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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 December 2013 (27.12.2013)

WIPO | PCT

(10) International Publication Number
WO 2013/192558 A1

(51) International Patent Classification:
F16B 5/02 (2006.01)

(21) International Application Number:
PCT/US2013/047126

(22) International Filing Date:
21 June 2013 (21.06.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/663,372 22 June 2012 (22.06.2012) US

(71) Applicant: **ILLINOIS TOOL WORKS INC.** [US/US]; 3600 West Lake Avenue, Glenview, Illinois 60026 (US).

(72) Inventors: **TROTTER, Jason K.**; c/o Illinois Tool Works Inc., 3600 West Lake Avenue, Glenview, Illinois 60026 (US). **MARK, Dennis M.**; c/o Illinois Tool Works Inc., 3600 West Lake Avenue, Glenview, Illinois 60026 (US).

(74) Agent: **HAUPTMAN, Benjamin J.**; LOWE HAUPTMAN HAM & BERNER, LLP, 2318 Mill Road, Suite 1400, Alexandria, Virginia 22314 (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, 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, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, 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:

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

(54) Title: GROMMET ASSEMBLY

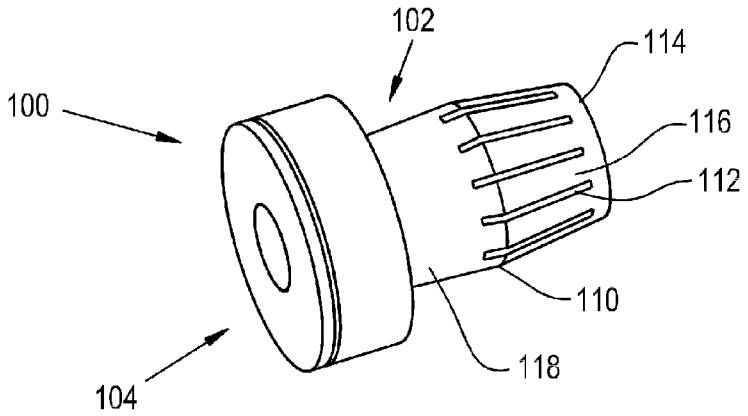

Fig. 1

(57) Abstract: An easy insert grommet assembly includes a grommet having a deformable portion near at least one end of the barrel, the deformable portion being mushroomed outwardly to form a flange after inserting the grommet into a structure. A second deformable portion can be used to form a second flange in similar manner. A compression limiter can be associated with the grommet.

WO 2013/192558 A1

GROMMET ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATIONS

[01] The present application claims the benefits of United States Provisional Application Serial No. 61/663,372, filed June 22, 2012.

FIELD OF THE INVENTION

[02] The present invention relates generally to insertable grommets, and, more particularly, to grommets used in panels, and, still more particularly, to grommets and compression limiters used with fasteners in automotive applications.

BACKGROUND OF THE INVENTION

[03] Grommets are used in many applications as isolators in mountings or connections of an assembly. In simple forms thereof, a grommet can be used to line an opening or hole, and may include a sleeve extending into or through the hole with a radially outwardly extending flange on at least one end of the sleeve, or on both ends of the sleeve. For enhanced isolation, flanges are provided at both ends of the sleeve, on opposite sides of an object to be mounted, such as a panel. A fastener placed through the grommet can be anchored in a second component. One flange of the grommet serves as an isolator between the head of the fastener and an outer surface of the first component, and the second flange of the grommet serves as an isolator between an opposite side of the first component and a confronting surface of the second component. Simple grommets such as this are sometimes referred to as an "H"-shaped grommet.

[04] Grommets have many applications in automotive assemblies, including relatively recent uses for securing sound deadening engine covers of plastic or the like on to cam covers and other structures of an automobile engine. The grommets serve to isolate the engine cover from the engine components and to limit the transmission of vibrations or sounds so that the engine cover functions to deaden noise from the engine.

[05] While grommets have been used for many years with success, they are not without disadvantages. Depending on the materials used, the required thickness and stiffness of the grommet, the relative sizes of the holes and the thickness of components, the length of the grommet and other factors, it is sometimes difficult to insert a grommet into its receiving hole. Particularly if the grommet has a large and/or stiff flange, forcing one of the flanges through the mounting hole can be both difficult and time consuming. If not fully inserted properly, the grommet can be distorted, making it difficult or impossible to insert the fastener; and a proper connection will not be created without the grommet properly positioned.

[06] Compression limiters are used in connections to limit the compressive force on components in the connection. For example, a compression limiter in a connection having a grommet can limit the compression applied against the flange or flanges of the grommet, so that a desired compression is achieved without over compression that may limit the effectiveness of the isolating properties for which the grommet is used.

SUMMARY OF THE INVENTION

[07] The easy insertion grommets disclosed herein are easy to assemble or insert from one side of a panel or other component by having a not-yet-formed or not-fully-formed flange at the lead end of the grommet that is placed into and through a hole in the panel or component. Without the flange fully formed, the grommet slides easily through the hole. The structure of the grommet includes a deformable portion that allows for compression of the grommet to create the flange on the lead end after the grommet has been fully inserted through the receiving hole. The grommet can include a compression limiter for clamping against, and can be provided in both two piece constructions with a grommet and compression limiter, and a three piece construction with a grommet, and a two-piece compression limiter. Each can be provided as a simple panel grommet, or can have a captured fastener included therewith, such as a captured nut or a captured bolt. A fixed flange can be provided at the head end of the grommet, or

a second deformable portion can be provided so that grommet flanges are formed at each grommet end upon axial compression of the grommet.

[08] In one aspect of a form thereof, a grommet assembly is provided with a grommet having a barrel, a first flange at one end of the barrel, and a deformable portion at an opposite end of the barrel from the first flange. A compression limiter extends into the barrel, and the deformable portion is adapted and configured for outward projection upon axial compression of the barrel, to form a second flange at the opposite end of the barrel.

[09] In another aspect of a form thereof, a grommet assembly is provided with a grommet having a barrel with an axial length and a first deformable portion near a first end of the barrel; and a compression limiter including a tube extending into the barrel and a radial flange at one end of the tube, the radial flange disposed outwardly of the barrel, and the tube having an axial length less than the axial length of the barrel. The deformable portion is adapted and configured to mushroom outwardly upon axial compression of the barrel, to form a grommet flange at the first end of the barrel.

[10] In still another aspect of a form thereof, a grommet assembly is provided with a grommet having a barrel, a first flange at one end of the barrel, and a segmented second flange at a deformable portion of the barrel at an opposite end of the barrel from the first flange. A compression limiter includes a tube extending into the barrel and a radial flange at one end of the tube, the radial flange disposed outwardly of the first flange at the one end of the barrel. The barrel has an uninstalled length longer then the length of the tube. An opposite end of the tube engages the opposite end of the barrel in the grommet assembly for holding the deformable portion in an outwardly mushroomed configuration.

[11] 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

[12] Fig. 1 is a perspective view of an easy insert grommet assembly;

[13] Fig. 2 is a perspective view of the grommet assembly inserted in a panel;

[14] Fig. 3 is a perspective view of the grommet assembly inserted in the panel, but illustrating the side opposite the side shown in Fig. 2;

[15] Fig. 4 is a cross-sectional view of the grommet assembly inserted in the panel;

[16] Fig. 5 is a cross-sectional view of the grommet;

[17] Fig. 6 is a an elevational view of the grommet;

[18] Fig. 7 is a cross-sectional view of a preassembled grommet and compression limiter;

[19] Fig. 8 is a cross-sectional view of another embodiment of the grommet;

[20] Fig. 9 is a cross-sectional view of yet another embodiment of the grommet;

[21] Fig. 10 is a cross-sectional view of the installation of a three piece grommet assembly;

[22] Fig. 11 is a cross-sectional view of another embodiment of the three piece grommet assembly;

[23] Fig. 12 is a cross-sectional view of an installation of the three piece grommet assembly shown in Fig. 11;

[24] Fig. 13 is a perspective view of a compression limiter;

[25] Fig. 14 is a perspective view of another embodiment of a compression limiter;

[26] Fig. 15 is an elevational view of a grommet;

[27] Fig. 16 is an elevational view of another embodiment of a grommet;

[28] Fig. 17 is a perspective view of an inner compression limiter piece;

[29] Fig. 18 is a cross-sectional view of yet another embodiment of a three piece grommet assembly;

[30] Fig. 19 is a cross-sectional view of a final installation of the three piece grommet assembly shown in Fig. 18;

[31] Fig. 20 is a cross-sectional view of a further embodiment of a three piece grommet assembly;

[32] Fig. 21 is a cross-sectional view of a still further embodiment of a three-piece grommet assembly18;

[33] Fig. 22 is an elevational view of yet another embodiment of a grommet;

[34] Fig. 23 is an elevational view of still another embodiment of a grommet;

[35] Fig. 24 is a perspective view of a yet further embodiment of a grommet assembly; and

[36] Fig. 25 is a cross-sectional view of the grommet assembly shown in Fig. 24, the grommet assembly being depicted in an installation with components held thereby.

[37] 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

[38] Referring now more particularly to the drawings, and to Fig. 1 in particular, an easy insertion grommet assembly 100 is shown, including a grommet 102 and a compression limiter 104. Grommet assembly 100 is depicted installed in a panel 150 (Figs. 2-4). Grommet 102 includes a head end 106 defining an outer radial flange 108. A sleeve or barrel 110 extends axially

from head end 106 and flange 108, and defines a generally cylindrical structure having an axial opening therethrough. Barrel 110 defines a plurality of circumferentially spaced, axially extending narrow elongate cutouts 112 inwardly from a lead end 114. Accordingly, a plurality of axially oriented bands 116 are defined between adjacent narrow elongate cutouts 112 and are commonly connected at opposite ends by lead end 114 at the distal ends of narrow elongate cutouts 112 and by a non-slit portion 118 of barrel 110 between radial flange 108 and the proximal ends of narrow elongate cutouts 112. As installed for use, radial bands 116 collectively form a segmented second flange 120

[39] It will be understood by those skilled in the art that compression limiter 104 is a generally cylindrical body that extends through the axial opening defined by barrel 110 of grommet 102, and compression limiter 104 also defines an axial opening therethrough for receiving a fastener. Compression limiter 104 further includes a radial flange 130 and a tube 132. At the lead or distal end of tube 132, a slight radial flange or foot 134 may be defined.

[40] Compression limiter 104 can be preassembled into grommet 102 by inserting the lead end of compression limiter 104 into the opening at the head end 106 of grommet 102, and forcing tube 132 into barrel 110 until radial flange 130 engages the outer surface of radial flange 108. Barrel 110 is of a length that is longer than the length of tube 132, so that foot 134 is at an intermediate position within barrel 132. This preassembled condition of grommet assembly 100 is illustrated in Fig. 7.

[41] In the use of grommet assembly 100, the preassembly of grommet 102 and compression limiter 104, is inserted through a hole 152 in panel 150 to form an installation 140 shown in Fig. 4. With radial flange 108 disposed against a first side 154 of panel 150 and held there against by hand, by tooling or by interference fit of the grommet in the panel, lead end 114 of barrel 110 is urged rearward and over the distal end or foot 134 of compression limiter 104. As lead end 114 is compressed rearward, bands 116 mushroom outwardly to thereby form segmented second flange 120 of grommet 102 on the opposite or second side 156 of panel 150. Grommet assembly 100 is thereby held in panel 150 by flange 108

engaged against first side 154 of panel 150 and segmented second flange 120 engaged against second side 156 of panel 150.

[42] It should be understood that in some situations and uses for grommet assembly 100 it may not be necessary to preassemble compression limiter 104 into grommet 102 before installing the preassembly into an article. Instead, grommet 102 can be installed in the article in which it is to be used, such as panel 150, and compression limiter 104 can be installed into grommet 102 with the grommet in place in the article. Thereafter, the completion of segmented second flange 120 can be performed as described previously.

[43] In the embodiment thus far described, the distal end of compression limiter 104 can define a slightly outwardly extending radial foot 134 for retaining the compressed form of grommet 102 depicted in Figure 4. Alternatively, the circumferential band defined by lead end 114 can establish an interference fit on compression limiter 104 to retain grommet 102 in the compressed form thereof. Axial compression of grommet 102 to form the mushroomed feature of segmented second flange 120 can be performed by hand, by tooling or can be established when a fastener is inserted through the grommet assembly previously installed in a panel and anchored in a second component to thereby draw panel 150 toward the second component. Axial compression of grommet 102 will thereby create the mushroomed form having segmented second flange 120 shown in Figure 4 as final fastening is established.

[44] To further facilitate retention of the compressed form of grommet 102, a radially inward enlargement 122 can be provided in the bore of grommet 102, at the distal end thereof, to better interfere and engage with tube 132 and radial flange or foot 134 of compression limiter 104.

[45] Figs 8 and 9 illustrate additional features that can be included in alternate embodiments of a grommet for the grommet assembly. In Fig. 8, a grommet 160 defines an outer flange 162 and a barrel 164. External notches 166 and an internal notch 168 are provided in barrel 164 at the desired locations of bending to mushroom the barrel outwardly to define the inner flange. The notches are areas of reduced thickness in barrel 164 that act as living hinges at the

specific locations. The notches allow the grommet barrel to fold over more easily at the desired locations. Barrel 164 can be solid, without axial cutouts therein.

[46] In the further embodiment shown in Fig. 9, a grommet 170 includes an outer flange 172 and a barrel 174 with external notches 176 and internal notches 178, substantially as described with respect to grommet 160 shown in Fig. 8. However, grommet 170 is formed so that barrel 174 is molded in a slight pre-bent shape to have a hip 180 to help with predictive compression and buckling of the grommet barrel and may also assist with retention in a panel or other structure such as panel 150 for ease of shipping, handling, assembly or swervicing.

[47] While Fig. 8 illustrates the use of notches only, and Fig. 9 illustrates the use of both notches and the pre-bent formation, it should be understood that the pre-bent formation can be used alone, without notches, and can provide more predictive buckling than a barrel with neither notches nor a pre-bent formation.

[48] Fig. 10 illustrates an installation 200 of a three-piece grommet assembly 202 with a bolt 204 to hold an engine cover 206 on a cam cover 208, the cam cover 208 defining a threaded opening 210 for threadedly engaging a threaded end 212 of bolt 204. Grommet assembly 202 includes a grommet 220 and a two-piece compression limiter including an outer compression limiter piece 222 and an inner compression limiter piece 224. Grommet 220 defines a permanently formed outer flange 226, a barrel 228 and an outwardly mushroomed inner flange 230, the inner flange 230 having been established as bolt 204 was tightened into cam cover 208 and outer compression limiter piece 222 and inner compression limiter piece 224 were drawn toward one another. Grommet 220 can be of any of the configurations described previously herein, including those having cutouts, those having notches and those having pre-shaped configurations for directing bending. Outer compression limiter piece 222 includes a radial flange 240 and a tube 242. Inner compression limiter piece 224 has an optional foot 244 and a tube 246.

[49] Yet another three piece grommet assembly is shown in Figs. 11-17. An installation 300 of this embodiment of a three-piece grommet assembly 302 can have a pre-installation of the grommet assembly 302 in a panel 306. Grommet assembly 302 includes a grommet 320 and a two-piece compression limiter including an outer compression limiter piece 322 and an inner compression limiter piece 324. Grommet 320 defines a permanently formed outer flange 326, a barrel 328 and an outwardly mushroomed inner flange 330, the inner flange 330 having been established as the grommet assembly is installed and compression limiter piece 322 and inner compression limiter piece 324 were drawn toward one another.

[50] Barrel 328 can include a plurality of axial cutouts 332 with defined axial bands 334 therebetween, substantially as described for the barrels, cutouts and bands of previous embodiments. An outer support ring 336 (Fig. 16) can be provided at the distal end of barrel 328. Grommet 320 also can be of any of the other configurations described previously herein, including those having notches in the barrels thereof and those having pre-shaped barrel configurations for directing bending.

[51] Outer compression limiter piece 322 includes a radial flange 340 and a tube 342. Inner compression limiter piece 324 has an optional foot 344 and a tube 346. Outer compression limiter piece 322 and inner compression limiter piece 324 are inserted into opposite ends of grommet 320. In a final assembled form, tube 342 of outer compression limiter piece 322 and tube 346 of inner compression limiter piece 324 slide telescopically past one another. It should be understood that various interference fit sizes and configurations, such as notches and depressions, or an enlarged interference ring 348 can be provided in the confronting surfaces of tubes 342 and 346, perhaps also with grommet 320, to hold the preassembled compression of grommet 320.

[52] Figs. 18 & 19 illustrate a further embodiment similar to that described for Figs 11-17, including grommet 320 and inner compression limiter piece 324. However, in this embodiment and an outer compression limiter piece

350 has an extended radial flange 352 and a tube 354, extended radial flange 352 being adaptable and deformable to capture a nut 360 as shown in Fig. 19.

[53] In Figure 20, a further grommet assembly is shown, which also is similar to grommet assembly 300 described previously and includes a grommet 320 and an inner compression limiter piece 324. An outer compression limiter piece 370 has a radial flange 372 and a tube 374, the tube 374 defining internal projections 376. A bolt 380 includes a head 382 and a shaft 384, with a circumferential, radially outward projecting ring 386 that can be forced past projections 376 so as to retain bolt 380 within the assembled grommet assembly.

[54] Fig. 21 illustrates a three-piece easy insertion grommet with retention features for retaining the assembly in a panel. A grommet assembly 400 includes a grommet 402 assembled with an outer compression limiter piece 404 and an inner compression limiter piece 406, substantially similar to those described previously. Grommet 402 includes an outwardly projecting knob or ring 408 to retain grommet 402 within a panel 410, along with outer compression limiter piece 404 and an inner compression limiter piece 406, which are assembled together with grommet 402. The retention feature established by ring 408 allows for pre-assembly of the grommet in a panel before handling and/or shipment for final use. It also retains the grommet in the panel during servicing.

[55] It should be understood that the various features described in Figs. 18-21 are not limited in use to the specific embodiments in which each is shown. Features for capturing a nut or a bolt, and features for securing the grommet in place can be applied to all of the various two-piece and three-piece grommet assemblies shown and described, as well as in other modifications thereof.

[56] Figs 22 & 23 illustrate modifications that can be made in the barrels for any of the grommets described previously herein. Grommet 420 includes an outer flange 422 and a barrel 424 with slits 426 therein rather than narrow elongate cutouts. Grommet 430 includes an outer flange 432 and a barrel 434 with slits 436 having circular cutouts 438 at the ends thereof to prevent tear propagation.

[57] In the embodiments thus far described, the grommets have included preformed, fixed outer flanges at the head end thereof and deformable portions that mushroom outwardly to form segmented inner flanges near an opposite and of the grommet, the mushrooming occurring during installation and tightening of a fastener with the grommet in an assembly. However, it should be understood that grommets having the various features described herein also can include multiple deformable regions to form more than a single flange by mushrooming the deformable regions outwardly as part of the installation process. Figs. 24 & 25 illustrated an installation 500 including a grommet assembly 502 with a bolt 504 to hold a first component 506 against a second component 508, the second component 508 defining a threaded opening 510 for threadedly engaging a threaded end 512 of bolt 504. Grommet assembly 502 includes a grommet 520 and a compression limiter 522. Compression limiter 522 includes a radial flange 524 and a tube 526. Grommet 520 is a tube or sleeve-like structure comprising a barrel 530. Barrel 530 defines a first plurality of circumferentially spaced, axially extending cutouts 532 near one end thereof and a second plurality of circumferentially spaced, axially extending cutouts 534 near the opposite end thereof. Accordingly, a first plurality of axially oriented bands 536 is defined between adjacent cutouts 532 and a second plurality of axially oriented bands 538 is defined between adjacent cutouts 534. Each of the pluralities of axially extending bands 536, 538 is compressed axially during final installation, whereby the bands mushroom outwardly, with bands 536 forming a first segmented flange 540 at one end of grommet 520 and bands 538 forming a second segmented flange 542 at the opposite end of grommet 520. It should be understood that the various other modifications described herein for the structures of grommets such as, for example and not limitation, the use of a radial inward enlargement such as enlargement 122, the use of external notches 166 and/or internal notches 168 and/or pre-bent shapes to include one or more hip 180 also can be incorporated as features of grommet 520. Further, the various other alternatives for features of compression limiters described previously herein, including the variations for both single piece and double piece compression

limiters and the fastener capturing features can be used together with or in place in place of compression limiter 522.

[58] It should be understood that the grommets described herein can be made of, for example, rubber, synthetic rubber, and other suitably malleable and deformable materials. The compression limiters described herein can be made of, for example, metals and other suitably rigid and strong materials.

[59] 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.

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

CLAIMS

WHAT IS CLAIMED IS:

1. A grommet assembly, comprising:

a grommet having a barrel, a first flange at one end of the barrel, and a deformable portion at an opposite end of the barrel from the first flange;

a compression limiter extending into the barrel; and

the deformable portion adapted and configured for outward projection upon axial compression of said barrel, and for forming a second flange at said opposite end of the barrel.

2. The grommet assembly of claim 1, said deformable portion of said barrel including axial cuts in the barrel.

3. The grommet assembly of claim 1, said compression limiter including an outer compression limiter piece and an inner compression limiter piece inserted into the barrel from opposite ends of the barrel.

4. The grommet assembly of claim 3, said outer compression limiter piece and said inner compression limiter piece configured for telescopic engagement, one inside of the other.

5. The grommet assembly of claim 1, said compression limiter including a radial flange outwardly of said first flange at one and of the barrel.

6. The grommet assembly of claim 5, said compression limiter including an outer compression limiter piece and an inner compression limiter piece inserted into the barrel from opposite ends of the barrel.

7. The grommet assembly of claim 1, said compression limiter including an outwardly extending foot at a distal end thereof.

8. The grommet assembly of claim 1, said deformable portion of said barrel including notches defining thinned regions in said barrel directing deformation of said barrel upon axial compression of said barrel.

9. The grommet assembly of claim 1, said barrel having an enlargement at a distal end thereof opposite said first flange.

10. The grommet assembly of claim 1, said compression limiter including a tube; a radial flange at one end of said tube, said radial flange disposed outwardly of said first flange at one end of said barrel; and an outwardly extending foot at an opposite end of said tube from said radial flange.

11. The grommet assembly of claim 1, said deformable portion of said barrel including axial slits with enlarged cutouts at each end of each slit.

12. The grommet assembly of claim 1, said grommet including an outward projection from said barrel.

13. The grommet assembly of claim 1, said compression limiter including an internal projection.

14. A grommet assembly, comprising:

a grommet having a barrel with an axial length and a first deformable portion near a first end of the barrel;

a compression limiter including a tube extending into said barrel and a radial flange at one end of said tube, said radial flange disposed outwardly of said barrel, and said tube having an axial length less than the axial length of said barrel; and

the deformable portion adapted and configured to mushroom outwardly upon axial compression of said barrel, and to form a grommet flange at said first end of the barrel.

15. The grommet assembly of claim 14, said grommet having a second deformable portion near a second end of said barrel, the second deformable portion adapted and configured to mushroom outwardly upon axial compression of said barrel, and to form a second grommet flange at said second end of the barrel.

16. The grommet assembly of claim 15, said first and second deformable portions including first and second pluralities of circumferentially spaced, axially extending cutouts in said barrel; said first and second pluralities of cutouts defining first and second pluralities of axially oriented bands, respectively; said first and second pluralities of axially oriented bands mushroomed outwardly to form first and second segmented flanges.

17. The grommet assembly of claim 14, said grommet having an outer fixed flange formed therein and positioned adjacent said flange of said compression limiter, and said deformable portion forming an inner segmented flange at an end of said grommet opposite said outer fixed flange.

18. A grommet assembly, comprising:

a grommet having a barrel, a first flange at one end of the barrel, and a segmented second flange at a deformable portion of said barrel at an opposite end of said barrel from the first flange;

a compression limiter including a tube extending into said barrel and a radial flange at one end of said tube, said radial flange disposed outwardly of said first flange at said one end of said barrel;

said barrel having an uninstalled length longer then the length of said tube; and

an opposite end of said tube engaging said opposite end of said barrel in said grommet assembly for holding said deformable portion in an outwardly mushroomed configuration.

19. The grommet assembly of claim 18, said tube including a radially outwardly extending foot at an end of said tube opposite said radial flange.

20. The grommet assembly of claim 18, said compression limiter including an outer compression limiter piece and an inner compression limiter piece engaged with one another in telescopic relationship.

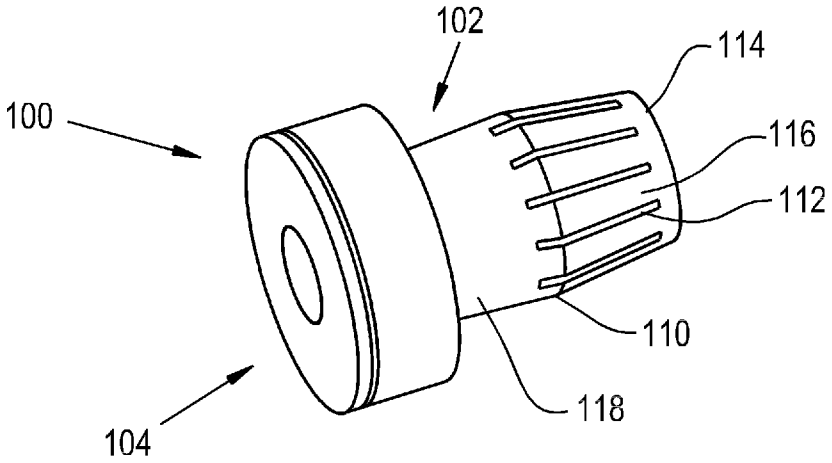

Fig. 1

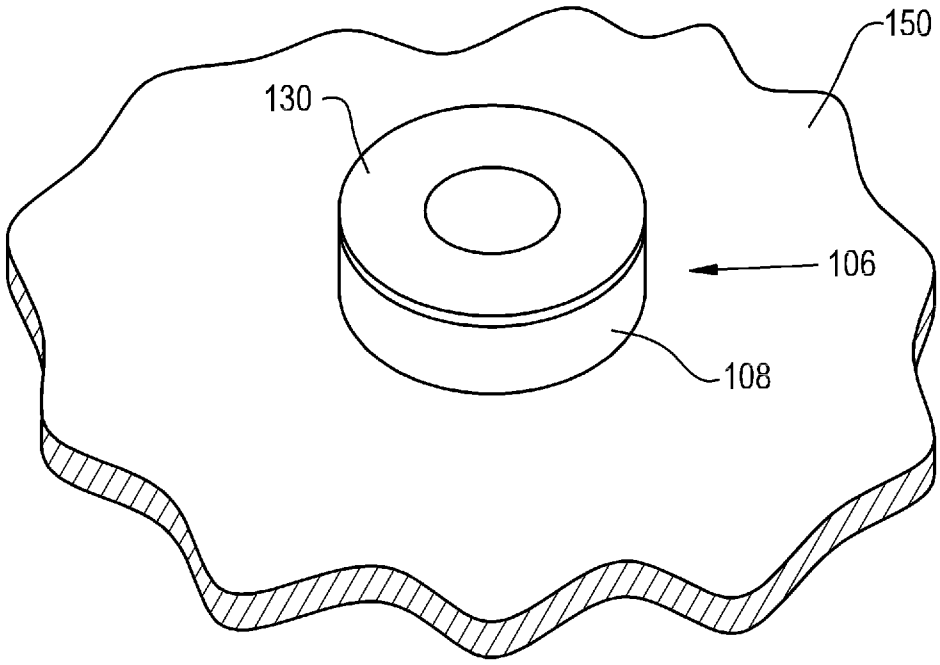

Fig. 2

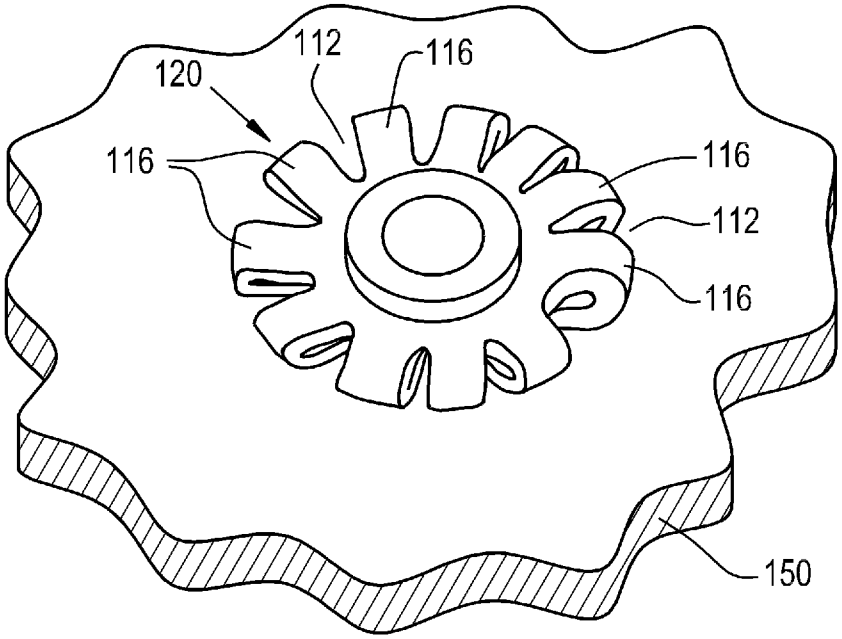
120
112
116
116
116
112
116
150

Fig. 3

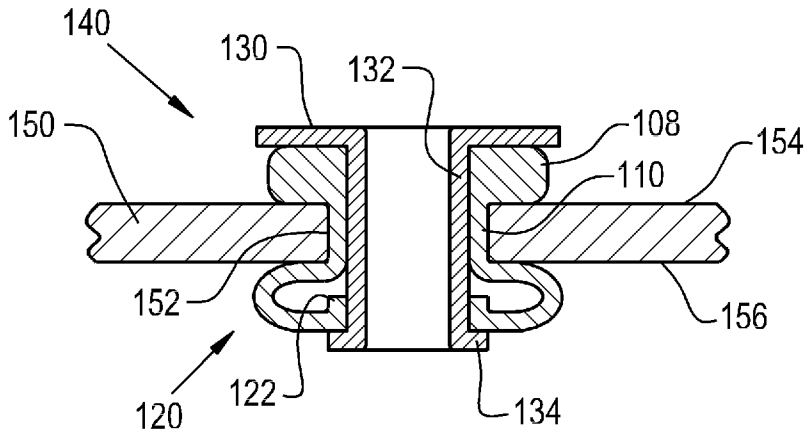
140
130
132
150
108
154
110
152
156
120
122
134

Fig. 4

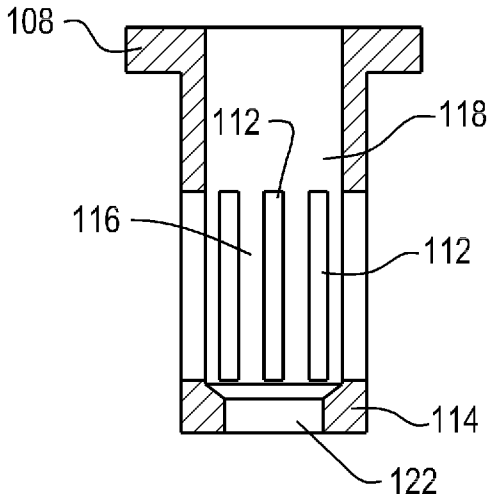

Fig. 5

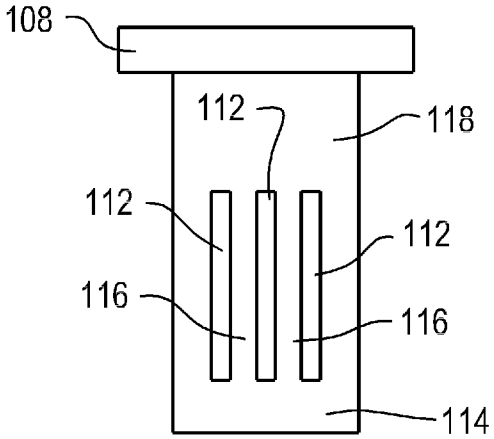

Fig. 6

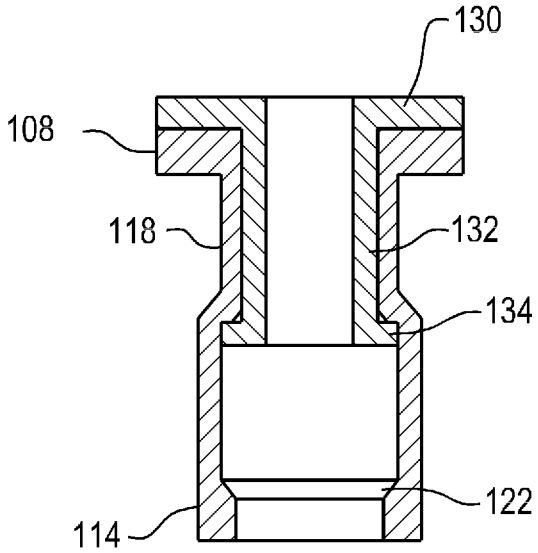

Fig. 7

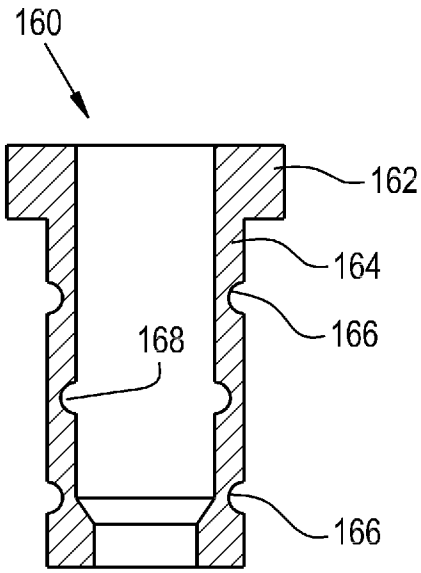

Fig. 8

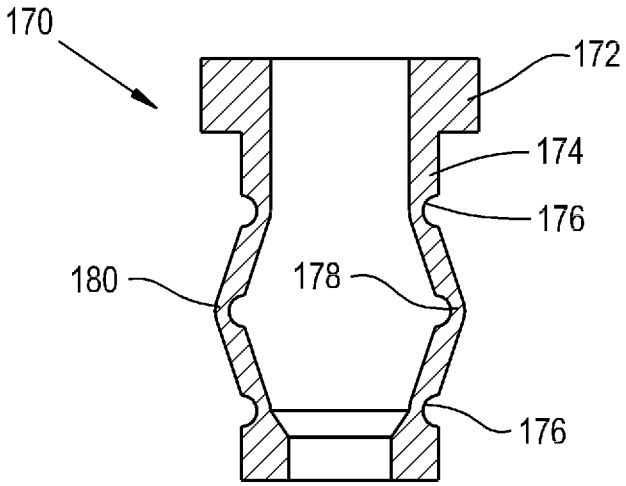
170
172
174
176
180
178
176

Fig. 9

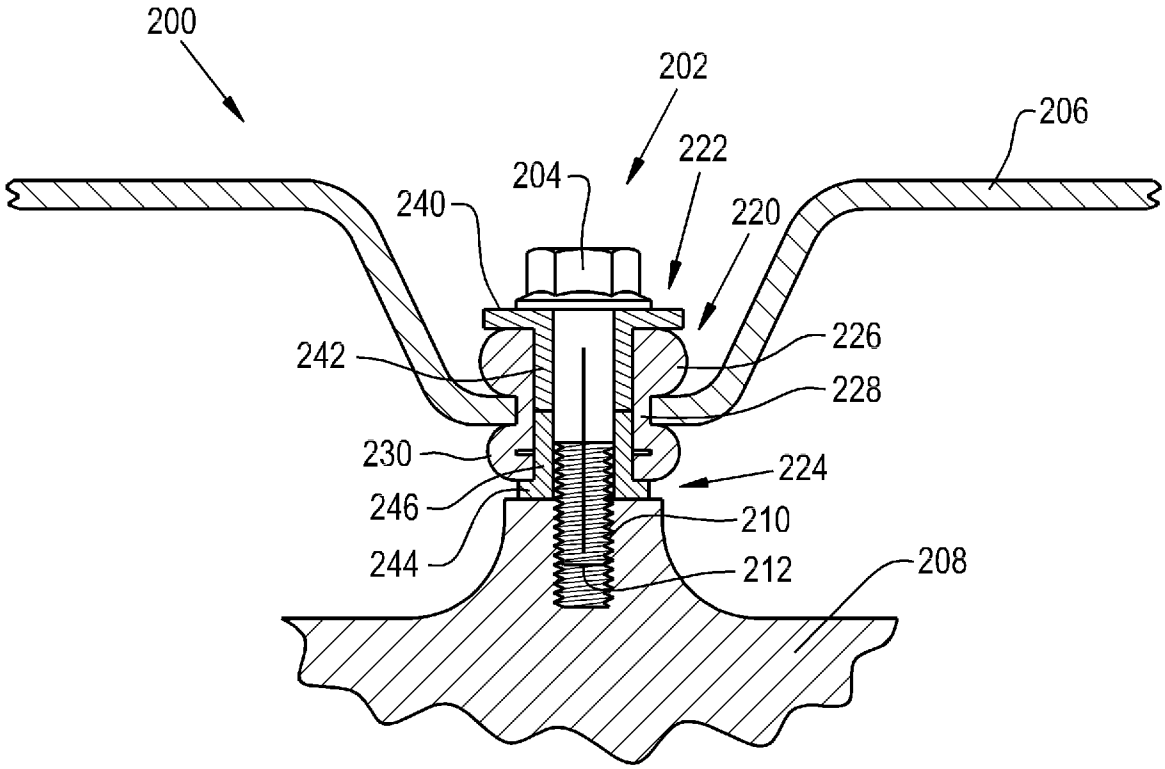
200
202
206
222
204
240
220
226
242
228
230
224
246
210
244
212
208

Fig. 10

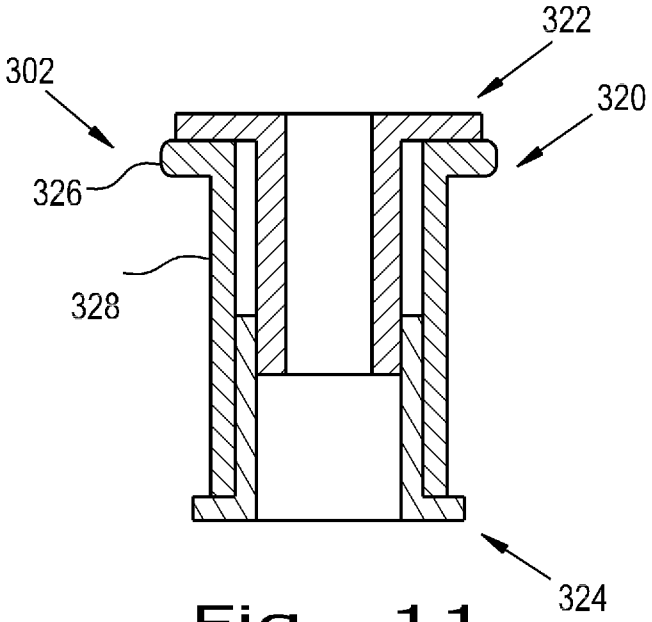

Fig. 11

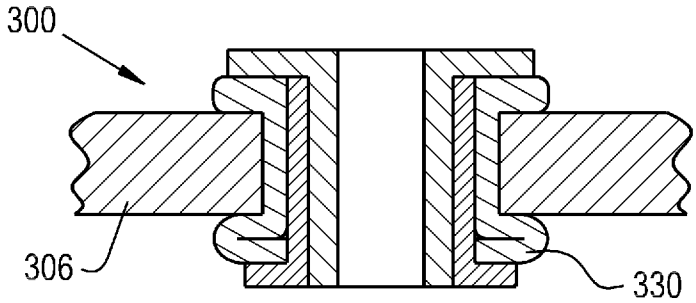

Fig. 12

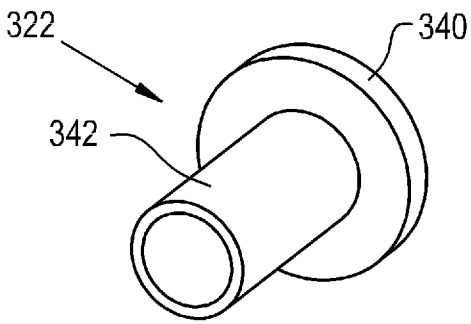

Fig. 13

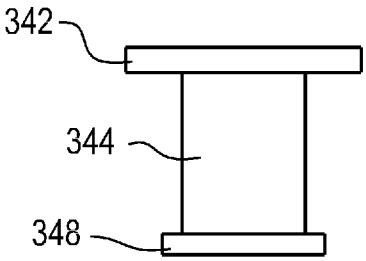

Fig. 14

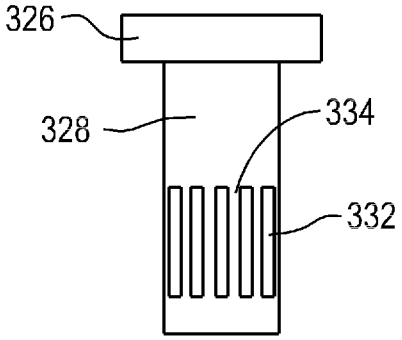

Fig. 15

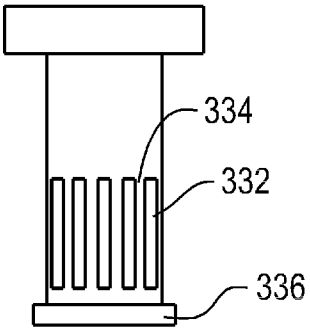

Fig. 16

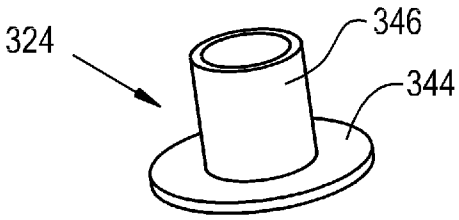

Fig. 17

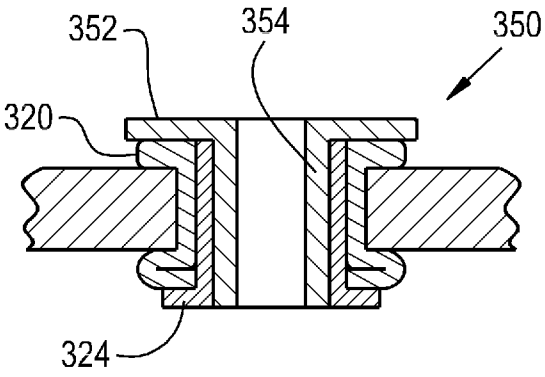

Fig. 18

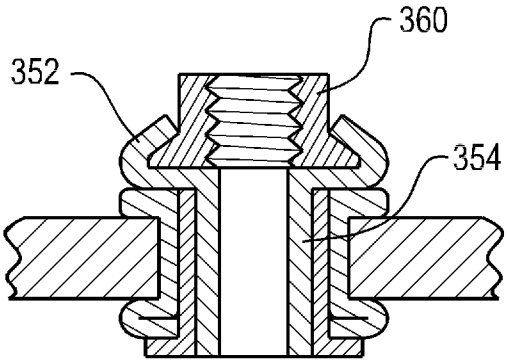

Fig. 19

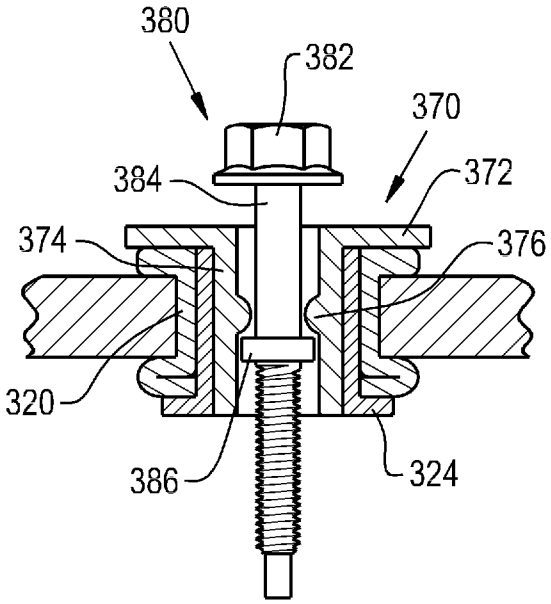

Fig. 20

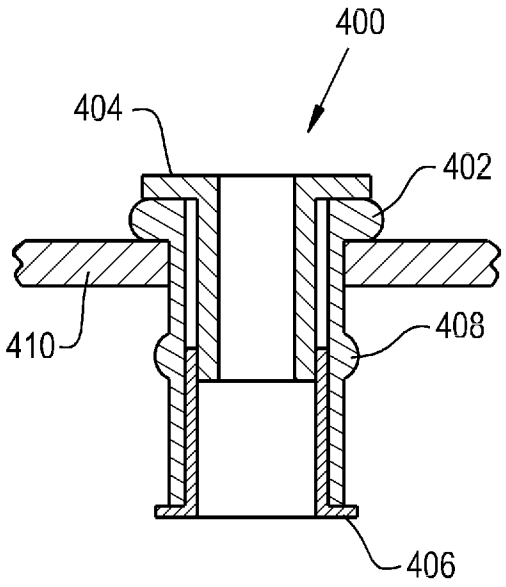

Fig. 21

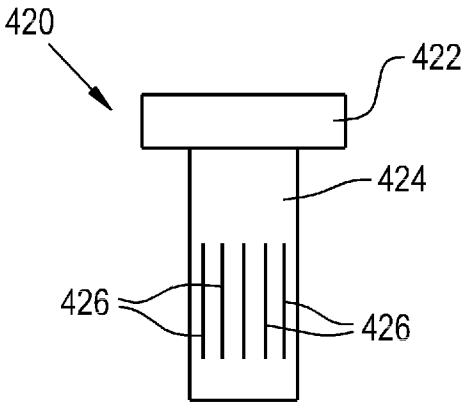

Fig. 22

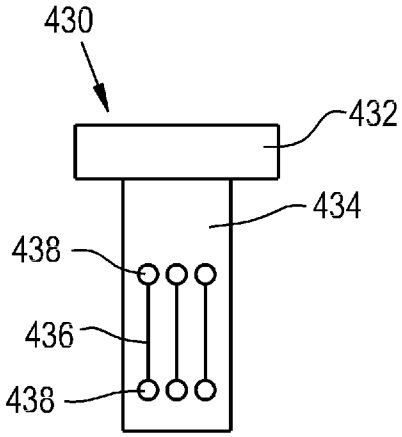

Fig. 23

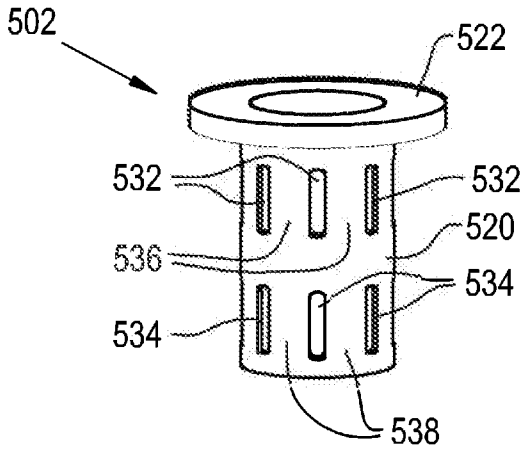
502
522
532
532
520
536
534
534
538

Fig. 24

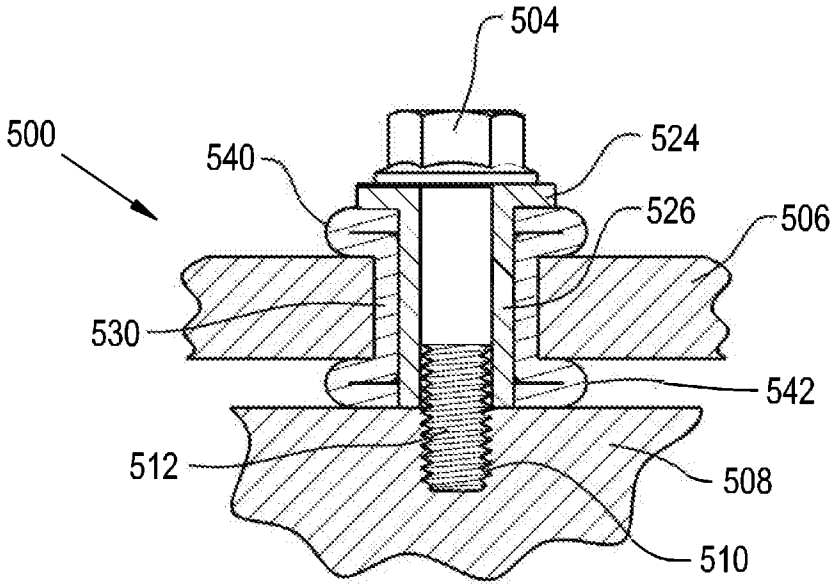
504
500
540
524
526
506
530
542
512
508
510

Fig. 25

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/047126

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16B5/02
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 F16F

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	US 3 128 999 A (SCHMITT REGIS V) 14 April 1964 (1964-04-14) figures 1-7	1,5,8,9, 12,14
X	US 3 013 643 A (PERRY PAUL E) 19 December 1961 (1961-12-19) figures 1,2	1,3,4,7, 12,14,15
A	EP 1 491 773 A1 (GAZ DE FRANCE [FR] GDF SUEZ [FR]) 29 December 2004 (2004-12-29) figures 1-3	1-20
A	US 3 479 081 A (SCHAAF HENRY W) 18 November 1969 (1969-11-18) figures 2,4	1-20
A	US 6 059 294 A (GORCE STEPHANE [FR]) 9 May 2000 (2000-05-09) figures 1-3	1-20

☐ 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
30 August 2013	06/09/2013

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	Huusom, Carsten

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2013/047126

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3128999 A	14-04-1964	NONE	
US 3013643 A	19-12-1961	GB 911006 A	21-11-1962
		US 3013643 A	19-12-1961
EP 1491773 A1	29-12-2004	AT 428057 T	15-04-2009
		EP 1491773 A1	29-12-2004
		ES 2325161 T3	27-08-2009
		FR 2856753 A1	31-12-2004
US 3479081 A	18-11-1969	NONE	
US 6059294 A	09-05-2000	DE 69612177 D1	26-04-2001
		DE 69612177 T2	23-08-2001
		EP 0781692 A1	02-07-1997
		FR 2743040 A1	04-07-1997
		US 6059294 A	09-05-2000