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(54) Title: CAPTIVE WASHER AND RELATED SCREW ASSEMBLY AND MANUFACTURING PROCESS OF A WASHER

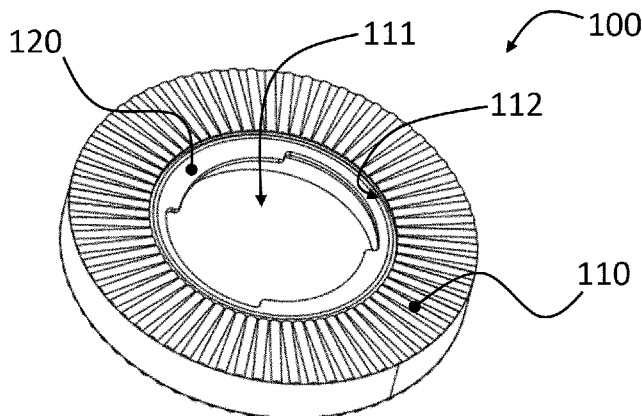


FIG. 1

(57) Abstract: A washer (100; 200) comprising a washer body (110; 210) having a hole (111; 211) for the passage of a screw stem (11) and comprising an internal seat (112; 212) circumferentially provided around the hole (111; 211). The washer (100; 200) further comprising an elastic insert (120; 220) housed in the internal seat (112; 212). The elastic insert (120; 220) is made of a metallic material and shaped with at least one projecting portion (121; 221) within the hole (111; 211). The at least one projecting portion (121; 221) is configured to cooperate by elastic interference with the screw stem (11). A related screw assembly comprising a screw (10) and a washer (100; 200). A related manufacturing process of a washer (100; 200).



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Title: Captive washer and related screw assembly and manufacturing process of a washer

DESCRIPTION

Technical field

- 5 The present invention relates to a washer. The present invention also relates to a screw assembly. The present invention also relates to a manufacturing process of a washer.

10 In general the present invention finds an application in the field of the devices for fixing or assembling constructive elements or parts of machines, such as screws or bolted junctions.

Prior art

In mechanics, a washer is a generally metallic small disc with a central hole, which is inserted between a nut or the head of a screw and the surface against which the assembly must be tightened.

- 15 In general a washer, also depending on its own geometrical features, allows:

- to distribute the clamping load on a wider surface, possibly preventing imprinting,
- to improve the clamping of the assembly, in particular avoiding the
20 unscrewing thereof and keeping the screw tensioned,
- to control the friction between the screw/nut and the surface,
- to act as a spacer.

The central hole of the washer allows the passage of an associated stem of a screw, in order to form an assembly.

In some known washers, the central hole has such a size and geometry as not to hinder the extraction of the stem, so that the washer be extracted may become unthreaded and 'get lost'.

5 Solutions exist to ensure a 'captivity', namely a condition in which the unthreading of the washer from the stem is prevented or impeded.

In some cases, the captivity of the washer is obtained due to the geometry of the screw or nut which the washer couples with.

10 Document US2192322(A) relates to a safety washer for a screw whose stem is equipped with a shoulder which is adjacent to the head with an edge portion which is bevelled towards the stem, in which the stem is then threaded, and a safety washer is inserted on the bevelled shoulder and driven into the resulting groove, where it stays due to its own elasticity.

15 Document US2303224(A) relates to a locking screw and washer assembly, in which the washer is kept permanently associated with the screw by a deformation of a threaded portion of the screw which is deviated from the normal helicoidal position thereof in order to ensure the washer retention.

20 In other cases, the captivity of the washer is obtained due to the geometry of the washer itself or of an element associated therewith, cooperating with the screw or nut.

25 Document US2277852(A) relates to a screw and washer assembly, in which the locking or spring washer is first positioned on the screw stem next to the head, and a thin washer is then applied, which is thus deformed to lock the locking or spring washer with respect to the screw thread.

Document US20180058494(A1) relates to a screw equipped with a flat washer and a rubber washer; the screw body comprises a cylindrical portion on which a groove is formed and a projection for locking in

engagement the flat washer.

Document CN205533672(U) relates to a screw and washer assembly; the washer hole is partially threaded to combine with the screw thread.

Document CN213575092(U) relates to a safety washer to be applied to a threaded stem of a screw, in which the washer comprises a stabilization groove formed within a locking groove, with a stabilization spring to combine the locking groove with a head of the screw and impede the loss of the washer during a fixation process.

Document US20190120281(A1) relates to a screw assembly comprising a fixation screw with a head in contact with a washer; in the washer opening through which the screw stem passes there is a coupling sleeve made of a metallic or plastic material with a U-shaped profile which radially opens outwards and is held in a jointed way with the washer; the junction sleeve has a plurality of clamping teeth which are radially projecting inwards and elastically adjustable which engage in an undercut of the fixation screw.

Summary of the invention

An object of the present invention is to overcome drawbacks of the prior art.

A particular object of the present invention is to provide a so-called 'captive' washer.

A further particular object of the present invention is to provide a captive washer which is couplable to a screw independently of the specific geometry of the latter.

A further particular object of the present invention is to provide a captive washer which can be assembled with no need to re-machine the screw which it is associated with.

These and other objects are achieved by a washer, a screw assembly

and a manufacturing process of a washer according to the features of the appended claims which form an integral part of the present description.

5 An idea underlying the present invention is to provide a washer equipped with an insert, which is pre-assembled by the manufacturer substantially forming a two-piece washer. The insert is metallic and it has such an elastic function as to allow the passage of the washer over the threaded part of a screw, while impeding it from escaping if it is subject to vibrations or jolts.

10 The invention provides a washer comprising a washer body having a hole for the passage of a screw stem and comprising an internal seat circumferentially provided around the hole. The washer further comprises an elastic insert housed in the internal seat. The elastic insert is made of a metallic material. The elastic insert is shaped with at least one projecting portion within the hole. The at least one projecting portion is configured to cooperate by elastic interference with the screw stem.

Moreover, the invention provides a screw assembly, comprising a screw and a washer. The screw has a screw stem with thread crests defining a nominal thread diameter. The washer has at least one projecting portion which defines an internal diameter of an elastic insert. The internal diameter of the elastic insert is smaller than the nominal thread diameter of the screw stem.

Moreover, the invention provides a manufacturing process of a washer. The manufacturing process comprises providing a washer body having a hole for the passage of a screw stem and comprising an internal seat circumferentially provided around the hole. The manufacturing process comprises housing an elastic insert in the internal seat, the elastic insert being made of a metallic material and shaped with at least one projecting portion within the hole, the at least one projecting portion being configured to cooperate by elastic interference with the screw

stem.

Advantageously, the present invention allows a particularly effective 'captive' washer to be provided.

Advantageously, the present invention provides a washer which is
5 couplable with a screw, possibly in a bolted junction, independently of
the specific geometry of the latter. For example, the washer can be
universal for each screw, with a same nominal diameter, without
requiring modifications or tuning. In particular, the washer of the
present invention is widely applicable, without limitations given by the
10 thread pitch, or by the fact that the screw is entirely or partially
threaded.

Advantageously, the washer of the present invention is effectively
couplable with a screw stem, both in a threaded part of the stem and in
an unthreaded part of the stem in case it is only partially threaded.

15 Advantageously, the present invention provides a washer which can be
assembled with no need to re-machine the screw, and without the aid of
particular equipment ("barehanded" in practice).

Advantageously, the elastic insert inserted in the appropriate seat of the
washer is not stiff as instead the threads are. The washer is thereby
20 axially held, but the elastic insert can advantageously remain free to
move in the radial direction and can rotate with respect to the axis of
the screw.

Advantageously, the elastic insert made of a metallic material helps in
recycling the component at the end of life; for example, in some
25 industries such as the automotive industry this recyclability is
fundamental ("*design for disassemble*"). Making the elastic insert of a
metallic material is also an indisputable advantage in terms of costs
with respect to some known solutions.

Preferably, the internal seat comprises an abutment portion for a rest of

the elastic insert, and a lip portion which is deformed within the hole in order to cooperate with the abutment portion, for housing the elastic insert.

5 Preferably, the lip portion is made by deformation of a circular crown or of a circular crown portion, of the washer body consisting of a metallic material. Preferably, the lip portion is made by plastic deformation.

Preferably, the elastic insert comprises a shaped flat leaf or it comprises a shaped wire spring, inserted in the respective internal seat.

10 Further features and advantages will be more apparent from the following detailed description of preferred non-limiting embodiments of the present invention, and from the dependent claims which outline preferred and particularly advantageous embodiments of the invention.

Brief description of the drawings

15 The invention is illustrated with reference to the following figures, given by way of non-limiting examples, in which:

- Figure 1 shows a washer in a first embodiment.
- Figure 2 shows an elastic insert of the washer of Figure 1.
- Figure 3 shows a sectional view of a washer body in the first embodiment.
- 20 – Figure 4 shows a sectional view of a washer body and of a related elastic insert in the first embodiment.
- Figure 5 shows an enlargement of a detail corresponding to Figure 4.
- Figures 6A, 6B, 6C, 6D show variants of the elastic insert in the
25 first embodiment.
- Figure 7 shows a screw assembly with a washer in the first

embodiment.

- Figure 8 shows an enlargement of a detail corresponding to Figure 7.
- Figures 9A, 9B, 9C, 9D show the assembly of a screw with a washer in the first embodiment.
- Figure 10 shows a washer in a second embodiment.
- Figure 11 shows an elastic insert of the washer of Figure 10.
- Figure 12 shows a sectional view of a washer body in the second embodiment.
- 10 – Figure 13 shows a sectional view of a washer body and of a related elastic insert in the second embodiment.
- Figure 14 shows an enlargement of a detail corresponding to Figure 13.
- Figure 15 shows an elastic insert in the second embodiment.
- 15 – Figure 16 shows a screw assembly with a washer in the second embodiment.
- Figure 17 shows an enlargement of a detail corresponding to Figure 16.
- Figures 18A, 18B, 18C, 18D show the assembly of a screw with a washer in the second embodiment.
- 20

In the different figures, analogous elements will be identified with analogous reference numbers.

Detailed description

Figure 1 shows a washer 100, which comprises a washer body 110

having a hole 111 for the passage of a stem of a screw (not represented).

The washer body 110 comprises an internal seat 112 (only partially visible in this figure) circumferentially provided around the hole 111.

5 The washer 100 further comprises an elastic insert 120 housed in the internal seat 112.

In this example, the washer 100 is provided with knurls, of the RIPPEN type, which prevent the disassembly of the bolted joint. However, the knurls might be absent in a variant.

10 Preferably, the washer body 110 is made of a metallic material such as steel, but it could also be made of a different material (such as aluminium, bronze, copper, titanium, etc.).

As will be described below, the washer 100 provides a leaf-like elastic insert 120, which is suitably shaped and inserted into the hole 111. Preferably the leaf 120 is separately sheared and it is then assembled
15 and locked in the washer body 110, in particular by a delicate riveting/plastic deformation operation.

Figure 2 shows the elastic insert 120, which is made of a metallic material and is shaped with projecting portions 121 within the hole 111. In particular, the elastic insert 120 comprises a shaped flat leaf.

20 The projecting portions 121 could consist of semi-annular portions which have an increased width in a profile of the leaf itself. In general, each of the one or more projecting portions 121 has a geometry which is adapted to create an internal diameter of the shaped flat leaf which is smaller than a nominal thread diameter of the screw stem.

25 There are one or more projecting portions in figure 121 which are shown with a semi-annular shape and diametrically opposed to each other in the elastic insert 120. The number of the projecting portions 121 could be increased depending on the elasticity which the designer

will want to give to the system, as well as the geometry thereof could be modified accordingly, as will be also described below with reference to Figures 6A, 6B, 6C, 6D.

5 The shaped flat leaf which defines the elastic insert 120 has in particular an annular closed substantially circular profile (or open, in variants which will be described hereafter).

As will be further described, the projecting portions 121 define an internal diameter which is smaller than the rest of the elastic insert 120, and they are such as to couple with the roots of a thread while
10 being able to have a check on the screw stem in a possibly unthreaded portion thereof.

By taking advantage of the elasticity of the metallic material of the elastic insert 120, the projecting portions 121 bend in the assembly step if they are subject to a force which pushes the washer 100 on a
15 corresponding screw, and by wedging into the root of the threads they lock the washer 100 on the screw, withstanding vibrations or jolts.

Figure 3 shows a sectional view of the washer body 110, in which the internal seat 112 is visible. The internal seat 112 comprises an abutment portion 113 configured for a rest of the elastic insert 120, as
20 will be further described.

Figure 4 shows a sectional view of the washer body 110 and of the related elastic insert 120 to form the washer 100, while Figure 5 shows an enlargement IV of a detail of Figure 4.

The internal seat 112 circumferentially extends on a substantially
25 cylindrical side wall of the washer body 110, which defines the hole 111. The internal seat 112 is substantially perpendicular to an axis of the hole 111 along which a screw stem is insertable.

The internal seat 112 further comprises a lip portion 114 which is deformed within the hole 111 and configured to cooperate with the

abutment portion 113 in order to house the elastic insert 120.

Therefore, the elastic insert 120 is held in the internal seat 112 on the one hand by the shoulder of the abutment portion 113 and on the other hand by the lip portion 114.

- 5 In particular, the lip portion 114 is made by deformation of a circular crown or a circular crown portion of the washer body 110. Preferably, the lip portion 114 is made by plastic deformation.

10 The leaf-like elastic insert 120 is assembled in the washer by mechanical deformation of the washer itself and, in addition or as an alternative, by a possible junction of material. In fact, for example rather than providing the lip portion 114, the elastic insert 120 could be joined to the abutment portion 113, by gluing or localized welding.

15 The elastic insert 120 is thus axially held in the washer 100, but free to move in the radial direction and free to rotate with respect to the axis of the hole 111.

As already described, the elastic insert 120 provides one or more projecting portions which are elastically deformable by applying a manual force which pushes the washer 100 on the screw.

20 The elastic insert 120 could be assembled to the washer body 110 even in a step following the shearing and the deformation of the latter to obtain the special seat 112. In particular, the external diameter of the elastic insert 120 could be smaller or greater than the diameter of the internal seat 112, depending on the geometry and the number of the projecting portions.

25 Variants 120b, 120c, 120d, 120e of the elastic insert 120 are represented in Figures 6A, 6B, 6C, 6D with one or more projecting portions 121 selected to decrease the stiffness of the elastic insert system, in favour of an ease of assembly of the washer 100 on the screw.

The projecting portions 121 could be formed with a half-moon shape, as in the embodiments 120c and 120d, or even simply like a little tooth or a tab as in the embodiments 120b and 120e.

5 In the variants 120c, 120d and 120e the shaped flat leaf defines a substantially circular profile, which is annular open, namely comprising a gap 123. The gap 123, or cut, in the profile of the elastic insert 120c, 120d and 120e allows the elasticity of the system to be optimized, both to aid the assembly of the elastic insert in the annular seat 112 of the washer, and to promote the elastic behaviour of the leaf-like elastic
10 insert when the washer assembly is assembled to the screw.

Figure 7 shows a screw assembly 10 with the washer 100, while Figure 8 shows an enlargement VII of a detail of Figure 7.

In these images, it is better understood that the one or more projecting portions 121 are configured to cooperate by elastic interference with the
15 screw stem 11.

In fact, the screw 10 has a screw stem 11 with thread crests 12 defining a nominal thread diameter 13. In particular, the thread crests 12 can be provided all along the screw stem 11 (which is thus completely threaded) or only along a portion of the screw stem 11 (which is thus
20 only partially threaded); in both cases, the one or more projecting portions 121 are configured to cooperate by elastic interference with the screw stem 11, in a threaded or unthreaded portion if any.

The projecting portions 121 of the washer 100 define an internal diameter of the elastic insert which is smaller than the nominal thread
25 diameter 13.

Preferably, the elastic insert 120 is further shaped with one or more indented portions 122 defining a greater diameter of the projecting portions 121 within the hole 111. The one or more indented portions 122 are particularly configured to allow a passage of the thread crests
30 12 of the screw stem 11 without interference.

Specifically, the elastic insert 120 is further shaped with indented portions 122 defining a second diameter of the elastic insert 120, the second diameter being greater than the nominal thread diameter 13.

5 In this regard, the indented portions 122 are configured to allow an unimpeded passage of the thread crests 12, whereas the projecting portions 121 are further configured for a passage of the thread crests 12 which is partially impeded by elastic interference.

10 In other words, the leaf 120 is designed with two internal diameters. In particular, the smaller internal diameter has one or more projecting portions 121 which are such as to interfere with the external diameter of the crest of the threads 13; the greater internal diameter of the leaf 120 in the area 122 where there are no projecting portions 121, is such as to be greater than the maximum external diameter 13 of the thread crests 12, so as to suitably limit the elastic interference in the assembly
15 step of the washer 100 on the screw 10, even to allow the assembly of the washer 100 on the screw without the aid of particular equipment.

The so-designed geometry enhances the elasticity of the system, allowing by a proper effort the washer 100 to be fitted on the screw 10, since the one or more projecting portions 121 of the elastic insert 120
20 bend while crossing the threads 12. Meanwhile, once the washer 100 is fitted onto the screw 10, it is not extracted by gravity or as a result of repeated vibrations, since the one or more projecting portions 121 of the elastic insert 120 wedge into the roots of the threads.

25 The right combination of the width of the projecting portions 121, the number of the projecting portions 121, together with the thickness of the leaf 120 define the overall elasticity of the system and thus the proper operation of the captive washer 100. In fact, the elasticity must be such as to allow the assembly on the screw 10 without an excessive effort, but while being such as to prevent an undesired disassembly.

30 Moreover, the geometry of the projecting portions 121 is so designed as

to interfere anyway with the thread root or with the stem of the screw 10. When the screw 10 is tightened, the insert 120 thereby applies an additional anti-unscrewing force on the screw itself.

5 Figures 9A, 9B, 9C, 9D illustrate the assembly of a screw 10 with a washer 100.

When fitting the screw 10 the elastic insert 120 bends against the thread crests so as to cross them (Fig. 9A). During the passage on the thread crest a slight rotation of the washer 100 and a transverse movement due to the fact that the elastic insert 120 will tend to orient
10 parallel to the thread plane (Fig. 9B) are possible. Once the elastic insert 120 has crossed the thread crest it returns in the rest position stretching (Fig. 9C). Finally, the elastic insert 120 leans in the rest position on the thread crest, impeding it from escaping if a suitable load which is capable of deforming the elastic insert 120 again is not applied
15 (Fig. 9D).

Figure 10 shows a washer 200, which comprises a washer body 210 having a hole 211 for the passage of a stem of a screw (not represented).

The washer body 210 comprises an internal seat 212 (only partially visible in the figure) circumferentially provided around the hole 211.

20 The washer 200 further comprises an elastic insert 220 housed in the internal seat 212.

In this example, the washer 100 is smooth and not provided with knurls; however, the knurls might be present in a variant.

Preferably, the washer body 210 is made of a metallic material such as
25 steel, but it could also be made of a different material (for example: aluminium, bronze, copper, titanium etc.).

In short, in this embodiment of the washer 200 provision is made to insert a suitably shaped wire spring 220 into the hole 211, which has a

dedicated seat 212 for housing it.

Figure 11 shows the elastic insert 220, which is made of a metallic material and is shaped with one or more projecting portions 221 within the hole 211. In particular, the elastic insert 220 comprises a shaped wire spring. The one or more projecting portions 221 preferably consist of internally curved portions in a profile of the shaped wire spring. Preferably, there are internally curved portions 221 distributed along the perimeter of the elastic insert 220. In variants, there could be one, two or more internally curved portions.

- 10 The shaped wire spring which defines the elastic insert 220 has in particular an annular open, substantially circular profile comprising a gap 223.

The shaped wire spring 220 can be assembled on the washer body 210 by riveting/deformation, as will be further described.

- 15 Similarly to what has been described for the washer 100, by taking advantage of the elasticity of the metallic material of the elastic insert 220, the one or more projecting portions 221 bend in the assembly step if they are subject to a force which pushes the washer 200 on a corresponding screw, and by wedging in the root of the threads they lock the washer 200 on the screw, withstanding vibrations or jolts.

Figure 12 shows a sectional view of the washer body 210, in which the internal seat 212 is visible. The internal seat 212 comprises an abutment portion 213 configured for a rest of the elastic insert 220, as will be further described.

- 25 Figure 13 shows a sectional view of the washer body 210 and of the related elastic insert 220 to form the washer 200, while Figure 14 shows an enlargement XIII of a detail of Figure 13.

The internal seat 212 circumferentially extends on a substantially cylindrical side wall of the washer body 210, which defines the hole

211. The internal seat 212 is substantially perpendicular to an axis of the hole 211 along which a screw stem is insertable.

The internal seat 212 further comprises a lip portion 214 which is deformed within the hole 211 and configured to cooperate with the abutment portion 213 in order to house the elastic insert 220.

Therefore, the elastic insert 220 is held in the internal seat 212 on the one hand by the shoulder of the abutment portion 213 and on the other hand by the lip portion 214.

In particular, the lip portion 214 is made by deformation of a circular crown or a circular crown portion of the body of the washer 210. Preferably, the lip portion 214 is made by plastic deformation.

Moreover, the washer 200 has similarities with the washer 100, according to what has already been described with reference to Figures 4 and 5.

Figure 15 exemplifies some features of the elastic insert 220, in which the shaped wire spring which defines the elastic insert 220 has an open annular profile comprising a gap 223. The gap 223 allows the diameter of the elastic insert 220 to be temporarily reduced, in order to insert it into the internal seat 212 after forming it on both sides (for example, by the deformation of the lip portion 214 or even in case the internal seat is obtained by machining or moulding).

In the assembly step of the washer 200 on the screw, the wire spring 220 enlarges also by taking advantage of the fact that it is open at the gap 223, allowing the washer 200 to cross the crest of the threads. With no forces being applied, the wire spring 220 returns at rest and wedges between the threads locking the washer 200 on the screw.

Similar features are found in the variants of the elastic insert 120c, 120d, 120e described with reference to Figures 6B, 6C, 6D.

Figure 16 shows a screw assembly 10 with the washer 200, while Figure 17 shows an enlargement XVI of a detail of Figure 16.

5 In these images, it is better understood that the projecting portions 221 are configured to cooperate by elastic interference with the screw stem 11.

In fact the screw 10 has a screw stem 11 with thread crests 12 defining a nominal thread diameter 13.

10 The projecting portions 221 of the washer 200 define an internal diameter of the elastic insert which is smaller than the nominal thread diameter 13.

Preferably, the elastic insert 220 is further shaped with one or more indented portions 222 defining a greater diameter of the projecting portions 221 within the hole 211. The one or more indented portions 222 are particularly configured to allow a passage over the thread crests 12 of the screw stem 11, without interference and thus limiting the required effort.

Specifically, the elastic insert 220 is further shaped with indented portions 222 defining a second diameter of the elastic insert 220, the second diameter being greater than the nominal thread diameter 13.

20 In this regard, the indented portions 222 are configured to allow an unimpeded passage of the thread crests 12, whereas the projecting portions 221 are further configured for a passage of the thread crests 12 which is partially impeded by elastic interference.

25 The assembly step of the washer 200 requires the wire spring 220 to be positioned in the seat 212 of the washer body 210. The external diameter of the wire spring 220 could be slightly smaller or greater than the diameter of the internal seat 212 depending on the need to keep the insert centred with respect to the washer and on the elasticity which is to be given to the system.

Moreover, the washer 200 has some similarities with the washer 100, according to what has already been described with reference to Figures 7 and 8.

5 Figures 18A, 18B, 18C, 18D illustrate the assembly of a screw 10 with a washer 200.

10 When fitting the screw 10 the elastic insert 220 is expanded sliding against the thread crests so as to cross them (Fig. 18A). During the passage on the thread crest the elastic insert 220 will tend to expand parallel to the plane of the thread (Fig. 18B). The elastic insert is thus able to pass crossing the thread crest; a slight rotation of the washer 200 and a transverse movement are anyway possible (Fig. 18C). Finally, the elastic insert 220 leans in the rest position on the thread crest, impeding it from escaping if a suitable load which is capable of deforming the elastic insert 220 again is not applied (Fig. 18D).

15 The present invention also relates to a related manufacturing process, intended for example to obtain the washers 100 or 200. In this regard, the features described with reference to the washers 100 or 200, or generally to the washer of the present invention, similarly apply to the manufacturing process according to the present invention.

20 Provision is made to provide a washer body 110 or 210 having a hole 111 or 211 for the passage of a screw stem 11 and comprising an internal seat 112 or 212 circumferentially provided around the hole 111 or 211.

25 Provision is made to house an elastic insert 120 or 220 in the internal seat 112 or 212; the elastic insert 120 or 220 is made of a metallic material and shaped with one or more projecting portions 121 or 221 within the hole 111 or 211; the one or more projecting portions 121 or 221 are configured to cooperate by elastic interference with the screw stem 11.

30 Preferably, provision is made to provide an abutment portion 113 or

213 in the internal seat 112 or 212, configured for a rest of the elastic insert 120 or 220, then to radially deform, at least partially, a lip portion 114 or 214 within the hole 111 or 211.

5 The lip portion 114 or 214 thereby cooperates with the abutment portion 113 or 213 in order to house the elastic insert 120 or 220. Preferably the deformation of the lip portion 114 or 214 occurs by plastic deformation.

10 The elastic insert 120 or 220 is inserted before the lip portion 114 or 214 is deformed. As an alternative, the elastic insert 120b or 220 is inserted after the lip portion 114 or 214 has been deformed, by taking advantage of a radial compression elasticity of the elastic insert 120b or 220 itself.

Still as an alternative, the internal seat 112 or 212 could be obtained by machining (thus, without deformation of the washer body 110 or 210).

15 Industrial applicability

The elastic insert in the washer of the present invention prevents the disassembly thereof due to vibrations or to the sole force of gravity, since deformable projecting portions wedge in the roots of a thread, locking the washer on the related screw in the rest position.

20 The elastic inserts have projecting portions with such a diameter as to interfere with the crests of the screw thread; at the same time the elastic insert has also some areas with a greater diameter with respect to the thread crests, in order to allow the crossing thereof. After crossing the projecting portions return in the neutral position and
25 wedge in the thread roots, preventing the disassembly of the washer due to the movement or to simple vibrations. The alternation and succession of the geometries of the projecting portions, which are suitably selected, define the elasticity of the system and thus the possibility to modulate the force required to assemble the washer on the
30 screw and the retaining force and thus to achieve the aim of making the

washer 'captive'.

Moreover, the elastic insert, interfering with the screw once it is tightened, generates an additional sliding force, a further hindrance to the loosening of the bolted joint. The elastic insert is selected so as to
5 have a spring return which is suited to the application.

Considering the here-quoted description, the skilled in the art will be allowed to bring further modifications and variants, in order to meet contingent and specific requirements.

It is evident that, where there are no technical incompatibilities which
10 are clear to the skilled in the art, the configurations of specific elements described with reference to certain embodiments, could be used in other here-described embodiments.

For example, the washer could be made flat, as in the here-represented embodiments, but it could also be made conical, with or without knurls
15 which prevent the disassembly of the bolted joint.

For example, an elastic insert positioned within the washer, which allows the assembly on the bolt but prevents the undesired disassembly, can also be developed with other geometries with respect to what is shown here, to give the designer the possibility to select the
20 optimum solution for the specific application, for example depending on a miniaturization or enlargement of the system.

The here-described embodiments are therefore to be understood as illustrative and non-limiting examples of the invention.

CLAIMS

1. Washer (100; 200) comprising a washer body (110; 210) having a hole (111; 211) for the passage of a screw stem (11) and comprising an internal seat (112; 212) circumferentially provided around said hole (111; 211), said washer (100; 200) further comprising an elastic insert (120; 220) housed in said internal seat (112; 212), said elastic insert (120; 220) being made of a metallic material and shaped with at least one projecting portion (121; 221) within said hole (111; 211), said at least one projecting portion (121; 221) being configured to cooperate by elastic interference with said screw stem (11).
2. Washer according to claim 1, wherein said internal seat (112; 212) comprises an abutment portion (113; 213) configured for a rest of said elastic insert (120; 220), and further comprises a lip portion (114; 214) deformed within said hole (111; 211) and configured to cooperate with said abutment portion (113; 213) housing said elastic insert (120; 220).
3. Washer according to claim 2, wherein said lip portion (114; 214) is made by deformation of a circular crown or a circular crown portion of a metallic material of said washer body (110; 201), in particular being made by plastic deformation.
4. Washer according to any one of claims 1 to 3, wherein said internal seat (112; 212) circumferentially extends on a substantially cylindrical side wall defining said hole (111; 211), said internal seat (112; 212) being substantially perpendicular to an axis of said hole (111; 211) along which said screw stem (11) is inserted.
5. Washer according to any one of claims 1 to 4, wherein said elastic insert (120; 220) is further shaped with at least one indented portion (122; 222) defining a diameter which is greater than said at least one projecting portion (121; 221) within said hole, said at least one indented portion (120; 220) being configured to allow a passage of thread crests (12) of said screw stem (11).

6. Washer according to any one of claims 1 to 5, wherein said elastic insert (120; 120b; 120c; 120d; 120e) comprises a shaped flat leaf.
7. Washer according to claim 6, wherein said shaped flat leaf (120; 120c; 120d; 120e) comprises a plurality of projecting portions (121) each having a geometry adapted to create an internal diameter of said shaped flat leaf (120; 120c; 120d; 120e), said internal diameter being smaller than a nominal thread diameter (13) of said screw stem (11).
8. Washer according to claim 6 or 7, wherein said shaped flat leaf (120; 120b; 120c; 120d; 120e) defines an annular closed or annular open, substantially circular profile comprising a gap (123).
9. Washer according to any one of claims 1 to 5, wherein said elastic insert (220) comprises a shaped wire spring.
10. Washer according to claim 9, wherein said shaped wire spring comprises said at least one projecting portion (221) consisting of one or more internally curved portions in a profile of said shaped wire spring.
11. Washer according to claim 9 or 10, wherein said shaped wire spring defines an annular open, substantially circular profile comprising a gap (223).
12. Screw assembly, comprising a screw (10) having a screw stem (11) with thread crests (12) defining a nominal thread diameter (13), and further comprising a washer (100; 200) according to any one of claims 1 to 11, wherein said at least one projecting portion (121; 221) defines an internal diameter of said elastic insert (120; 220), said internal diameter being smaller than said nominal thread diameter (13).
13. Screw assembly according to claim 12, wherein said thread crests (12) are provided all along said screw stem (11) or along a portion of said screw stem (11).
14. Screw assembly according to claim 12 or 13, wherein said elastic

insert (120; 220) is further shaped with at least one indented portion (122; 222) defining a second diameter of said elastic insert (120; 220), said second diameter being greater than said nominal thread diameter (13), said at least one indented portion (122; 222) being configured to allow an unimpeded passage of said thread crests (12), said at least one projecting portion (121; 221) being further configured for a partially impeded passage of said thread crests (12) by elastic interference.

15. Manufacturing process of a washer (100; 200), said manufacturing process comprising:

10 - providing a washer body (110; 210) having a hole (111; 211) for the passage of a screw stem (11) and comprising an internal seat (112; 212) circumferentially provided around said hole (111; 211),

- housing an elastic insert (120; 220) in said internal seat (112; 212), said elastic insert (120; 220) being made of a metallic material and shaped with at least one projecting portion (121; 221) within said hole, said at least one projecting portion (121; 221) being configured to cooperate by elastic interference with said screw stem (11).

16. Manufacturing process according to claim 15, further comprising:

- providing an abutment portion (113; 213) in said internal seat (112; 212), configured for a rest of said elastic insert (120; 220),

- providing a lip portion (114; 214) within said hole (111; 211),

- at least partially radially deforming said lip portion (114; 214) in order to cooperate with said abutment portion (113; 213) and to house said elastic insert (120; 220), preferably deforming by plastic deformation.

17. Manufacturing process according to claim 16, wherein said lip portion (114; 214) is deformed before or after said elastic insert (120; 220) has been housed in said internal seat.

18. Manufacturing process according to claim 15, wherein said internal

seat (112; 212) is made by machining.

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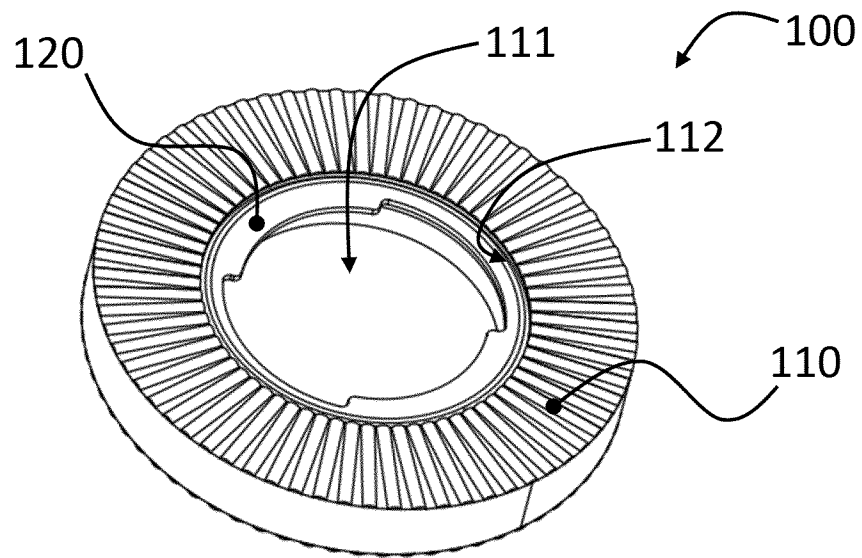


FIG. 1

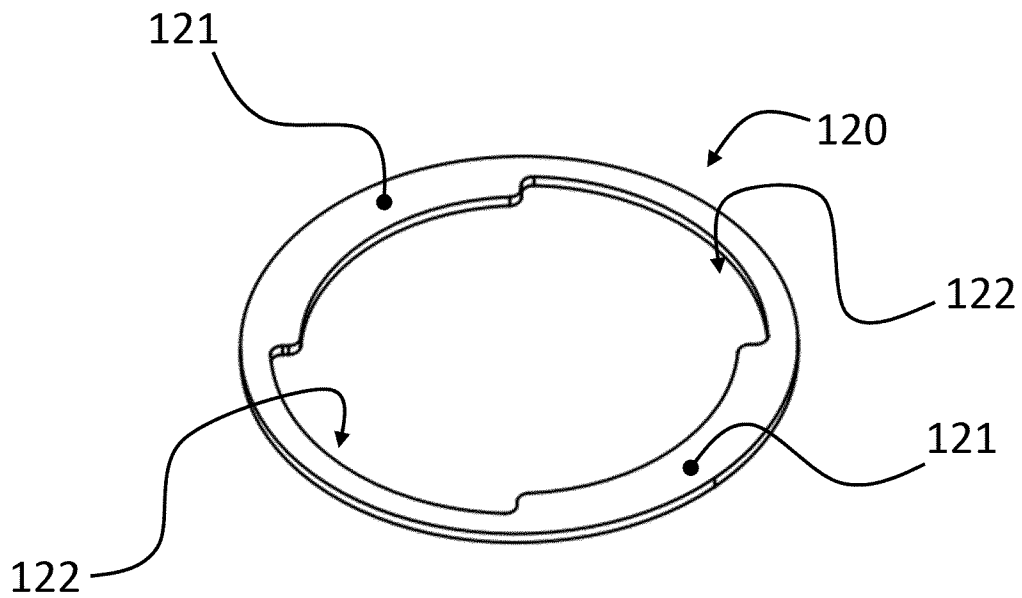


FIG. 2

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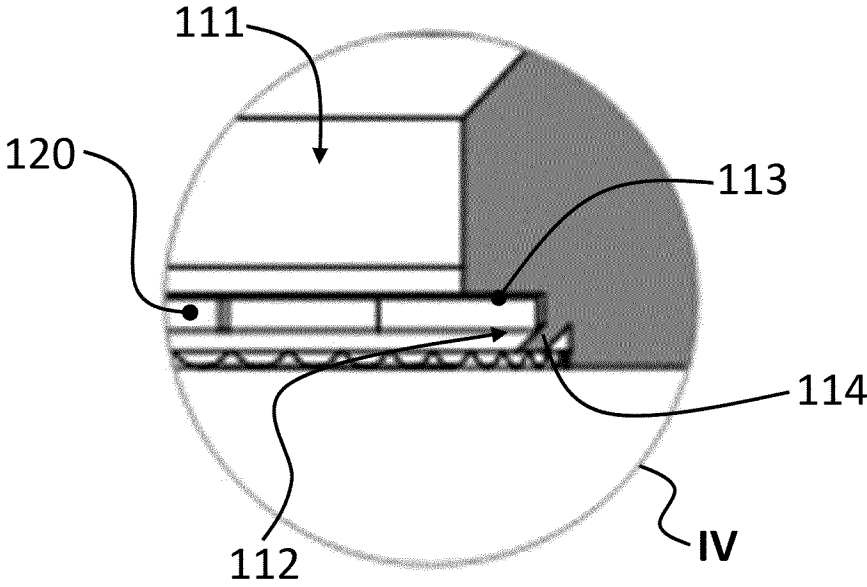
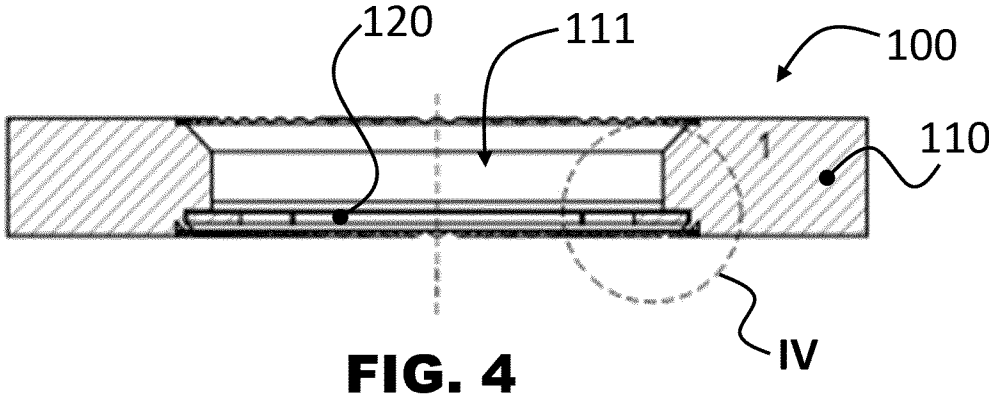
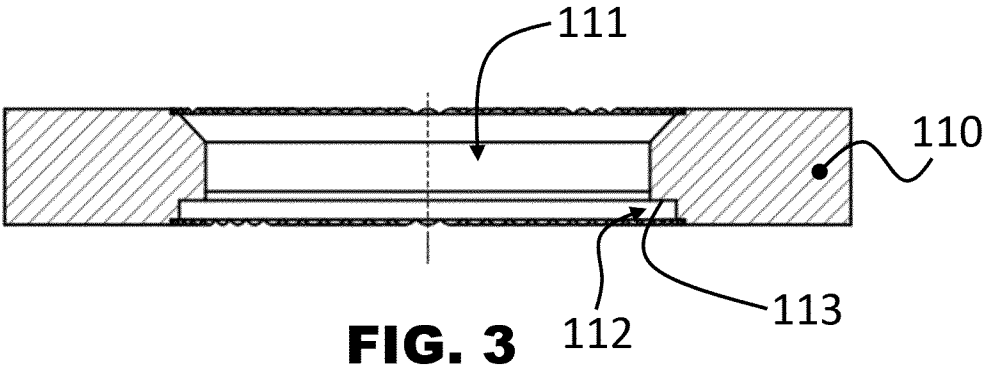


FIG. 5

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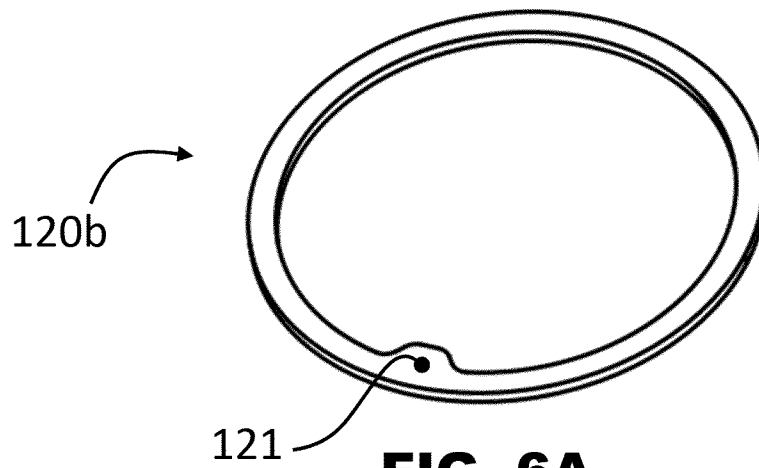


FIG. 6A

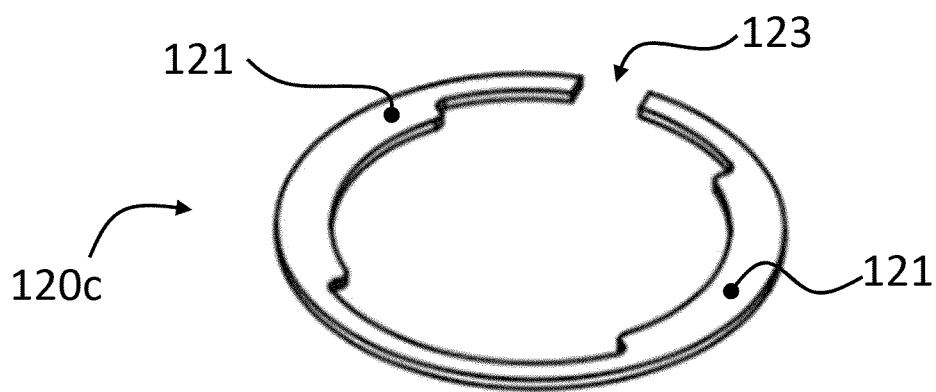


FIG. 6B

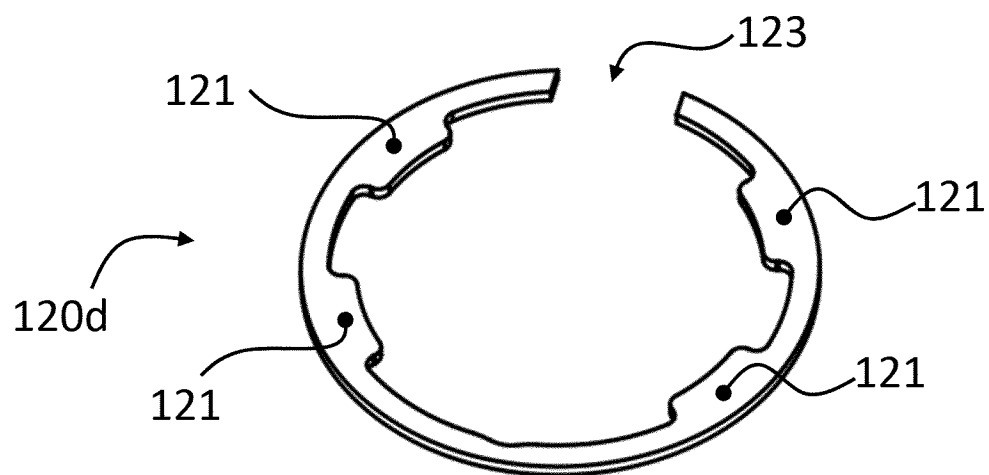


FIG. 6C

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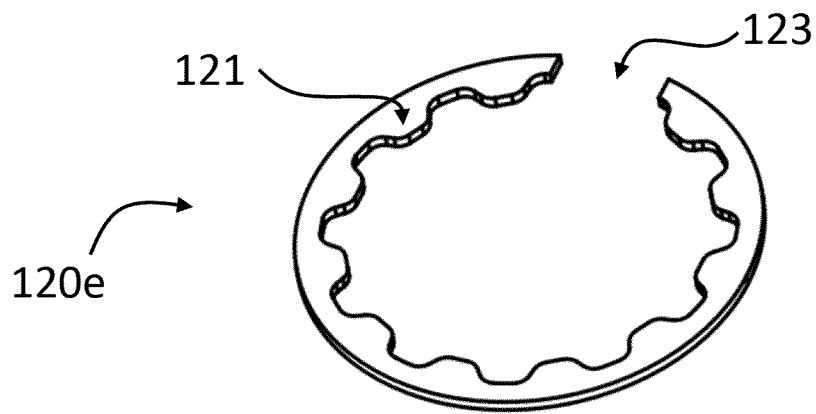


FIG. 6D

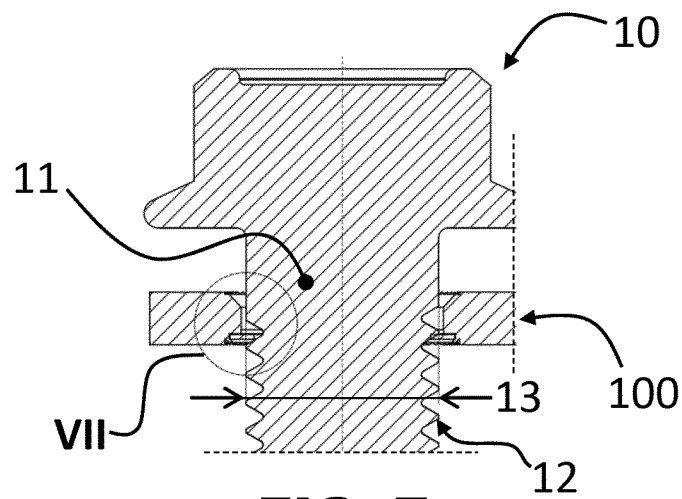


FIG. 7

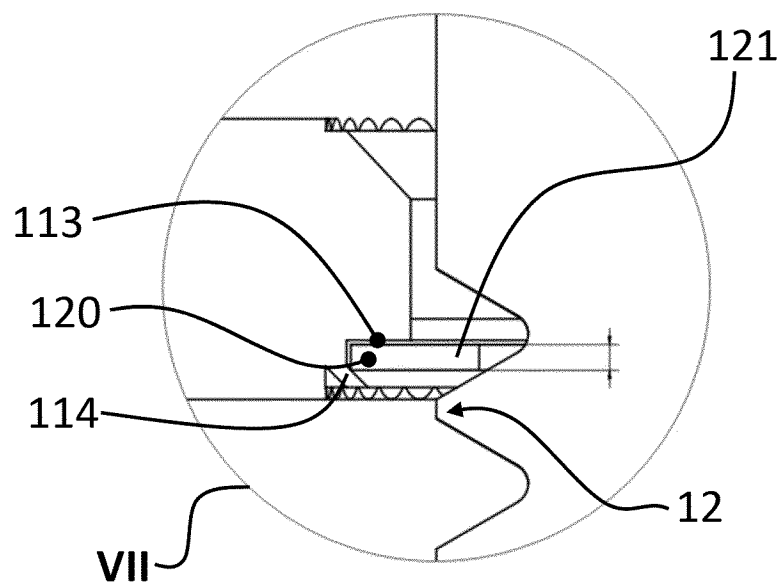


FIG. 8

FIG. 9A

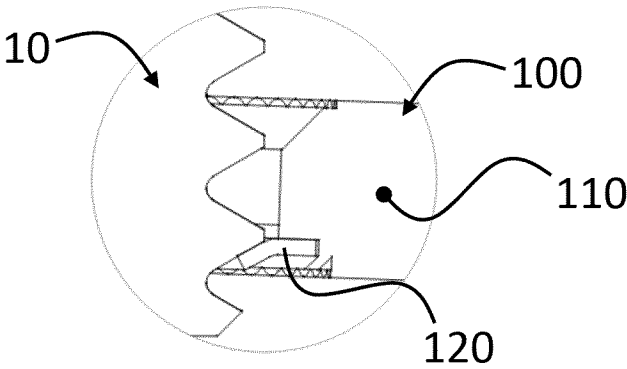


FIG. 9B

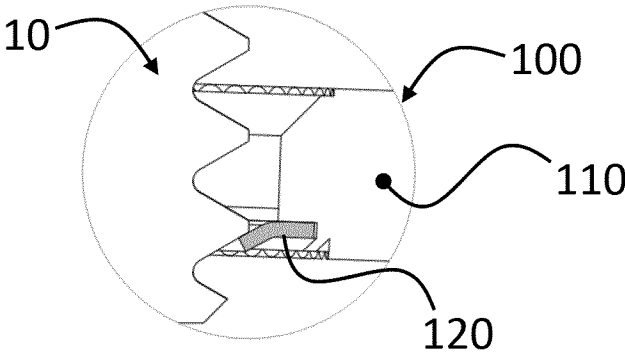


FIG. 9C

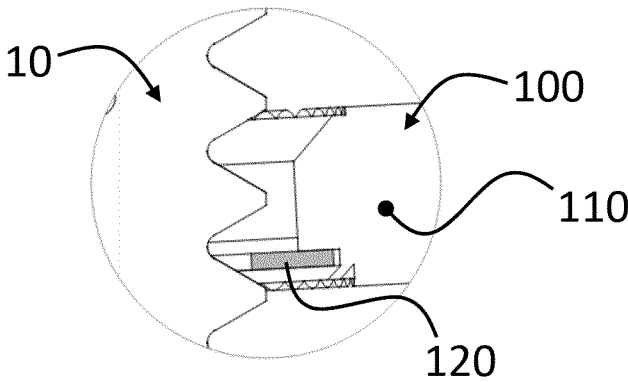
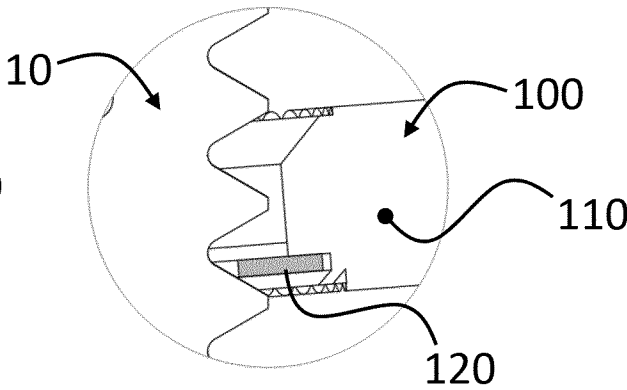


FIG. 9D



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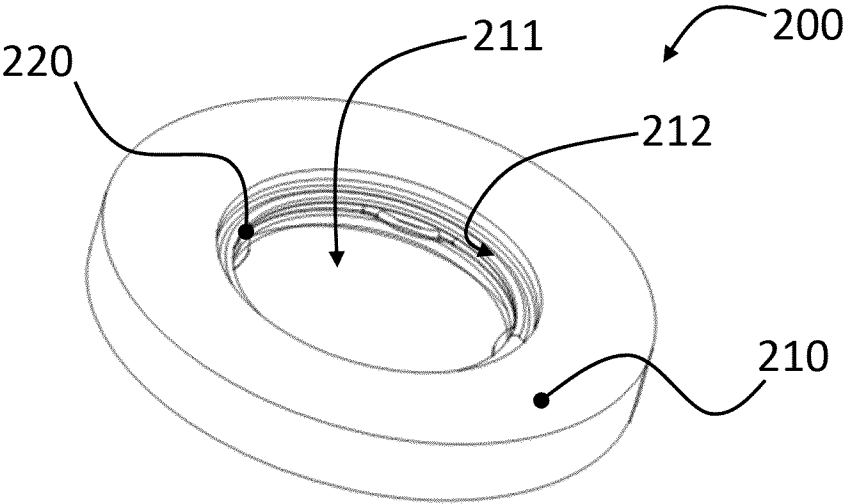


FIG. 10

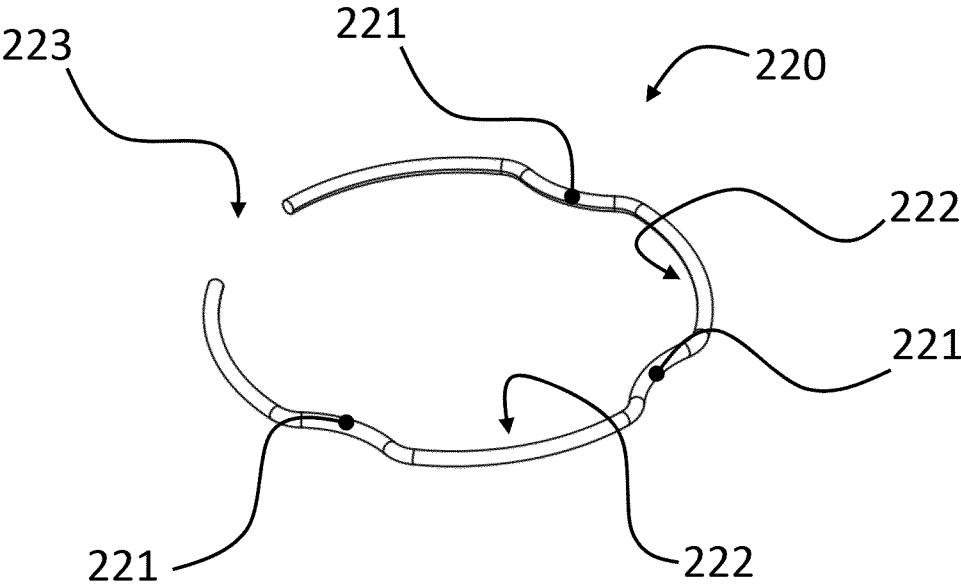


FIG. 11

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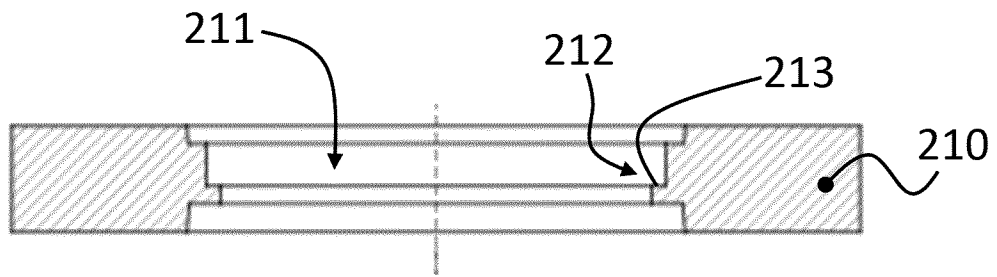


FIG. 12

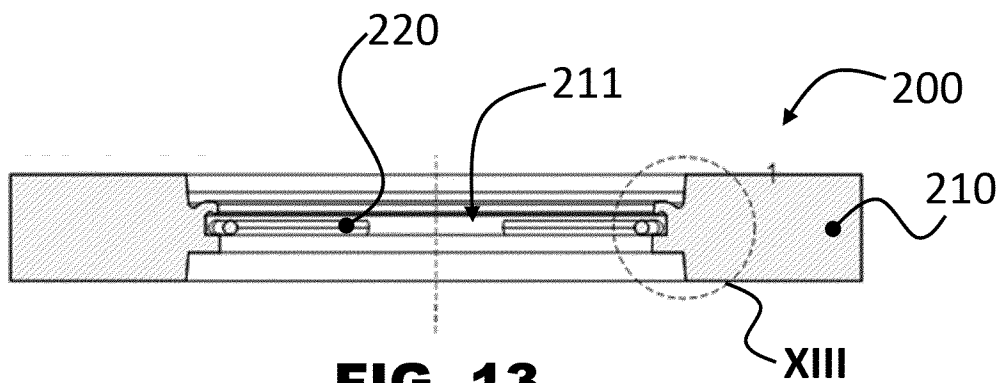


FIG. 13

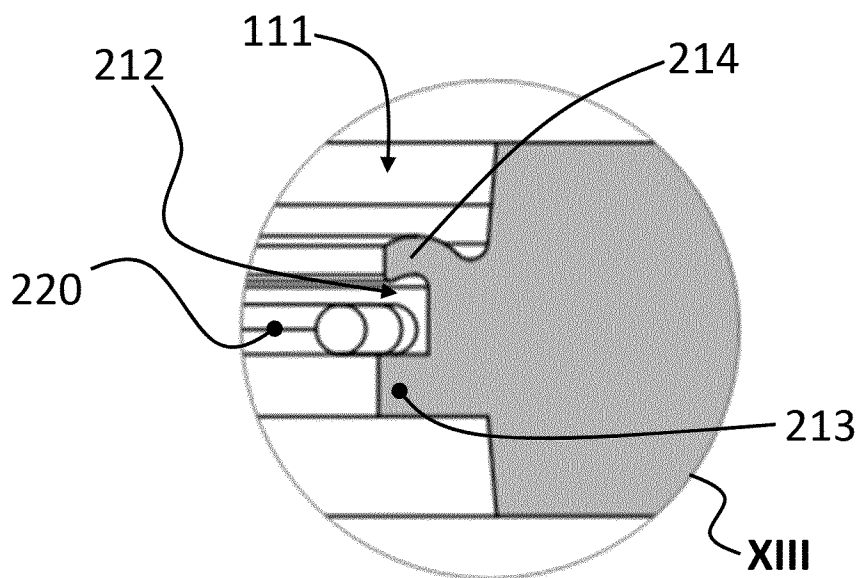


FIG. 14

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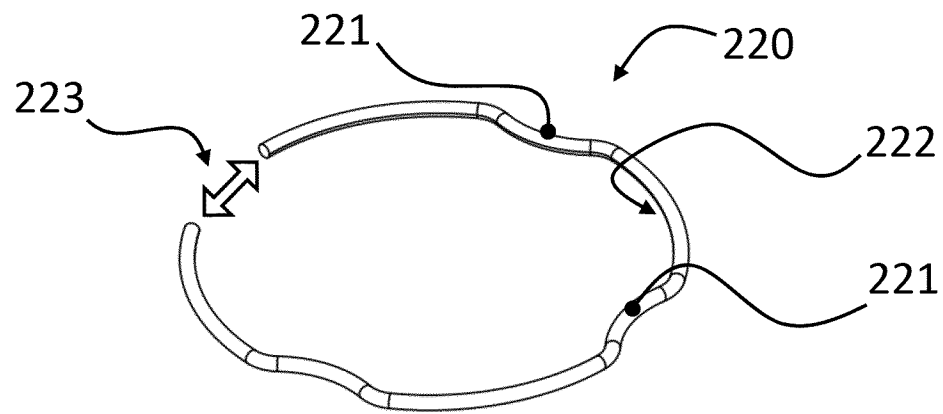


FIG. 15

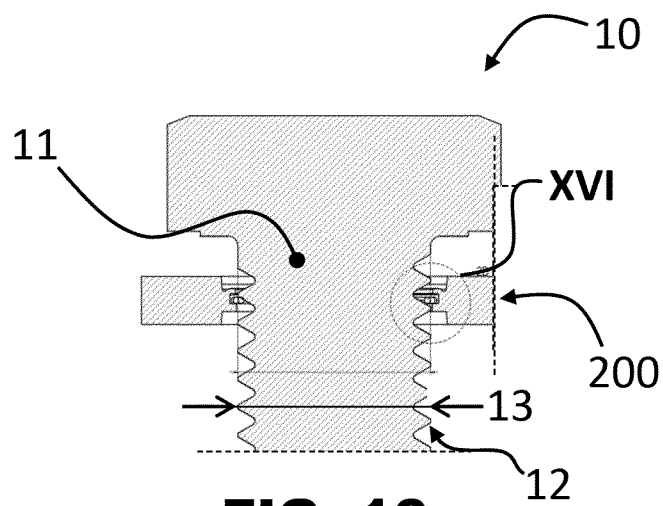


FIG. 16

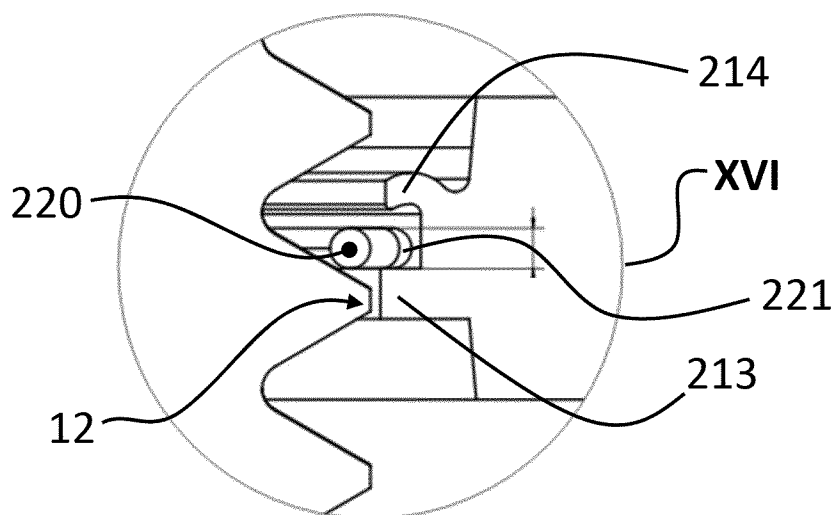


FIG. 17

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FIG. 18A

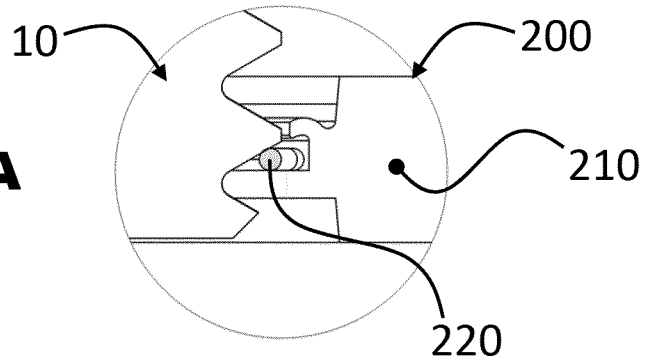


FIG. 18B

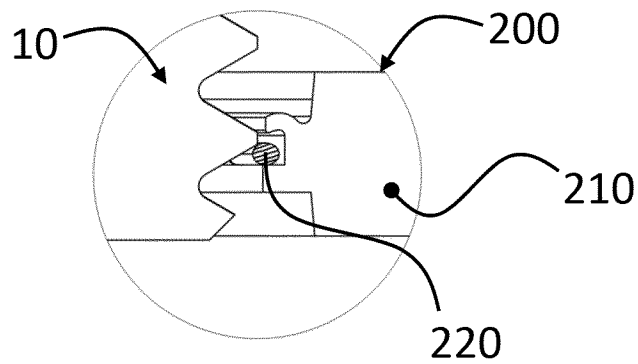


FIG. 18C

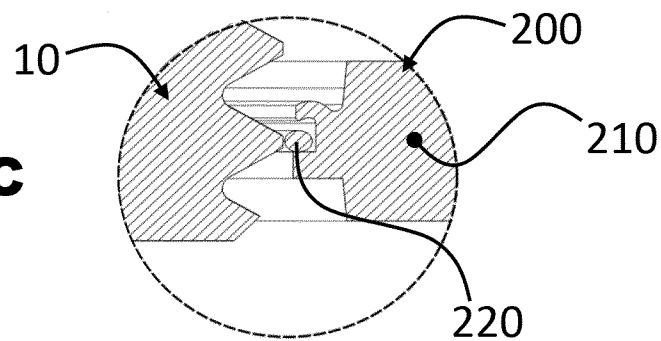
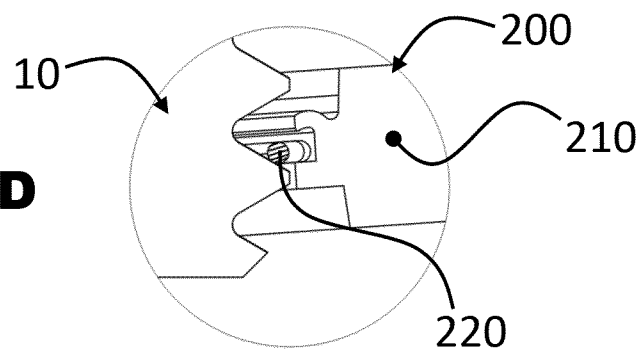


FIG. 18D



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2023/084424

A. CLASSIFICATION OF SUBJECT MATTER

INV. F16B43/00

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2019/120281 A1 (LUTTER FRANK [DE]) 25 April 2019 (2019-04-25) cited in the application the whole document -----	1, 4, 12, 13, 15, 18
A	US 2013/101371 A1 (SPIJKER JOHANNES GERHARDUS [NL] ET AL) 25 April 2013 (2013-04-25) the whole document -----	1-18
A	US 8 616 818 B2 (TRAVIS ROBERT D [US]; RAYTHEON CO [US]) 31 December 2013 (2013-12-31) the whole document -----	1-18



Further documents are listed in the continuation of Box C.



See patent family annex.

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

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

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"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

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Date of the actual completion of the international search

1 March 2024

Date of mailing of the international search report

12/03/2024

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Authorized officer

Pirog, Pawel

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2023/084424

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