according to some embodiments of the present invention.

[0047] **Fig. 12C** is a cross sectional view of the tamper proof fastener of **Fig. 12A** being inserted into a socket and the reinforcement member inserted therethrough.

5 [0048] **Fig. 13A** is a cross sectional view of a tamper proof fastening mechanism including an elastic guiding member, according to some embodiments of the invention.

[0049] **Fig. 13B** is a cross sectional view of the taper proof mechanism of **Fig. 13A** being inserted into a socket in elements for connecting thereof.

10 [0050] **Fig. 14A** is a cross sectional view of a fastening mechanism including a shear bolt fastener having a tubular pin portion, according to some embodiments of the present invention, wherein the fastener is not yet inserted into a designated socket.

[0051] **Fig. 14B** is a cross sectional view of the fastener of **Fig. 14A** inside the socket before its head portion is removed.

15 [0052] **Fig. 14C** is a cross sectional view of the fastener of **Fig. 14A** inside the socket after its head portion has been removed.

[0053] **Fig. 15A** is a cross sectional view of a fastening mechanism including a collapsing fastener, according to some embodiments of the present invention, wherein the fastener is right after being inserted into a designated socket.

20 [0054] **Fig. 15B** is a cross sectional view of the collapsing fastener of **Fig. 15A** inside the socket in a collapsed position.

[0055] **Fig. 16A** is a side view of a shear bolt fastener having a conical shaped pin portion upper part, according to some embodiments of the invention.

25 [0056] **Fig. 16B** is a cross sectional sided view of the shear bolt fastener of **Fig. 16A** having the conical shaped pin portion upper part, inserted into a socket perforated between two elements for allowing the fastener to connect these elements, where the head portion of the fastener is removed (sheared), wherein the conical shape of the pin portion allows filling a space created inside the socket with filling materials.

30 [0057] **Fig. 17A** is a side view of a shear bolt fastener having a conical shaped pin portion upper part and having a coating material coating at least parts of the pin portion thereof, according to other embodiments of the invention.

[0058] **Fig. 17B** is a cross sectional sided view of the shear bolt fastener of **Fig. 17A** having the conical shaped pin portion upper part, inserted into a socket perforated between two elements for allowing the fastener to connect these elements, where the

head portion of the fastener is removed (sheared), wherein the conical shape of the pin portion allows filling a space created inside the socket with filling materials.

[0059] **Fig. 18** is a side view of a shear bolt fastener having a conical shaped pin portion upper part, according to yet another embodiment of the invention.

- 5 [0060] **Fig. 19** is a side view of a shear bolt fastener having an irregular shape of a pin portion upper part including a protruding section that is located off-center to a main central axis of the fastener, according to another embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

- 10 [0061] In the following detailed description of various embodiments, reference is made to the accompanying drawings that form a part thereof, and in which are shown by way of illustration specific embodiments in which the invention may be practiced. It is understood that other embodiments may be utilized and structural changes may be made without departing from the scope of the present invention.

- 15 [0062] The present invention, in some embodiments thereof, provides tamper proof fasteners, fastening mechanisms and fastening methods for using thereof for allowing permanently fixing multiple elements (at least two) to one another. The fasteners, fastening mechanisms and methods provided, allow improving currently used permanent fixes such as prior art shear pins or bolts and the like for improving
20 prevention of disconnecting elements that they are fastened together.

- [0063] Reference is now made to **Figures 2A- 2C** schematically illustrating a shear bolt fastener **10** that can be fastened (closed) by rotating to a first rotational direction (e.g. counterclockwise), and **Figures 3A- 3C** schematically illustrate another shear bolt fastener designed for rotating to an opposite direction (e.g. clockwise) to that of the
25 bolt illustrated in **Figures 2A-2C**, for fastening. Each shear bolt **100/200** includes a pin portion **112/212** having a widening part **112a/212a** and a threaded part **112b/212b**; and a bolt head portion **111/211** having a polygonal head part **111a/211a** and a connecting bit **111b/211b**, which may also be polygonal. The head part **111a/211a** can be removed by disconnecting the bit **111b/211b** from the pin portion **112/212** by
30 unscrewing thereof (e.g. by using a corresponding polygonal wrench) or by forcefully hitting it off (e.g. by using a hammer). To fasten each shear bolt **100/200** a polygonal wrench may be used for screwing thereof into a respective female threaded socket in

the respective two or more elements that are to be connected. The head part **111b/211b** of each shear bolt **100/200** may include a marking indicating the shear bolt's rotational direction for fastening thereof. A multiplicity of mixed types of shear bolts **100b** and **b200** may be used for fastening elements to one another for enhancing the permanent fix fastening.

[0064] Once the bolt head of the respective shear bolt **111/211** is removed, there is no indication as to the rotational direction for unfastening the respective shear bolt **100/200** and therefore, an unauthorized attempt to open the screwing of the respective shear bolt **100/200** by unscrewing thereof may work for one or more of the shear bolts **100/200** but may damage the tool used for unscrewing when attempting to unscrew the other type of shear bolt **200/100** using the same rotation direction. This may confuse the unauthorized person attempting to tamper with the fastening and convince this person to leave the attempt due to the time it will require him/her for removing the bolts **100/200**.

[0065] Reference is now made to **Fig. 3D**, schematically illustrating a casing **900** for protecting one or more components of a vehicle that includes several elements such as elements **910** and **920** that should be permanently affixed together after the component(s) are encased thereby in a non-removable manner. Shear bolts **100** and **200** are used to fasten the elements **910** and **920**, where the shear bolts **100** and **200** are scattered in no particular order throughout the casing **900**.

[0066] **Figures 4A- 4F** schematically illustrate a tamper proof fastener **300** having a hard plate **313** made of hard material(s) such as steel or ceramics according to some embodiments of the invention. The fastener **300** includes a widening head portion **311** and a pin portion **312**, which may be threaded. The pin portion **312** includes a slit **314** for receiving the hard plate **313** therein. The width "**D**" of the hard plate **313** (see **Fig. 4E**) is slightly larger than the diameter "**d**" of the pin portion **312** and therefore can deform (e.g. bend) once the pin portion **312** is forced/threaded into the socket **23'**. **Fig. 4E** shows the plate **313** inside the pin portion **312** before it was inserted into the socket **23'** and **Fig. 4F** shows how the hard plate **313** can be deformed once inserted into the socket **23'**.

[0067] The hard plate **313** prevents the fastener **300** from being pooled out by rotation thereof e.g. by using a rotating tool **31** since the deforming of the protruding

plate **313** enhances the grip it has onto the inner walls of the socket **23'** and therefore enhances the fastening of the elements **21'** and **22'** to one another.

[0068] As illustrated in **Figures 4B-4D**, the socket **23'** may be configured to fit the design of the fastener **300** as well as to optimize the fastener's **300** hold of the elements **21'** and **22'** once threaded/inserted into the socket **23'**. In this case, the socket **23'** has three sections: a first section **23a'** having a funnel shape fitting the widening funnel shape of the fastener's head **311**; a second section **23b'** having a tubular shape; and a third section **23c'** which may be threaded as a female thread to receive a male thread section of the pin portion **312** of the fastener **300**.

[0069] According to some embodiments of the invention, there is provided a tamper-proof fastener for fastening elements to one another that includes a head portion and a pin portion, where the pin portion includes an expansion mechanism allowing at least part of an outer surface thereof to expand once the pin portion is inserted into a socket perforated through the elements to be fastened to one another. The expansion mechanism may include, for instance a widening lower edge of a pin portion of a fastener of any design such as a regular screw design, a shear bolt design and the like, where the widening edge is made from the same material as the fastener of is an attachment thereto made from softer materials for allowing squeezing into the socket and then widening when inside for applying more pressure over the socket's inner walls for enhancing fastening of the pin portion thereto.

[0070] **Fig. 5** shows a shear bolt permanent fix fastener **40** having a head portion **41** with a polygonal had part **41b** and a connecting part **41a** and a pin portion **42** having a pin part **42a** and a widening lower edge by including an attachment **42b**, according to one embodiment of the invention. The attachment **42b** is made from a much flexible and softer material such as rubber, polymeric and/or silicon based flexible materials and the like to improve the hold of this pin portion part to the inner walls of a socket to which it is inserted to fasten elements.

[0071] **Fig. 6** shows a shear bolt permanent fix fastener **50** having a head portion **51** with a polygonal had part **51b** and a connecting part **51a**; and a pin portion **52** having a pin part **52a** and a lower edge that has an adhesive attachment **52b**, according to one embodiment of the invention. the adhesive attachment **52b** may simply be an adhesive material attached to the lower edge of the pin portion **52** or a sticker

attachment having an adhesive material on both sides thereof to allow both adhering to the pin portion **52** lower edge as well as to the socket inner walls.

[0072] **Fig. 7A-7D** show a fastening mechanism including a tamper proof fastener

60 having a pin portion **62** with a widening threaded bottom part **62c** and a non-

threaded middle part **62c** for allowing permanent fixing thereof, according to other

embodiments of the invention. The fastener **60** has a shear bolt head portion **61**

including a polygonal head part **61b** and a connecting bit **61a**; and the pin portion **62**

having a widening upper part **62a** a middle tubular part **62b** and a widening threaded

lower part **62c**. The fastening mechanism depends also on the configuration of a

designated socket **93** perforated between elements **91** and **92**, where the socket **93** is

configured of three sections: an upper first section **93a** configured to receive and hold

the funnel shaped upper part **62a** of the pin portion **62**; a second section **93b** having a

threaded part for receiving the screw thread of the lower part **62c** of the pin portion **62**

on its way through the socket **93**; and a non-threaded third section **93c**. The treaded

lower part **62b** of the pin portion **62** is threaded through the threaded portion of the

second section **93b** of the socket **93** when fastened therethrough and then further

inserted and designed to completely be inserted into the non-threaded third section **93c**.

In this way, once the fastener **60** is fully inserted into the socket **93** for connecting the

elements **91** and **92**, the male-screw threaded portion thereof is not in the female-screw

threaded portion of the socket **93** enhancing tamper proof characteristics of the

fastening mechanism since it prevents the fastener **60** from being unscrewed from the

socket **93**. Since in this example, the fastener **60** is a shear bolt, the head portion **61**

thereof can be removed by using a tool **32** such as a hammer, a wrench or a screwdriver

for removing thereof to further enhance tamper proof characteristics of the fastening

mechanism.

[0073] Other types of fasteners may be used for this mechanism that are not

necessarily shear bolt based by can also be standard screws having only a very limited

lower threaded portion, where the design of the socket corresponds to the pin portion

threaded edge length to allow fastener unscrewing/removal prevention.

[0074]

Fig. 8A-8C show a permanent fix fastener **70** having a head portion **70c** a

threaded pin portion **70a** and a non-threaded pin portion **70b** for allowing permanent

fixing thereof, according to other embodiments of the invention. Similarly to the

fastening mechanism described in respect to **Figures 8A-8C**, this fastener **70** does not include the shear bolt head design and also requires the same socket **93** configuration.

[0076] **Fig. 9** shows a fastening mechanism including; (i) a permanent fix shear bolt fastener **80** having a head portion **81** and a pin portion **82**; (ii) a rotating nut **95** fastened to the fastener's **80** threaded lower part **82b**; (iii) and a socket **93'** perforated in elements **91'** and **92'** and a multiplicity of stoppers such as stoppers **94a** and **94b** that are made from material and/or shape designated for improving the hold of the fastener **80** to the inner walls of the socket **93'** for enhancing permanent fixation thereof, according to embodiments of the invention. The fastener **80** pin portion **82** includes a tubular non-threaded part **82a** and a threaded part **82b**, which is screwed to the nut **95**. The stoppers **94a** and **94b** are located inside the socket **93'** or may be attached to the nut **95**. When the fastener **80** (attached to the nut **95**) is rotated (e.g. by a polygonal wrench **30**) to be inserted into the socket **93'**, the stoppers **94a** and **94b**, made of resilient, flexible and/or soft materials such as rubber, polymeric/silicon based elastic materials and the like, widen and deform and/or adhere to the nut **95** thereby improving and enhancing the attachment between the fastener **80** and the elements **91'** and **92'** via the socket **93'** perforated therethrough.

[0077] **Fig. 10A-10B** show a permanent fix fastener **400** having a split pin portion **420** and a mechanism utilizing thereof, according to one embodiment of the invention.

[0078] According to these embodiments, the fastener **400** includes a head portion **410** and the pin portion **420**, where the pin portion **420** includes multiple pins such as pins **421a** and **421b**. The split edge serves as a spring that allows contracting the pin portion **420** for inserting thereof into a socket **26** perforated through elements **24** and **25** for connecting thereof, and then applying pressure outwardly towards the inner walls of the socket **26b** due to their design for enhancing the grip of the pin portion **420** onto the elements **24** and **25** for enhancing fastening characteristics of the mechanism.

[0079] As illustrated in **fig. 10A**, the socket **26** includes: a widening lower section **26a**; a second tubular section **26b** and a third widening funnel shaped section **26c**.

Additionally, as illustrated in **Figures 10A-10B**, each pin **421a/421b** includes a protruding edge **425a/425b** respectively, for being inserted into the designated widening space **26a** in the socket **26**.

[0080] **Figures 11A-11C** illustrate a fastener **400'** and fastening mechanism that is very similar to fastener **400** and fastening mechanism described in **Figures 10A-10B**.

these embodiments of the present invention, include a mechanism that uses the fastener **400'** having a head portion **410'** and a split pin portion **420'**, where the split portion **420'** includes pins **421a'** and **421b'** each having a protrusion **425a'** and **452b'** respectively. The socket **26** is designed in the same manner as described in relation to

5 **Figures 10A-10B**. The only difference is that the fastener **400'** also includes a channel **401** located along a coaxial axis of the fastener **400'** for receiving a reinforcement member **430'** therethrough once the fastener **400'** is fully inserted in the socket **26**. The reinforcement member **430'** allows further pushing the pins **421a'** and **421b'** towards the walls of the socket **26** for enhancing the grip of the fastener **400'** thereto.

10 **[0081]** **Fig. 12A** shows a tamper proof fastener **500** having a head portion **510**; and a split lower edge of its respective pin portion **520** including protrusions **521a** and **521b**, according to another embodiment of the present invention.

[0082] **Fig. 12B-12C** show the tamper proof fastener **500** being inserted into a socket **26'** perforated in two elements **24'** and **25'** for connecting thereof and a separate

15 reinforcement member **530** for enhancing fastening of the fastener **500**, according to some embodiments of the present invention. the fastener **500** includes a hollowed channel **501** along its main vertical axis into which a lower rod like part of the reinforcement member **530** is to be inserted. The reinforcement member **530** has a diameter that is close to the diameter aperture of the channel **501** for allowing thereof

20 to apply pressure over the inner walls of the channel **501** towards the inner walls of the socket **26'** for enhancing the fastening of the fastener **500** to the elements **24'** and **25'**.

[0083] **Figures 13A-13B** show a tamper proof fastening mechanism including a spring pin fastener **600** having an elastic guiding member **610** and a reinforcement member **630**, according to some embodiments of the invention. The guiding member

25 **610** has an elongated channel **612** for receiving the reinforcement member **630** therein once the guiding member **610** is inside a designated socket **29** of elements **27** and **28** that are to be connected thereby. To enhance fastening characteristics, the outward surface of the guiding member **610** includes an elastic cover (e.g. made of elastic materials such as rubber, polymeric/silicon based elastic solids and the like) and

30 optionally has a non-uniform surface such as a wiggly or wrinkly surface made of elastic materials that can be squeezed (compressed) for entering the socket **29** that may have a smaller diameter than that of the fastener **600** and then naturally decompress and thereby apply force outwardly over the inner walls of the socket **29** for improving hold

of the fastener **600** to the socket walls **29**. The reinforcement member **630** may further enhance those very same qualities.

[0084] **Figures 14A-14C** show a fastening mechanism including a shear bolt fastener **700** having a head portion **710** and a tubular pin portion **720**, according to some embodiments of the present invention. The socket **266** perforated through elements **277** and **288** into which the fastener **700** is configured to receive the tubular pin portion **720** such that the surface of the pin portion will not protrude from the element **288**.

[0085] **Figures 15A-15B** show a fastening mechanism including a collapsing fastener **800**, according to some embodiments of the present invention. The collapsing fastener **800** may have multiple sections **810**, **820** and **830** that can telescopically connect to each other for collapsing and thereby shortening the length of the fastener **800** once inside the socket **266**.

[0086] **Figures 16A-16B** illustrate a shear bolt fastener **801**, according to some embodiments of the invention. The shear bolt fastener **801** includes a head portion **805** and a pin portion **802**, where the pin portion **802** includes a pin and a conical upper part **803** creating a shape of a protrusion **804** at the upper edge thereof. The protrusion **804** connects to the head portion **805** before the head portion **805** is removed. The head portion **805** has a corresponding receiving shape that is conical to fit the upper part **803** of the pin portion **802** such that they create a space **807** between the lower part of the head portion **805** and the upper part **803** of the pin portion **802**. The space **807** can be filled with materials that enhance fastening or proof tamper prevention characteristics of the mechanism such as plastic, adhesive and/or ceramic materials or steel that are much harder than the material from which the fastener is made (such as aluminum) for deforming a drill/screwdriver bit on attempt to rotate the fastener **801** once affixed to the elements **271** and **272**; or other materials that can create smoke upon friction with a tool used for rotation of the pin portion **802**.

[0087] **Figures 17A -17B** show a similar fastening mechanism and fastener **811** to the fastener **801** described in **Figures 16A-16B** having the same shape of a shear bolt head portion **815**; and pin portion **812** having a similar conical upper part **813** and protrusion **814** creating similar space **817** therebetween. This fastener **811**, however, also includes one or more coated areas **812a** and **812b** that include the same materials as filled in space **817** such as ceramic, adhesive and/or plastic materials.

[0088] Fig. 18 shows a shear bolt fastener **821** having a head portion **825** and a pin portion **822** having a conical shaped upper part **823**, according to yet another embodiment of the invention. In this embodiment, the head portion **825** does not have a compatible conical receiving shape as in embodiments illustrated in **Figures 15A-15B**.

5 The conical shape creates a protrusion 824 and a space 827 between the head portion 825 and the upper part **823**. In this embodiment the protrusion **825** is located centrally in respect to a main vertical axis "z" of the fastener **821**.

[0089] Fig. 19 shows a shear bolt fastener **831** having a head portion **835** and a pin portion **832**, where the pin portion **832** includes an upper part **833** having an
10 irregular shape creating an off-centered protrusion **834** in respect to a main vertical axis "z" of the fastener **831**.

[0090] Many alterations and modifications may be made by those having ordinary skill in the art without departing from the spirit and scope of the invention. Therefore, it must be understood that the illustrated embodiment has been set forth only for the
15 purposes of example and that it should not be taken as limiting the invention as defined by the following invention and its various embodiments.

[0091] Therefore, it must be understood that the illustrated embodiment has been set forth only for the purposes of example and that it should not be taken as limiting the invention as defined by the following claims. For example, notwithstanding the fact
20 that the elements of a claim are set forth below in a certain combination, it must be expressly understood that the invention includes other combinations of fewer, more or different elements, which are disclosed in above even when not initially claimed in such combinations. A teaching that two elements are combined in a claimed combination is further to be understood as also allowing for a claimed combination in
25 which the two elements are not combined with each other, but may be used alone or combined in other combinations. The excision of any disclosed element of the invention is explicitly contemplated as within the scope of the invention.

[0092] The words used in this specification to describe the invention and its various embodiments are to be understood not only in the sense of their commonly defined
30 meanings, but to include by special definition in this specification structure, material or acts beyond the scope of the commonly defined meanings. Thus if an element can be understood in the context of this specification as including more than one meaning,

then its use in a claim must be understood as being generic to all possible meanings supported by the specification and by the word itself.

[0093] The definitions of the words or elements of the following claims are, therefore, defined in this specification to include not only the combination of elements which are literally set forth, but all equivalent structure, material or acts for performing substantially the same function in substantially the same way to obtain substantially the same result. In this sense it is therefore contemplated that an equivalent substitution of two or more elements may be made for any one of the elements in the claims below or that a single element may be substituted for two or more elements in a claim. Although elements may be described above as acting in certain combinations and even initially claimed as such, it is to be expressly understood that one or more elements from a claimed combination can in some cases be excised from the combination and that the claimed combination may be directed to a sub-combination or variation of a sub-combination.

[0094] Insubstantial changes from the claimed subject matter as viewed by a person with ordinary skill in the art, now known or later devised, are expressly contemplated as being equivalently within the scope of the claims. Therefore, obvious substitutions now or later known to one with ordinary skill in the art are defined to be within the scope of the defined elements.

[0095] The claims are thus to be understood to include what is specifically illustrated and described above, what is conceptually equivalent, what can be obviously substituted and also what essentially incorporates the essential idea of the invention.

[0096] Although the invention has been described in detail, nevertheless changes and modifications, which do not depart from the teachings of the present invention, will be evident to those skilled in the art. Such changes and modifications are deemed to come within the purview of the present invention and the appended claims.

CLAIMS

What is claimed is:

1. A tamper-proof fastener for fastening at least two elements to one another, said fastener comprising:
 - 5 a) a pin portion; and
 - b) a head portion connected to said pin portion, said head portion is configured for allowing said fastening mechanism to connect said at least two elements to one another by using a designated fastening tool and for being sheared off from said pin portion once said pin portion is inserted to a socket perforated through said at least
- 10 two elements for connecting thereof,
wherein said pin portion comprises an expansion mechanism allowing at least part of an outer surface thereof to expand once said pin portion is inserted into said socket perforated through said at least two elements.
2. The fastening mechanism according to claim 1, wherein said pin portion and said
- 15 expansion mechanism thereof comprise a split edge portion comprising multiple pins, each respective pin of said split portion is made of a material of an elasticity level that allows it to bend inwardly towards a respective main central axis of said fastening mechanism during insertion of said pin portion into said socket and to retract to an open position by moving away from said central axis once already inserted in said
- 20 socket, thereby applying pressure upon a receiving inner wall of said socket when said pin portion is inside thereof for securing said pin portion in said socket.
3. The fastening mechanism according to claim 2, wherein said pin portion further comprises an inner channel perforated along a central axis thereof for allowing using a reinforcement member configured for being inserted through said channel for opening
- 25 said split edge portion.
4. The fastening mechanism according to claim 3, wherein said reinforcement member is left inside said channel after insertion thereof for maintaining said split edge portion in the open position.
5. The fastening mechanism according to claim 2, wherein said socket perforated between
- 30 said elements is configured in a shape of a longitudinal channel having a bottom part that widens for allowing said split edge portion to open therein.
6. The fastening mechanism according to claim 5, wherein each said pin of said split edge portion includes a protruding part configured for being inserted into said bottom part of

said channel of said socket for preventing said pin portion from being removed therefrom.

- 5 7. The fastening mechanism according to claim 1, wherein said expansion mechanism comprises a guiding member made from an elastic material, configured for enveloping a pin of said pin portion, wherein said guiding member is configured for being inserted into said socket separately and said pin is forcefully inserted into said guiding member to strengthen a pressure applied by said pin portion over inner walls of said socket coupled thereto, thereby enhancing a grip of said pin portion to said socket inner walls.
- 10 8. The fastening mechanism according to claim 1, wherein said pin portion includes a threaded portion and said socket has a threaded portion configured to receive and fasten to said threaded portion of the pin portion for securing said pin portion to said elements in said socket by screwing thereof.
- 15 9. The fastening mechanism according to claim 1, wherein said elements form a casing when fastened by at least one said fastening mechanism, for casing at least one vital component of a vehicle.
10. A tamper-proof fastening mechanism for fastening at least two elements to one another, said fastening mechanism comprising:
 - 20 a pin portion that comprises an expansion mechanism allowing at least part of an outer surface thereof to expand once said pin portion is inserted into a socket perforated through said at least two elements.
- 25 11. The fastening mechanism according to claim 9, wherein said pin portion comprises a split edge portion comprising multiple pins, each respective pin of said split portion is made of a material of an elasticity level that allows it to bend inwardly towards a respective main central axis of said fastening mechanism during insertion of said pin portion into said socket and retract to an open position from said central axis once already inserted in said socket.
- 30 12. The fastening mechanism according to claim 10, wherein said pin portion further comprises an inner channel perforated along its central axis for allowing using a reinforcement member configured for being inserted through said channel for opening said split edge portion.

13. The fastening mechanism according to claim 11, wherein said reinforcement member is left inside said channel after insertion thereof for maintaining said split edge portion in the open position.
- 5 14. The fastening mechanism according to claim 10, wherein said socket perforated between said elements is configured in a shape of a longitudinal channel having a bottom part that widens for allowing said split edge portion to open therein.
- 10 15. The fastening mechanism according to claim 13, wherein each said pin of said split edge portion includes a protruding part configured for being inserted into said bottom part of said channel of said socket for preventing said pin portion from being removed therefrom.
16. The fastening mechanism according to claim 9, wherein said elements form a casing when fastened by at least one said fastening mechanism, for casing at least one vital component of a vehicle.
- 15 17. A tamper-proof fastening mechanism for fastening at least two elements to one another, said fastening mechanism comprising:
- a) a pin portion; and
 - b) a head portion connected to said pin portion, said head portion is configured for allowing said fastening mechanism to connect said at least two elements to one another by using a designated fastening tool and for being sheared off from said pin portion once said pin portion is inserted to a socket perforated through said at least 20 two elements for connecting thereof,
- wherein at least part of said pin portion is telescopic comprising multiple parts overlapping one another for enabling to slide one into the other for compression of said pin portion.
- 25 18. A safety mechanism comprising:
- a) at least two elements having a plurality of sockets perforated thereover, each of said sockets is perforated through said at least two elements for receiving a fastener portion therein for connecting said elements to one another;
 - 30 b) a plurality of fasteners each having a threaded portion and a head portion that allows using a rotating tool for fastening said fastener by rotating thereof to a predefined direction and removing thereof by rotating it to an opposite rotating

direction, said plurality of fasteners comprise at least one fastener of a first type and at least one fastener of a second type,

wherein said first type fastener is configured to fasten said elements by rotating it to a first rotation direction and removing thereof by rotating it to a second rotating
5 direction opposite to the first rotation direction, and

wherein said second type fastener is configured to fasten said elements by rotating it to the second rotation direction and removing thereof by rotating it to the first rotating direction opposite thereto,

wherein each of the plurality of fasteners regardless of its particular type is

10 designed to appear the same from at least one side thereof that is configured for being exposed to a viewer once the respective fastener is secured to said elements for preventing a respective viewer from visually distinguishing the type and therefore the rotation direction of each respective fastener.

19. The safety system according to claim 18, wherein each said fastener is a shear bolt

15 having a pin portion and a head portion connected to said pin portion, said head portion is configured for allowing said fastening mechanism to connect said at least two elements to one another by using a designated fastening tool and for being sheared off from said pin portion once said pin portion is inserted to a respective socket perforated through said at least two elements for connecting thereof.

20 20. The safety mechanism according to claim 18, wherein said plurality of elements form a casing for at least one vital component of a vehicle when fastened to one another using said plurality of fasteners, encasing said at least one vital component therein.

21. A safety mechanism comprising:

- 25 a) At least two elements having at least one socket perforated therethrough; and
b) at least one shear bolt for fastening said elements to one another, said shear bolt comprising:

(i) a pin portion comprising a bottom threaded portion; and

(ii) a head portion connected to said pin portion, said head portion is configured

30 for allowing said fastening mechanism to connect said at least two elements to one another by using a designated fastening tool and for being sheared off from said pin portion once said pin portion is inserted to a socket perforated through said at least two elements for connecting thereof,

wherein said socket comprises a longitudinal section and a widening bottom section ,
wherein once rotating said pin portion further into said socket, the threaded portion of
said pin portion reaches said widening edge section, which is not threaded and
therefore said pin portion is unable to be unscrewed therefrom.

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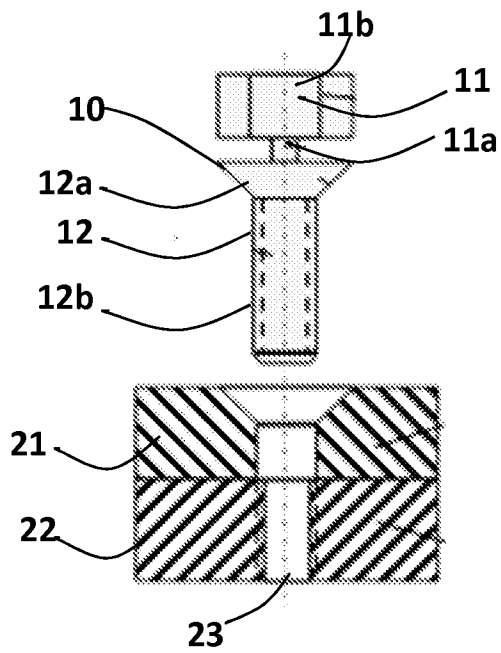


Fig. 1A
(Prior Art)

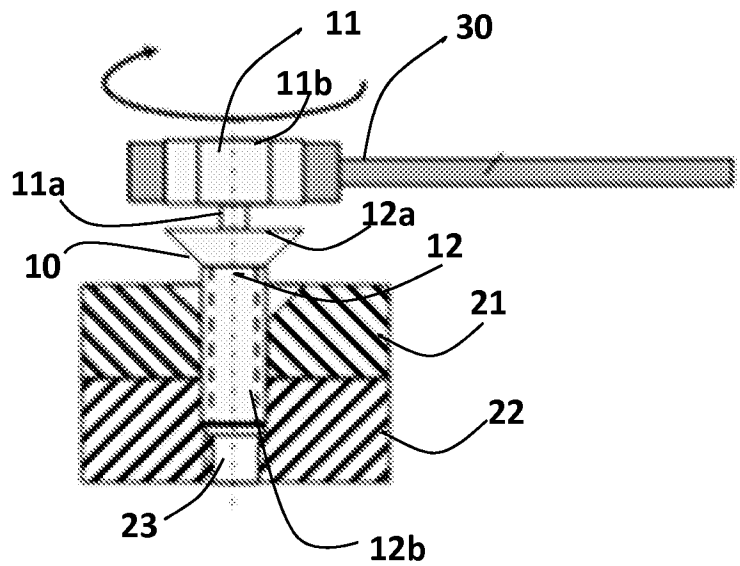


Fig. 1B
(Prior Art)

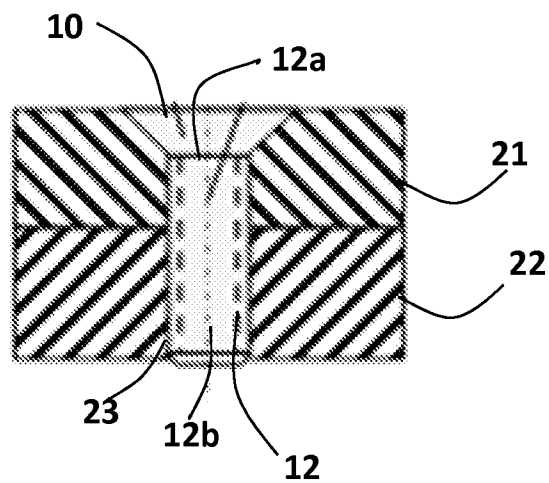


Fig. 1C
(Prior Art)

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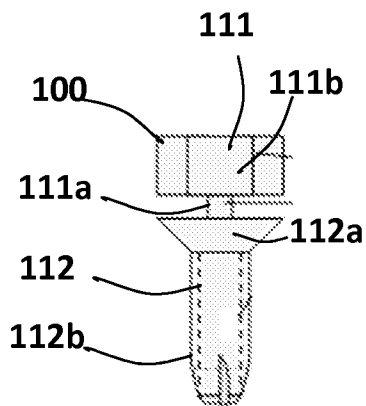


Fig. 2A

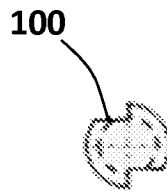


Fig. 2B

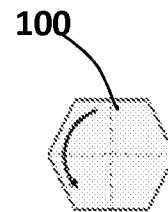


Fig. 2C

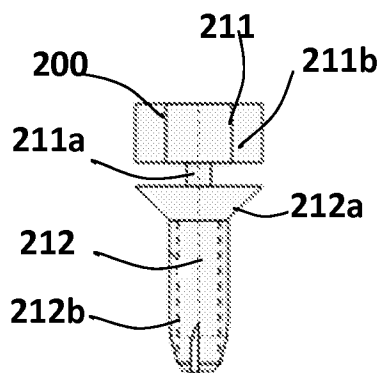


Fig. 3A



Fig. 3B

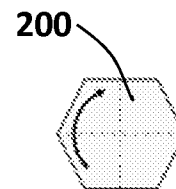


Fig. 3C

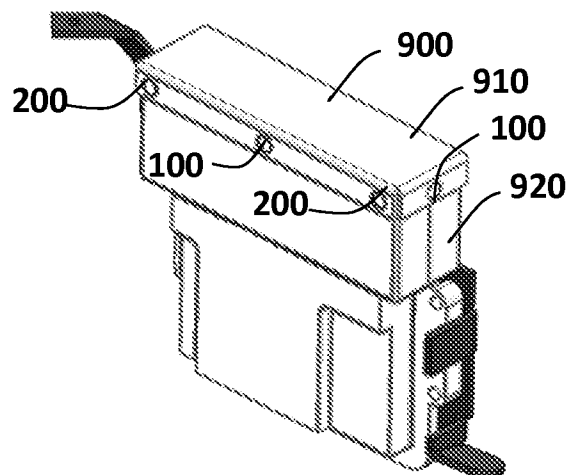


Fig. 3D

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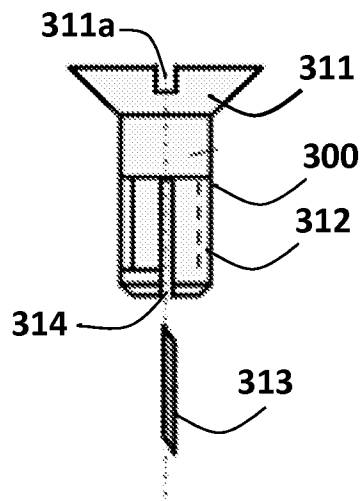


Fig. 4A

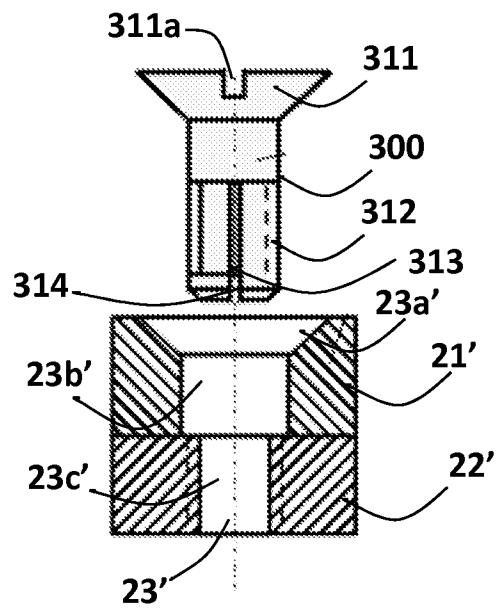


Fig. 4B

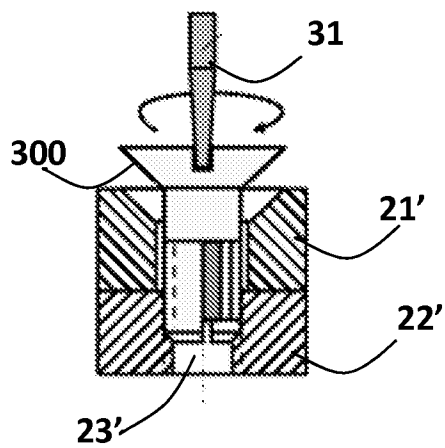


Fig. 4C

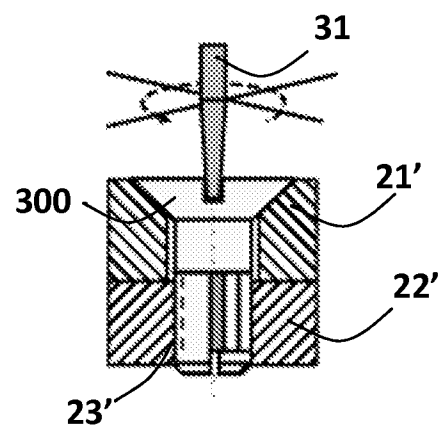


Fig. 4D

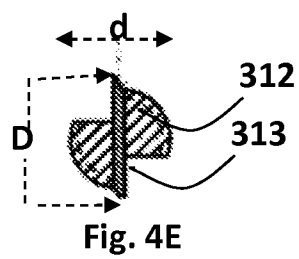


Fig. 4E

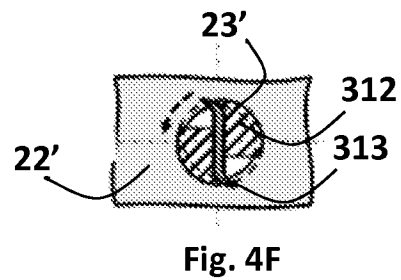


Fig. 4F

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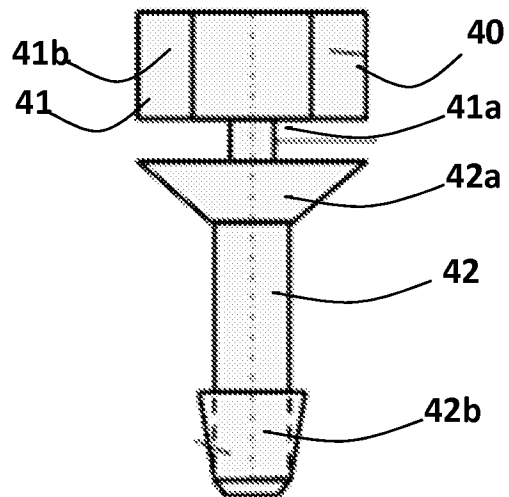


Fig. 5

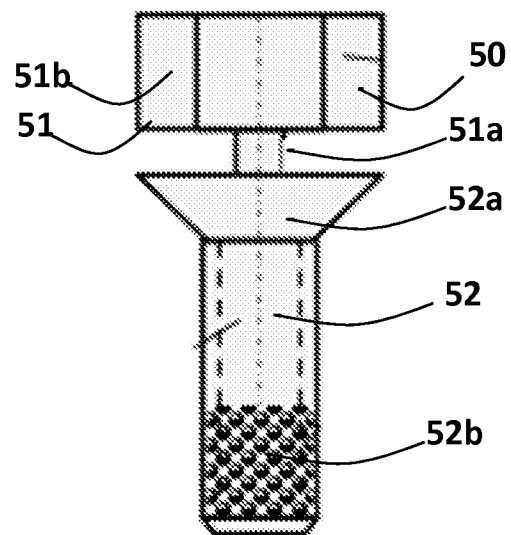


Fig. 6

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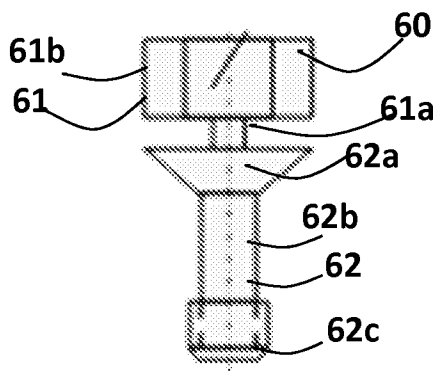


Fig. 7A

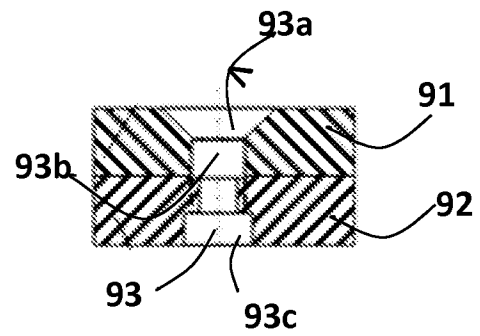


Fig. 7B

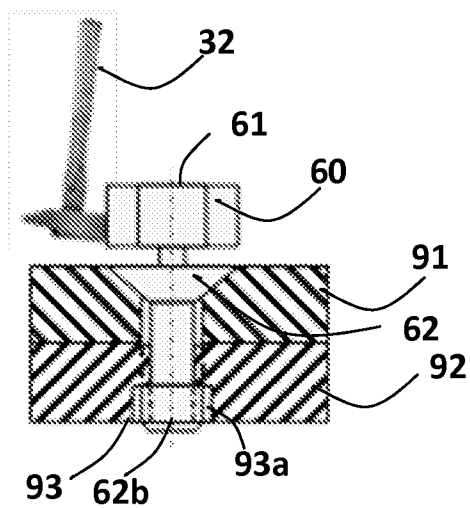


Fig. 7C

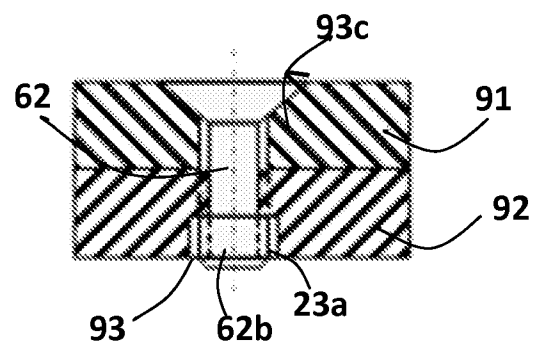


Fig. 7D

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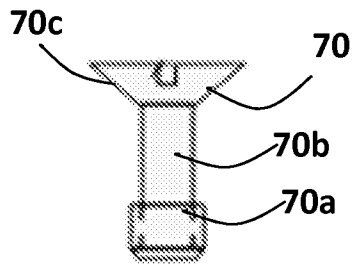


Fig. 8A

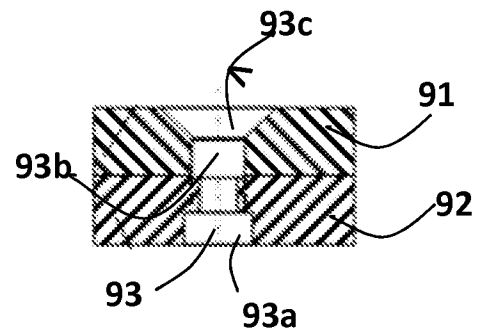


Fig. 8B

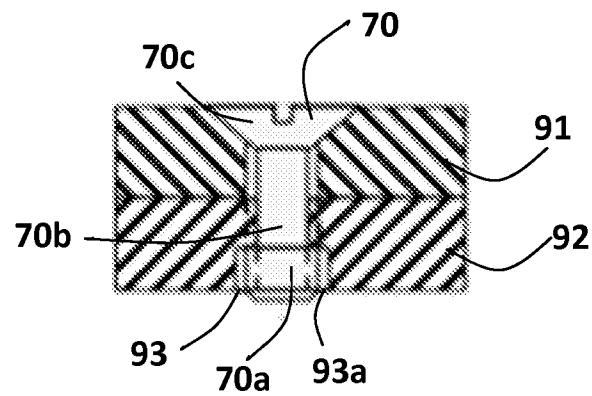


Fig. 8C

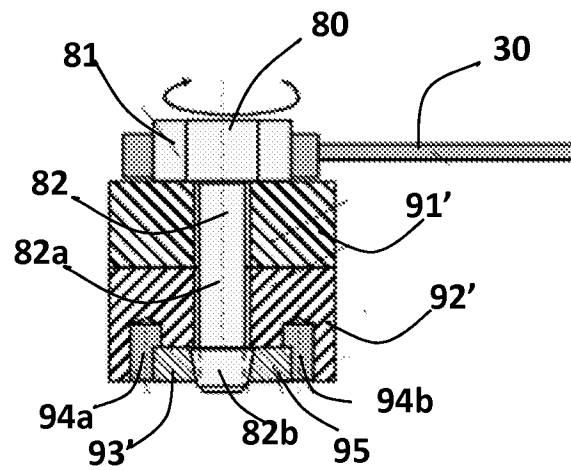


Fig. 9

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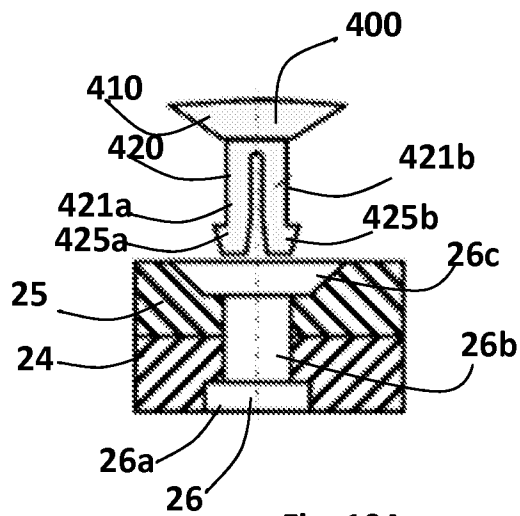


Fig. 10A

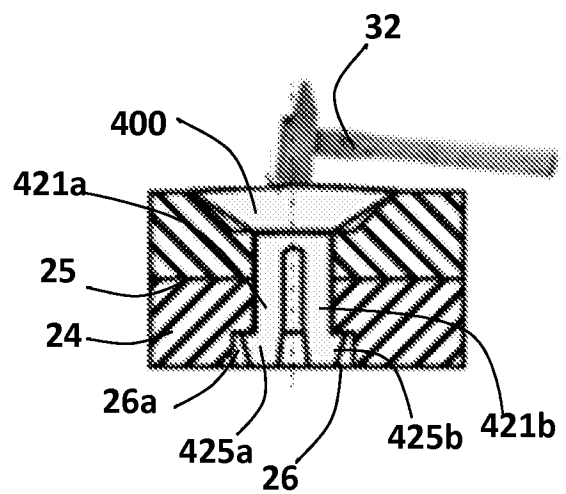


Fig. 10B

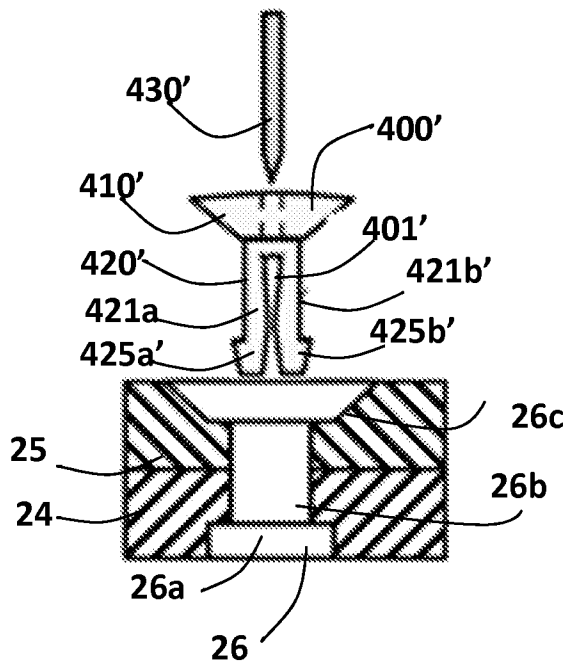


Fig. 11A

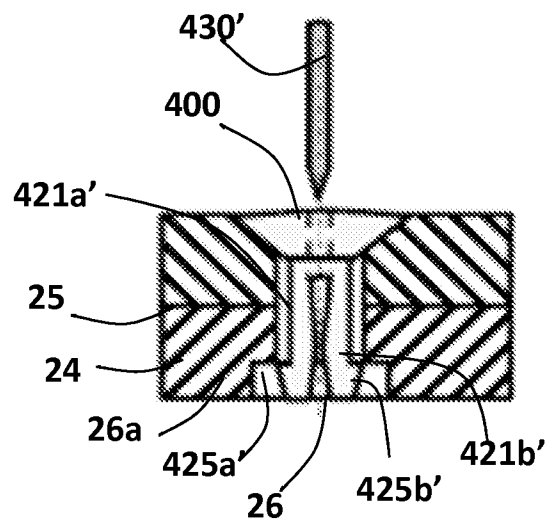


Fig. 11B

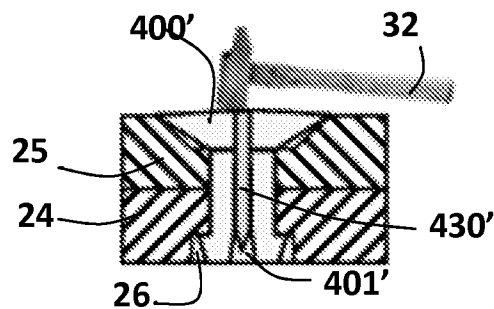


Fig. 11C

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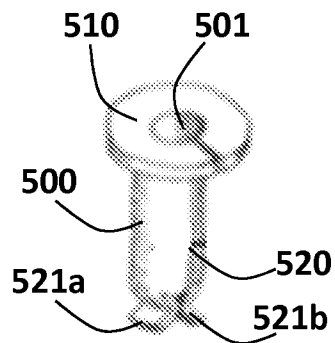


Fig. 12A

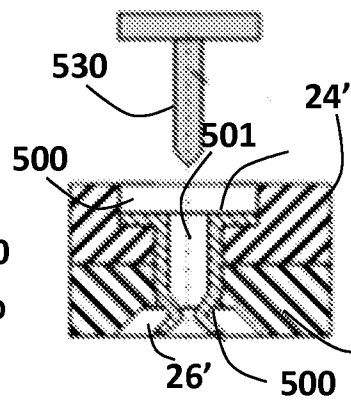


Fig. 12B

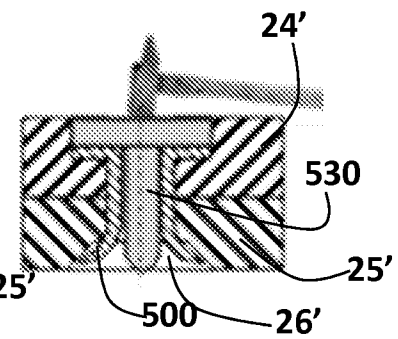


Fig. 12C

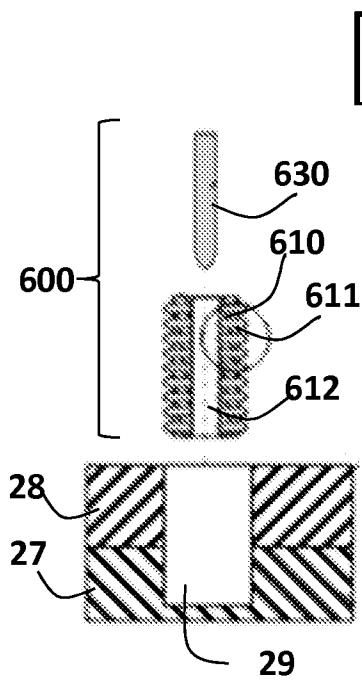


Fig. 13A

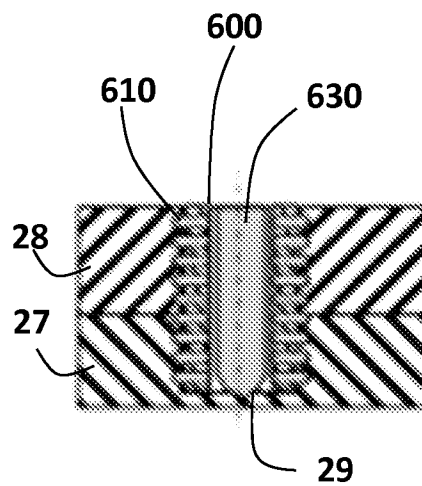


Fig. 13B

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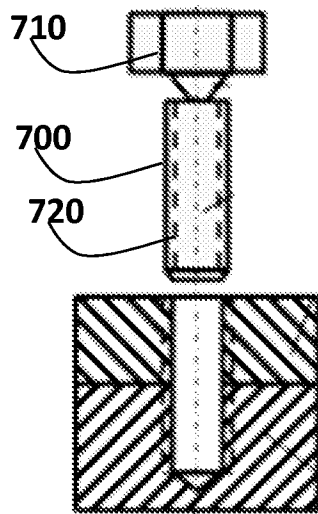


Fig. 14A

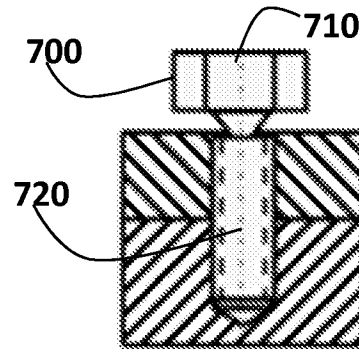


Fig. 14B

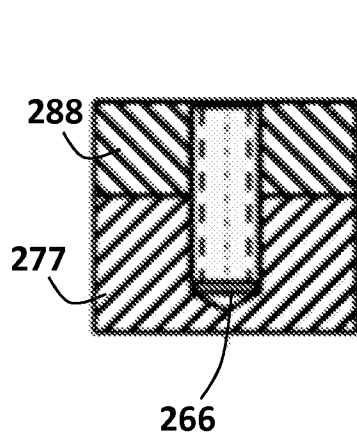


Fig. 14C

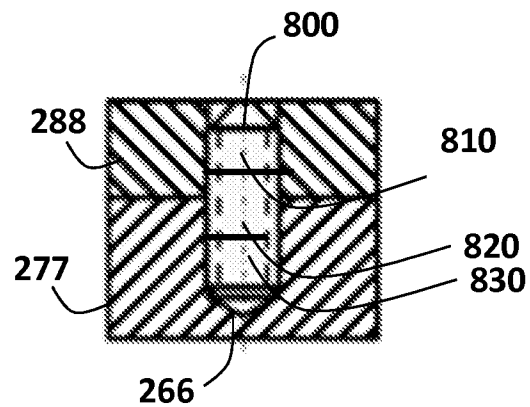


Fig. 15A

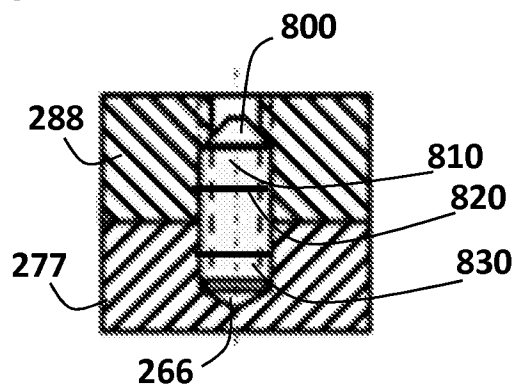


Fig. 15B

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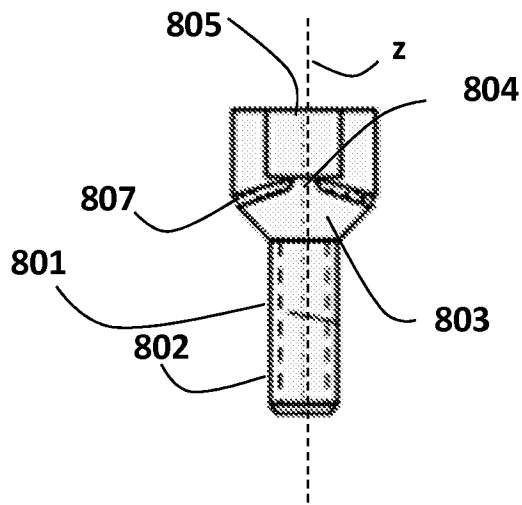


Fig. 16A

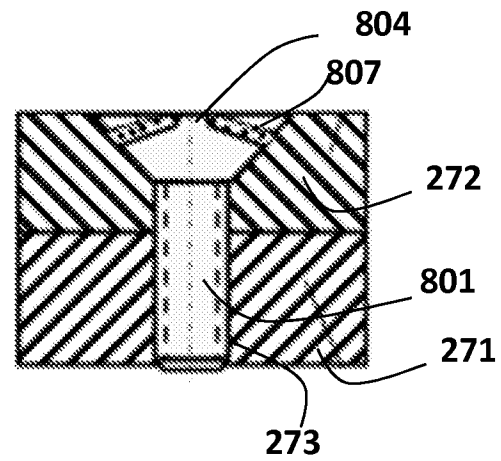


Fig. 16B

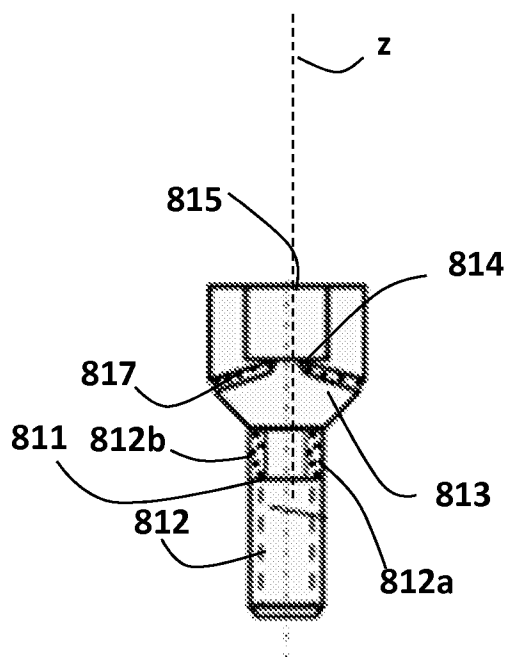


Fig. 17A

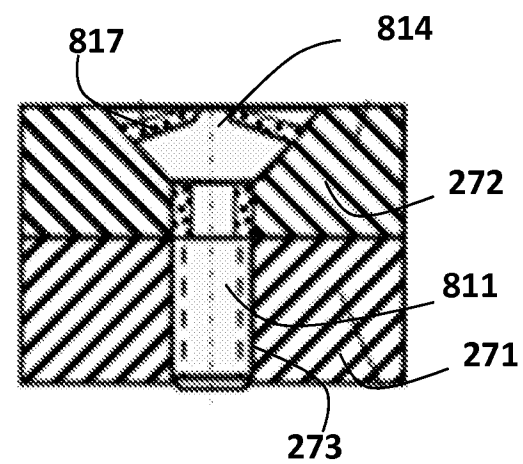


Fig. 17B

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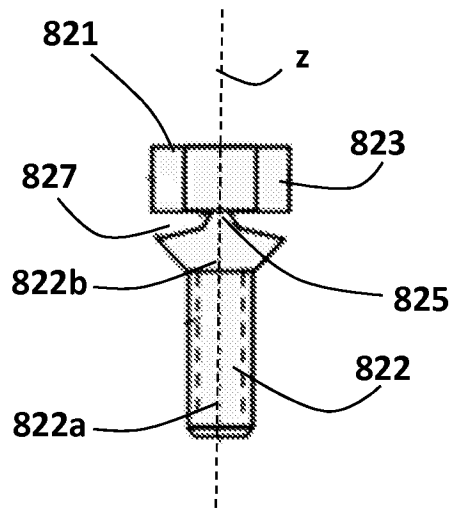


Fig. 18

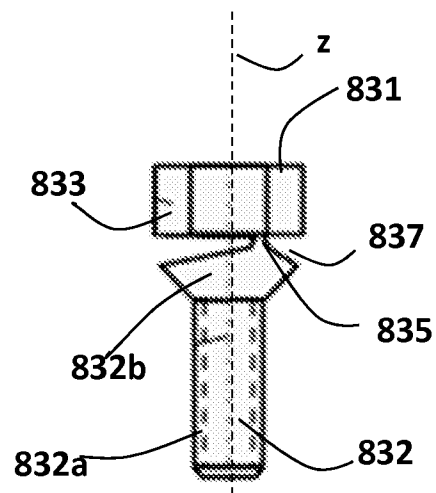


Fig. 19

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IL2012/050276

A. CLASSIFICATION OF SUBJECT MATTER

IPC (2012.01) F16B 31/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC (2012.01) F16B 13/04, F16B 31/02

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)

Databases consulted: USPTO, Esp@cenet, EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5120168 A WILLIAM PADULA 09 Jun 1992 (1992/06/09) abstract,fig.1-4,col.1,3,6	1-9,11-16,18-20
A		21
Y	US 4411570 A JURIC ILIJA 25 Oct 1983 (1983/10/25) whole	1-9,11-16,19,20
X	whole	10
X	US 2760399 A REA STANLEY 22 Jul 1952 (1952/07/22) whole	17
Y	US 7014403 A HIGGANBOTHAM DALE 21 Mar 2006 (2006/03/21) abstract,fig.9,10,col.5-6	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

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

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“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

30 Oct 2012

Date of mailing of the international search report

30 Oct 2012

Name and mailing address of the ISA:

Israel Patent Office

The Technology Park, Bldg.5, Malcha, Jerusalem, 96951, Israel

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/IL2012/050276

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US2004/0022596 JOSEF D. 05 Feb 2004 (2004/02/05) fig.1,par.0036	17

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IL2012/050276

Patent document cited search report	Publication date	Patent family member(s)	Publication Date
US 5120168 A	09 Jun 1992	NONE	
US 4411570 A	25 Oct 1983	NONE	
US 2760399 A	22 Jul 1952	NONE	
US 7014403 A	21 Mar 2006	NONE	

