



(51) International Patent Classification:

B60R 13/02 (2006.01) **B60R 21/213** (2011.01)
B60R 21/20 (2011.01) **F16B 19/10** (2006.01)

(21) International Application Number:

PCT/US2013/057173

(22) International Filing Date:

28 August 2013 (28.08.2013)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/695,599 31 August 2012 (31.08.2012) US

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(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,
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OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM,
ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished
upon receipt of that report (Rule 48.2(g))

(54) Title: CURTAIN AIRBAG FASTENER

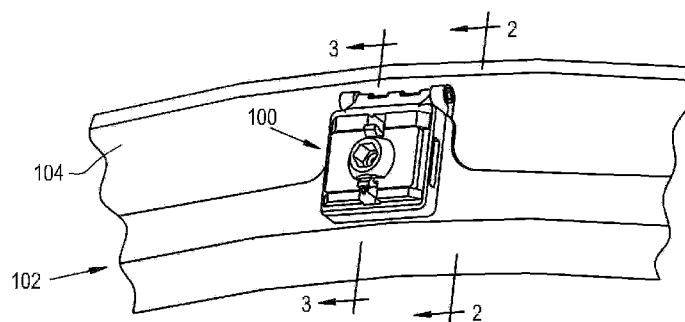


Fig. 1

(57) Abstract: A fastener suitable for securing side curtain airbags in a vehicle has a body with a deflectable collet and a locking pin received in the collet. The pin has a head, a shaft and a region between the head and the shaft that accommodates less torque applied to the head than is accommodated by the head. The region receives torque applied to the head only if the pin is inserted insufficiently in the collet. If the pin is inserted adequately, torque applied to the head is transferred to the body.

CURTAIN AIRBAG FASTENER

CROSS-REFERENCE TO RELATED APPLICATIONS

- [01] The present application claims the benefits of United States Provisional Application Serial No. 61695,599 filed August 31, 2012.

FIELD OF THE INVENTION

- [02] The present invention relates to fasteners, and, more particularly, to fasteners for assemblies requiring quick, easy attachment, strong retention and feedback or verification of proper installation. Most particularly, the invention pertains to fastener assemblies for side curtain airbag installations in motor vehicles.

BACKGROUND OF THE INVENTION

- [03] Side curtain airbags have been added as an additional measure of passenger safety in automobiles. A side curtain airbag assembly is retained behind interior trim of the headliner, just above the side window of the vehicle. During a crash event, the airbag is deployed between the vehicle occupant and the window or other side structures of the vehicle.
- [04] A fastener for holding a side curtain airbag in place must be strong enough to retain the airbag assembly in place even during aggressive, rapid deployment of the air bag during a vehicle crash event. It is necessary also to retain a side curtain airbag assembly in a fixed position without rattling during vehicle operation. Desirably, the fastener can be inserted quickly and easily in a simple operation, yet has strong retention force. Still further desirable is a fastener assembly that is conducive to pre-assembly steps so that final installation of the airbag assembly can be performed quickly and efficiently. Still further, desirably the fastener is small and thin to be accommodated behind vehicle interior trim panels.
- [05] An early known fastener assembly for side curtain airbags includes a bolt and a weld nut of standard design. To use the fastener, it is necessary to provide

an opening by punching or stamping a frame-like member of the vehicle roof structure, and to position and secure a nut, such as by welding, in the correct location. This requires an additional manufacturing step for welding the nut in place, in addition to the subsequent securing steps for installing the airbag assembly in position. The assembly steps required for installing the airbag assembly can be time consuming and complex, including positioning the airbag in the proper location, separately acquiring a bolt, inserting the bolt through the airbag assembly, and rotating the bolt into the nut that was welded in place in the roof structure during a previous step. An attachment assembly of this type is robust, but can be expensive in materials and installation costs. Further, it is necessary to fix a standard bolt in the tightened position so that vibrations during subsequent operation of the vehicle do not cause the bolt to work loose, backing out of the weld nut.

[06] In some installation and assembly processes, it is desirable to acquire and record data documenting that all fasteners have been properly positioned, properly tightened and properly verified. In a standard bolt and nut attachment, some degree of verification can be achieved through visual inspection and/or by acquiring torque readings for the tightened fasteners. However, an improperly inserted fastener can exhibit the expected high torque readings even when not properly tightened in place. Further, when using a standard bolt there has not been a satisfactory procedure for ensuring that the individual readings recorded for verification have each been acquired from different fasteners. Multiple readings can be acquired from a single fastener, either intentionally or inadvertently.

[07] Issues such as those noted above and others have been present in the assembly and installation structures and processes for installing fastener assemblies used to attach side curtain airbags in automobiles. Accordingly, improvements in fastener assembly structures, installation processes and installation verification procedures are desirable and advantageous.

[08] U.S. Patent 7,837,225 provides a fastener for side curtain airbag assemblies that can be preassembled onto the airbag assembly for subsequent

final installation of the air bag in a simple, rapid step. Various designs for the fastener provide testing and verification procedures to ensure that the fastener is adequately and properly installed. The curtain airbag fastener disclosed herein provides further improvements in the design, installation and use of a curtain airbag fastener.

SUMMARY OF THE INVENTION

- [09] The present invention provides a fastener having a deflectable collet and a locking pin received in the collet. The pin has a head, a shaft and a region between the head and the shaft, the region accommodating less torque applied to the head than accommodated by the head. The region receives torque applied to the head only if the pin is inserted insufficiently in the collet.
- [10] In one aspect of one form thereof, the present invention provides improvements in the structure and design of first and second body components foldable one against another for capturing a portion of an airbag assembly therebetween. More specifically, a hinge between the first and second body components includes a locking structure allowing the components to be folded one against the other easily, while thereafter inhibiting relative movement of the body components away from one another. The improved locking structure enhances design freedom in the size and shape of the fastener away from the hinge members in comparison to the locking feature disclosed in, for example, the aforementioned United States Patent 7,837,225.
- [11] In a further aspect of a form thereof, the present invention provides a fastener assembly with a body having first and second body components foldable one against another for capturing therebetween an article to be held by the fastener assembly. A flexible collet includes a plurality of collet segments affixed to one of the body components and extendable through the other of the body components when the body components are folded together. The collet has a hip of greatest girth and progressively narrow portions extend on either side of the hip. A pin in the collet inhibits inward flexion of the collet segments. The pin is designed together with the body components such that torque testing equipment can be used to verify proper installation of the pin. More specifically,

the pin will accommodate a higher torque when properly installed and only a lower torque if improperly installed. Further, upon testing and verification the pin is altered such that the same fastener cannot be tested/verified a second time.

[12] An advantage of the invention in at least one form thereof is providing a fastener for side curtain airbags that can be pre-assembled with all components on the airbag assembly and subsequently installed in a vehicle in an easy assembly process, and with the fastener readily accommodated behind vehicle interior trim panels.

[13] Another advantage of the invention in at least one form thereof is providing a fastener assembly for side curtain airbags that is robust and secure when properly installed, yet will fail during installation testing and verification to indicate an improperly installed fastener.

[14] Still another advantage of the invention in at least one form thereof is providing a fastener assembly that provides both visual and physical verification of proper installation, and that can provide both visual and physical identification of fasteners for which the installation process has been verified, and that prevent second or subsequent testing of the same fastener.

[15] A further advantage of the invention in at least one form thereof is providing a fastener requiring low insertion force yet high extraction force in an assembly.

[16] Other features and advantages of the invention will become apparent to those skilled in the art upon review of the following detailed description, claims and drawings in which like numerals are used to designate like features.

BRIEF DESCRIPTION OF THE DRAWINGS

[17] Fig. 1 is a fragmentary view of an airbag fastener assembly as part of a side curtain airbag assembly in an automobile;

[18] Fig. 2 is a cross-sectional view of the side curtain airbag assembly shown in Fig. 1, taken along line 2-2 of Fig. 1;

[19] Fig. 3 is a cross-sectional view of the side curtain airbag assembly shown in Fig. 1, taken along line 3-3 of Fig. 1;

[20] Fig. 4 is a perspective view of a curtain airbag fastener;

- [21] Fig. 5 is another perspective view of a curtain airbag fastener, generally showing the side opposite the side shown in Fig. 4;
- [22] Fig. 6 is a cross-sectional view of a pin in the curtain airbag fastener;
- [23] Fig. 7 is a perspective view of the pin;
- [24] Fig. 8 is another perspective view of the pin, showing the pin from a different angle;
- [25] Fig. 9 is a perspective view of a body in the curtain airbag fastener;
- [26] Fig. 10 is another perspective view of the body in the curtain airbag fastener, generally showing the side opposite the side shown in Fig. 9;
- [27] Fig. 11 is a further perspective view of the body in the curtain airbag fastener, with the body depicted in a condition of use;
- [28] Fig. 12 is a cross-sectional view of the fastener during an early stage of installation;
- [29] Fig. 13 is a cross-sectional view of the fastener during a stage of installation following that shown in Fig. 12;
- [30] Fig. 14 is a cross-sectional view of the fastener during a stage of installation following that shown in Fig. 13;
- [31] Fig. 15 is a cross-sectional view of the body;
- [32] Fig. 16 is a another cross-sectional view of the body
- [33] Fig. 17 is still another cross-sectional view of the body;
- [34] Fig. 18 is a perspective view of the curtain airbag fastener depicted in a preassembled condition prior to final installation and use;
- [35] Fig. 19 is a perspective view of the preassembled curtain airbag fastener at the start of installation for use;
- [36] Fig. 20 is a perspective view of the curtain airbag fastener during a stage of installation following that shown in Fig. 19;
- [37] Fig. 21 is a perspective view of the curtain airbag fastener during a stage of installation following that shown in Fig. 20;
- [38] Fig. 22 is a perspective view of the curtain airbag fastener during a stage of installation following that shown in Fig. 21;

- [39] Fig. 23 is a perspective view of the curtain airbag fastener during a stage of installation following that shown in Fig. 22;
- [40] Fig. 24 is a perspective view of the curtain airbag fastener during a stage of installation following that shown in Fig. 23;
- [41] Fig. 25 is a perspective view of the curtain airbag fastener during a stage of installation following that shown in Fig. 24;
- [42] Fig. 26 is a perspective view of the completed installation of a curtain airbag fastener;
- [43] Fig. 27 is a perspective view of the installed curtain airbag fastener from a different angle; and
- [44] Fig. 28 is another perspective view of the installed curtain airbag fastener.
- [45] Before the embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or being carried out in various ways. Also, it is understood that the phraseology and terminology used herein are for the purpose of description and should not be regarded as limiting. The use herein of “including”, “comprising” and variations thereof is meant to encompass the items listed thereafter and equivalents thereof, as well as additional items and equivalents thereof.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

- [46] Referring now more specifically to the drawings, a fastener assembly 100 is shown securing an airbag assembly 102, such as a curtain airbag assembly, within a roof component 104 of a motor vehicle. Fastener assembly 100 to be described in greater detail hereinafter has particular advantages when used for fastening airbag assembly 102; however, it should be understood that a fastener assembly having features as described herein can be used for other purposes as well.
- [47] Airbag assembly 102 includes a fastening tab 110 and an airbag 112, which is depicted herein as a generally elongated cylindrical body. Airbag

assembly 102 may include an openable frame or holder, an inflatable bag, a trigger mechanism and the like. Airbag 112 can be of different constructions, and fastener assembly 100 can be used with different constructions. Accordingly, airbag 112 will not be described in further detail in that those skilled in the art will readily understand other structures and details included in the airbag assembly. Those skilled in the art also will understand readily that fastening tab 110 and the airbag to which it is attached may be of various designs and constructions. Those depicted in the drawings submitted here with our merely exemplary.

[48] Roof component 104 includes an outer shell 114 and an inner structure 116 defining a hole 118 to which airbag assembly 102 is connected via fastener assembly 100. The configurations of roof component 104, including outer shell 114, inner structure 116 and hole 118 are merely exemplary of suitable configurations, and still other constructions and arrangements can be used together with a fastener of the present invention.

[49] Fastener assembly 100 includes a body 120 and a pin 122 received in body 120. Body 120 includes a first anchoring body component 124 and a second clamping body component 126 connected one to another by a hinge 128. Body 120 is configured for capturing and retaining fastening tab 110 of airbag assembly 102, and for being secured to an inner structure of a roof component in a vehicle. First anchoring body component 124 and second clamping body component 126 are pivotal about hinge 128 toward one another to secure fastening tab 110 there between. Accordingly, first anchoring body component 124 has an inner face 130 and an outer face 132, and second clamping body component 126 has an inner face 134 and an outer face 136, each relative to a folded or closed position of body 120.

[50] First anchoring body component 124 is configured to be secured in a structure so as to fix or anchor the fastener in place while also cooperating with clamping body component 126 to hold an element, such as airbag assembly 102. In the exemplary embodiment, first anchoring body component 124 includes a panel 140. A flexible collet 144 extends away from inner face 130 and may be

comprised of multiple collet segments 150, 152, 154, 156 that are flexibly movable under force and separated from one another by longitudinal slits, openings or spaces. In the exemplary embodiment shown, four collet segments 150, 152, 154, 156 are shown; however, it should be understood that more or fewer slits can be used to define more or fewer flexibly movable collet segments. Collet segments 150, 152, 154, 156 are joined to inner face 130 at the proximal ends thereof. At the distal ends thereof, the collet segments are discrete one from another to provide flexibility. Outer surfaces of distal end regions of the collet segments are shaped to collectively define a hip 158 of greatest girth for collet 144, the outer surfaces of the collet segments tapering inwardly in each axial direction from hip 158. An opening 160 extends through collet 144 and panel 140 and is configured to receive pin 122 therein, as will be described in greater detail hereinafter. Elongated pedestals 162, 164 project from outer face 132 near to, and on opposite sides of opening 160. Pedestals 162, 164 have confronting, spaced face surfaces 166, 168 that interact with pin 122 in a manner to be described subsequently herein.

[51] Second clamping body component 126 can be held to first anchoring body component 124 with fastening tab 110 between the body components. In the exemplary embodiment, second clamping body component 126 includes a second panel 180 and a hole 184 defined through second panel 180.

[52] Hinge 128 includes a lid lock feature, as seen more clearly in Figs. 15-17. A lid lock tooth 190 on first anchoring body component 124 presents a lead in ramp 192 in the direction of closing second clamping body component 126 against first anchoring body component 124 and an abrupt confronting face 194 in the direction of rotating second clamping body component 126 away from first anchoring body component 124. First anchoring body component 124 is similarly provided with an angled lead in face 196 in the direction of closing and an abrupt face 198 in the direction of opening. Accordingly, a mid-rotation interference (Fig. 16) is presented by lid lock tooth 190 against the transition point 200 between lead in face 196 and abrupt face 198.

- [53] When body components 124 and 126 are rotated toward one another, lead in ramp 192 and lead in face 196 confront, allowing relatively more easy passage past the interference of lid lock tooth 192 against the transition 200. From a closed position, relative rotation moving body components 124 and 126 away from one another presents abrupt confronting face 194 against abrupt face 198, and it is relatively more difficult to move lid lock tooth 192 past transition 200. Providing a lid lock feature as described operable within the confines of hinge 128 provides advantages over structures having latching features along the edges of the body components opposite the edges defining the hinge. With locking features provided within the confines of the hinge structure, the shapes, sizes and configurations of body components 124 and 126 away from hinge 128 are not restricted by the need for cooperating locking features. The body components can be made of desirable shapes and sizes for installation where needed and can perhaps be made smaller.
- [54] Pin 122 includes an elongated shaft 210 and a head 212 at one end of shaft 210. Shaft 210 is configured to be received through opening 160 and collet 144. Shaft 210 may include one or more ridge 214 for sliding engagement along spaces between adjacent collet segments 150, 152, 154, 156. Accordingly, pin 122 is rotationally positioned correctly relative to body 120 so that shaft 210 is received through opening 160. One or more protuberance and/or depression can be provided along the shaft 210 and/or interior surfaces of the collet segments so as to establish a sufficient interference fit of pin 210 within collet 144 after preassembly of the faster on an airbag, so that pin 122 is held securely in body 120. Shaft 210 can be a various shapes, and in the exemplary embodiment is generally rectangular.
- [55] Head 212 is generally rectangular and elongated, and includes sides 220, 222 and ends 224, 226. The width of head 212 between sides 220, 222 corresponds to the space between face surfaces 166, 168 of pedestals 162, 164. Accordingly, when pin 122 is fully inserted relative to body 120, sides 220, 222 of head 212 confront face surfaces 166, 168 of pedestals 162, 164, and may be in physical contact therewith or in close proximity thereto. Head 212 further

defines a hex head socket 228 having a minimal floor 230 and a center opening 232.

[56] A breakaway neck region 240 between shaft 210 and head 212 is formed with a relatively thin outer wall 242 and cavity 244 therein. Accordingly, the strength of neck region 230 in resisting applied torque is significantly less than the strength of head 212 or of shaft 210. A center support pin 246 extends from shaft 210 through cavity 244 to the level of floor 230 in center opening 232. Accordingly, axial force exerted against pin 122 by way of an implement or tool inserted in hex head 228 is transmitted through support pin 246 directly to shaft 210 without applying force along thin wall 242 of neck region 240.

[57] Body 120 and pin 122 can be formed from suitable plastics by known molding techniques. Body 120, including first anchoring body component 124, second clamping body component 126 and hinge 128 can be cast as a single structure. For initial shipment and a subsequent preassembly, pin 122 can be partially inserted into body 120 and held there in by the aforementioned protuberances and/or depressions causing an interference fit of the pin in the body.

[58] Fastening tab 110 of airbag assembly 102 is provided with necessary holes or apertures for securement between inner faces 130, 134 of body components 124, 126. Accordingly, flexible collet 144 can be passed through one such opening in fastening tab 110 (Figs. 19-20). Clamping body component 126 is folded toward and against fastening tab 110 by passing hole 184 over collet 144. Lid lock feature 190 operates as described previously herein to allow body components 124 and 126 to move toward one another while resisting movement away from one another after fastening tab 110 has been sandwiched securely between inner face 130 and inner face 134 (Fig. 21). In an advantageous embodiment, hip 158 has a girth larger than the minor diameter of hole 184 so that collet segments 150, 152, 154, 156 engage the edge of the slot and deflect inwardly as collet 144 passes through hole 184. After hip 158 has passed completely through hole 184, the collet segments rebound outwardly, and second clamping body component 126 is held against first anchoring body component

124 even without the added security of lid lock feature 190. Fastener 100 is thus preassembled onto airbag assembly 102 for transportation to and final assembly at a motor vehicle assembly plant.

[59] For final assembly and installation, flexible collet 144 is inserted through a hole of a structural member in the automobile interior. With the collet 144 properly position, a tool 300 is inserted into socket 228. Axial force applied by tool 300 drives pin 122 to its fully seated position. When the installer observes, determines or otherwise believes the pin to be fully inserted, torque is applied via tool 300.

[60] With pin 122 fully inserted in body 120, head 212 is positioned between pedestals 162, 164 and sides 224, 226 of head 222 are disposed against or in close proximity to face surfaces 166, 168 of pedestals 162, 164. Accordingly, pin 122 is not rotatable at non-excessive torque. If pin 122 is not fully inserted, so that head 212 is axially outwardly positioned from pedestals 162, 164, less resistance to rotation of pin 122 is present due to the relatively weaker area provided by neck region 240. If the pin is not properly inserted, torque applied against head 222 by tool or implement 300 inserted in hex head socket 228 is transmitted to the neck region 240, and will cause the neck region to break before the verification torque level is reached. Alternatively, when the pin is properly inserted, the applied torque is transmitted from head 212 directly to pedestals 162, 164 and is not applied against neck region 240. Suitable testing equipment will apply torque up to the required verification torque, indicating proper insertion of the pin. Thereafter, additional torque applied by the relatively stronger implement or tool 300 in hex head socket 228 will result in stripping or deforming the hex head configuration of the relatively softer plastic material. Accordingly, after a fastener has been tested and verified it cannot be inadvertently or intentionally tested a second time. By ensuring that pin 122 resists rotation under a determined torque it can be verified that pin 122 has been fully inserted, with head 212 positioned between pedestals 162, 164 as described above. Torque measurements can be taken by manually operated tools or by automatic data acquiring apparatus for measuring torque.

- [61] Pin head clamps, fasteners or clips 310, 312 can be provided adjacent hole 160 to engage and capture head 212 so that head 212 does not fall from the assembled fastener if broken away after attachment. Accordingly, clips 310, 312 are flexible arms having tabs overlying portions of head 212 when pin 122 is fully inserted in collet 144 and head is positioned between pedestals 162, 164.. The clips deflect outwardly to allow head 212 to pass there between, and then rebound inwardly to overlie and capture head 212. Further, axial travel stop ribs or protrusions 314, 316 can be provided at the proximal end of shaft 210 so that shaft 210 will not fall through the fastener if separated from head 212.
- [62] It should be understood that variations and modifications can be made while taking advantage of the features of the present invention. For example, while the clamping body component has been shown and described as being sandwiched between the anchoring body component and the structure to which the fastener assembly is attached, the general relationships of the body components can be reversed. For example, the anchoring body component can be attached to the structure directly, between the clamping body component and the structure. The clamping body component can then be locked or otherwise engaged with the anchoring body component to secure an element being held by the fastener, the element being held between the anchoring body component and the clamping body component. Still further variations can be used, such as a pin having a head larger than a hole in the clamping body component, with the pin extending through the clamping body component and secured in the anchoring body component
- [63] Variations and modifications of the foregoing are within the scope of the present invention. It is understood that the invention disclosed and defined herein extends to all alternative combinations of two or more of the individual features mentioned or evident from the text and/or drawings. All of these different combinations constitute various alternative aspects of the present invention. The embodiments described herein explain the best modes known for practicing the invention and will enable others skilled in the art to utilize the invention. The

claims are to be construed to include alternative embodiments to the extent permitted by the prior art.

[64] Various features of the invention are set forth in the following claims.

CLAIMS

WHAT IS CLAIMED IS:

1. An airbag fastener, comprising:
a body having first and second body components holdable one to another for capturing a portion of an airbag assembly therebetween;
a collet affixed to one of said body components and extending away therefrom; and
a pin received in the collet, the pin having a region thereof of relatively more limited torque resistance exposed to applied torque only when the pin is inadequately inserted into the collet.
2. The airbag fastener of claim 1, said pin having a head, a shaft, and a breakaway neck region between said head and said shaft
3. The airbag fastener of claim 2, said body having confronting spaced surfaces, and said head of said pin being disposed between said confronting surfaces when said pin is fully inserted in said collet.
4. The airbag fastener of claim 2, said breakaway neck region including an outer wall and a cavity.
5. The airbag fastener of claim 2, said body having confronting spaced surfaces, said head of said pin being disposed between said confronting surfaces when said pin is fully inserted in said collet; and said body having

fastener clips engaging said head when said head is disposed between said confronting surfaces.

6. The airbag fastener of claim 2, said head defining a hex socket.

7. The airbag fastener assembly of claim 6, said socket having a floor, and said breakaway neck region including an outer wall and a cavity between said floor and said shaft.

8. The airbag fastener assembly of claim 7, including a center support pin extending through said cavity between said floor and said shaft.

9. The airbag fastener assembly of claim 8, said body having confronting spaced surfaces, and said head of said pin being disposed between said confronting surfaces when said pin is fully inserted in said collet.

10. The airbag fastener assembly of claim 1, said pin having a head configuration shaped to engage a torque applying implement.

11. The airbag fastener assembly of claim 10, said head configuration accommodating a greater torque than said region of relatively more limited torque resistance.

12. A fastener assembly, comprising:

a body having a collet affixed thereto and extending away therefrom, said collet including deflectable collet segments defining an opening there between;

a pin received in the collet opening, the pin having a region thereof of relatively more limited torque resistance exposed to applied torque only when the pin is inadequately inserted into the collet opening; and

said pin and said body configured for torque applied against said pin being transferred to said body and not to said region of relatively more limited torque resistance when said pin is adequately inserted in the collet opening.

13. The fastener assembly of claim 12, said pin having a head, a shaft, and a breakaway neck region between said head and said shaft.

14. The fastener assembly of claim 13, said body having confronting spaced surfaces, and said head of said pin being disposed between said confronting surfaces when said pin is fully inserted in said collet.

15. The fastener assembly of claim 14, said body having fastener clips engaging said head when said head is disposed between said confronting surfaces.

16. The fastener assembly of claim 12, said pin having a head, a shaft, and a breakaway neck region between said head and said shaft, said head defining a socket, said socket having a floor, and said breakaway neck region including an outer wall and a cavity between said floor and said shaft.

17. The fastener assembly of claim 16, including a center support pin extending through said cavity from said floor to said shaft.

18. The fastener assembly of claim 12, said body having first and second components connected by a hinge, and said hinge defining a locking feature configured so that the first and second components are relatively more easily rotated toward each other than away from each other.

19. An airbag fastener assembly, comprising:
a body having first and second body components configured to hold an airbag component therebetween;

a hinge between the first and second body components enabling relative rotation there between; and

a locking feature defined by the hinge configured so that the first and second components are relatively more easily rotated toward each other than away from each other.

20. The airbag fastener assembly of claim 19, said body defining a deflectable collet; the assembly further including a locking pin received in the collet, and the pin having a head, a shaft and a region between the head and the shaft that accommodates less torque applied to the head than is accommodated by the head.

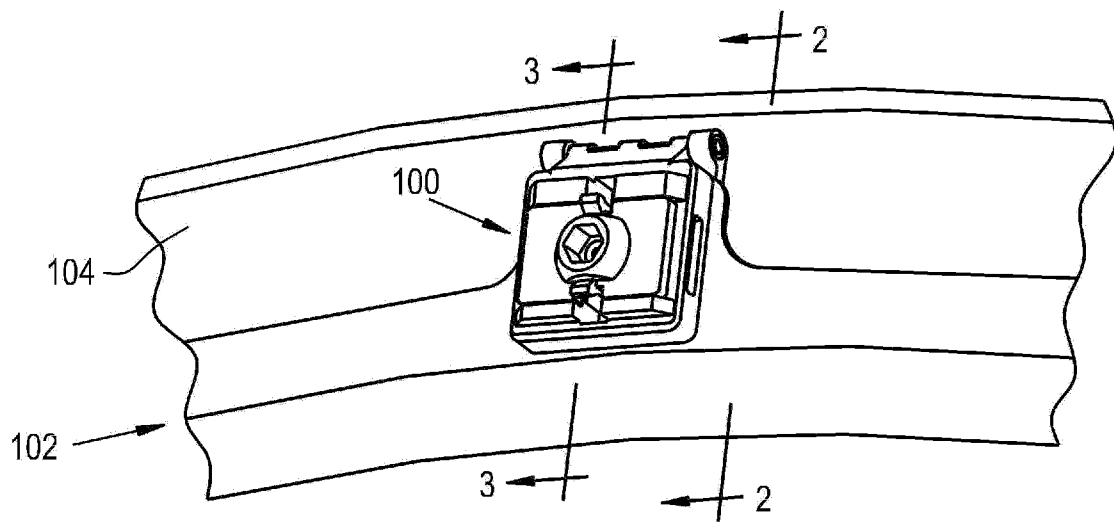


Fig. 1

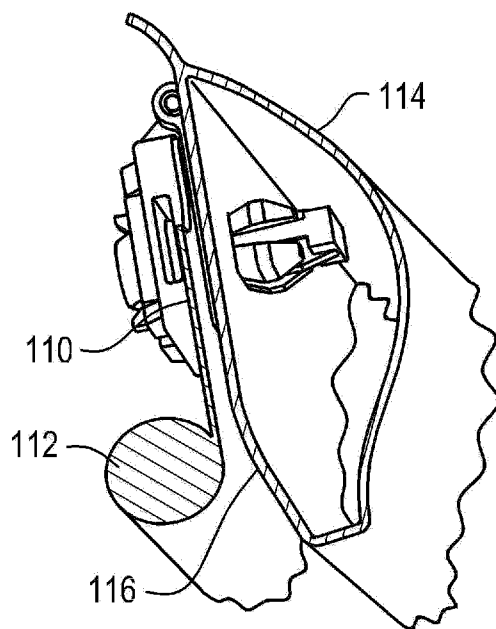


Fig. 2

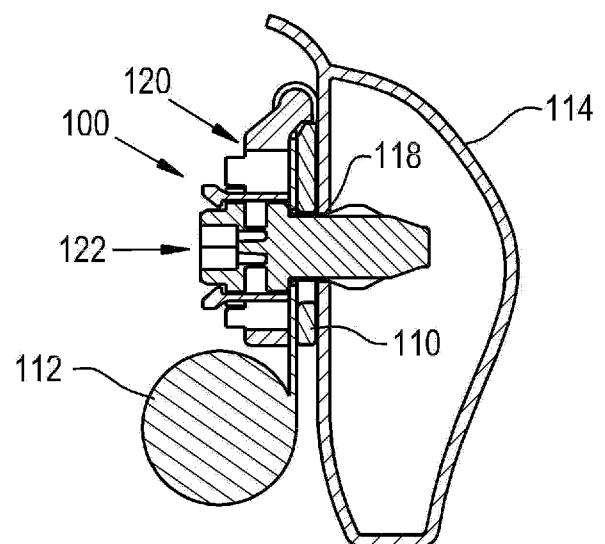


Fig. 3

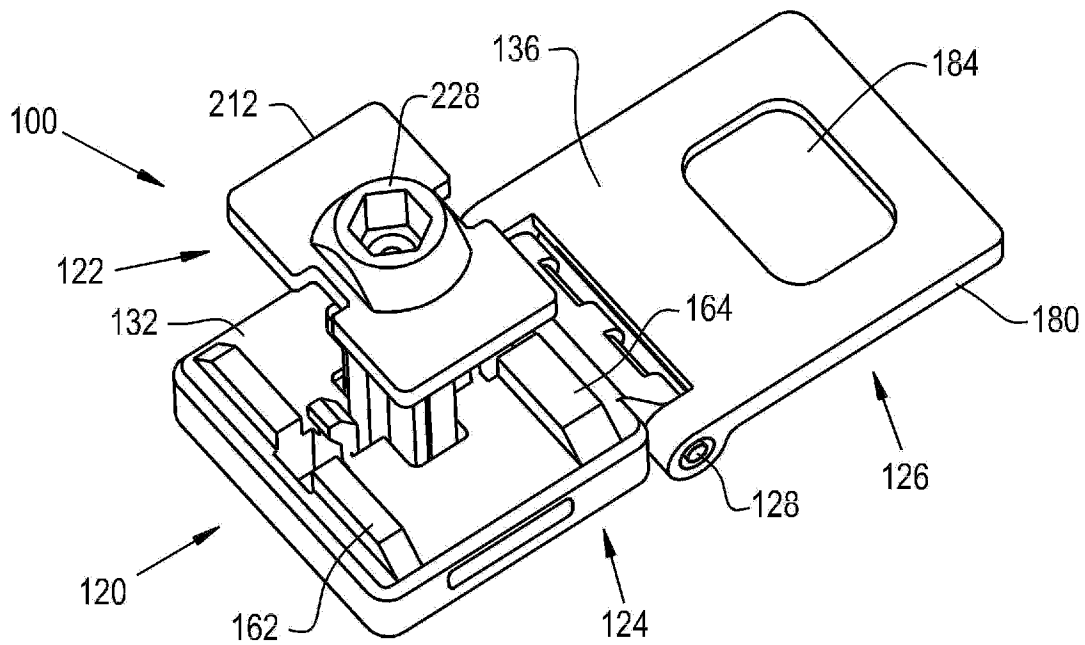


Fig. 4

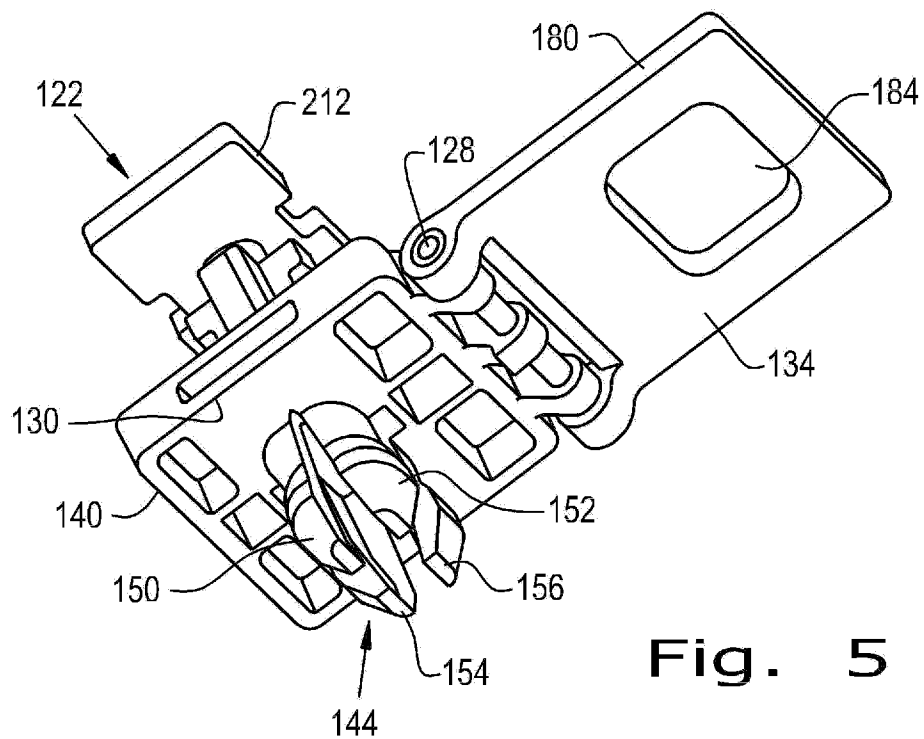


Fig. 5

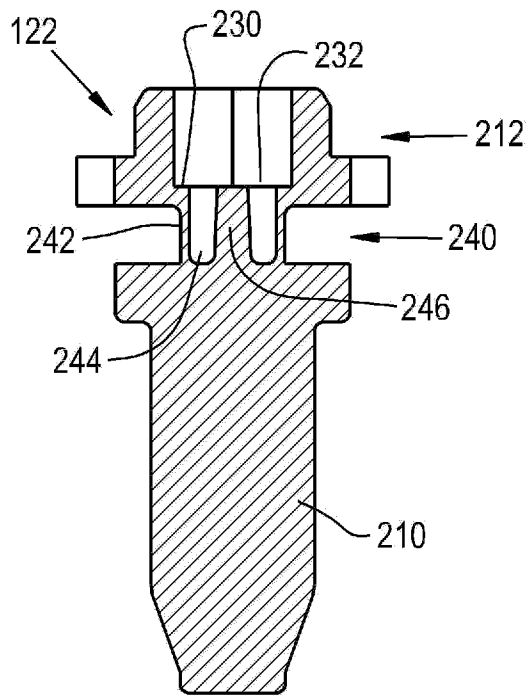


Fig. 6

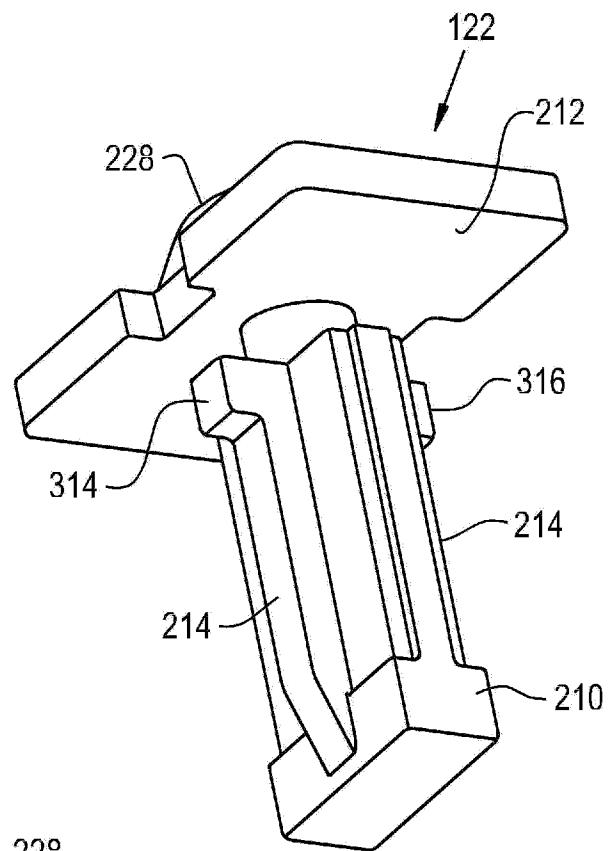


Fig. 7

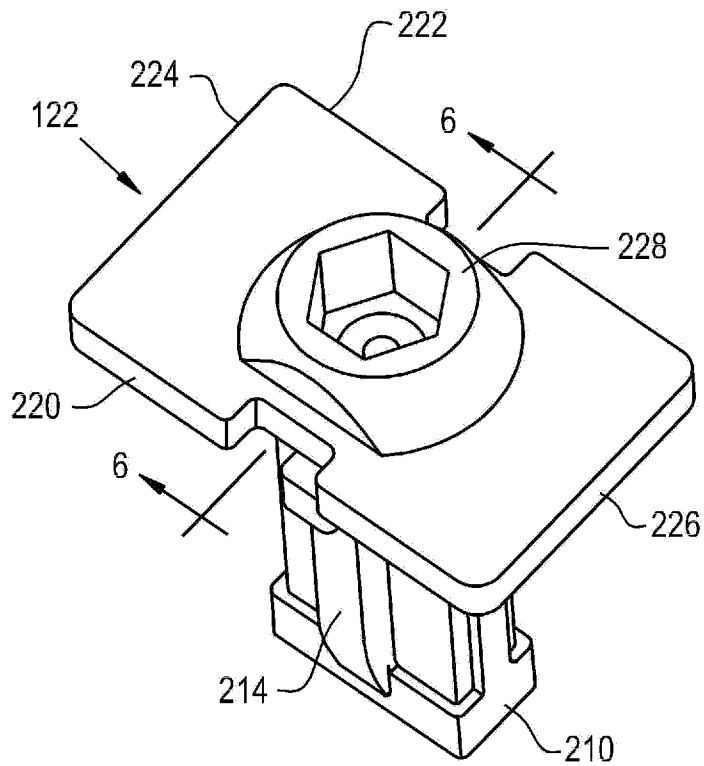
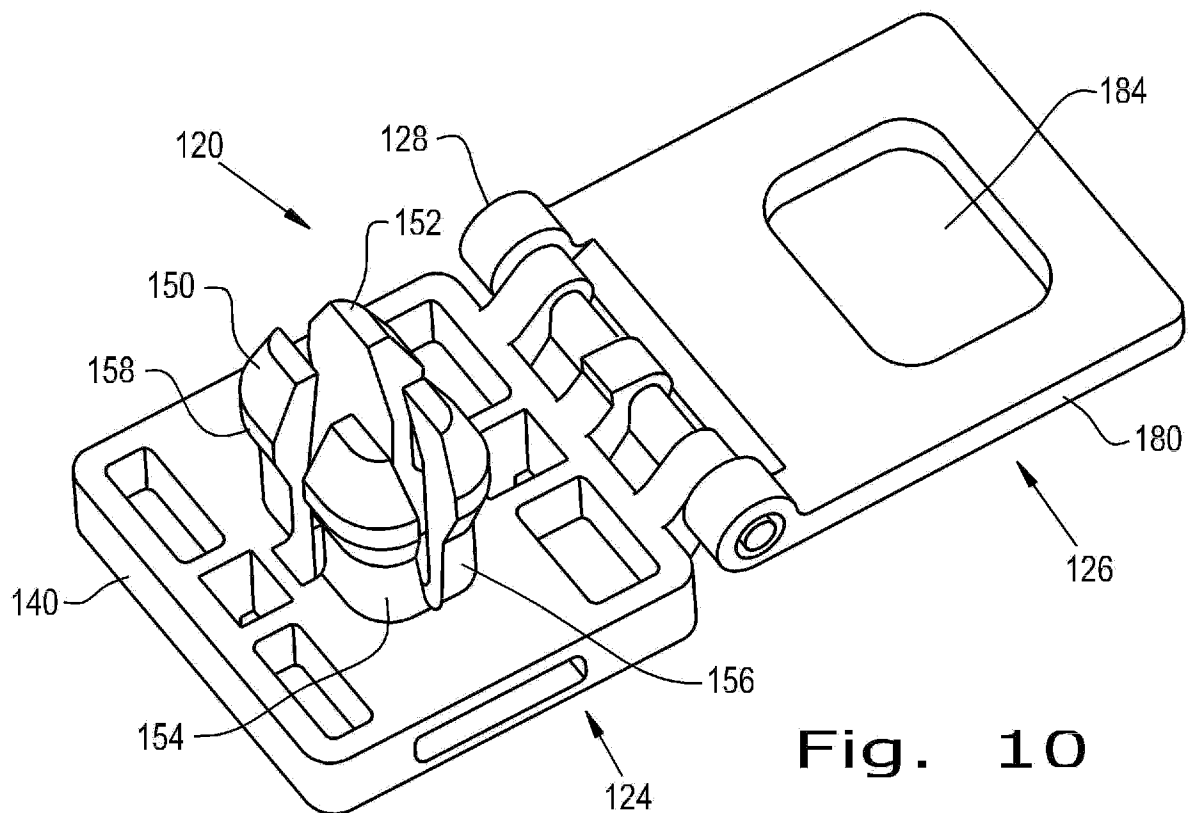
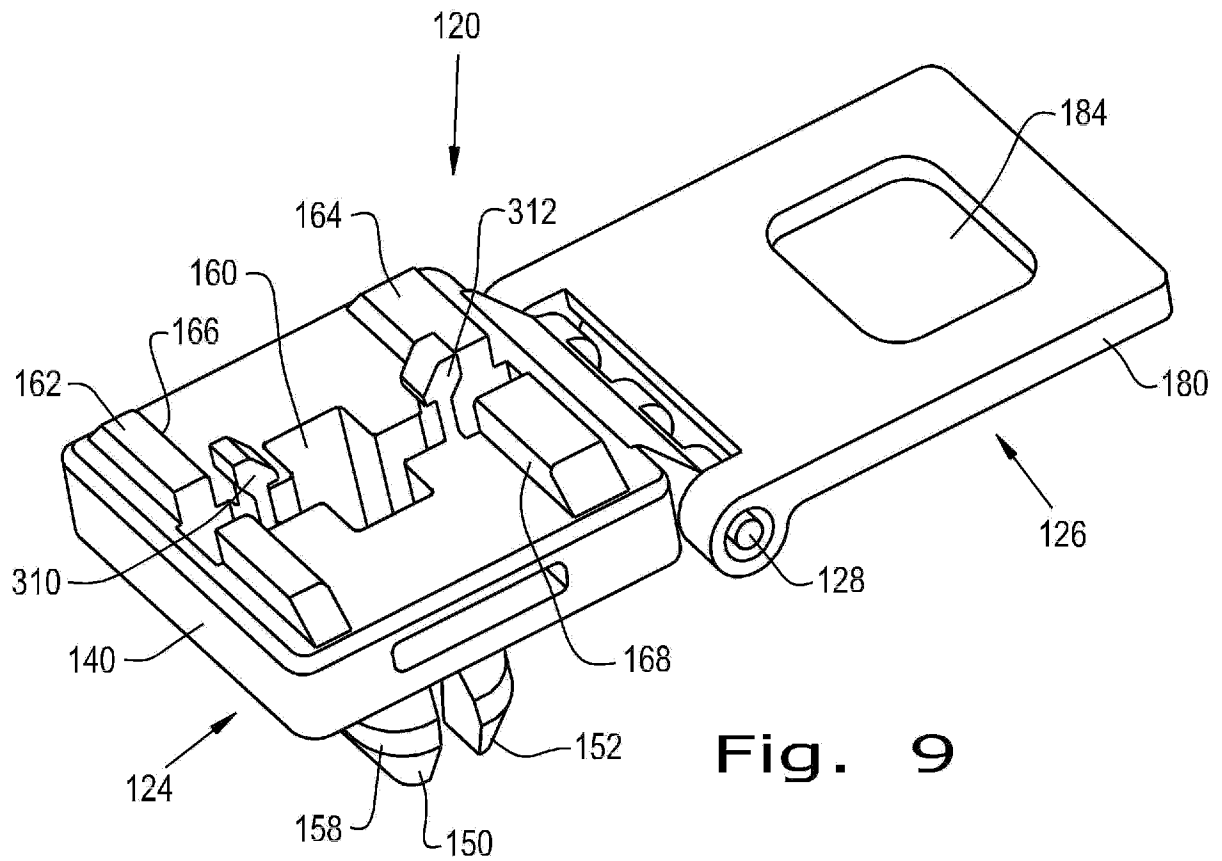


Fig. 8



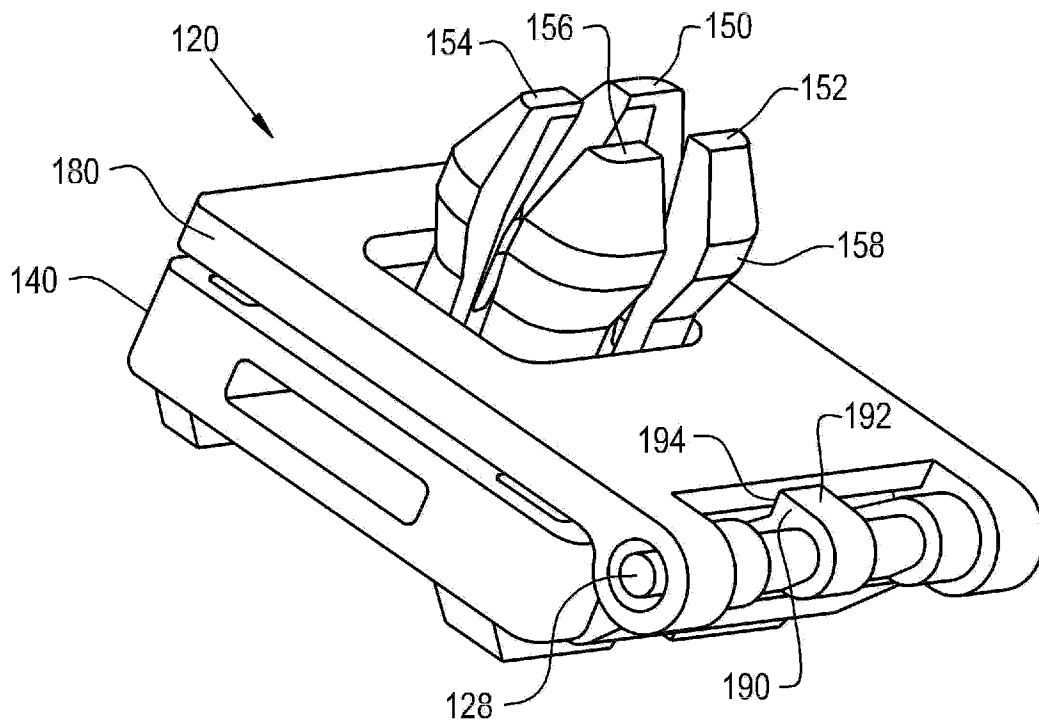


Fig. 11

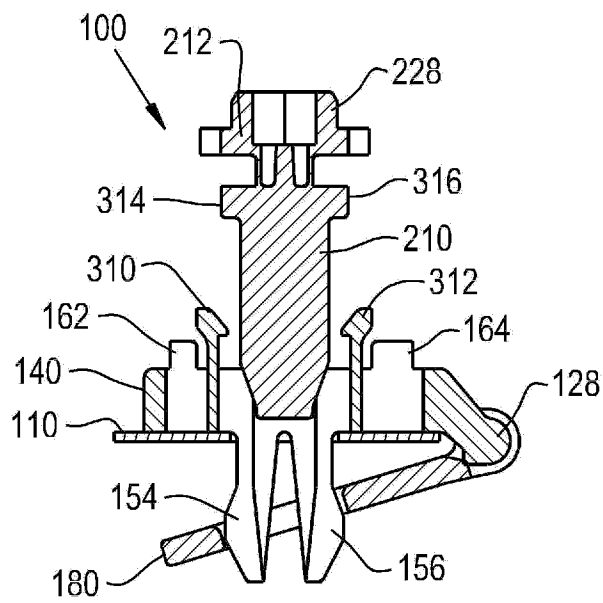


Fig. 12

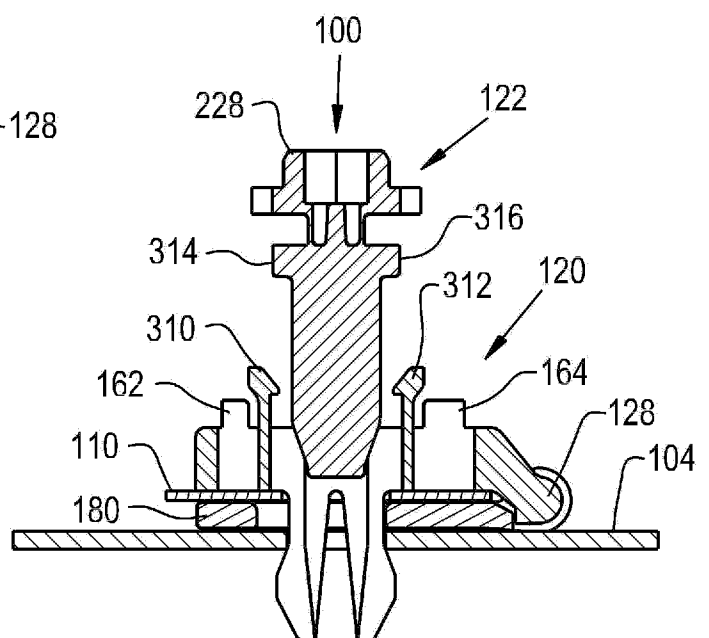


Fig. 13

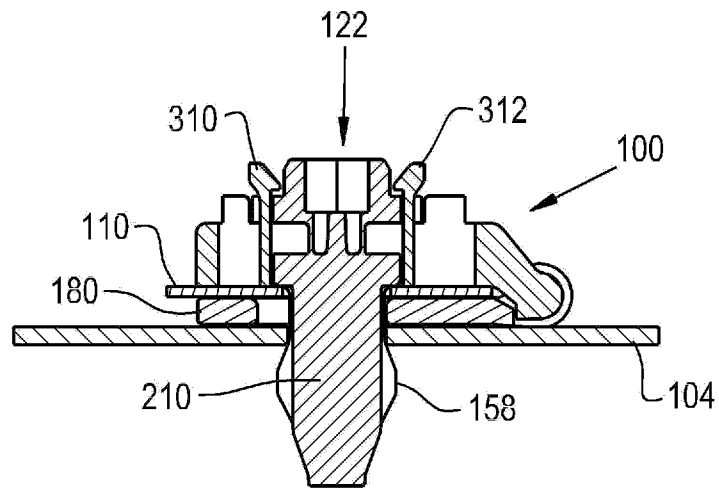


Fig. 14

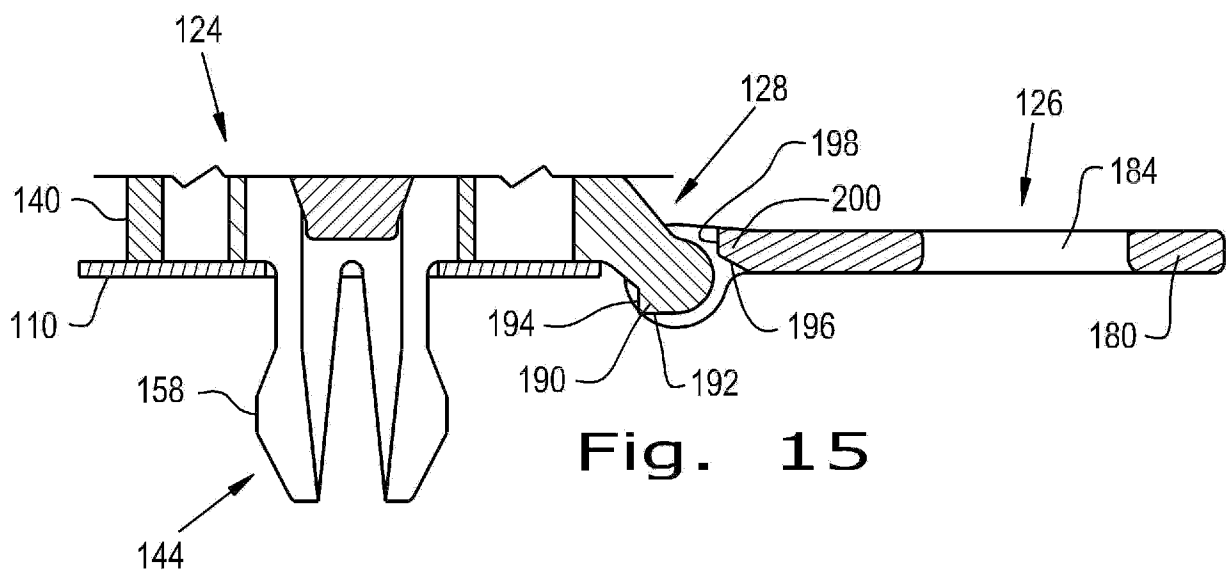


Fig. 15

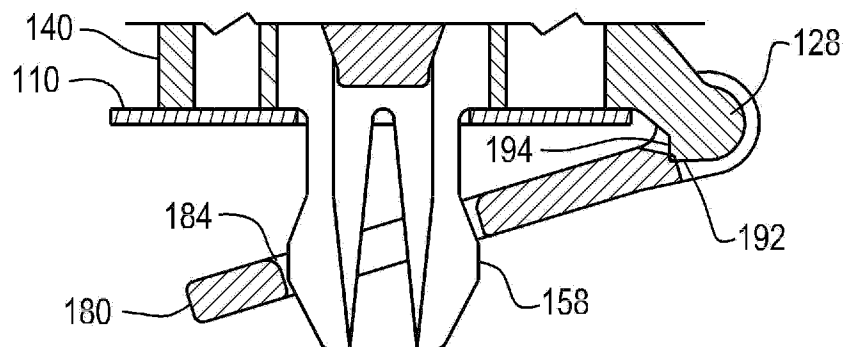


Fig. 16

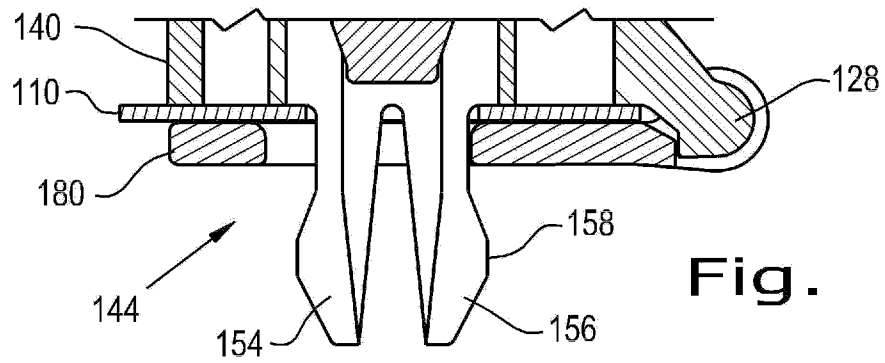


Fig. 17

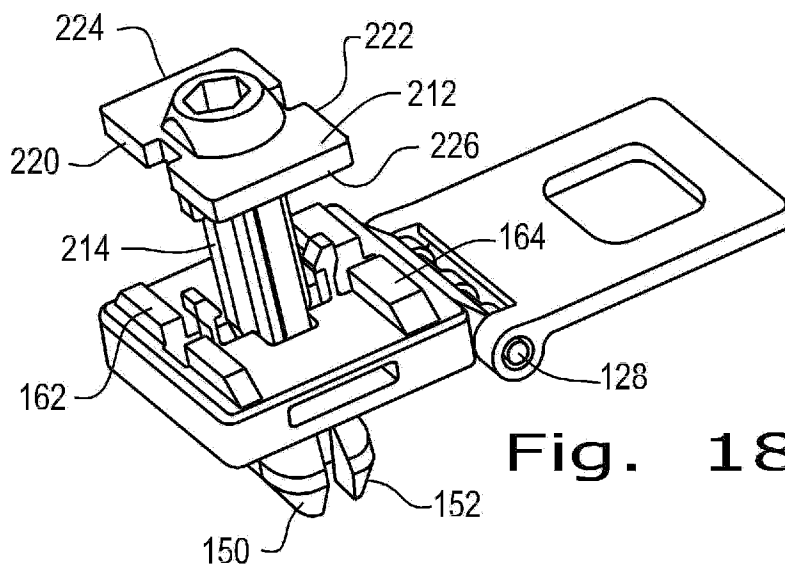


Fig. 18

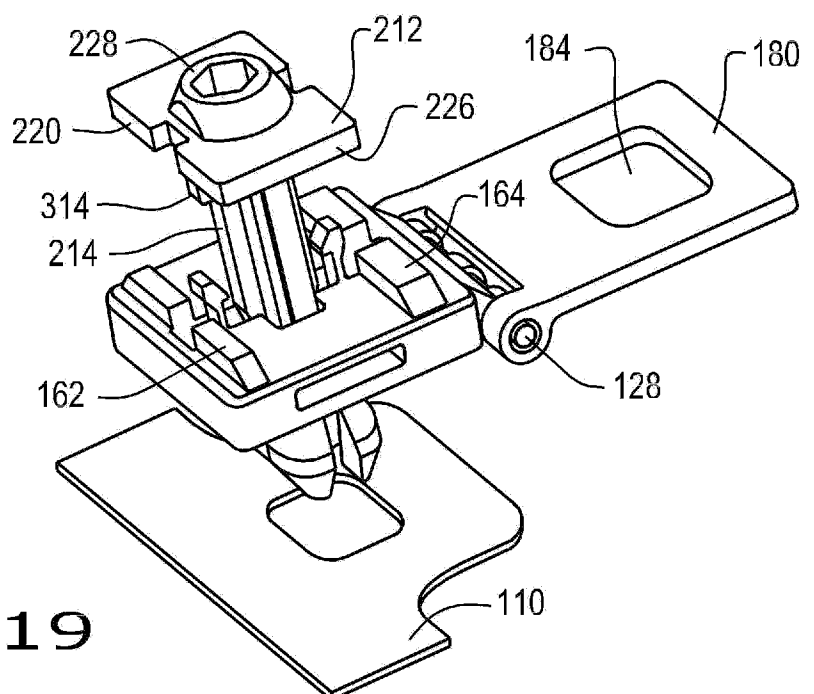


Fig. 19

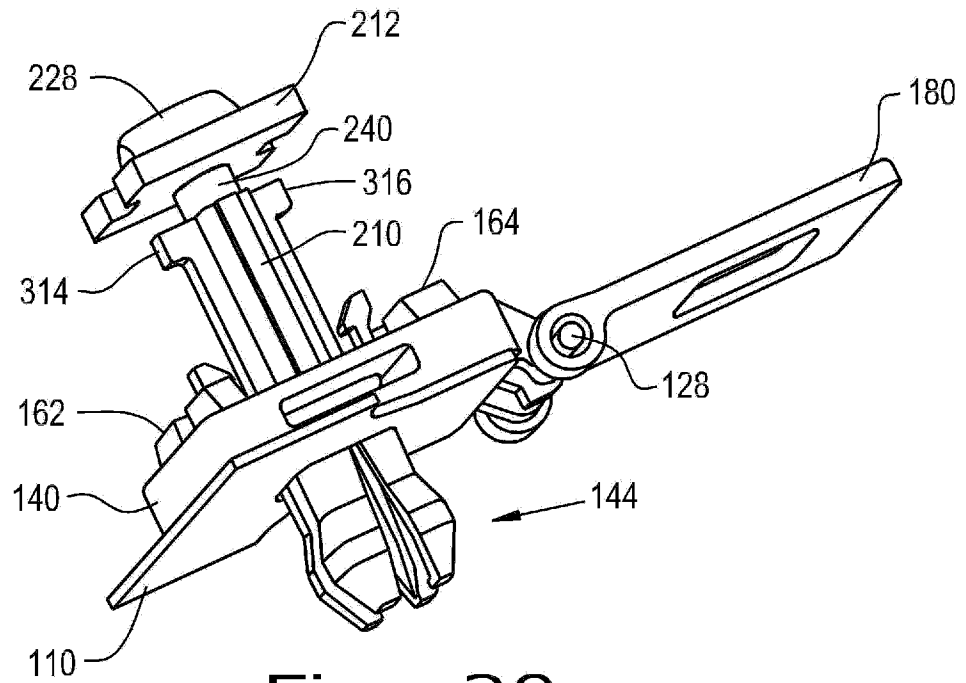


Fig. 20

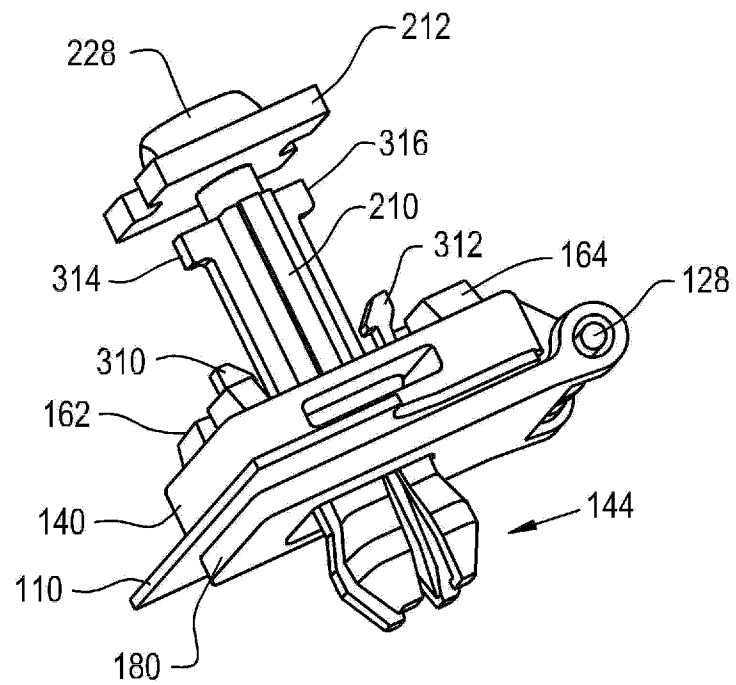
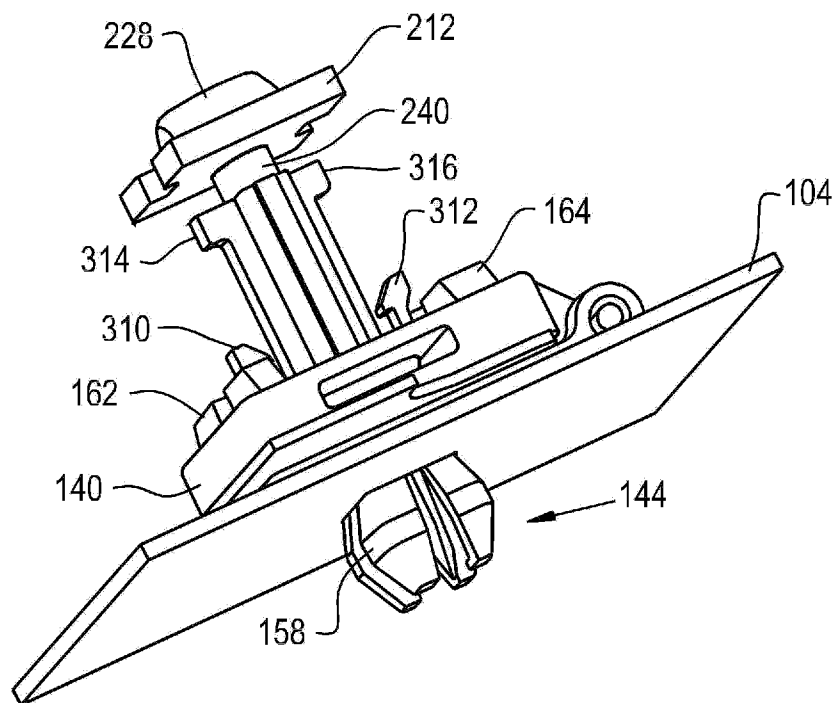
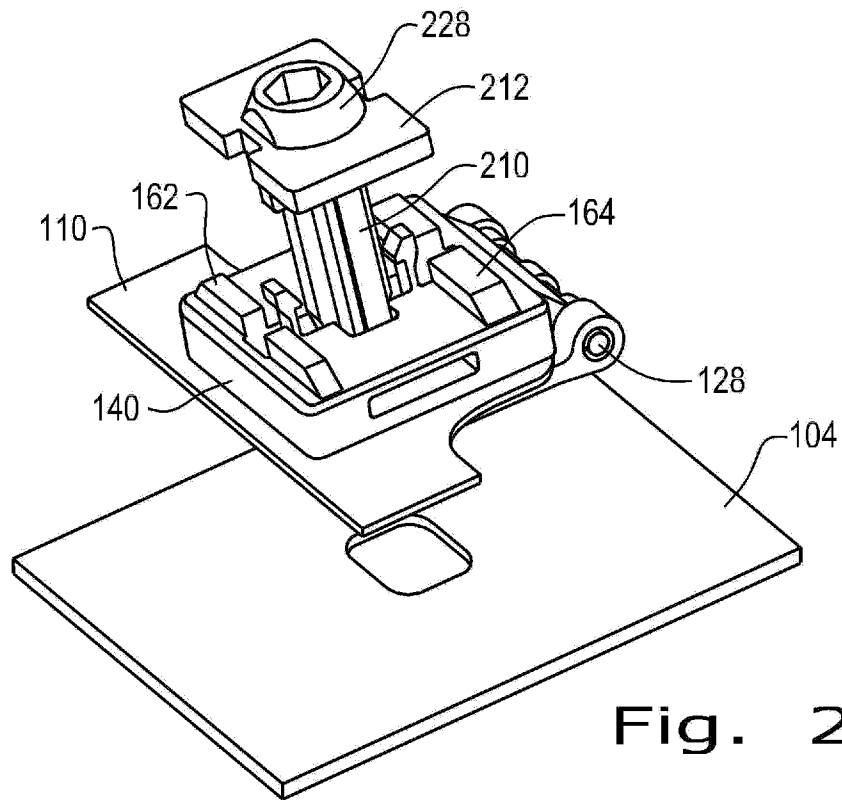


Fig. 21



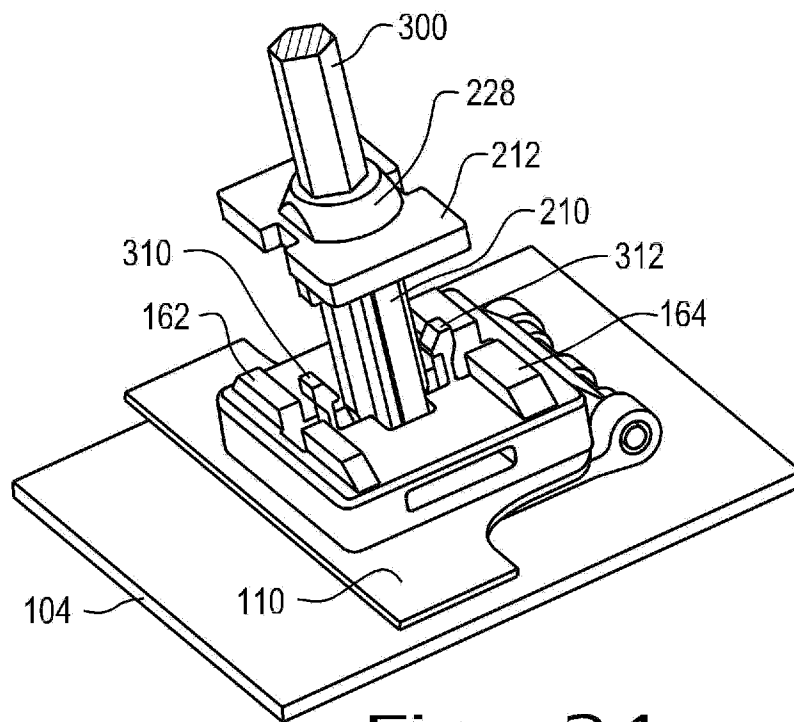


Fig. 24

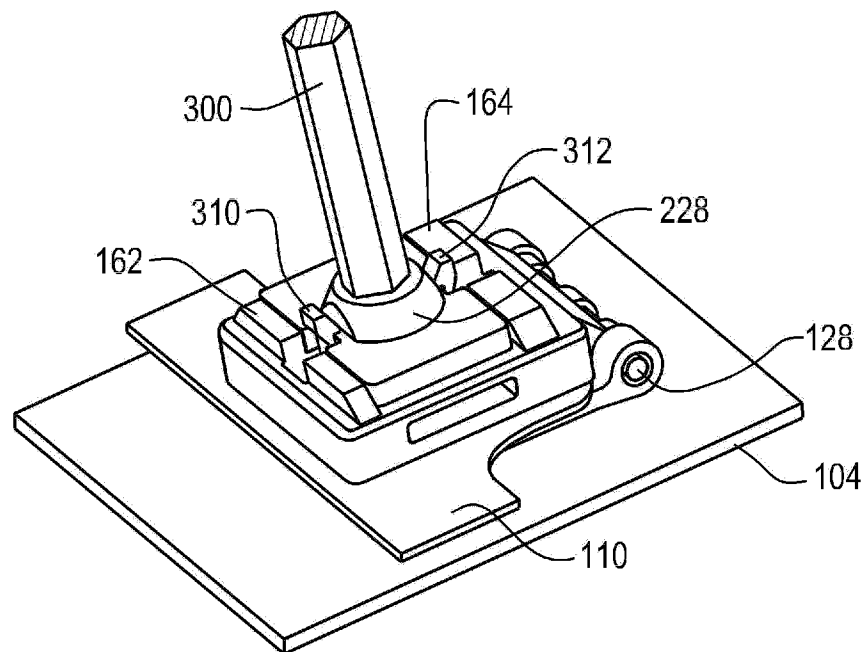


Fig. 25

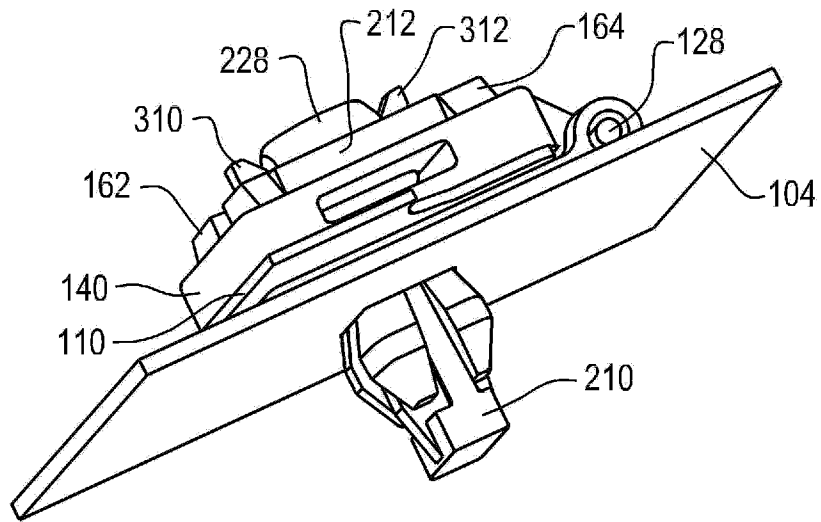


Fig. 26

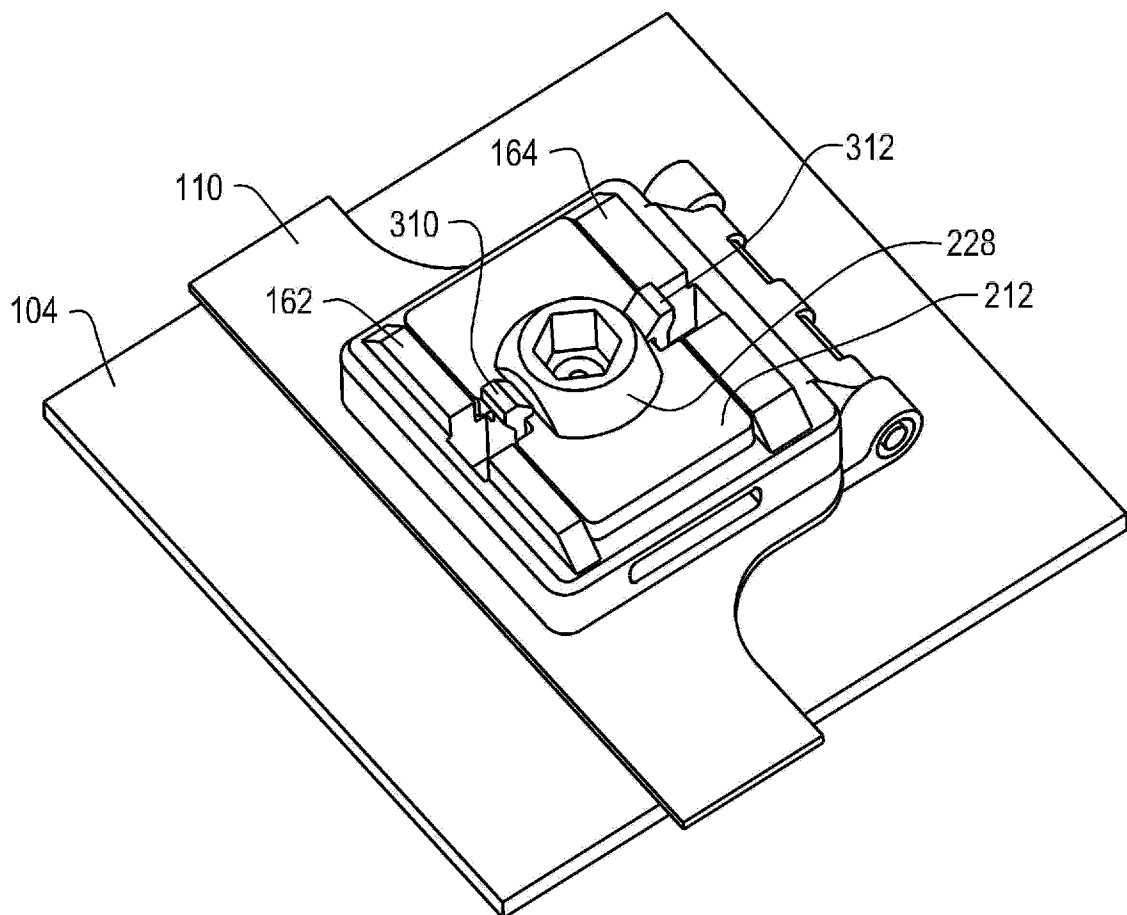


Fig. 27

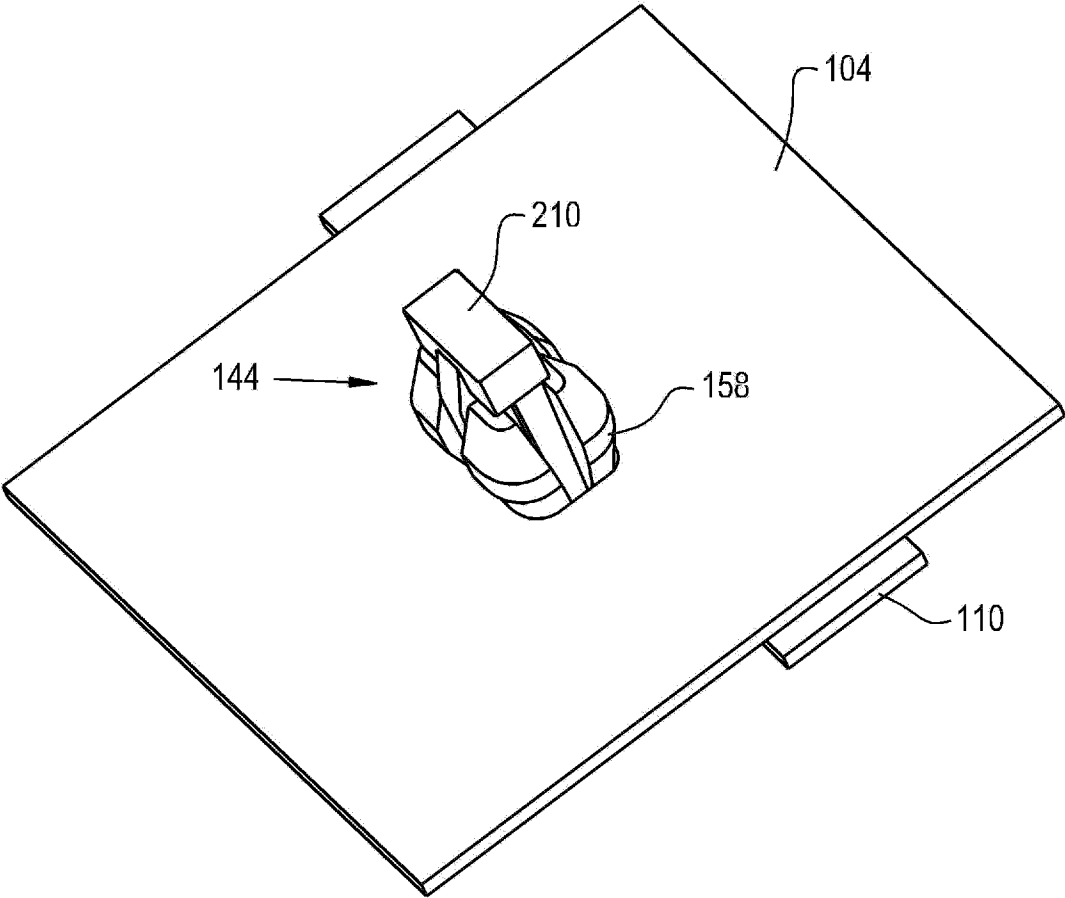


Fig. 28