(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 January 2025 (23.01.2025)

WIPO | PCT

(10) International Publication Number
WO 2025/019673 A1

(51) International Patent Classification:
F16B 21/08 (2006.01) *F16B 39/282* (2006.01)
F16B 37/02 (2006.01) *F16B 5/06* (2006.01)
F16B 37/04 (2006.01) *F16B 21/07* (2006.01)
F16B 37/12 (2006.01) *F16B 2/22* (2006.01)

(21) International Application Number:
PCT/US2024/038549

(22) International Filing Date:
18 July 2024 (18.07.2024)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
63/527,897 20 July 2023 (20.07.2023) US

(71) Applicant: **TESLA, INC.** [US/US]; 1 Tesla Road, Austin, TX 78725 (US).

(72) Inventors: **YU, Yongquan**; 1 Tesla Road, Austin, TX 78725 (US). **USLU, Kenan**; 1 Tesla Road, Austin, TX 78725 (US).

(74) Agent: **PERDOK, Monique, M.** et al.; Schwegman Lundberg & Woessner, P.A., P.O. Box 2938, Minneapolis, MN 55402 (US).

(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, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, 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, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE,

(54) Title: PLUGS, CLIPS, AND FASTENERS

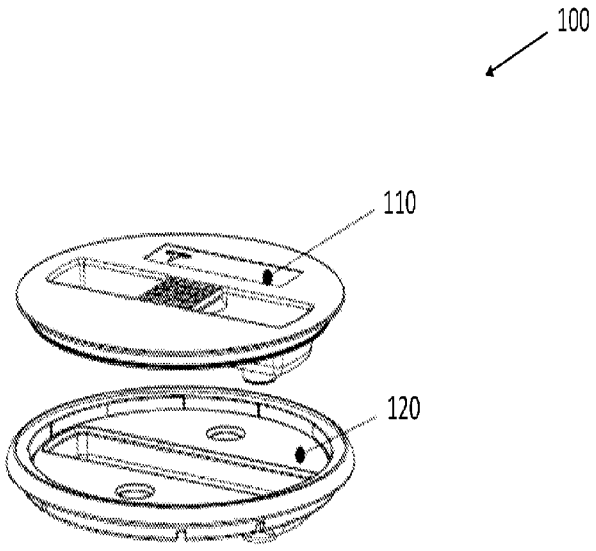


Fig. 1B

(57) Abstract: Plugs, clips, and fasteners that can be used on die casted parts and panels for a vehicle assembly are disclosed herein. Various aspects of this disclosure described below may reduce of manufacturing processing steps, tolerate greater load, and allow longer use.

WO 2025/019673 A1

[Continued on next page]

SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

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

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

PLUGS, CLIPS, AND FASTENERS

CLAIM FOR PRIORITY

[0001] This application claims the benefit of priority of U.S. Provisional Application Serial No. 63/527,897, filed July 20, 2023, which is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The present application relates to plugs, clips, and fasteners. More particularly, the plugs, clips, and fasteners can be used on die casted parts.

BACKGROUND

[0003] Various types of plugs, clips, and fasteners are needed during manufacturing and assembling processes of many devices, for example, vehicles. Production and installation of some plugs, clips, and fasteners may be time-consuming during manufacturing processes. Such plugs, clips, and fasteners may wear off or break due to use. There remains a need for more durable plugs, clips, and fasteners that are easier and more efficient to produce and install.

SUMMARY

[0004] Some examples described herein generally relate to improved designs for plugs, clips, and fasteners, primarily used in manufacturing and assembly processes, such as in vehicle assembly. These components can be important, if not essential, for holding parts together securely and efficiently.

[0005] In some examples, a hole plug is proved. An example hole plug comprises a soft piece and a hard piece. The soft piece is designed to cover a hole and attach to it with a snap fit, featuring receiving bays for the hard piece. The hard piece fits inside the soft piece and has extrusions that lock into the receiving bays of the soft piece. The design allows for easy and secure attachment, providing a durable solution that can withstand significant loads without substantial deformation. This arrangement may be particularly useful in environments where components are subject to frequent stress.

[0006] In some examples, a panel clip is provided. An example panel clip comprises a top portion, a bottom portion, and a middle portion, and is used to attach two panels together. The bottom portion includes a column with a

window that allows snap fit joints to flex and lock into place, making installation easier. The clip accommodates varying panel thicknesses and hole sizes, which may be beneficial for materials like aluminum die casted panels that may have inconsistent dimensions due to manufacturing tolerances. It requires lower insertion force while ensuring a strong hold, reducing the risk of damage during assembly.

[0007] In some examples, a clip nut is provided. An example clip nut includes a clip with a window and a nut that attaches to the clip. The nut overlaps with a hole in the panel, allowing a fastener to secure everything in place. Various designs allow the clip nut to attach to different parts of a panel, including edges and corners, with some designs allowing the nut to slide along the clip for adjustable positioning. The clip nut is easy to install and can be adjusted or removed for maintenance, offering flexibility in use. It may be particularly useful for die casted panels, reducing the need for additional machining of holes.

[0008] In some examples, a threaded nut is provided. An example threaded nut features a hexagonal head, a cylindrical body with tri-lobular threads, and a collar with angular teeth. The design allows for quick and secure fastening with just a quarter turn, making it ideal for fast-paced assembly lines. The tri-lobular threads provide a strong hold in the panel, suitable for creating semi-permanent joints.

[0009] In some examples, these plugs, clips, and fasteners seek to streamline manufacturing and assembly processes, reduce the need for additional tools or steps, and enhance the durability and reliability of the connections in various applications, particularly in automotive manufacturing.

[0010] One aspect is directed to a hole plug comprising a soft piece sized and shaped to cover a hole and be coupled to the hole with a snap fit, the soft piece comprising one or more receiving bays. The hole plug further comprises a hard piece sized and shaped to fit at least partially inside the soft piece, the hard piece comprising at least one extrusion configured to be fit inside the at least one receiving bay and couple the hard piece to the soft piece.

[0011] A variation of the aspect above is, wherein the soft piece and the hard piece are further configured to be coupled with a snap fit.

[0012] Another aspect is directed to a panel clip comprising a top portion configured to be attached to a first panel, a bottom portion configured to be

attached to a second panel, and a middle portion extending between the top portion and the bottom portion. The bottom portion comprises a column extending from a bottom side of the panel clip to the middle portion, and at least one snap fit joint extending from the bottom side of the panel clip. The column comprises a window configured to receive a top end of the at least one snap fit joint when the at least one snap fit joint is deflected inward towards the column.

[0013] Another aspect is directed to a clip nut comprising a clip and a nut. The clip comprises a clip body, the clip body comprising a window, and a clip head, the clip head configured to attach to a panel with one or more teeth, the panel having a hole. The nut comprises a tab and a hole, the tab configured couple the nut to the clip body. The hole of the nut overlaps with the hole in the panel and at least a portion of the window, and the hole of the nut is configured to receive a fastener.

[0014] A variation of the aspect above is, wherein the panel comprises a first side and a second side, the nut being configured to be positioned on the first side of the panel, and the fastener being configured to be inserted from the second side of the panel.

[0015] A variation of the aspect above is, wherein the panel is curved.

[0016] A variation of the aspect above is, wherein the panel clip head is configured to attach to an edge of the panel.

[0017] Another aspect is directed to a clip nut comprising a clip and a nut. The clip comprises a clip body, the clip body comprising an elongated window having at least one channel; and a clip head sized and shaped to grip on to an edge of a panel, the clip head comprising one or more teeth configured to secure the clip to the panel, the panel having a hole. The nut comprises a tab and a hole, the tab configured to be fit inside the at least one channel and couple the nut to the clip body, the tab being movable along the at least one channel. The nut is sized and shaped to be inserted into the hole of the panel, and the hole of the nut is configured to receive a fastener.

[0018] Another aspect is directed to a clip nut a clip and a nut. The clip comprises a clip body, the clip body comprising a window and a clip ring extending from a side of the window; and a clip head sized and shaped to fit into an inner side of a corner of a panel, the clip head comprising one or more teeth configured to secure the clip head to the panel, the panel having a hole. The nut comprises a tab and a hole, the tab configured to couple the nut to the clip body.

The clip ring of the clip body is configured to snap onto the hole on the panel, and the hole of the nut is configured to receive a fastener.

[0019] Another aspect is directed to an adjustable clip nut configured to grip on an edge of a panel and engage with a hole in the panel. The adjustable clip comprises a clip body and a nut. The clip body is configured to grip on the edge of the panel and extend along at least a portion of the panel. The nut is engaged with the clip body to slide along the clip body and the portion of the panel so as to locate at least a portion of the nut in the hole.

[0020] A variation of the aspect above is, wherein the portion of the nut is configured to receive a fastener.

[0021] Another aspect is directed to a clip nut configured to fit within a corner between two legs of a panel and engage with a hole in one of the two legs. The clip nut comprises a clip body and a nut. The clip body is configured to engage the corner of the panel and extend along at least a portion of the one of the two legs. The nut is engaged with the clip body so as to locate at least a portion of the nut in the hole.

[0022] A variation of the aspect above is, wherein the portion of the nut is configured to receive a fastener.

[0023] Another aspect is directed to a threaded nut comprising a cavity extending from a top side to a bottom side, a head proximate to the top side and having a hexagonal outer shape, a cylindrical body proximate to the bottom side, a plurality of tri-lobular threads disposed over an outer surface of the cylindrical body, and a collar positioned between the head and the cylindrical body.

[0024] A variation of the aspect above is, wherein the plurality of tri-lobular threads are sized and shaped to secure the fastener when the head is rotated a quarter turn.

[0025] A variation of the aspect above is, wherein the collar comprises angular teeth.

[0026] A variation of the aspect above is, wherein the cavity is configured to receive a fastener.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The present disclosure is described with reference to the accompanying drawings, in which like reference characters reference like elements, and wherein:

[0028] **Fig. 1A** is a perspective view of a hole plug according to an example of the present disclosure.

[0029] **Fig. 1B** is a perspective exploded view of the hole plug of **Fig. 1A**.

[0030] **Fig. 1C** is a top view of the hole plug of **Fig. 1A** installed in a hole.

[0031] **Fig. 1D** is a cross-sectional view of the hole plug in **Fig. 1C** taken along line 1D-1D.

[0032] **Fig. 1E** is a cross-sectional view of the hole plug in **Fig. 1C** taken along line 1E-1E.

[0033] **Fig. 1F** is a close-up view of the hole plug in **Fig. 1E**.

[0034] **Fig. 1G** is a close-up view of the hole plug in **Fig. 1E**.

[0035] **Fig. 2A** is a perspective view of a panel clip according to an example of the present disclosure.

[0036] **Fig. 2B** is a bottom view of the panel clip of **Fig. 2A**.

[0037] **Fig. 2C** is a side view of the panel clip of **Fig. 2A**.

[0038] **Fig. 2D** is a cross-sectional view of the panel clip in **Fig. 2C** taken along line 2D-2D.

[0039] **Fig. 2E** is a front view of the panel clip of **Fig. 2A**.

[0040] **Fig. 3A** is a perspective view of a clip nut having a movable nut according to an example of the present disclosure.

[0041] **Fig. 3B** illustrates the clip nut of **Fig. 3A** being aligned with and moving towards the panel.

[0042] **Fig. 3C** illustrates adjusting a position of the nut along the clip nut so as to align the nut with a hole in the panel.

[0043] **Fig. 3D** illustrates the clip nut of **Fig. 3A** about to be clipped onto the panel.

[0044] **Fig. 4A** is a front perspective view of a clip nut according to an example of the present disclosure.

[0045] **Fig. 4B** is a rear view of the clip nut of **Fig. 4A**.

[0046] **Fig. 4C** is a cross-sectional view of the clip nut of **Fig. 4A** taken along line A-A.

[0047] **Fig. 4D** is a front view of the clip nut of **Fig. 4A**.

[0048] **Fig. 4E** illustrates the clip nut of **Fig. 4A** moving into a corner of a panel.

[0049] **Fig. 4F** illustrates the clip nut of **Fig. 4A** about to be snapped onto a hole in the panel.

[0050] **Fig. 4G** is a close-up view of the hole in the panel from **Fig. 4F**.

[0051] **Fig. 4H** is a rear perspective view of the clip nut of **Fig. 4A**.

[0052] **Fig. 5A** is a top view of a quarter turn nut according to an example of the present disclosure.

[0053] **Fig. 5B** is a bottom view of the quarter turn nut of **Fig. 5A**.

[0054] **Fig. 5C** is a cross-sectional view of the quarter turn nut of **Fig. 5A** taken along line 5C-5C.

[0055] **Fig. 5D** is a top view of a quarter turn nut according to an example of this present disclosure.

[0056] **Fig. 5E** is a bottom view of the quarter turn nut of **Fig. 5D**.

[0057] **Fig. 5F** is a cross-sectional view of the quarter turn nut of **Fig. 5D** taken along line 5F-5F.

[0058] **Fig. 6A** is a perspective view of another example of a quarter turn nut.

[0059] **Fig. 6B** is a bottom view of the quarter turn nut of **Fig. 6A**.

[0060] **Fig. 6C** is a side view of the quarter turn nut of **Fig. 6A**.

DETAILED DESCRIPTION

[0061] Generally described, one or more aspects of the present disclosure relate to plugs, clips, and fasteners. In certain examples, this disclosure relates to plugs, clips, and fasteners that can be used on die casted parts and panels for a vehicle assembly. Various aspects of this disclosure described below may reduce manufacturing processing steps, tolerate greater load, and allow longer use.

[0062] One aspect of this disclosure includes a hole plug that has a large load resistance. In some examples, the hole plug can be used with oversized holes. As shown in **Figs. 1A-1G**, an example of a hole plug 100 according to this disclosure can include a soft piece 120 and a hard piece 110. In some examples, the soft piece 120 can be attached onto a hole 190 (see **Fig. 1C**) to cover the hole 190. In some examples, the soft piece 120 can be attached to the hole 190 through a snap fit, a snug fit, or another other desirable fastening mechanism. As shown in **Fig. 1G**, the soft piece 120 can include one or more snap fit joints 150 configured to couple the soft piece 120 to the hole 190.

[0063] In some examples, the hard piece 110 of the hole plug 100 can be attached onto the soft piece 120 through a snap fit, a snug fit, or any other desirable attachment mechanism. For example, the hard piece 110 can include one or more extrusions 112 configured to fit inside one or more corresponding receiving bays 122 on the soft piece 120. Interference 130 between the one or more extrusions 112 of the hard piece 110 and the one or more corresponding receiving bays 122 of the soft piece 120 may create a snug fit and couple the hard piece 110 and soft piece 120 together. The hard piece 110 may further include one or more snap fit joints 140 to secure the hard piece 110 to the soft piece 120 as shown in **Fig. 1G**. In accordance with various examples, a hole plug disclosed herein may withstand a load in the ranges of, e.g., 100-200N, 50-200N, 150-200N, over a diameter in the ranges of, e.g., 100-300mm, 10-300mm, 50-200mm, 150-200mm, without significant deflection, e.g., within 5mm, 10mm, 15mm, or 15mm. Of course other load ranges and other diameters also fall within this disclosure.

[0064] Another aspect of this disclosure includes a panel clip for holding panels together that can accommodate a range of panel thicknesses and hole sizes. For example, such panel clips can be used on aluminum die casted panels, which may have greater manufacturing tolerances, resulting in varying panel thicknesses P_{min} to P_{max} (e.g., varying between thickness ranges of 1-5mm, 1-3mm, 1.5-3mm, etc.) and hole sizes W (e.g., decreasing or increasing within 5mm, 3mm, 7mm, etc.).

[0065] As shown in **Figs. 2A-2E**, the panel clip 200 disclosed herein can include a top portion 210, a bottom portion 220, and a middle portion 230 disposed between the top portion 210 and the bottom portion 220. In some examples, the top portion 210 is configured to be coupled to a first panel, and the bottom portion 210 is configured to be coupled to a second panel, thereby retaining the first and the second panels together, with the middle portion 230 positioned between the first and the second panels. In some examples, the top portion 210 can be coupled to the first panel by snapping a top plate 212 of the top portion 210 into a hole in the first panel, and keeping the first panel between the top plate 212 and a bottom plate 214 of the top portion 210 (see **Fig. 2A**).

[0066] In some examples, the bottom portion 220 can include a column 222 and one or more snap fit joints 224 extending upward from a bottom side of the panel clip 200 from the column 222. When being inserted into a hole on the

second panel, the one or more snap fit joints 224 may be pushed towards the column 222 by the hole, and return to their starting position once fully inserted. The column 222 of the bottom portion 220 can further include a cavity or window 226, allowing the one or more snap fit joints 224 to move further into the column 222 when being inserted into the hole. With the window 226, the one or more snap fit joints 224 may have more room to bend, requiring a lower insertion force (e.g., around 30N, 40N, 45N, or 50N) while maintaining a higher extraction force (e.g., around 170N, 200N, 220N, 250N).

[0067] Another aspect of this disclosure includes a clip nut that can provide a nut to a hole on a panel by clipping the nut onto the hole. Various examples of the clip nut can be easy to install and adaptable to different hole locations. In some examples, the clip nut can be implemented on a hole on a die casted panel to reduce manufacturing steps in machining the hole. In some examples, the clip nut can also be removed for service.

[0068] The clip nut can include a clip portion and a nut portion. In some examples, the nut portion can be coupled to the clip portion by fitting a tab of the nut portion inside two slots on two sides of the clip portion. In some examples, the clip portion can further include a window that at least partially overlaps with a hole on the nut portion. The hole on the nut portion can be configured to receive a bolt. In some examples, the clip portion can include one or more teeth configured to bite onto the panel and secure the clip nut to the panel.

[0069] As shown in **Figs. 3A-3D**, a clip nut 300 can include a clip portion 310 that is elongated, and a nut portion 320 coupled to the clip portion 310. In some examples, the nut portion 320 can be coupled to the clip portion 310 by inserting a tab 322 of the nut portion 320 into two slots or channels 312 on two sides of the clip portion 310. In some examples, the nut portion 320 can be movable along the channels 312 relative to the clip portion 310. In some examples, the clip portion 310 of the clip nut 300 may include a clip body 318 and a clip head 314. In some examples, the clip head 314 can be configured to clip onto an edge of a panel 390. In some examples, at least a portion of the panel proximate the edge is flat.

[0070] As shown in **Figs. 3B-3D**, the clip nut 300 can be clipped onto the panel 390 with the clip head 314. In some examples, the clip head 314 can include on or more teeth 316 configured to bite onto the panel 390 and prevent the clip nut 300 from disengaging from the panel 390. While moving the clip

nut 300 towards the panel 390, the nut portion 320 can be moved to a position along the channels 312 in correspondence to a location of a hole 392 in the panel 390 and inserted into the hole 392. In some examples, the nut portion 320 can be sized and shaped to be smaller than or approximately equal to the hole 392 in the panel 390 so that it can be easily inserted through the hole 392. A hole 324 inside the nut portion 320 can be configured to receive a bolt. For example, in some examples, the hole 324 can include threads on an inner side of the hole 324. When the nut portion 320 of the clip nut 300 is inserted into the hole 392, the hole 324 on the nut portion 320 can be configured to receive a bolt in lieu of the hole 392 on the panel 390.

[0071] **Figs. 4A-4H** shows another example of a clip nut 400 according to this disclosure. The clip nut 400 can similarly include a clip portion 410 and a nut portion 420. The nut portion 420 can be coupled to the clip portion 410 by fitting a tab 422 of the nut portion 420 inside two slots 412 of the clip portion 410. The clip nut 400 can be different from the clip nut 300 in that the nut portion 420 may be fixed inside the slots 412. In some examples, the clip portion 410 can include a clip head 414 and a clip body 418 having a window 417 that overlaps with a hole 424 on the nut portion 420. In some examples, the hole 424 of the nut portion 420 can include threads and be configured to receive and secure a bolt inside the hole 424.

[0072] In some examples, the clip head 414 of the clip portion 410 may be configured to fit inside a curved corner 490 of a panel (e.g., sheet metal), having a curvature that can be similar or greater than that of the curved corner 490 such that the clip nut 400 might be secured to the panel. In some examples, the clip head 414 of the clip portion 410 may further include a plurality of teeth 416 configured to bite onto the panel when the clip nut 400 is inserted into the curved corner 490, preventing the clip nut 400 from disengaging from the panel. In some examples, the clip body 418 can further include a clip ring 419 extending from a side of the window 417. The clip ring 419 can be sized and shaped to be able to snap onto a hole 492 on the panel to further secure the attachment of the clip nut 400 to the panel. When the clip nut 400 is attached in place, the hole 424 of the nut portion 420 of the clip nut 400 may substantially overlap with the hole 492 on the panel such that the hole 424 of the clip nut 400 may act as a nut hole in lieu of the hole 492 on the panel to receive a bolt.

[0073] This disclosure also includes a quarter turn nut that does not require any special equipment (e.g., a c-clamp) to create a single sided access assembly. Of course the quarter fastener can be configured to rotate more or less than a quarter turn and still fall within the scope of this disclosure. In some examples, a torque gun can be used to install the quarter turn nut. In some examples, the quarter turn nut can be used with any panel that is thicker than a predetermined thickness (e.g., 2mm, 3mm, 4mm, 5mm). In some examples, the quarter turn nut can include angular teeth on an under-head collar of the quarter turn nut to create a semi-permanent joint to the panel, which can be used to attach to other panels. In some examples, the quarter turn nut can be made of a material that is strong than plastic, e.g., metal. As shown in **Figs. 5A-5C**, a quarter turn nut 500 disclosed herein can include tri-lobular threads 510 disposed over a cylindrical surface of the quarter turn nut 500. Similarly, as shown in **Figs. 5D-5F**, a quarter turn nut 600 disclosed herein can include tri-lobular threads 610 disposed over a cylindrical surface of the quarter turn nut 600. The tri-lobular threads 610 can be steeply angled so that less rotation is required to attach the quarter turn nut 600 to a panel. **Fig. 6A-6C** shows another exemplary example of a quarter turn nut 700 similar to the quarter turn nuts 500 and 600 above.

EXAMPLES

[0074] Some examples may include the following aspects.

[0075] Example 1 includes a hole plug comprising: a soft piece sized and shaped to cover a hole and be coupled to the hole with a snap fit, the soft piece comprising one or more receiving bays; and a hard piece sized and shaped to fit at least partially inside the soft piece, the hard piece comprising at least one extrusion configured to be fit inside the at least one receiving bay and couple the hard piece to the soft piece.

[0076] Example 2 includes the hole plug of Example 1, wherein the soft piece and the hard piece are further configured to be coupled with a snap fit.

[0077] Example 3 includes a panel clip comprising: a top portion configured to be attached to a first panel; a bottom portion configured to be attached to a second panel; and a middle portion extending between the top portion and the bottom portion, wherein the bottom portion comprises: a column extending from a bottom side of the panel clip to the middle portion, and at least

one snap fit joint extending from the bottom side of the panel clip, wherein the column comprises a window configured to receive a top end of the at least one snap fit joint when the at least one snap fit joint is deflected inward towards the column.

[0078] Example 4 includes a clip nut comprising: a clip comprising: a clip body, the clip body comprising a window; and a clip head, the clip head configured to attach to a panel with one or more teeth, the panel having a hole; and a nut comprising a tab and a hole, the tab configured couple the nut to the clip body, wherein the hole of the nut overlaps with the hole in the panel and at least a portion of the window, and the hole of the nut is configured to receive a fastener.

[0079] Example 5 includes the clip nut of Example 4, wherein the panel comprises a first side and a second side, the nut being configured to be positioned on the first side of the panel, and the fastener being configured to be inserted from the second side of the panel.

[0080] Example 6 includes the clip nut of Example 4 or Example 5, wherein the panel is curved.

[0081] Example 7 includes the clip nut of any one of Examples 4-6, wherein the panel clip head is configured to attach to an edge of the panel.

[0082] Example 8 includes a clip nut comprising: a clip comprising: a clip body, the clip body comprising an elongated window having at least one channel; and a clip head sized and shaped to grip on to an edge of a panel, the clip head comprising one or more teeth configured to secure the clip to the panel, the panel having a hole; and a nut comprising a tab and a hole, the tab configured to be fit inside the at least one channel and couple the nut to the clip body, the tab being movable along the at least one channel, wherein the nut is sized and shaped to be inserted into the hole of the panel, and the hole of the nut is configured to receive a fastener.

[0083] Example 9 includes a clip nut comprising: a clip comprising: a clip body, the clip body comprising a window and a clip ring extending from a side of the window; and a clip head sized and shaped to fit into an inner side of a corner of a panel, the clip head comprising one or more teeth configured to secure the clip head to the panel, the panel having a hole; and a nut comprising a tab and a hole, the tab configured to couple the nut to the clip body; wherein the

clip ring of the clip body is configured to snap onto the hole on the panel, and the hole of the nut is configured to receive a fastener.

[0084] Example 10 includes an adjustable clip nut configured to grip on an edge of a panel and engage with a hole in the panel, the adjustable clip comprising: a clip body and a nut, the clip body being configured to grip on the edge of the panel and extend along at least a portion of the panel, the nut being engaged with the clip body to slide along the clip body and the portion of the panel so as to locate at least a portion of the nut in the hole.

[0085] Example 11 includes the adjustable clip nut of Example 10, wherein the portion of the nut is configured to receive a fastener.

[0086] Example 12 includes a clip nut configured to fit within a corner between two legs of a panel and engage with a hole in one of the two legs, the clip nut comprising: a clip body and a nut, the clip body being configured to engage the corner of the panel and extend along at least a portion of the one of the two legs, the nut being engaged with the clip body so as to locate at least a portion of the nut in the hole.

[0087] Example 13 includes the clip nut of Example 12, wherein the portion of the nut is configured to receive a fastener.

[0088] Example 14 includes a threaded nut comprising: a cavity extending from a top side to a bottom side; a head proximate to the top side and having a hexagonal outer shape; a cylindrical body proximate to the bottom side; a plurality of tri-lobular threads disposed over an outer surface of the cylindrical body; and a collar positioned between the head and the cylindrical body.

[0089] Example 15 includes the threaded nut of Example 14, wherein the plurality of tri-lobular threads are sized and shaped to secure the fastener when the head is rotated a quarter turn.

[0090] Example 16 includes the threaded nut of Example 14 or Example 15, wherein the collar comprises angular teeth.

[0091] Example 17 includes the threaded nut of any one of Examples 14-16, wherein the cavity is configured to receive a fastener.

[0092] In some examples, a hole plug comprises: a soft piece configured to cover and attach to a hole via a snap fit, the soft piece including multiple receiving bays; a hard piece designed to fit at least partially within the soft piece, featuring multiple extrusions each configured to engage with a corresponding receiving bay in the soft piece; wherein the engagement between the extrusions

and the receiving bays provides a reversible locking mechanism allowing for easy assembly and disassembly.

[0093] In some examples, the soft piece is made from a flexible polymer material and the hard piece is made from a durable metal, providing a combination of flexibility and strength.

[0094] In some examples, the soft piece includes a textured surface around the receiving bays to increase friction and enhance the secure fit between the soft and hard pieces.

[0095] In some examples, a panel clip comprises: a top portion designed to attach to a first panel; a bottom portion designed to attach to a second panel; a middle portion extending between the top and bottom portions; wherein the bottom portion includes a flexible snap fit joint capable of accommodating variations in panel thickness and hole size; further comprising a locking mechanism within the bottom portion to enhance the retention force after installation.

[0096] In some examples, the top portion includes a pressure-sensitive adhesive layer to temporarily hold the clip in place during assembly before permanent attachment.

[0097] In some examples, the locking mechanism includes a ratchet feature that allows for incremental adjustments of the snap fit joint's tension.

[0098] In some examples, a clip nut comprises: a clip body with an integrated window and a clip head designed to attach to a panel via multiple teeth; a nut with a tab and a threaded hole, where the tab is designed to slide within channels located on the clip body; wherein the nut is adjustable along the length of the clip body to align with a hole in the panel; further comprising a locking mechanism to secure the nut's position once aligned.

[0099] In some examples, the channels in the clip body are lined with a wear-resistant material to prolong the life of the clip nut during repeated adjustments.

[0100] In some examples, the clip nut further comprising a spring mechanism integrated into the clip body to automatically align the nut with the panel hole when positioned nearby.

[0101] In some examples, a threaded nut, comprises: a hexagonal head and a cylindrical body; tri-lobular threads on the cylindrical body designed for rapid engagement with a panel; a collar with angular teeth positioned between

the head and the cylindrical body; wherein the collar is designed to engage with the panel surface to prevent rotational movement once installed.

[0102] In some examples, the tri-lobular threads are coated with an anti-corrosion treatment to enhance durability in harsh environments.

[0103] In some examples, the angular teeth on the collar are replaceable to allow for maintenance and prolong the operational lifespan of the nut.

[0104] In some examples, a fastening system comprises: a combination of a hole plug, a panel clip, and a clip nut as summarized above, wherein each component is configured to interlock with at least one other component; wherein the system provides a modular approach to assembly, allowing for various configurations depending on application requirements; further comprising a unified installation tool designed to engage with each component of the system.

[0105] In some examples, the unified installation tool includes a digital interface to provide feedback on the installation force and alignment accuracy during use.

[0106] In some examples, each component of the system is color-coded according to its function, facilitating easier identification and assembly by technicians.

[0107] The foregoing disclosure is not intended to limit the present disclosure to the precise forms or particular fields of use disclosed. As such, it is contemplated that various alternate examples and/or modifications to the present disclosure, whether explicitly described or implied herein, are possible in light of the disclosure. Having thus described examples of the present disclosure, a person of ordinary skill in the art will recognize that changes may be made in form and detail without departing from the scope of the present disclosure. Thus, the present disclosure is limited only by the claims.

[0108] In the foregoing specification, the disclosure has been described with reference to specific examples. However, as one skilled in the art will appreciate, various examples disclosed herein can be modified or otherwise implemented in various other ways without departing from the spirit and scope of the disclosure. Accordingly, this description is to be considered as illustrative and is for the purpose of teaching those skilled in the art the manner of making and using various examples of the disclosed clips, plugs, and fasteners. It is to be understood that the forms of disclosure herein shown and described are to be taken as representative examples. Equivalent elements, materials, processes or

steps may be substituted for those representatively illustrated and described herein. Moreover, certain features of the disclosure may be utilized independently of the use of other features, all as would be apparent to one skilled in the art after having the benefit of this description of the disclosure.

Expressions such as "including," "comprising," "incorporating," "consisting of," "have," "is" used to describe and claim the present disclosure are intended to be construed in a non-exclusive manner, namely allowing for items, components or elements not explicitly described also to be present. Reference to the singular is also to be construed to relate to the plural.

[0109] Further, various examples disclosed herein are to be taken in the illustrative and explanatory sense, and should in no way be construed as limiting of the present disclosure. All joinder references (e.g., attached, affixed, coupled, connected, and the like) are only used to aid the reader's understanding of the present disclosure, and may not create limitations, particularly as to the position, orientation, or use of the systems and/or methods disclosed herein. Therefore, joinder references, if any, are to be construed broadly. Moreover, such joinder references do not necessarily infer that two elements are directly connected to each other. Additionally, all numerical terms, such as, but not limited to, "first," "second," "third," "primary," "secondary," "main" or any other ordinary and/or numerical terms, should also be taken only as identifiers, to assist the reader's understanding of the various elements, examples, variations and/or modifications of the present disclosure, and may not create any limitations, particularly as to the order, or preference, of any element, example, variation and/or modification relative to, or over, another element, example, variation and/or modification.

[0110] It will also be appreciated that one or more of the elements depicted in the drawings/figures can also be implemented in a more separated or integrated manner, or even removed or rendered as inoperable in certain cases, as is useful in accordance with a particular application.

CLAIMS

1. A hole plug comprising:

a soft piece sized and shaped to cover a hole and be coupled to the hole with a snap fit, the soft piece comprising one or more receiving bays; and

a hard piece sized and shaped to fit at least partially inside the soft piece, the hard piece comprising at least one extrusion configured to be fit inside the one or more receiving bays and couple the hard piece to the soft piece.

2. The hole plug of Claim 1, wherein the soft piece and the hard piece are further configured to be coupled with a snap fit.

3. A panel clip comprising:

a top portion configured to be attached to a first panel;

a bottom portion configured to be attached to a second panel; and

a middle portion extending between the top portion and the bottom portion,

wherein the bottom portion comprises:

a column extending from a bottom side of the panel clip to the middle portion, and

at least one snap fit joint extending from the bottom side of the panel clip,

wherein the column comprises a window configured to receive a top end of the at least one snap fit joint when the at least one snap fit joint is deflected inward towards the column.

4. A clip nut comprising:

a clip comprising:

a clip body, the clip body comprising a window; and

a clip head, the clip head configured to attach to a panel with one or more teeth, the panel having a hole; and

a nut comprising a tab and a hole, the tab configured couple the nut to the clip body,

wherein the hole of the nut overlaps with the hole in the panel and at least a portion of the window, and the hole of the nut is configured to receive a fastener.

5. The clip nut of Claim 4, wherein the panel comprises a first side and a second side, the nut being configured to be positioned on the first side of the panel, and the fastener being configured to be inserted from the second side of the panel.

6. The clip nut of Claim 4, wherein the panel is curved.

7. The clip nut of Claim 4, wherein the clip head is configured to attach to an edge of the panel.

8. A clip nut comprising:

a clip comprising:

a clip body, the clip body comprising an elongated window having at least one channel; and

a clip head sized and shaped to grip on to an edge of a panel, the clip head comprising one or more teeth configured to secure the clip to the panel, the panel having a hole; and

a nut comprising a tab and a hole, the tab configured to be fit inside the at least one channel and couple the nut to the clip body, the tab being movable along the at least one channel,

wherein the nut is sized and shaped to be inserted into the hole of the panel, and the hole of the nut is configured to receive a fastener.

9. A clip nut comprising:

a clip comprising:

a clip body, the clip body comprising a window and a clip ring extending from a side of the window; and

a clip head sized and shaped to fit into an inner side of a corner of a panel, the clip head comprising one or more teeth configured to secure the clip head to the panel, the panel having a hole; and

a nut comprising a tab and a hole, the tab configured to couple the nut to the clip body;

wherein the clip ring of the clip body is configured to snap onto the hole on the panel, and the hole of the nut is configured to receive a fastener.

10. An adjustable clip nut configured to grip on an edge of a panel and engage with a hole in the panel, the adjustable clip nut comprising:

a clip body and a nut, the clip body being configured to grip on the edge of the panel and extend along at least a portion of the panel, the nut being engaged with the clip body to slide along the clip body and the portion of the panel so as to locate at least a portion of the nut in the hole.

11. The adjustable clip nut of Claim 10, wherein the portion of the nut is configured to receive a fastener.

12. A clip nut configured to fit within a corner between two legs of a panel and engage with a hole in one of the two legs, the clip nut comprising:

a clip body and a nut, the clip body being configured to engage the corner of the panel and extend along at least a portion of one of the two legs, the nut being engaged with the clip body so as to locate at least a portion of the nut in the hole.

13. The clip nut of Claim 12, wherein the portion of the nut is configured to receive a fastener.

14. A threaded nut comprising:

a cavity extending from a top side to a bottom side;

a head proximate to the top side and having a hexagonal outer shape;

a cylindrical body proximate to the bottom side;

a plurality of tri-lobular threads disposed over an outer surface of the cylindrical body; and

a collar positioned between the head and the cylindrical body.

15. The threaded nut of Claim 14, wherein the plurality of tri-lobular threads are sized and shaped to secure the threaded nut when the head is rotated a quarter turn.

16. The threaded nut of Claim 14, wherein the collar comprises angular teeth.

17. The threaded nut of Claim 14, wherein the cavity is configured to receive a fastener.

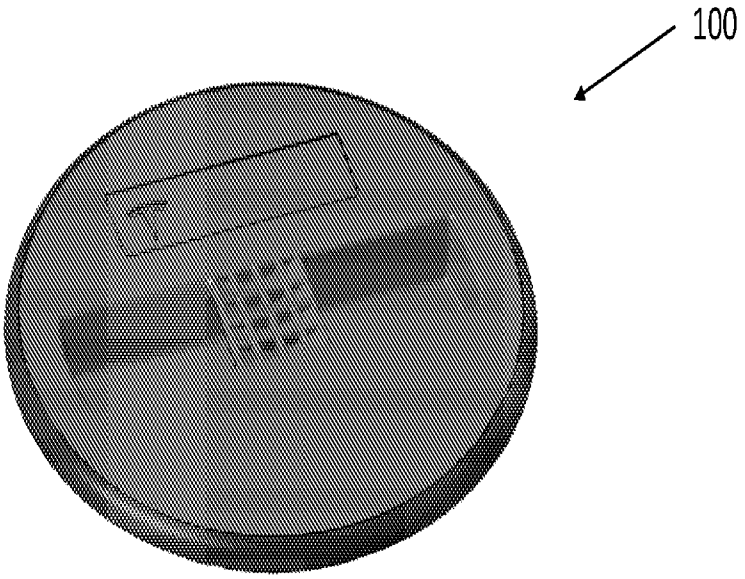


Fig. 1A

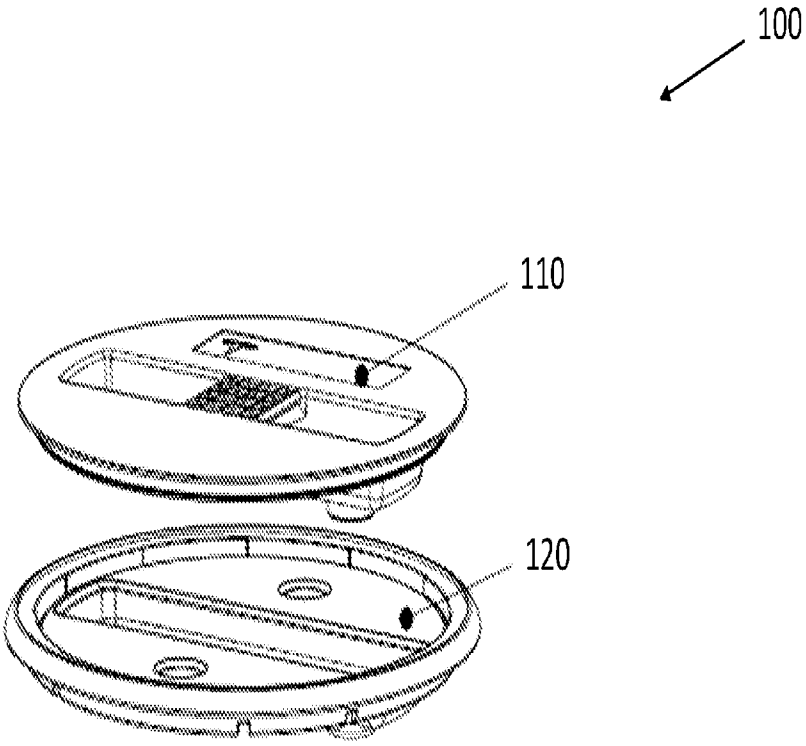


Fig. 1B

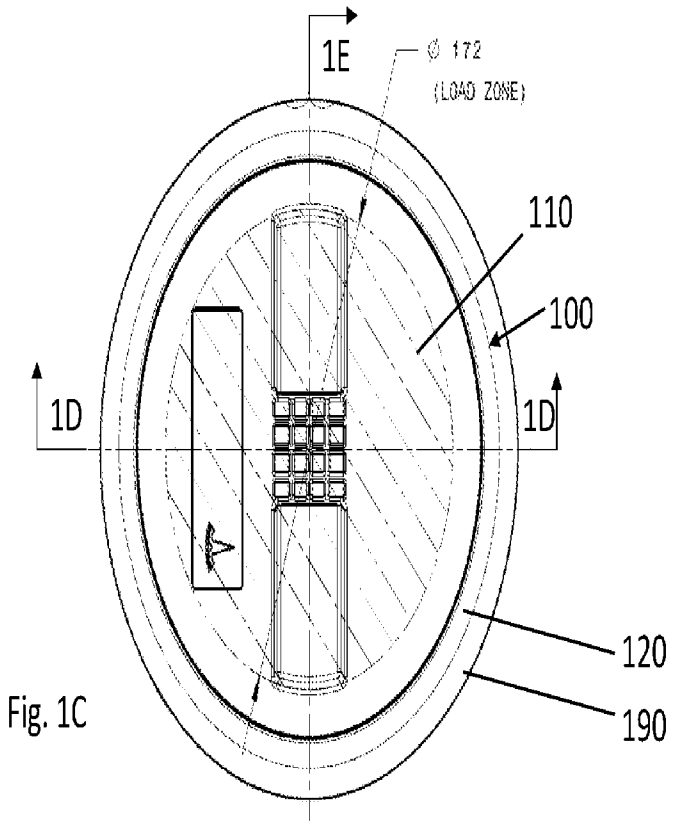


Fig. 1C

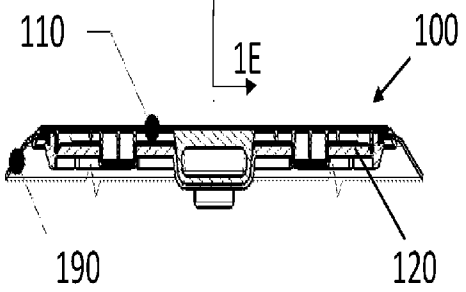


Fig. 1D

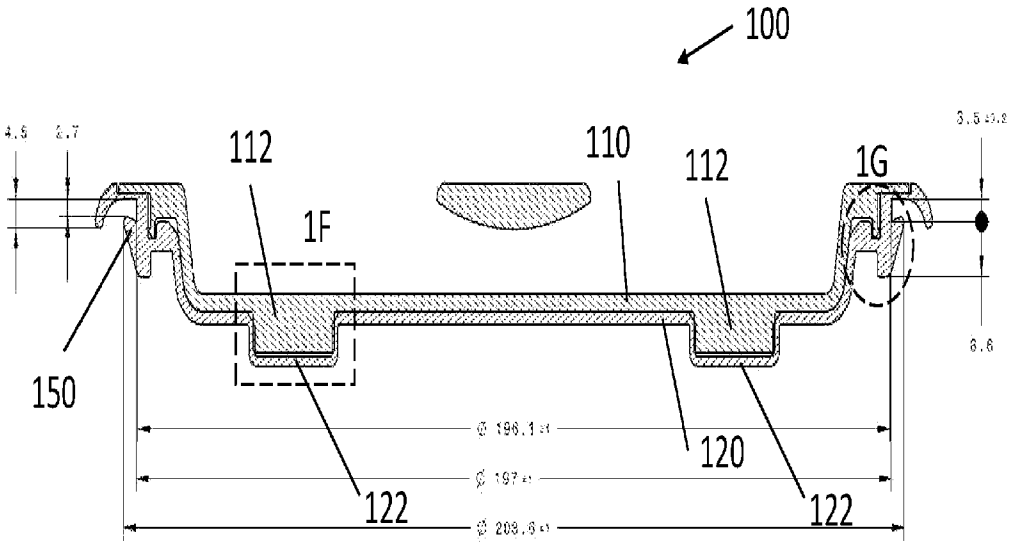


Fig. 1E

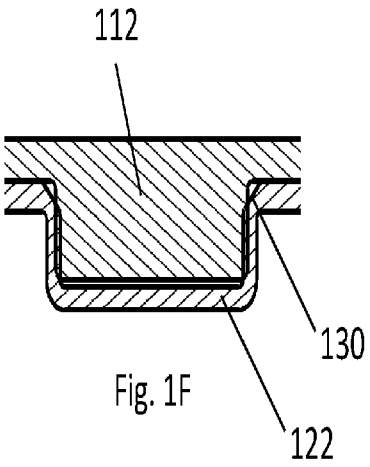


Fig. 1F

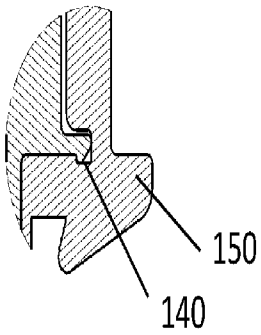


Fig. 1G

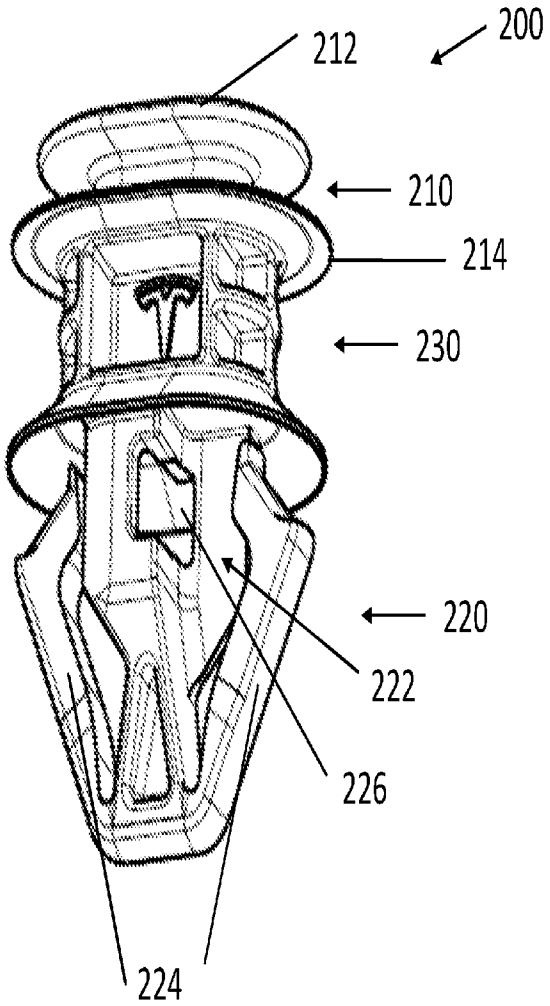


Fig. 2A

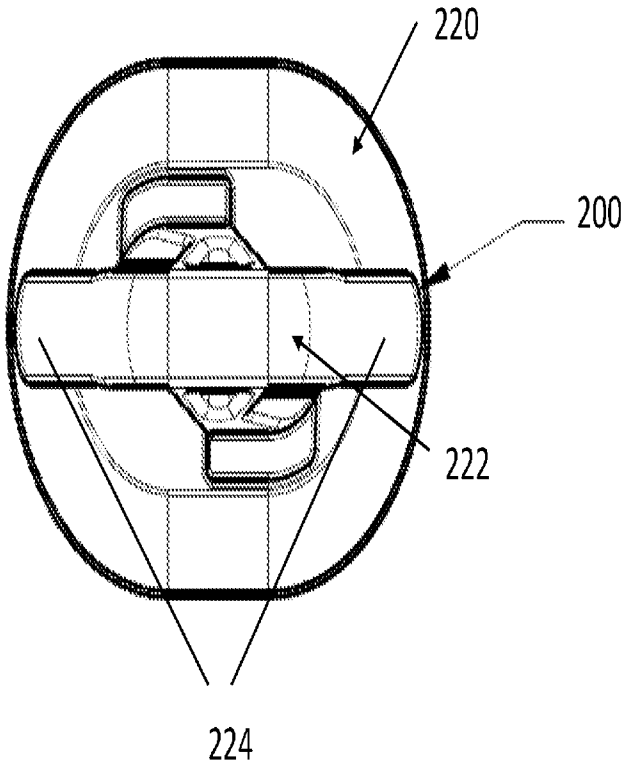


Fig. 2B

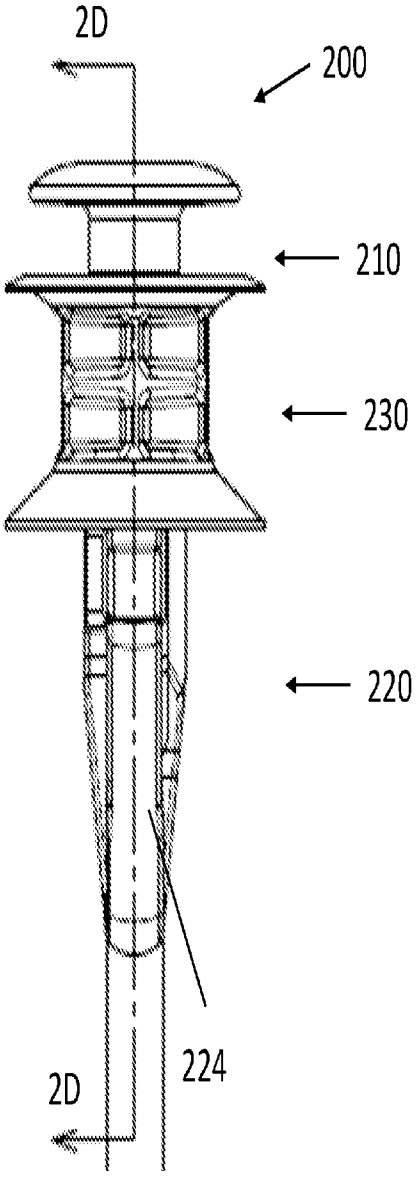


Fig. 2C

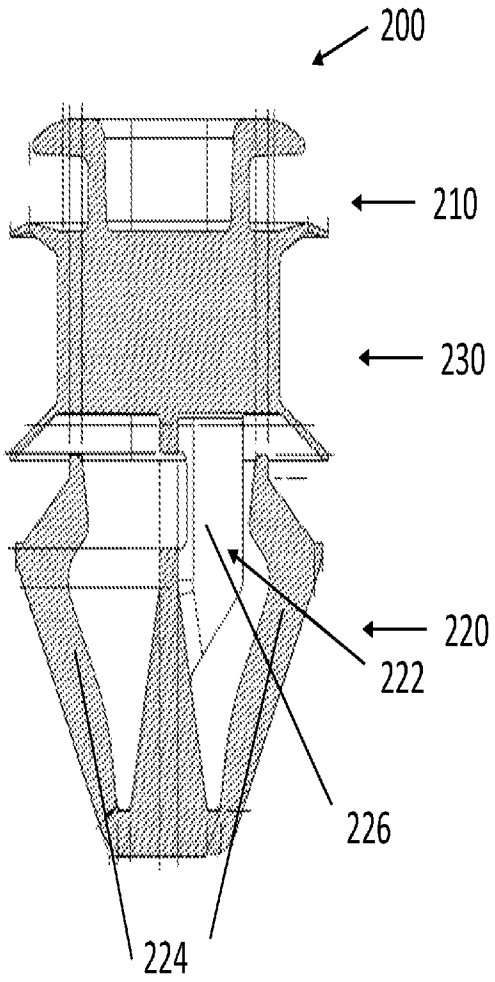


Fig. 2D

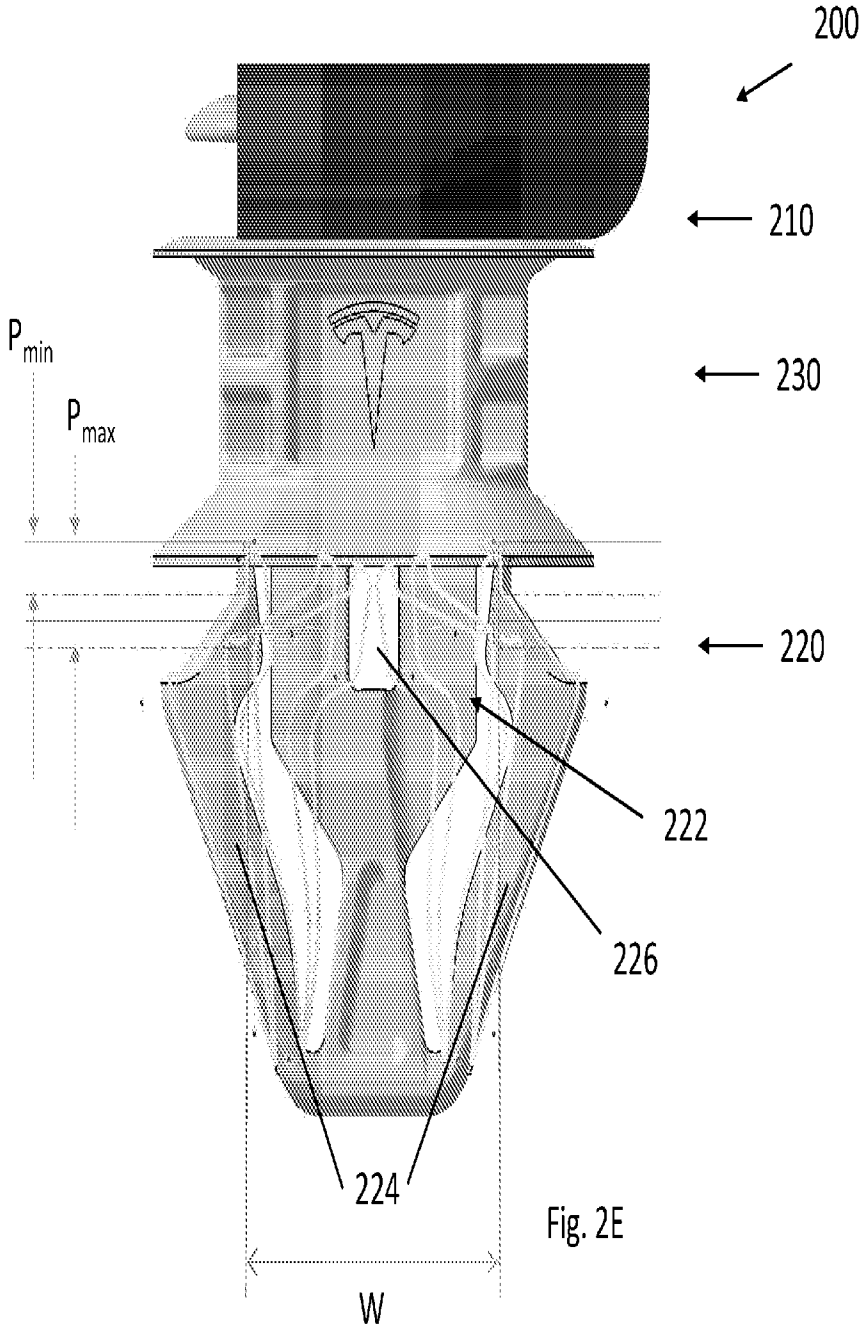


Fig. 2E

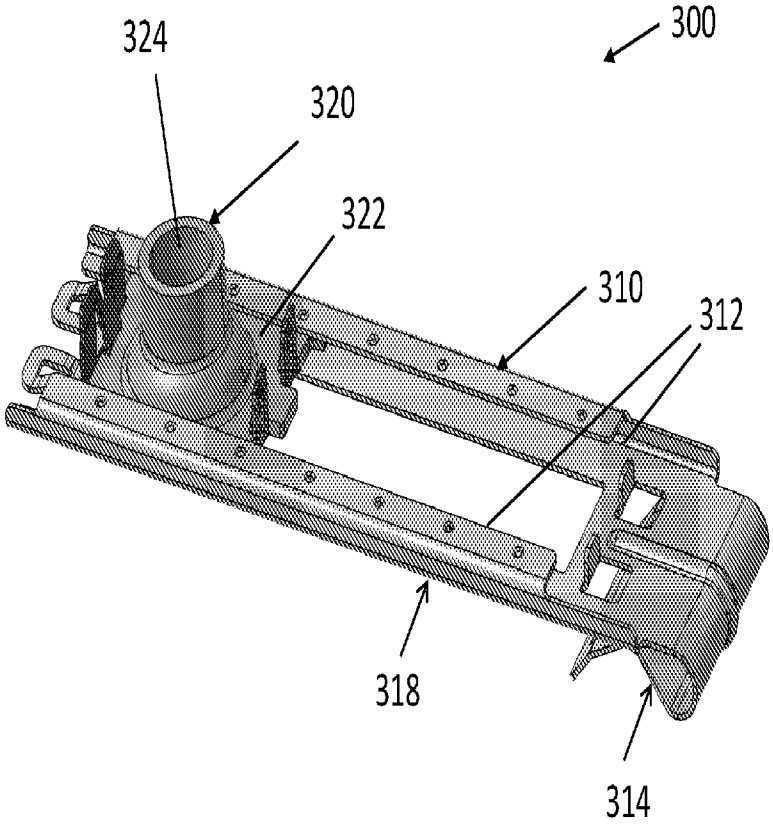


Fig. 3A

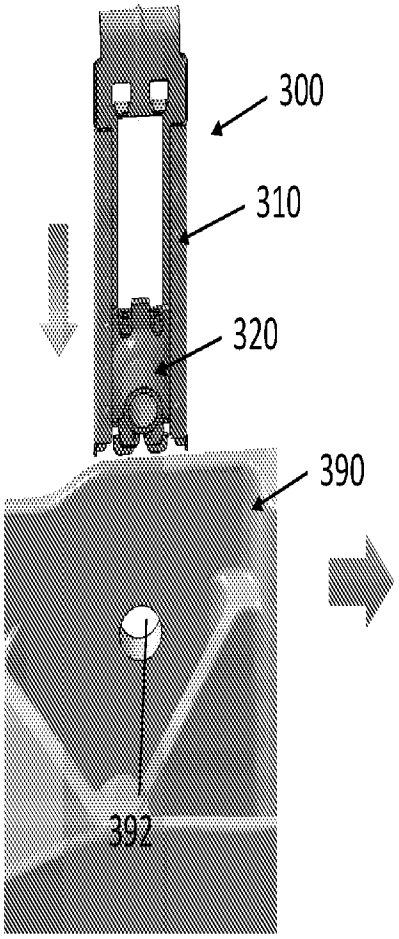


Fig. 3B

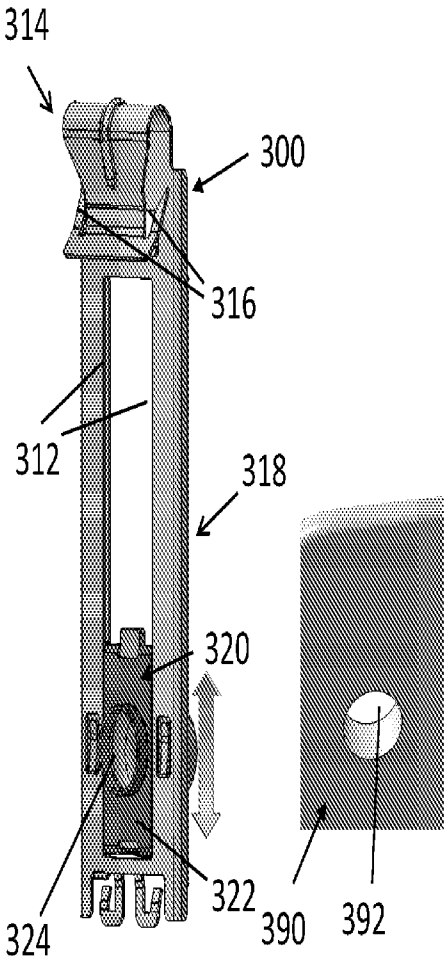


Fig. 3C

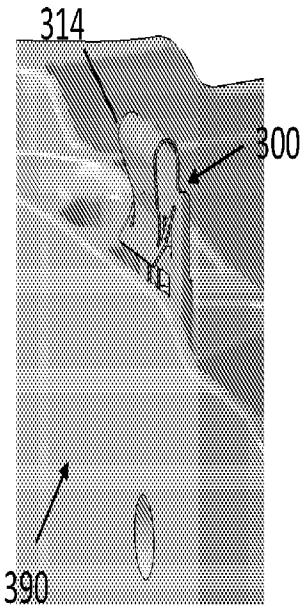


Fig. 3D

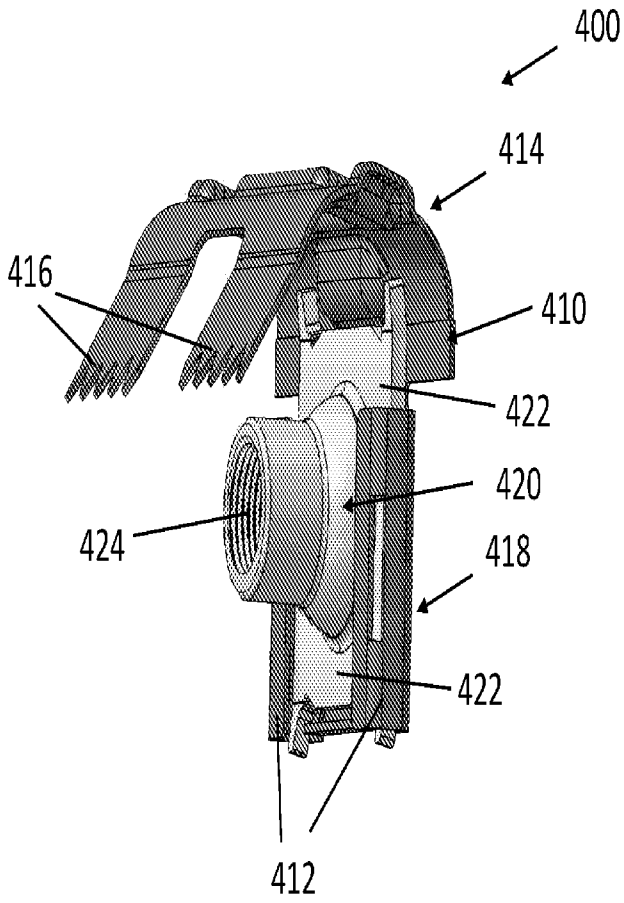


Fig. 4A

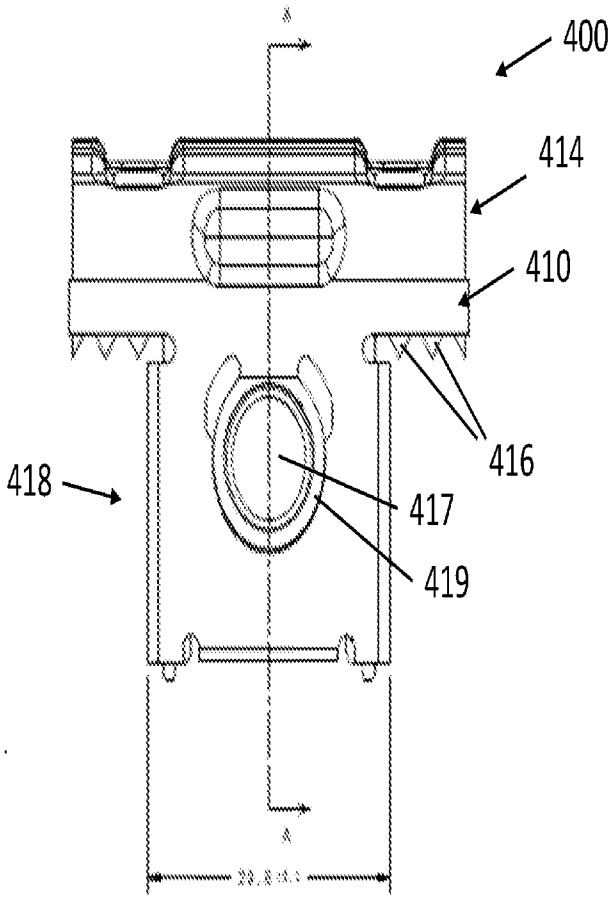


Fig. 4B

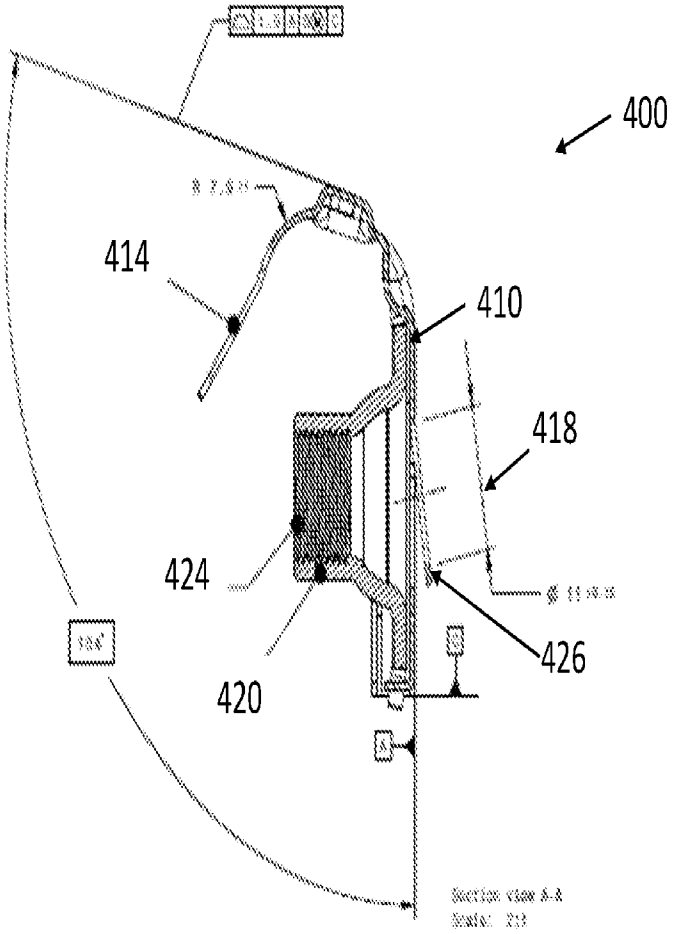


Fig. 4C

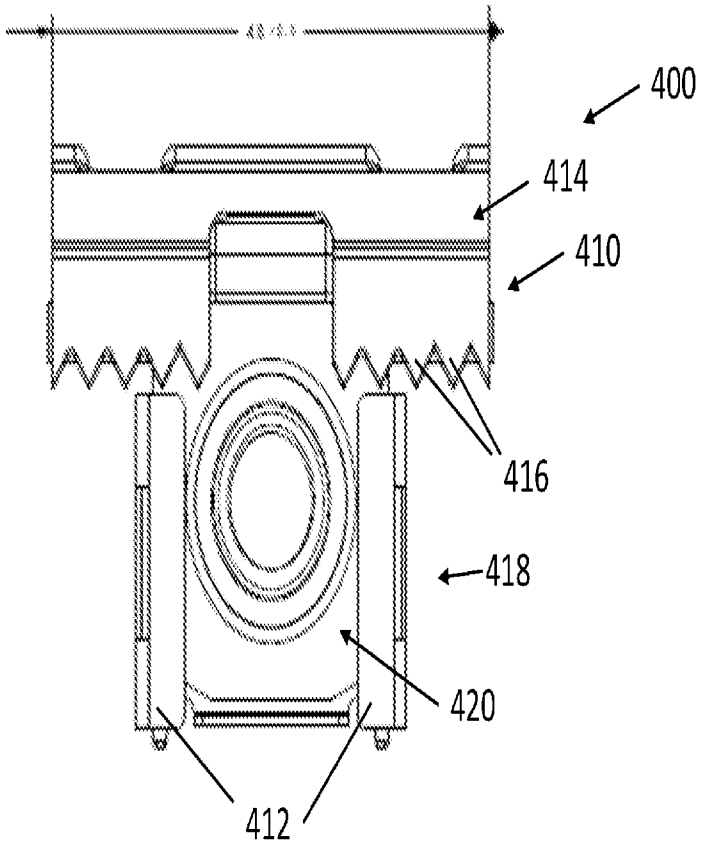


Fig. 4D

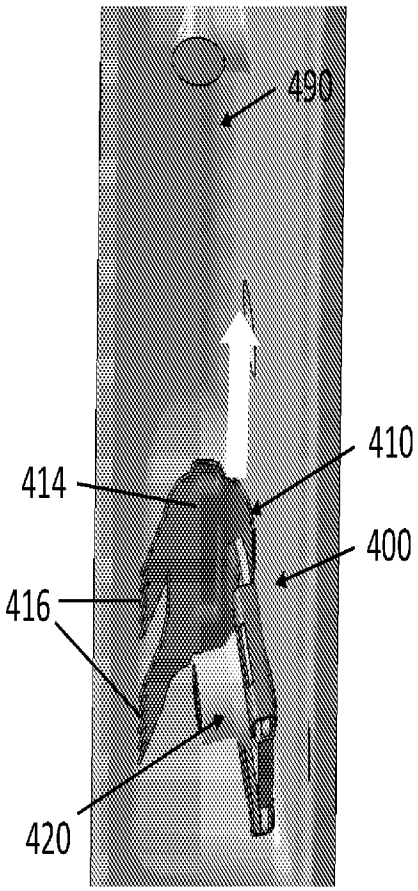


Fig. 4E

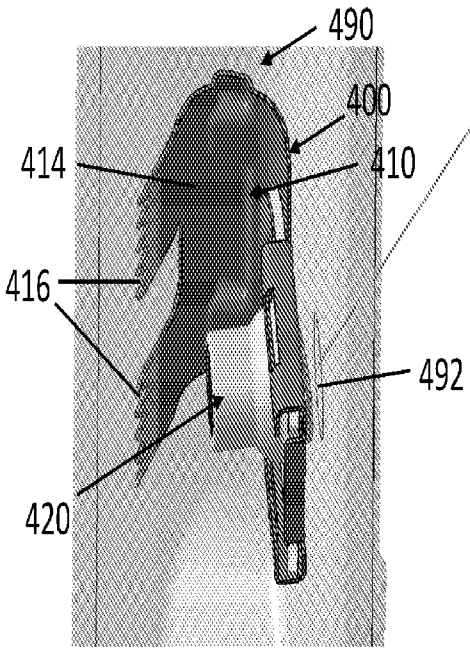


Fig. 4F

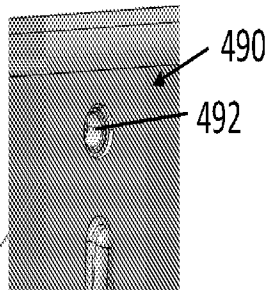


Fig. 4G

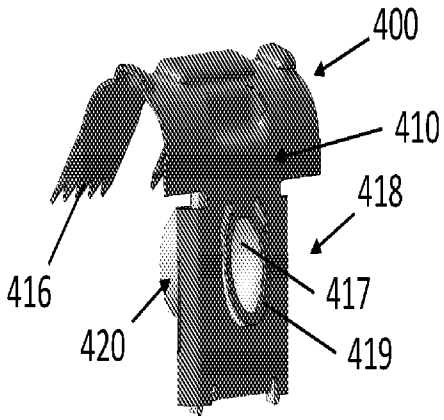


Fig. 4H

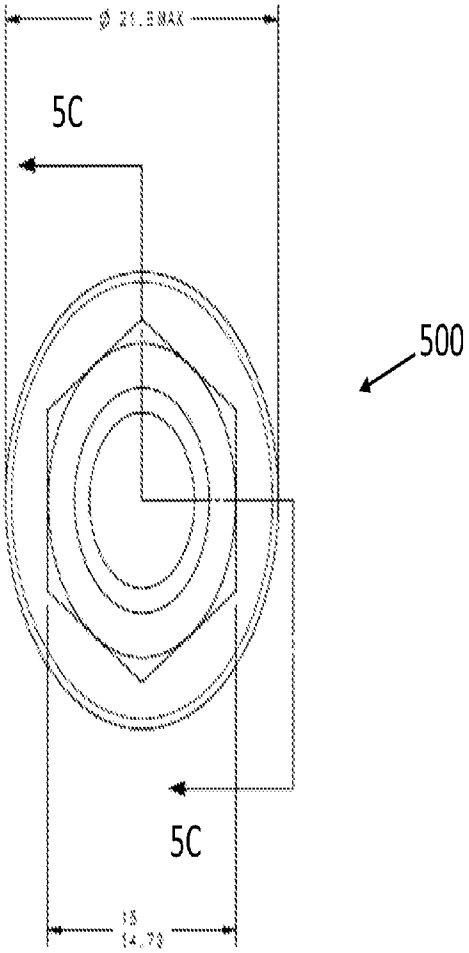


Fig. 5A

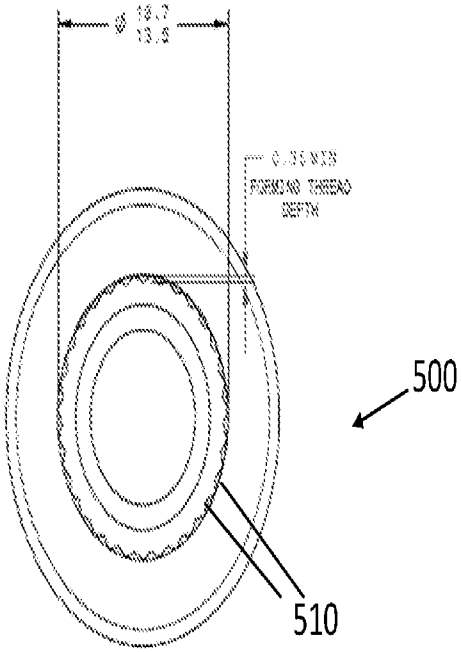


Fig. 5B

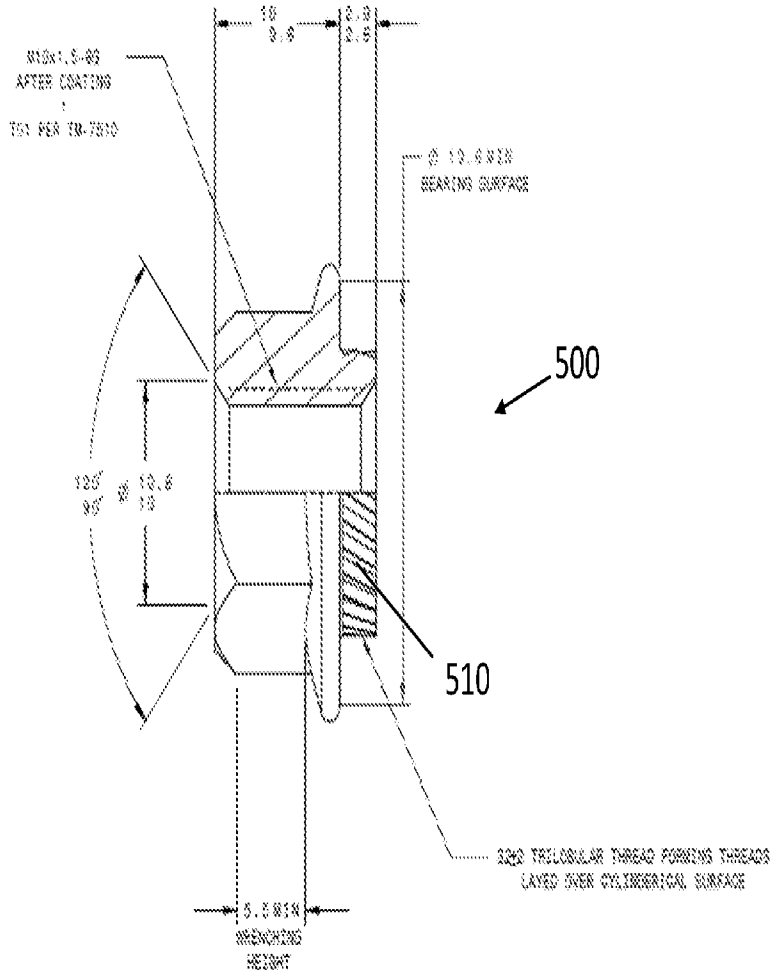


Fig. 5C

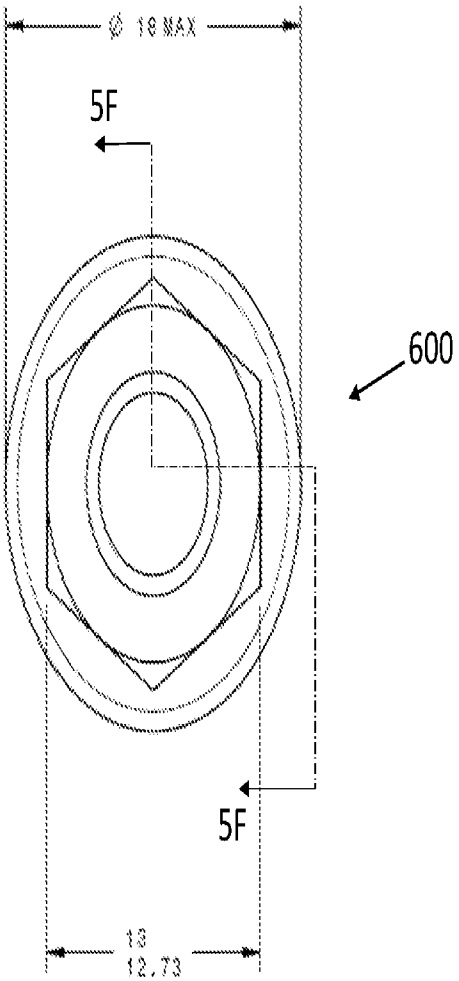

Ø 19 MAX
5F
600
5F
13
12.73

Fig. 5D

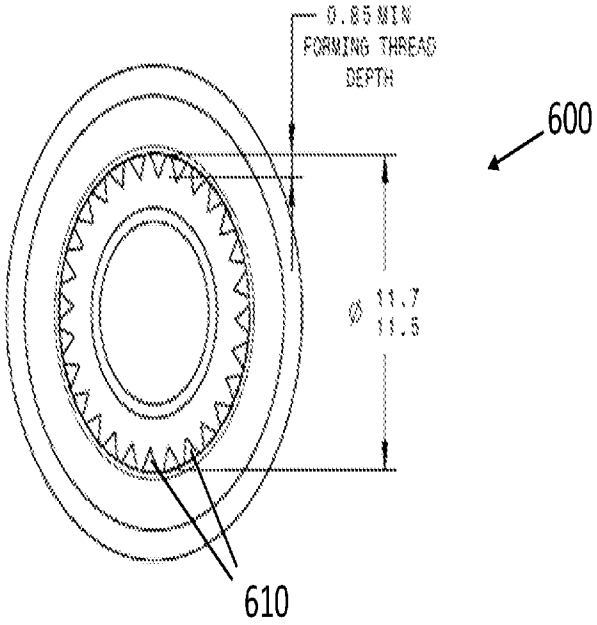

0.85 MIN
FORMING THREAD
DEPTH
600
Ø 11.7
11.5
610

Fig. 5E

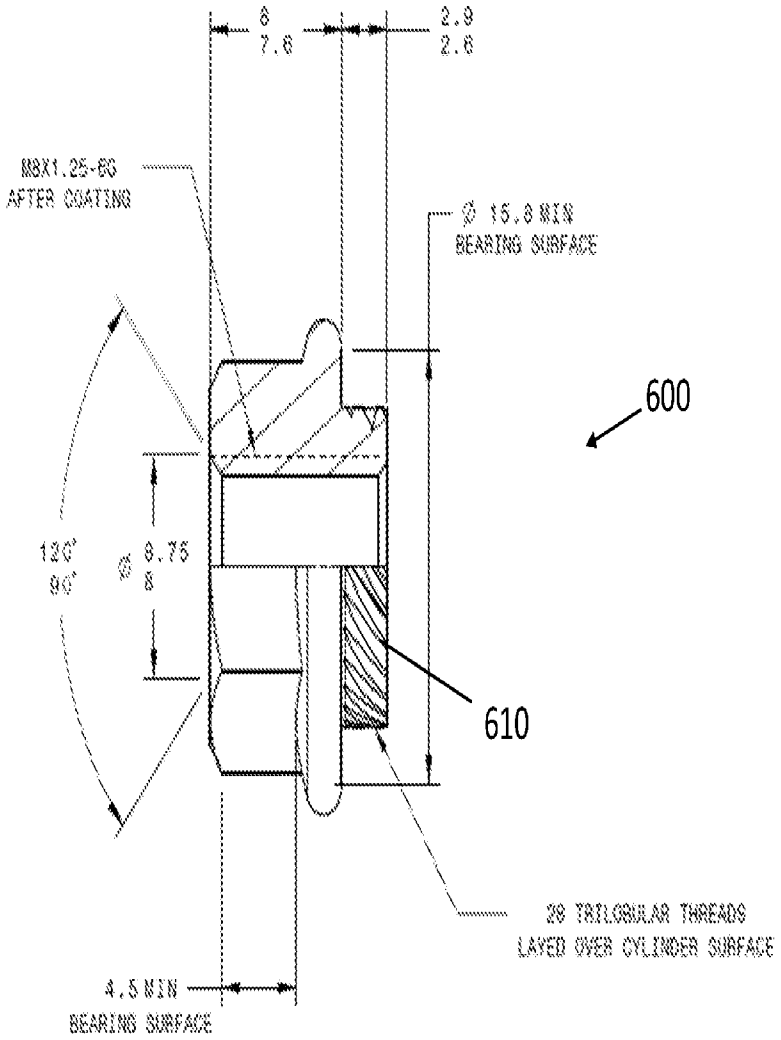

8
7.6
2.9
2.6
M8X1.25-6G
AFTER COATING
Ø 15.8 MIN
BEARING SURFACE
600
120°
90°
Ø 8.75
8
610
28 TRILOBULAR THREADS
LAYED OVER CYLINDER SURFACE
4.5 MIN
BEARING SURFACE

Fig. 5F

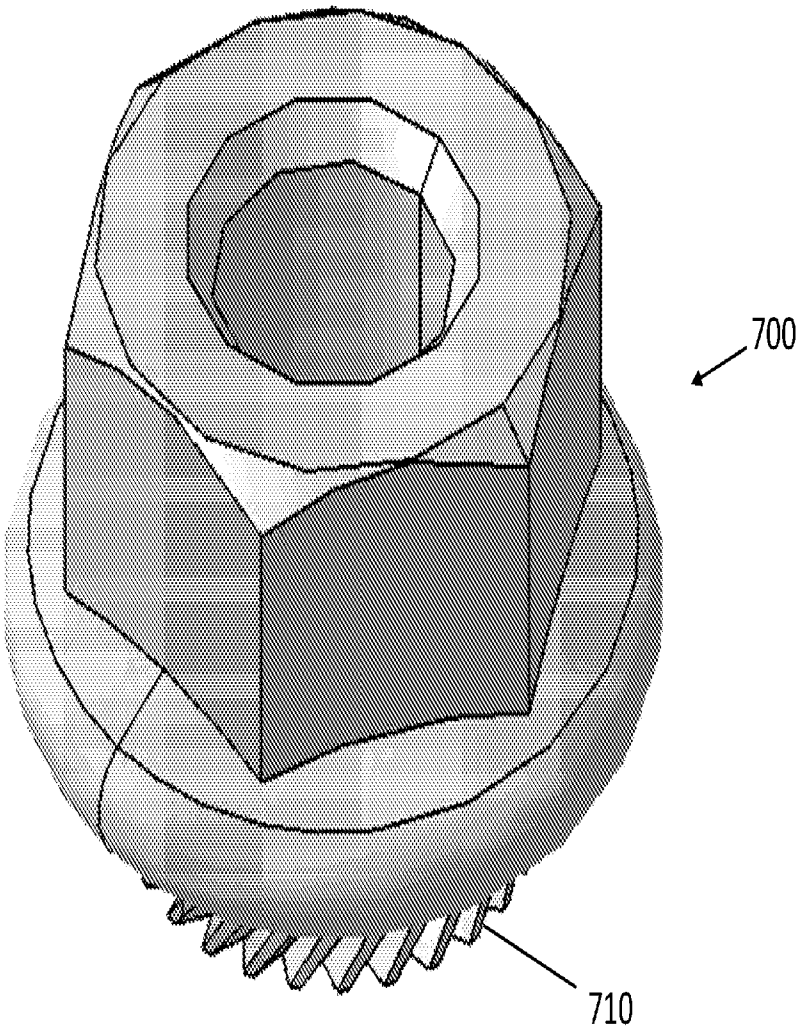


Fig. 6A

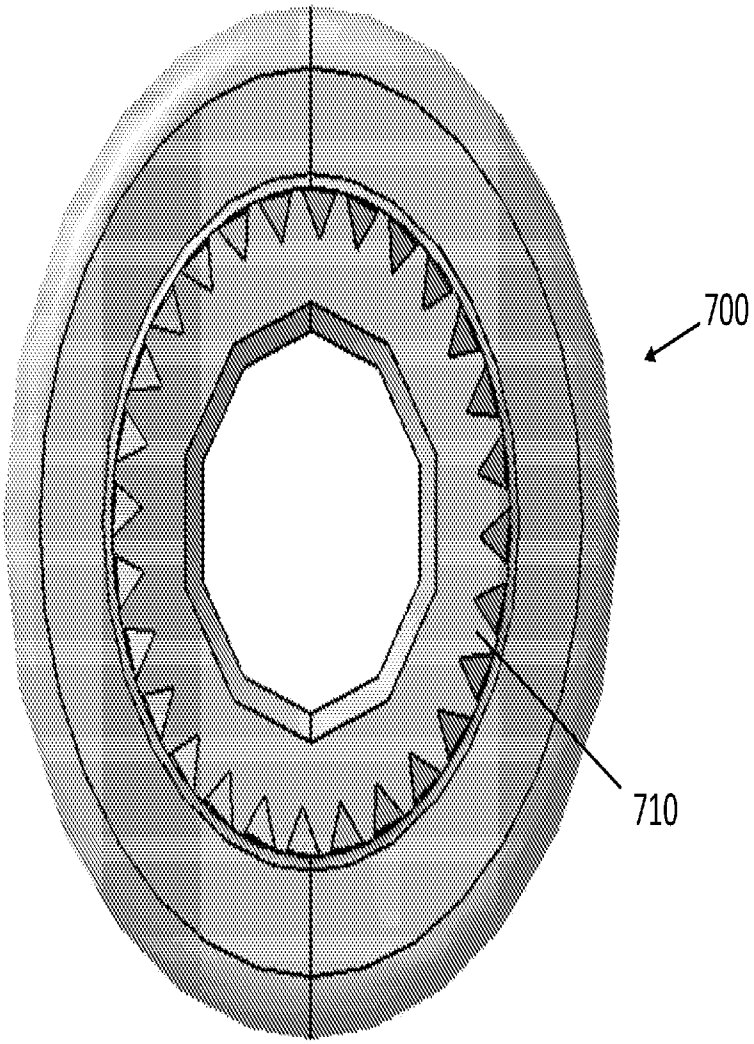


Fig. 6B

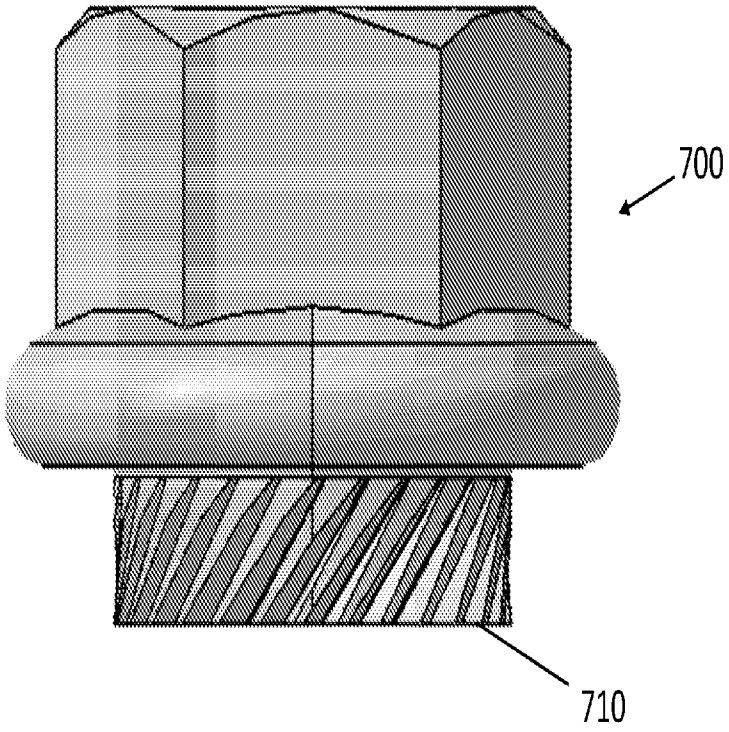


Fig. 6C

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2024/038549

A. CLASSIFICATION OF SUBJECT MATTER

INV. F16B21/08 F16B37/02 F16B37/04 F16B37/12 F16B39/282
F16B5/06 F16B21/07 F16B2/22

ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F16B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2007 026544 A1 (DAIMLER AG [DE]; ITW AUTOMOTIVE PROD GMBH & CO [DE]) 11 December 2008 (2008-12-11) paragraphs [0029] - [0043]; figures 1-8 -----	1,2

☐ 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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 October 2024	23/12/2024

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Sisinni, Giovanni

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2024/038549

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims;; it is covered by claims Nos.:
1, 2

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1, 2

   Hole plug

   ---

2. claim: 3

   Panel clip

   ---

3. claims: 4-13

   Clip nut

   ---

4. claims: 14-17

   Threaded nut

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2024/038549

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102007026544 A1	11-12-2008	NONE	