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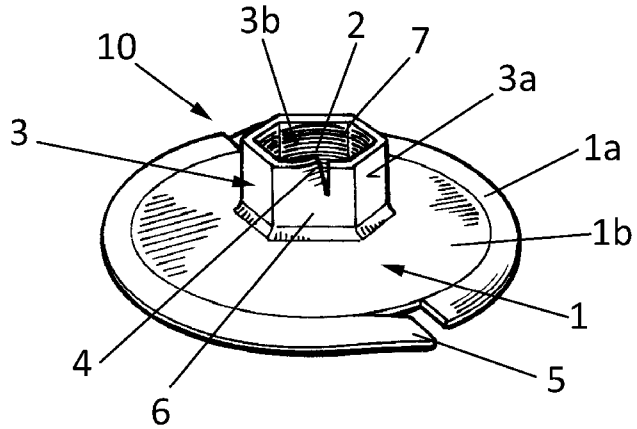

Fig. 4a

(57) Abstract: The invention relates to a fastening device 10 comprising a threaded tubular portion 3, an axial passage 2 arranged in a central area of the tubular portion, which defines a screw axis 9, and a tightening means 6 for facilitating the screwing in of the device, wherein the fastening device is made by means of stamping from a metal sheet. The fastening device comprises means 4,5 for preserving a tightening torque. The invention also relates to a fastening system for fastening a component of a washing machine comprising such fastening device 10, to a washing machine comprising such fastening system, and a method for manufacturing such fastening device 10.

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FASTENING DEVICE, FASTENING SYSTEM, WASHING MACHINE WITH FASTENING SYSTEM, AND METHOD FOR MANUFACTURE OF FASTENING DEVICE

The present invention relates to a fastening device, a fastening system for fastening a component of a washing machine comprising such fastening device, to a washing machine comprising such fastening system, and a method for manufacturing such fastening device.

The fastening device according to the present invention can be applied, for example, in fastening the components of a washing machine, such as in fastening a belt pulley to a drum shaft, or of a counterweight to a tub.

The joining of a belt pulley to a drum shaft of a washing machine is a key point, since if this fastening is not sufficiently strong, it runs a risk of breaking free and rendering the washing machine useless. In particular, such fastening must completely avoid any relative movement between the pulley and the drum shaft.

A known fastening device for a pulley in the present context is generally expensive and complex, since it requires a very high tightening torque to guarantee good transmission of the torques generated by the motor. The three following system are in current use:

- Very large, high-torque rigid metric nuts;

- Drum shaft having one end provided with chamfers and fasteners that rivet or hold the pulleys that, in turn, have complementary chamfers, as disclosed in GB 2 412 711 A. In this connection, there is inevitably a tolerance that can eventually loosen the fastening.

- By means of an elastic washer and nut that exerts torque. The elastic washer maintains the torque and eliminates relaxation losses of the materials that comprise the joint. It is a reliable connection, but requires an additional washer which can make the product more expensive and can involve mistakes in assembly.

The prior art fastening device based on a rigid nut has the problem of losing torque with use. For example, an initial torque of 90 N•m can decrease to 70 N•m. The drum shaft section where it joins the pulley has a chamfer that engages the pulley to prevent relative rotation between the two in case the nut loses torque. This chamfer implies needing to lengthen the shaft by a few millimeters.

Fixation with a chamfer requires a tolerance for introduction into the pulley orifice, which occasionally requires that the pulley mount be rotated around the axis to allow for the tolerance. If the nut is screwed in this position during operation of the machine, the pulley tends to occupy its correct position shortly after loosening the screw and removing the fastening, which ultimately damages the washing machine.

Currently, all or most of the nuts are manufactured from steel blocks, and are made by means of stamping and/or machining. Among these nuts is a subclass that is self-locking, braking, or anti vibration nuts.

Practically all manufacturers obtain these nuts by adding material and deforming them, which requires another thickness of weaker material (described in US 3,354,926 A), or adding or inserting a material, normally plastic (described in EP 0 047 061 A1).

Self-locking nuts are obtained by adjusting the nut collar to the screw threads by deformation when applying tightening torque. Compared to Nyloc nuts, Cleveloc nuts have the disadvantage that excessive tightening torque is required to achieve the same setting. These two tightening devices are rather costly to produce.

Elastic fastening devices exist in the prior art as disclosed in ES 2 399 121 A1, which application was published after filing the application whose priority is being claimed herewith. They are made by shaping from a metallic sheet and comprise a threaded axial passage arranged in a central area of the fastening device which defines a screw axis, an elastic washer section that extends from the axial passage in a radial direction away from the screw axis, and a tightening means to facilitate the screwing in of the device.

This device, although improved compared to the above, still has the problem of torque loss.

The present invention provides a solution to the aforementioned problem by means of a fastening device, a system for fastening a washing machine, a washing machine, and a method for manufacturing the elastic fastening device according to the respective independent claim attached. The dependent claims, the subsequent description and the attached drawing define preferred embodiments of the invention.

Thus, a first solution of the invention defines a fastening device comprising a threaded tubular portion, an axial passage provided in a central area of the tubular portion that defines a screw axis, and tightening means to facilitate the screwing in of the device where the fastening device is made by means of stamping from sheet metal and further comprising means for preserving a tightening torque, especially for locking and/or adjustment.

Means for preserving a tightening torque is especially obtainable by forming, more especially by sheet metal forming. The term "forming" includes the concepts of locally forming and deforming.

The fastening device of the invention allows a proper bond components from a single piece, with the proper torque and which is also made of a single sheet of stamped sheet incorporating means for anti-rotation locking and/or means for self adjustment. Thus, the fastening device of the present invention provides a better performance in threaded joints that undergo vibrations and in which it is essential to maintain the torque. The locking means prevents rotation that would unscrew the tightening device while the adjustment means ensures a stable pressure and reduces vibrations.

Furthermore, the use of a fastening device such as that of the present invention enables the fastening of the pulley without the need for a chamfer since no torque is lost, but is maintained constantly during the life of the machine.

Other advantages provided by the fastening device of the present invention include the reduced cost, ease of assembly, the elimination of part numbers, and guaranteeing the joint between the components.

Advantageously, the tightening means provided in the fastening device allows easy screwing into the counter-threads, which will be installed by means of a suitable tool, manual or automatic.

In one embodiment the axial passage is internally threaded on the internal wall of the tubular portion and the tightening means is arranged in the external wall of the tubular portion. In this case, it will be threaded to male-type screw counter-threads.

And, in another embodiment the axial passage is externally threaded in the external wall of the tubular portion and the tightening means is arranged in the axial passage in the internal wall of the tubular portion. In this case, it will be threaded to the counter-threads of a female-type orifice.

In one embodiment, the locking means comprises at least one deformation of the tubular portion, especially the locking means is in the form of at least one deformation of the tubular portion. The at least one deformation can be arranged on the threaded wall of the tubular portion. That is, the deformation can be made by adding material to the screw threads or by a deformation of the tubular portion collar. Thus, although the force required for tightening will be larger, the pressure to the counter-threads will ensure durable tightening. A particular embodiment of the deformation provides that the deformation is designed as a cut of the sheet that is folded toward the threaded wall. Thus, a mechanical interlock of the deformation in the counter-threads is created.

The fastening device can comprise a washer section extending from the axial passage in a radial direction away in relation to the screw axis. The washer section is preferably made from the same piece of sheet metal as the tubular body.

In one embodiment, the adjustment means comprises the washer section and a tab arranged on the perimeter of the washer section folded in a direction away from the tubular portion.

This will provide the characteristics of a type of thread known as spring thread in the fastening device. This ensures a stable pressure that accommodates changes in temperature and/or pressure while reducing vibrations and facilitating precise adjustment of the final pressure.

The tab arranged on the perimeter can be provided with a sharp edge allowing an improved preserving of the tightening torque because of scratching on the fixation surface while the fastening device is screwed.

In one embodiment, the tightening means is configured as a tightening wall having a polygonal contour, preferably hexagonal. More usually, very common tools are used in this type of tightening means, such a crescent wrench or Allen wrench.

In one embodiment, the elastic fastening device comprises a washer section having a cross-section with rotational symmetry about the screw axis. In this case, the cross-section of the washer section can preferably comprise a supporting portion and a portion substantially inclined with respect to the supporting portion.

In a preferred embodiment, the supporting portion has a free end spaced apart from the surface that supports the washer section in the installation position of the elastic fastening device. The supporting portion can have a substantially convex shape relative to the surface that it supports. Thus is formed a washer section flange that provides the advantage of avoiding recesses in the surface that supports the device as well as facilitating the sliding of the washer section against said surface during installation.

In one embodiment, the elastic fastening device is obtained from a single piece, preferably by stamping from a metal sheet of stainless steel or steel. In the context of the invention, the term "sheet " includes the concept of "plate".

In one embodiment in which the fastening device is obtained from a metallic sheet, the threaded axial passage is obtained by a rolling process. In one embodiment, the fastening device is made of tempered steel or spring steel. The use of these materials is especially advantageous because in addition to offering the elastic properties required by the device, they are high quality materials.

In a second solution of the present invention, a system is defined for fastening a washing machine component comprising an elastic fastening device according to the first solution of the present invention.

A third solution of the present invention defines a washer comprising an elastic fastening device according to the first solution of the present invention.

In a fourth solution of the present invention is defined a method for manufacturing an elastic fastening device according to the first solution of the present invention. The method comprises the following steps: stamping from a metallic sheet, which comprises obtaining by stamping from a washer section and/or a tubular portion projecting from a central ring area of the washer section; forming of the means for preserving a tightening torque, especially the locking means and/or adjustment means; opening of the axial passage; rolling of the tubular portion, which comprises obtaining a threaded section on the tubular portion by rolling; and heat treatment, preferably tempering, of the stamped and milled metallic sheet.

Stamping, rolling, and heat treatment enables imparting the device with adequate mechanical properties such as hardness, elasticity and resilience. Especially, it is possible to obtain an elastic fastening device with a higher elastic limit and mechanical strength. Furthermore, the method provides the advantage of low cost, and thus reduced cost of parts manufactured by the use of same. Especially in comparison to conventional fastening nuts used in systems for fastening the drum pulley of washers, which are obtained by lathe work or machining.

In one embodiment of the method for manufacturing the elastic fastening device, the step of stamping from the metallic sheet comprises obtaining a tightening section with a tightening wall having a polygonal cross-section, preferably hexagonal, which constitutes the tightening means.

All the characteristics described in this specification (including the claims, description, and drawings) can be combined in any combination, except combinations of such features as are mutually exclusive.

For a better understanding of the present invention, its solutions, and advantages, preferred embodiments of the invention are now described in details with reference to the figures of the attached drawing. In the drawing:

Figure 1a shows a fastening device according to a first embodiment of the present invention,

Figure 1b shows a plane view of the fastening device from Figure 1a,

Figure 2a shows a fastening device according to a second embodiment of the present invention,

Figure 2b shows a plane view of the fastening device from Figure 2a,

Figure 3a shows a fastening device according to a third embodiment of the present invention,

Figure 3b shows a plane view of the fastening device from Figure 3a,

Figure 4a shows a perspective view of a fastening device according to a fourth embodiment of the present invention,

Figure 4b shows a plane view of the fastening device from Figure 3a,

Figure 4c shows a fastening device from Figure 4a mounted on a drum shaft from a washing machine,

Figure 5a shows a cross-sectional view of a fastening device according to a fifth embodiment of the present invention, and

Figure 5b shows a fastening device from Figure 5a mounted on the drum shaft of a washing machine.

The figures show embodiments of the fastening device according to the present invention. Said device comprises threaded axial passage 2 arranged in a central area of the fastening device, which defines screw axis 9, washer section 1, which extends from the axial passage in a radial direction away from screw axis 9, and tightening means 6 to facilitate the screwing in of the device.

Figures 1a and 1b show a first embodiment of the fastening device, which has a substantially cylindrical tubular portion 3 projecting from a central area of washer section 1. Said tubular portion 3 has internal threads 7 and configures threaded axial passage 2 centered on screw axis 9. The fastening device also has an edge that protrudes from the periphery of the base of the tubular portion forming washer section 1. External wall 3a of tubular portion 3 is formed with a hexagonal shape forming tightening means 6. Tubular portion 3 has a vertical deformation in the six corners of the hexagon of the tightening means, which deforms threads 7 of internal wall 3b to form the locking means. When a fastening means 10 such as this is screwed into male-type counter-threads, this locking means 4 is deformed providing additional pressure that prevents accidental disassembly.

Figures 2a and 2b show a second embodiment of the fastening device, which has a substantially cylindrical tubular portion 3 projecting from a central area of washer section 1. Said tubular portion 3 has internal threads 7 and configures threaded axial passage 2 centered on screw axis 9. The fastening device also has an edge that protrudes from the periphery of the base of the tubular portion forming washer section 1, which in this embodiment is a nut support. External wall 3a of tubular portion 3 is formed with a hexagonal shape forming tightening means 6. Tubular portion 3 has deformations in the form of indentations in the top of the six faces of the hexagon of the tightening means, which deform threads 7 of internal wall 3b forming locking means 4. In the same manner as for fixing device 10 of the previous figures, this is screwed into male-type counter-threads, this locking means 4 is deformed to provide additional pressure that prevents accidental disassembly.

Figures 3a and 3b show a third embodiment of the fastening device. In this embodiment, the fastening device has tubular portion 3 projecting from the central area of washer section 1. Tubular portion 3 has external wall 3b with a substantially polygonal external shape, in particular hexagonal, which constitutes tightening means 6, and is internally

threaded, having threaded internal wall 3b, forming threaded axial passage 2. The internal shape of tubular portion 3 is also polygonal, with threads 7 provided thereon. In this embodiment the tightening means itself has the polygonal shape of tubular portion 3, which allows the screwing in of the device with the aid of a crescent wrench-type tool of the kind used for the nut threads. Tubular portion 3 in locking means 4 comprises at least one deformation 4 of tubular portion 3, which is made as a cut of the metal sheet forming a tab folded toward the internal wall 3b that has threads 7.

Figures 4a to 4c show a fourth embodiment of the fastening device. In this embodiment, the fastening device has tubular portion 3 projecting from the central area of washer section 1. Tubular portion 3 has external wall 3b with a substantially polygonal external shape, in particular hexagonal, which constitutes tightening means 6, and is internally threaded, having threaded internal wall 3b, forming threaded axial passage 2. The internal shape of tubular portion 3 is also polygonal, with threads 7 provided thereon. In this embodiment the tightening means itself has the polygonal shape of tubular portion 3, which allows the screwing in of the device with the aid of a crescent wrench-type tool of the kind used for the nut threads. Tubular portion 3 in locking means 4 comprises at least one deformation of tubular portion 3, which is made as a cut of the metal sheet folded toward the internal wall 3b that has threads 7.

Washer section 1 is flexible and has a cross-section with rotational symmetry about screw axis 9, the cross-section with supporting portion 1a, and portion 1b substantially inclined with respect to supporting portion 1a. Adjustment means 5 is formed by a tab arranged on the perimeter of the supporting portion of washer section 1 folded in a direction of tightening of the fastening device.

Figure 4c shows the fastening device mounted on drum shaft 11 of a washing machine, against which pulley 12 is set. Drum shaft 11 has counter-threads 8 into which are screwed threads 7 of fastening device 10. Locking means 4 in the form of the cut folded from the upper wall of tubular portion 3 is made in such a manner as to face counter-threads 8 in the opposite sense from that of the turning of the screw, which engages the counter-threads while avoiding accidental unscrewing. The figures show only one cut folded, but locking means 4 can have more than one. Supporting portion 1a of washer section 1 also has a tab from adjustment means 5, and as mentioned above for the lock-

ing means, can also have more than one tab. Fastening device 10 of the present invention permits fastening of pulley 12 without needing a chamfer on shaft 11 since it does not lose torque. Advantageously, in the fastening device of the present invention, both threads 7 and tightening means 6 are integrated by means of tools into the tubular part of the fastening device, reducing the height of the nut so that it doesn't protrude from the rear part of the washing machine.

Figures 5a and 5b show a fastening device 10 according to a fifth embodiment, in which axial passage 2 is externally threaded for fastening to an element with complementary female-type counter-threads 8 from shaft 11. In this embodiment, tightening means 6 is configured as a polygonal contour from internal wall 3b of tubular portion 3, to allow insertion of a tightening tool corresponding to an Allen-type wrench. This embodiment has the additional advantage of tubular portion 3 not projecting from washer section 1, and opposite to the expectation from the joint with shaft 11, the protruding height of the fastening device once mounted on the shaft will be even lower than in the previous embodiment.

Although the fastening device of the present invention has been described with reference to its application for fastening pulley 12 to a washing machine drum shaft, it is understood that it is equally applicable in the fastening of other elements or components, in particular those of washing machines, such as a counterweight.

The fastening device is preferably manufactured from a steel sheet of between 1.5 mm and 3 mm in thickness, preferably substantially 2 mm. For example, carbon steel C45E according to the EN-10132 standard can be used. When the fastening device is manufactured from a steel plate approximately 2 mm thick in accordance with the method of the invention, it can support a workload of 150 kg/mm^2. Moreover, for the entire piece including threads 7 to be under tension, it has the property of being self-braking and has greater resistance to loosening.

LIST OF REFERENCE NUMERALS

10	Fastening device
1	Washer section
1a	Supporting portion of the washer section
1b	Inclined portion of the washer section
2	Axial passage
3	Tubular portion
3a	External wall of the tubular portion
3b	Internal wall of the tubular portion
4	Locking means
5	Adjustment means
6	Tightening means
7	Threads
8	Counter-threads
9	Screw axis
11	Drum shaft
12	Pulley

CLAIMS

1. A fastening device (10) comprising a threaded tubular portion (3), an axial passage (2) arranged in a central area of the tubular portion (3), which defines a screw axis (9), and tightening means (6) for facilitating the screwing in of the device (10), wherein the fastening device (10) is made by means of stamping from a metal sheet, **characterized in that** the fastening device (10) comprises means (4,5) for preserving a tightening torque.

2. The fastening device (10) according to claim 1, characterized in having threads (7) on the internal wall (3b) of the tubular portion (3) of the axial passage (2), and the tightening means (6) is arranged on the external wall (3a) of the tubular portion (3).

3. The fastening device (10) according to claim 1, characterized in having threads (7) on the external wall of the tubular portion (3), and the tightening means (6) is arranged on the axial passage (2) on the internal wall (3b) of the tubular portion (3).

4. The fastening device (10) according to one of the preceding claims, characterized in that the means (4,5) for preserving a tightening torque comprises locking means (4) with at least one deformation (4) of the tubular portion (3).

5. The fastening device (10) according to claim 4, characterized in that the deformation (4) is made as a cut in the sheet folded towards the wall (3a, 3b) that has the threads (7).

6. The fastening device (10) according to any of the preceding claims, characterized in that the tightening means (6) is made as a tightening wall having a polygonal contour, preferably hexagonal.

7. The fastening device (10) according to any of the claims 5 and 6, characterized in that the fastening device (10) comprises a washer section (1) extending from the axial passage (2) in a radial direction away in relation to the screw axis (9).

8. The fastening device according to claim 7, characterized in that the means (4,5) for preserving a tightening torque comprises adjustment means (5) including the washer section (1) and a tab arranged at a perimeter of the washer section (1) folded in a tightening direction of the fastening device.

9. The fastening device according to any of the claims 7 and 8, characterized in that the washer section (1) is flexible and has a cross-section with rotational symmetry in relation to the screw axis (9), the cross-section having a supporting portion (1a) and a portion (1b) substantially inclined in relation to the supporting portion (1a).

10. The fastening device according to any of the preceding claims, characterized in being made of tempered steel or spring steel.

11. A fastening system for fastening a component of a washing machine, in particular a component such as the belt pulley (12) to a drum shaft (11) or a counterweight of the oscillating group, comprising an elastic fastening device according to one of claims 1 to 10.

12. A washing machine comprising a fastening system for fastening a component of a washing machine according to claim 11.

13. A method for manufacturing an elastic fastening device (10) according to one of claims 1 to 10, comprising the following steps:

stamping from a metallic sheet, comprising the obtainment of a washer section (1) and/or a tubular portion (3);

rolling of the tubular portion (3), comprising the obtainment of threads (7);

forming of the means (4,5) for preserving a tightening torque; and

heat treatment, preferably tempering, of the stamped and milled metallic sheet.

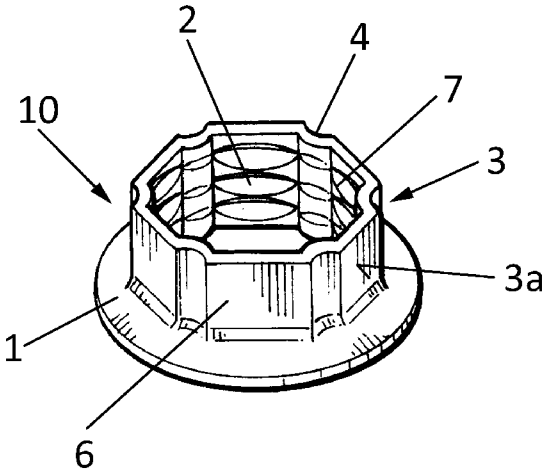

Fig. 1a

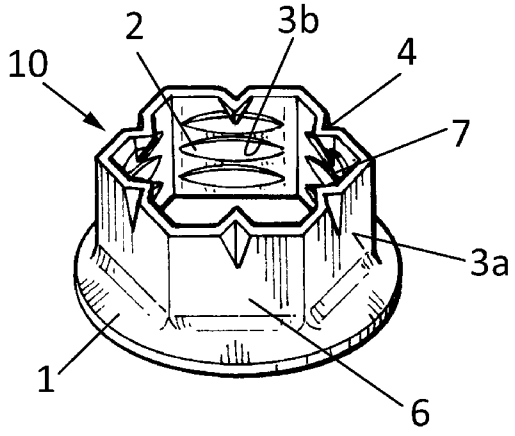

Fig. 2a

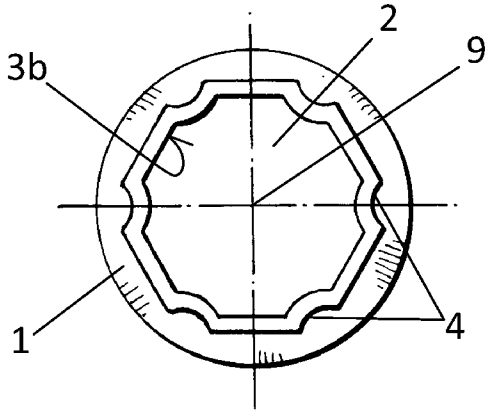

Fig. 1b

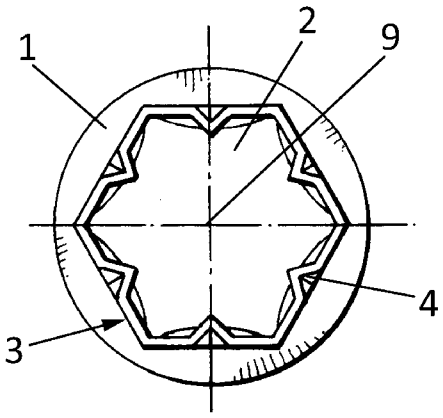

Fig. 2b

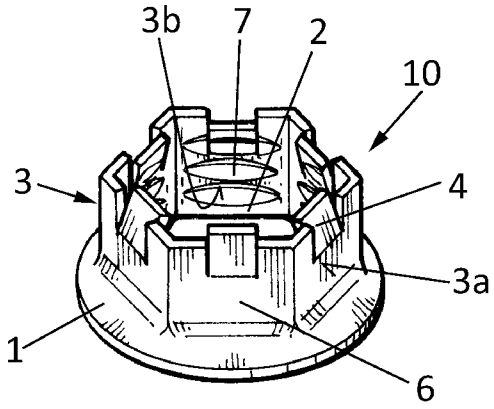

Fig. 3a

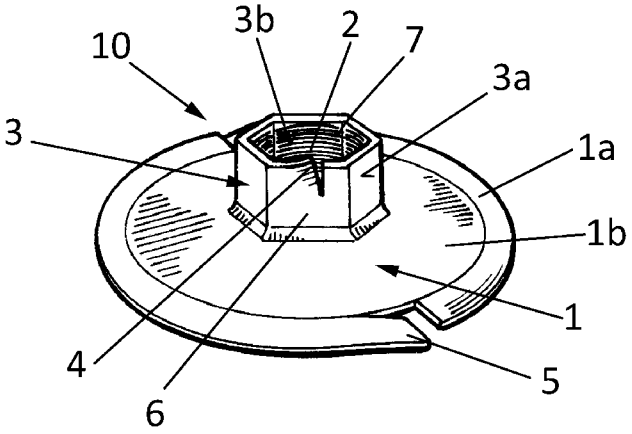

Fig. 4a

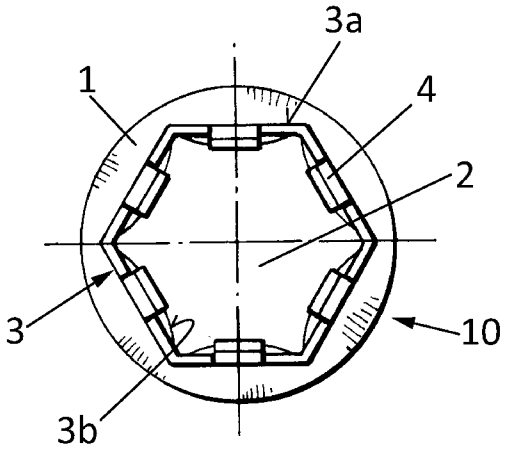

Fig. 3b

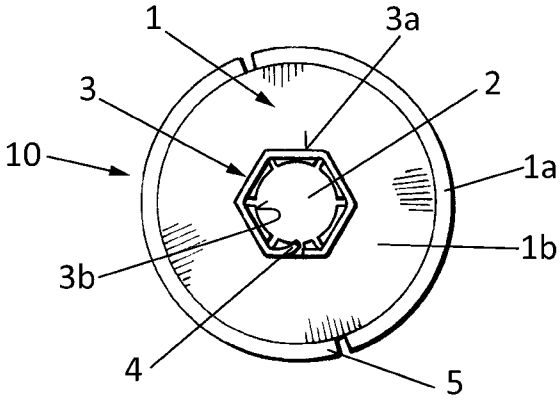

Fig. 4b

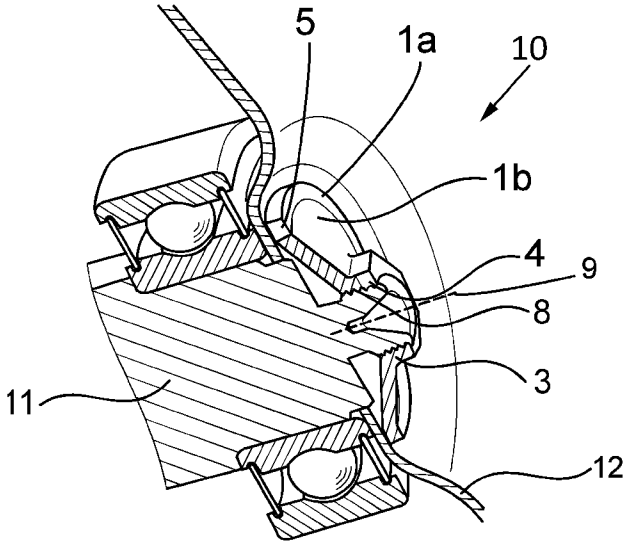

Fig. 4c

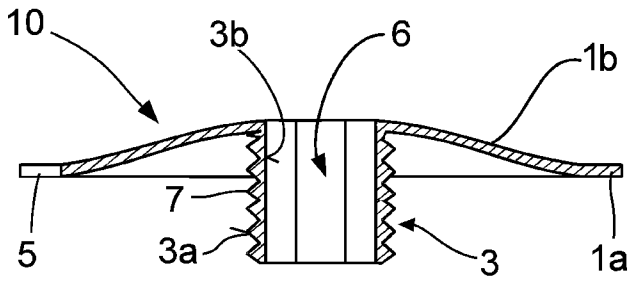

Fig. 5a

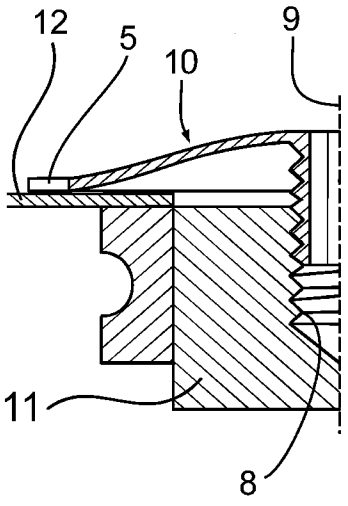

Fig. 5b

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/060508

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16B35/04 F16B37/02 F16B39/26 F16B39/284 D06F37/00
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 D06F

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)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 575 802 A (ARTHUR HUGO THOMPSON) 6 March 1946 (1946-03-06) page 1, line 10 - line 30 page 3, line 106 - line 112; figures 1-8 page 3, line 13 - line 53	1-13
X	US 2 581 312 A (TINNERMAN GEORGE A) 1 January 1952 (1952-01-01) column 4, line 55 - column 5, line 24; figures 1-7	1,2,4, 6-9
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A	CZ 302 768 B6 (CVUT V PRAZE [CZ]) 26 October 2011 (2011-10-26) figures 6,7	8

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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
21 May 2014	30/05/2014

Name and mailing address of the ISA/	Authorized officer
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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