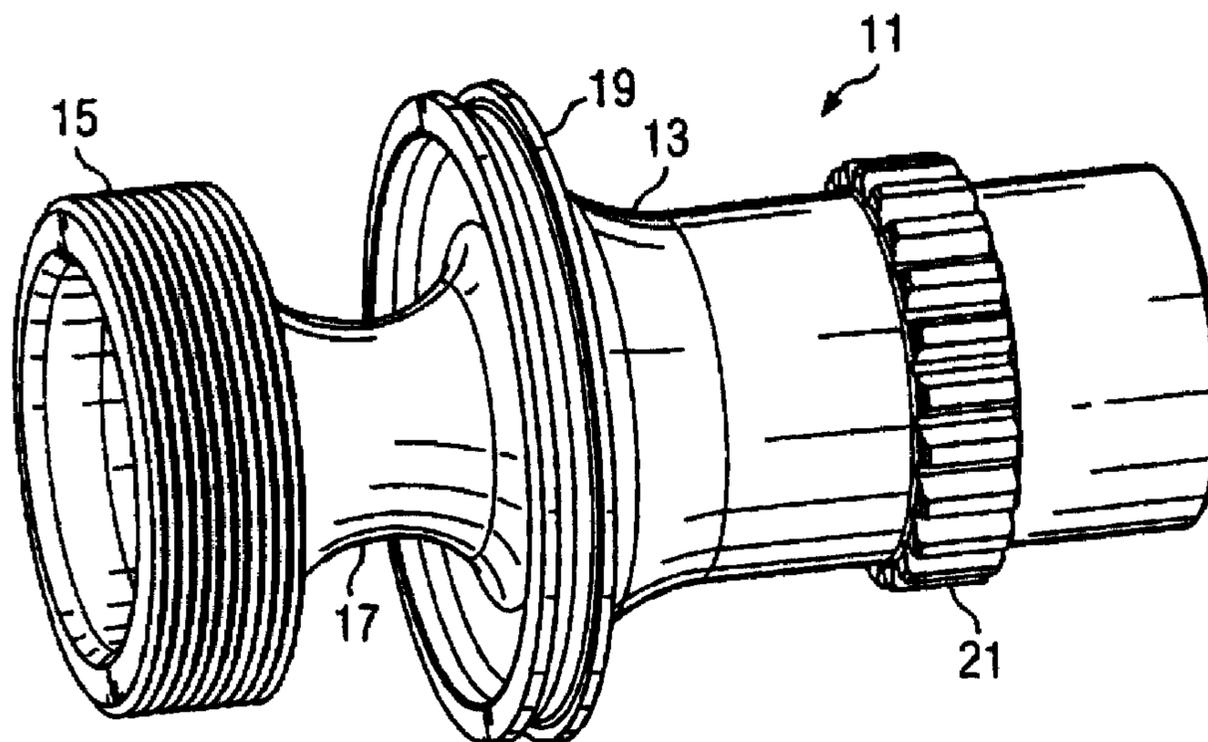




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(54) Titre : ATTACHE FILETEE FLEXIBLE
(54) Title: FLEXIBLE THREADED FASTENER



(57) Abrégé/Abstract:

A fastener includes a head, a threaded member, and a resilient shank portion interconnecting the head portion and the threaded portion. The shank portion includes a first end adjacent the head and a second end adjacent the threaded member. The shank includes a tubular section having an inner wall and an outer wall between the first end and the second end. The tubular section has a curved axial profile. The tubular section is axially elastically deformed as the fastener is torqued down.

FLEXIBLE THREADED FASTENER**ABSTRACT OF THE DISCLOSURE**

5 A fastener includes a head, a threaded member, and
a resilient shank portion interconnecting the head
portion and the threaded portion. The shank portion
includes a first end adjacent the head and a second end
adjacent the threaded member. The shank includes a
10 tubular section having an inner wall and an outer wall
between the first end and the second end. The tubular
section has a curved axial profile. The tubular section
is axially elastically deformed as the fastener is
torqued down.

FLEXIBLE THREADED FASTENER**GOVERNMENT RIGHTS STATEMENT**

5 This invention was made with Government support
under Contract No. N00019-91-C-0172 awarded by the
Department of the Navy. The Government has certain
rights in this invention.

FIELD OF THE INVENTION

10 The present invention relates generally to the
field of fasteners, and more particularly to threaded
fastener having an axially elastic shank.

DESCRIPTION OF THE PRIOR ART

15 A common device for clamping together two halves of
a mechanical joint is a threaded fastener such as a bolt
or a screw. When a threaded fastener is torqued down,
the fastener is preloaded to hold the joint tightly
together. Over time and through use, the axial
20 dimensions of the clamped members of the joint may
change, thereby reducing the preload on the fastener and
causing the joint to loosen. Also, a fastener may tend
to untorque to cause the joint to loosen. In order to
maintain the integrity of the joint, it is usually
25 necessary to re-torque the fasteners periodically.

SUMMARY OF THE INVENTION

30 Briefly stated, the present invention provides a
fastener including a head, a threaded member, and a
resilient shank portion interconnecting the head portion
and the threaded portion. The shank portion includes a

first end adjacent the head and a second end adjacent the threaded member. The shank includes a tubular section having an inner wall and an outer wall between the first end and the second end. The tubular section has a curved axial profile. The tubular section is axially elastically deformed as the fastener is torqued down.

BRIEF DESCRIPTION OF THE DRAWINGS

10 Figure 1 is a perspective view of a fastener according to the present invention.

Figure 2 is a section view of a fastener according to the present invention engaged with a member.

15 Figure 3 is a first detail view taken from Figure 2.

Figure 4 is a second detail view taken from Figure 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

20 Referring now to the drawings, and first to Figure 1, a fastener according to the present invention is designated generally by the numeral 11. Fastener 11 is of generally tubular construction having an outer wall 14 and an inner wall 16. Fastener 11 includes a head 13, a threaded member 15, and a shank 17 connecting head 13 and threaded member 15.

25 Head 13 includes a radially outwardly extending flange 19. Head 13 also includes a wrench spline 21 that may be engaged by a spanner wrench or the like to apply torque to fastener 11. Those skilled in the art will recognize that fastener 11 can include other wrench

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engaging arrangements, such as wrench flats and the like.

Figure 2 illustrates sectional views of fastener 11 engaged with a mechanical joint including member 23 having a threaded bore and a second member having a smooth bore 25. The upper half of Figure 3 illustrates fastener 11 in hand-tight engagement with the joint comprising members 23 and 25. The lower half of Figure 2 illustrates fastener 11 in torqued engagement with the joint.

As best illustrated in Figure 3, flange 11 includes a frusto-conical face 27. The taper of face 27 is exaggerated in Figure 3 for purposes of illustration. Preferably, the taper of face 27 is on the order of one degree. Flange 19 may include an annular groove 29 axially rearward of face 27. When fastener 11 is torqued to its preloaded position, as illustrated in the lower half of figure 2, flange 19 elastically deforms such that face 27 becomes flush with member 25, as illustrated in Figure 4. Groove 29 aids in the elastic deformation of flange 29.

Shank 17 includes a curved neck 31. As illustrated in Figure 2, neck 31 has an inwardly curved, C-shaped or horseshoe-shaped axial profile. When fastener 11 is torqued to its made-up configuration with respect to the joint, neck 31 is elastically deformed thereby to impart stretch to shank 17. More specifically and is shown in the lower half of Figure 2, neck 31 is elastically deformed between threaded member 15 and flange 19 in the same way that a horse shoe may be stretched by applying force to its legs. As fastener 11 is rotated to advance

threaded member 15 into thread bore 25, shank 17 stretches through the bending in the curved walls of neck 31 to axially preload fastener 11. The bending deflection results in a total axial deflection in fastener 11 that is much greater than that produced by the tensile strain of the material alone or that is produced in a conventional fastener with the same axial load and the same material cross-section. The increased deflection allows fastener 11 to maintain sufficient preload in the joint while adjusting to changes in the axial dimensions of the clamped members during operation of the joint. As the axial dimension of the joint shortens over time, shank 17 shortens. However, because of the elasticity provided by curved neck 31, fastener 11 retains sufficient preload to keep the joint tight. The fastener of the present invention thus eliminates the requirement of a periodic re-torque as is required with existing fasteners.

The fastener of the present invention has been illustrated and described with respect to presently preferred embodiments. Those skilled in the art will recognize other embodiments. For example, while the fastener of the present invention has been illustrated and described as a bolt-type fastener, those skilled in the art will recognize that present invention has applicability to other fasteners such as studs and the like. The foregoing description is for purposes of illustration rather than limitation.

WHAT IS CLAIMED IS:

1. A fastener, which comprises:
 - a head portion;
 - a threaded portion;
 - 5 a resilient shank portion interconnecting the head portion and the threaded portion.

2. The fastener as claimed in claim 1, wherein said resilient shank portion is defined by a reduced diameter
10 portion between the head portion and the threaded portion.

3. The fastener as claimed in claim 1, wherein said head portion includes an outwardly extending flange
15 facing said threaded portion.

4. The fastener as claimed in claim 3, wherein said flange includes a frusto-conical face.

- 20 5. The fastener as claimed in claim 4, wherein said frusto-conical face is tapered inwardly.

6. The fastener as claimed in claim 4, wherein said flange includes a reduced diameter portion axially
25 outward of said frusto-conical face.

7. The fastener as claimed in claim 1, wherein said resilient shank portion is defined by a tubular structure having an outer wall and an inner wall.
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8. The fastener as claimed in claim 7, said tubular structure includes a reduced diameter portion.

5 9. The fastener as claimed in claim 7, wherein said tubular structure includes a first end adjacent said threaded portion and a second end adjacent said flange portion.

10 10. The fastener as claimed in claim 9, wherein said tubular structure includes a reduced diameter portion intermediate said first and second ends.

15 11. The fastener as claimed in claim 9, wherein said inner and outer walls are curved between said first and second ends.

20 12. The fastener as claimed in claim 9, wherein said inner and outer wall have a generally C-shaped axial profile intermediate said first and second ends.

13. The fastener as claimed in claim 12, wherein said generally C-shaped axial profile defines a reduced diameter portion between said first and second ends.

14. A fastener, which comprises:
a head;
a threaded member; and,
a shank connecting said head and said threaded
5 member, said shank including a first end adjacent said
head and a second end adjacent said threaded member,
said shank including tubular section between said first
end and said second end, said tubular section having an
inner wall and an outer wall, and said tubular section
10 having a curved axial profile.
15. The fastener as claimed in claim 14, wherein said
tubular section includes a portion between said first
and second end having a generally C-shaped axial
15 profile.
16. The fastener as claimed in claim 15, wherein said
portion having a C-shaped axial profile defines a
reduced diameter portion.
20
17. The fastener as claimed in claim 14, wherein said
tubular section includes a reduced diameter portion
between said first and second ends.
- 25 18. The fastener as claimed in claim 14, wherein said
head portion includes an outwardly extending flange
facing said threaded portion, said flange including an
inwardly tapered frusto-conical face.

19. The fastener as claimed in claim 18, wherein said flange includes a reduced diameter portion axially outward of said frusto-conical face.

5 20. A fastener, which comprises:

a threaded member; and,

10 a shank connected to and said threaded member, said shank including a first end and a second end, said shank including tubular section between said first end and said second end, said tubular section having an inner wall and an outer wall, and said tubular section having a non-uniform axial profile.

15 21. The fastener as claimed in claim 20, wherein said tubular section includes a portion between said first and second end having a generally C-shaped axial profile.

20 22. The fastener as claimed in claim 21, wherein said portion having a C-shaped axial profile defines a reduced diameter portion.

25 23. The fastener as claimed in claim 20, wherein said tubular section includes a reduced diameter portion between said first and second ends.

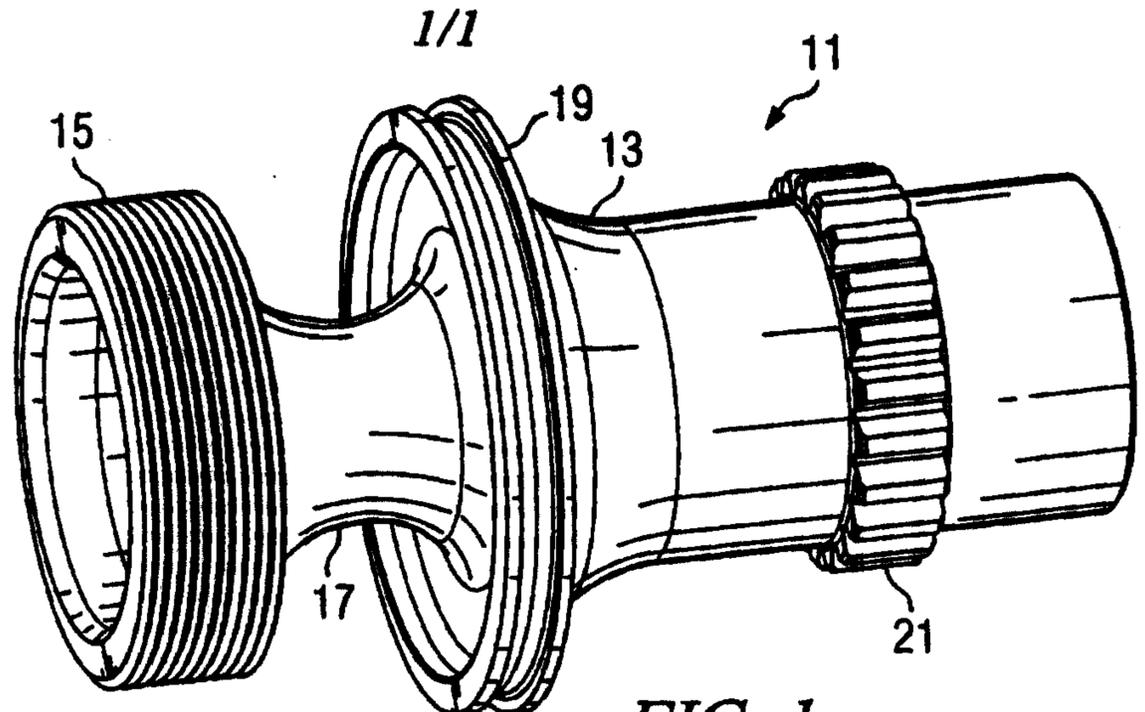


FIG. 1

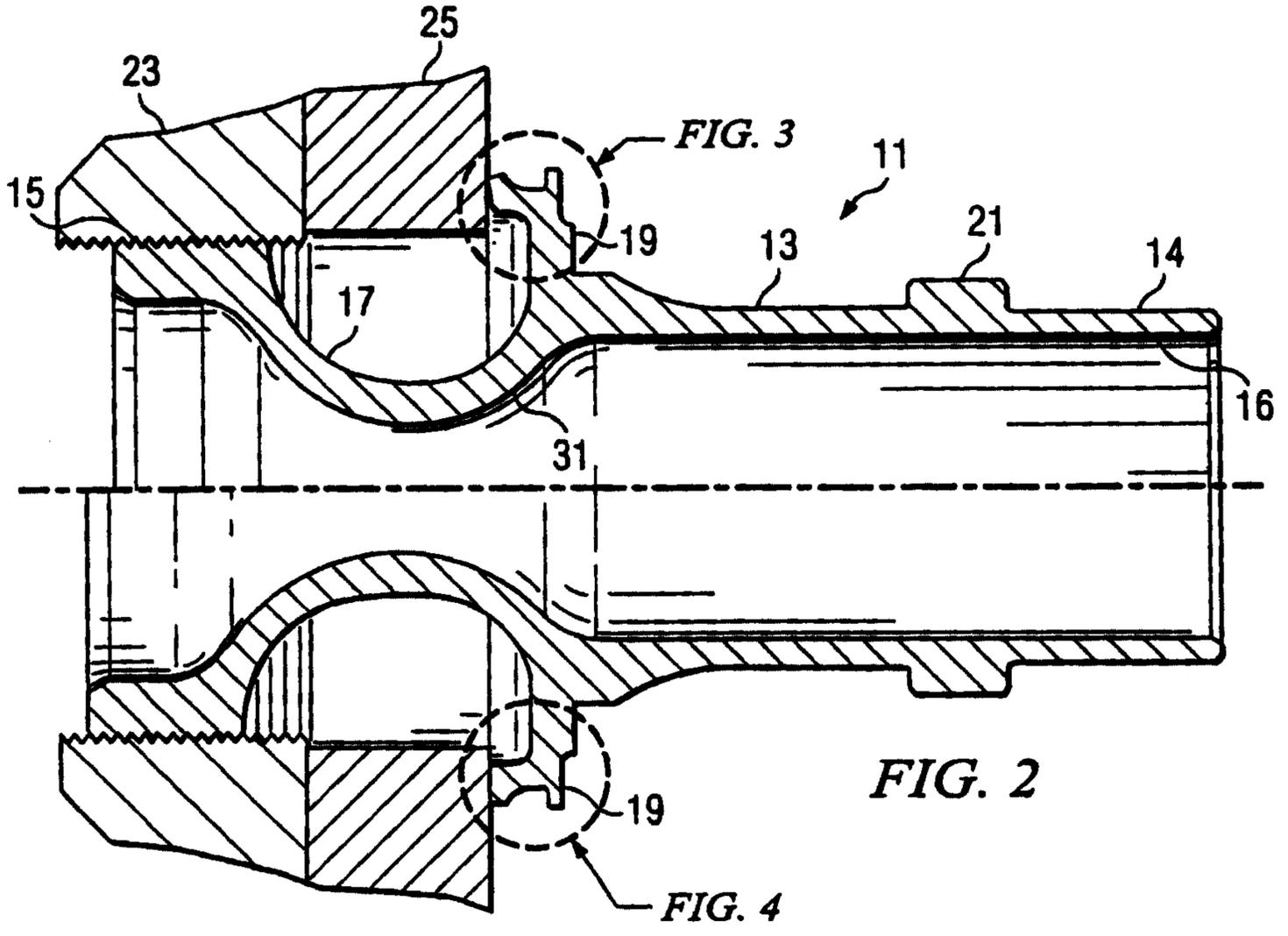


FIG. 2

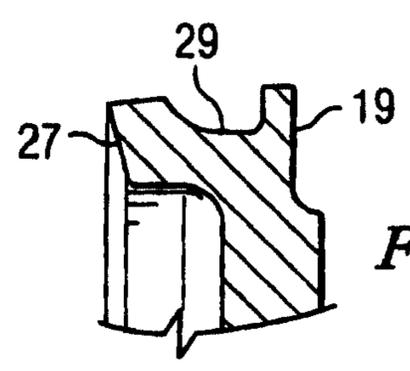


FIG. 3

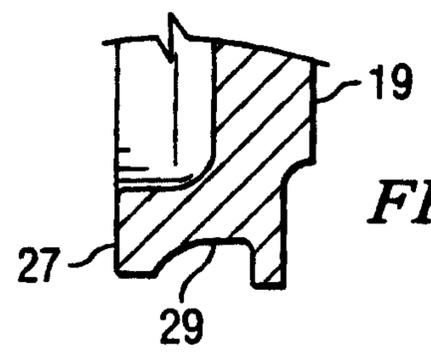


FIG. 4

