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(71) Applicant(s)
MacLean Fogg Company

(72) Inventor(s)
Brewer, Robert;Jakuszeski, Gerald

(74) Agent / Attorney
A J PARK, Level 11 60 Marcus Clarke Street, Canberra, ACT, 2601

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(71) Applicant *(for all designated States except US)*: **MACLEAN-FOGG COMPANY** [US/US]; 1000 Allanson Road, Mundelein, IL 60060 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BREWER, Robert** [US/US]; 8647 Donna Street, Westland, MI 48185 (US). **JAKUSZESKI, Gerald** [US/US]; 5190 Seymour Lake Road, Oxford, MI 48371 (US).

(74) Common Representative: **MACLEAN-FOGG COMPANY**; Alden, Dana, Andrew, 1000 Allanson Road, Mundelein, IL 60060 (US).

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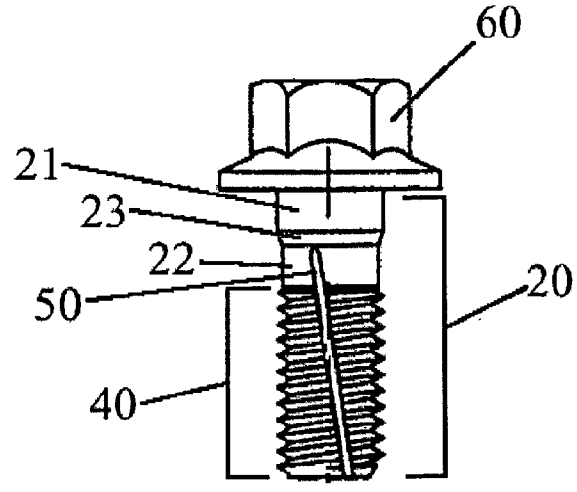
(54) Title: FLUID CONNECTOR



(57) Abstract: A fluid connector, comprising a shaft (22) having at least one solid shaft element and a plurality of connector surfaces, wherein the plurality of connector surfaces includes a surface with a plurality of threads (40) and a plurality of grooves (50).

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FLUID CONNECTOR

FIELD OF THE INVENTION

This invention relates to connectors for fluid distribution systems, and particularly to fluid connectors used to distribute fluids under pressure.

BACKGROUND OF THE INVENTION

Fluid connectors are known in the art and are referred to as "flow bolts" or "flow bolt assemblies." Such devices in the prior art are typically fabricated with external threads and an internal cavity through which fluid flows. Examples of such flow bolts are shown in U.S. Patent No. 5,011,192 to Campo, entitled "Bolt Retaining Hydraulic End Fitting Assembly." However, such flow bolts are weaker connectors because they are made with an internal cavity.

The object of the present invention is to go at least some way towards overcoming this and other disadvantages inherent in prior-art systems, or to at least provide the public with a useful choice.

SUMMARY OF THE INVENTION

In one aspect, the present invention provides a fluid connector for conducting fluid, comprising:

a) an elongated shaft and a head including a torque transferring structure and;

b) the shaft including a plurality of shaft sections between the head and a free end of the shaft and being substantially solid along its entire length;

c) a first shaft section comprising an outer surface that is threaded;

d) a second shaft section located between the threaded section and the head and comprising an outer surface that is unthreaded and generally cylindrical in shape;

e) a third shaft section located between the second shaft section and the head and comprising an outer surface that is unthreaded and generally cylindrical in shape

f) the outer surface of the third shaft section is provided with a diameter that is greater than a diameter of the outer surface of the second shaft section; and

g) a plurality of longitudinally extending grooves that are provided on the first shaft section.

In another aspect, the present invention provides a fluid connector for conducting fluid, comprising:

a) an elongated shaft and a head that includes a torque transferring structure;

b) the shaft including a plurality of shaft sections between the head and a free end of the shaft and being substantially solid along its entire length;

c) a first shaft section comprising an externally threaded section;

d) a second shaft section located between the threaded section and the end and comprising an outer surface that is an unthreaded section and generally cylindrical in shape;

e) a third shaft section located between the second shaft section and the head and comprising an outer surface that is unthreaded and generally cylindrical in shape;

f) the outer surface of the third shaft section is provided with a diameter that is greater than a diameter of the outer surface of the second shaft section;

g) a fourth shaft section located between the second shaft section and the third shaft section and comprising an outer surface; and

h) a plurality of longitudinally extending grooves that are provided on the first shaft section.

In another aspect, the present invention provides a fluid connector for conducting fluid, comprising:

a) an elongated shaft and a head that includes a torque transferring structure;

b) the shaft including a plurality of shaft sections between the head and a free end of the shaft;

c) a first shaft section comprising an outer surface that is threaded;

d) a second shaft section located between the threaded section and the head and comprising an outer surface that is unthreaded;

e) a third shaft section located between the second shaft section and the head and comprising an outer surface that is unthreaded;

f) the outer surface of the third section is provided with a diameter that is greater than a diameter of the outer surface of the second shaft section; and

g) a plurality of longitudinally extending grooves are provided on the first shaft section.

In yet another aspect, the present invention provides a method for fabricating a bolt, comprising:

a) providing a metal rod;

b) providing a die:

c) extruding the metal rod through use of the die;

d) cold forming the metal rod, at least in part, to provide a shaft and a head, so that:

i) the head includes a torque transferring structure;

ii) the head includes a flange located adjacent to the torque transferring structure;

iii) a generally cylindrical surface is located adjacent to the flange;

iv) located adjacent to the generally cylindrical surface is a surface that extends from the generally cylindrical surface towards an axis of the bolt;

e) rolling a threaded surface into the shaft; and

f) providing a plurality of grooves so that the grooves extend from an end of the bolt.

The scope of the present invention is defined solely by the appended claims, and is not affected to any degree by the statements within this summary. Briefly stated, a fluid connector, comprising a shaft having at least one solid shaft element and a plurality of connector surfaces, wherein the plurality of connector surfaces includes a surface with a plurality of threads and a plurality of grooves.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 depicts a preferred embodiment of a fluid connector.

Figure 2 depicts the bottom view of the preferred embodiment of a fluid connector seen in Figure 1.

Figure 3 depicts an alternative embodiment of a fluid connector.

Figure 4 depicts a view of the outside of a second embodiment of a fluid connector.

Figure 5 depicts a third embodiment of a fluid connector.

Figure 6 depicts a fourth embodiment of a fluid connector.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

Turning now to the drawings, FIGS. 1 and 2 show a fluid connector 10 in the form of a flow bolt constituting a preferred embodiment of the present invention. The flow bolt 10 is composed of a metal, preferably aluminum. According to one aspect of the present invention, the metal is copper. According to another aspect of the present invention, the metal is iron.

Those skilled in the art will appreciate that the metal is an alloy. According to one aspect of the present invention, the metal includes ferrous and non-ferrous materials. According to another aspect of the present invention, the metal is a steel. Those skilled in the art will appreciate that steel is in a plurality of formulations, such as stainless steel. According to one embodiment of the present invention the steel is a low carbon steel. In another embodiment of the present invention, the steel is a medium carbon steel. According to yet another embodiment of the present invention, the steel is a high carbon steel.

Those with skill in the art will also appreciate that the metal is a super alloy. According to one aspect of the present invention, the super alloy is bronze; according to another aspect of the present invention, the super alloy is a high nickel material. According to yet another aspect of the present invention, the flow bolt 10 is composed of martensitic material. According to still another aspect of the present invention, the flow bolt 10 is composed of austenitic material. According to another aspect of the present invention, the metal is a ferritic material.

The flow bolt 10 includes a shaft 20 and a head 60. The shaft 20 is composed of at least one of a plurality of shaft sections. According to one aspect of the present invention, a shaft section is cylindrical in shape. According to another aspect of the present invention, a shaft section is conical in shape. According to yet another aspect of the present invention, the shaft sections are solid. According to still another aspect of the present invention, the shaft sections are hollow.

FIG. 1 depicts the preferred embodiment of the present invention wherein the flow bolt shaft 20 is composed of a plurality of shaft sections provided with a plurality of outer surfaces 21, 22, 23, and 40. The shaft 20 includes an upper shaft section having an outer surface 21 that is generally cylindrical in shape, a lower shaft section that is provided with an outer surface 22 that is generally cylindrical in shape, intermediate shaft section that is provided with an outer surface 23 that is generally frusto-conical in shape, and a shaft section that is provided with an outer surface 40 that is threaded. In the preferred embodiment, the surface 21 is joined to the surface 22 via the surface 23.

The flow bolt shaft 20 of the present invention is provided with a plurality of connector surfaces. The surface 22 is an unthreaded surface, as is the surface 21. The surface 22 has a smaller diameter than the surface 21. The surface 23 is sloped relative to an axis 11 of the bolt and located adjacent to the surfaces 21, 22.

FIG. 1 depicts the preferred embodiment flow bolt 10 of the present invention composed of a plurality of connector surfaces. FIG. 2 depicts a bottom view of the preferred embodiment flow bolt 10 of the present invention. The surface 22 and the surface 40 include a plurality of grooves 50 extending longitudinally from the surface 23 to an end of the bolt 10. In the bolt 10 there are four such grooves 50 extending spirally and spaced from each other around the bolt 10.

The connector surfaces of the present invention perform a plurality of functions. The threads of the surface 40 function to fasten the fluid connector flow bolt 10 to another structure. This function is accomplished through the interaction of the threads and cooperating threads of another structure (not shown).

In use of the flow bolt 10, the grooves 50 function to channel fluid from around the section 22 of the shaft 20 to the free end of the shaft. This function is accomplished with at least one groove 50, although more are preferred, as illustrated here.

The flow bolt 10 is fabricated through a plurality of processes. According to one aspect of the present invention, the flow bolt 10 is machined. According to another aspect of the present invention, the flow bolt 10 is hot formed or forged. According to yet another aspect of the present invention, the flow bolt 10 is fabricated through casting. The preferred embodiment of the flow bolt is cold formed (also known as "cold head").

The process of cold forming the preferred embodiment begins with a metal wire or metal rod which is drawn to size. After being drawn to size, the wire or rod is upset by being run through a series of dies or extrusions. After the wire has been through a series of dies or extrusions, it has been changed to a semi-formed state. In this semi-formed state, the metal is rolled so that a surface with at least one groove 50 is formed. In the preferred embodiment, a plurality of grooves 50 are rolled into the shaft 20 so that they form spirals. Those skilled in the art will appreciate that a plurality of grooves 50 can be fabricated so that they are straight and do not form a spiral, however, and, furthermore, that the grooves can be fabricated with any degree of spiral.

While the preferred embodiment depicted in FIG. 1 illustrates grooves 50 fabricated through rolling, those skilled in the art will appreciate that a groove or grooves

may be fabricated in other ways. The grooves of the present invention are not limited to fabrication through rolling. As used herein, a groove is any structure which allows for fluid flow on a connector surface.

After a plurality of grooves 50 have been impressed into the surface, threads are formed on the surface of the shaft section 40 through a similar rolling process. In the preferred embodiment, threads are rolled to a depth which is half the depth of the grooves 50. Those skilled in the art will appreciate that the grooves and the threads can be made through machining or drilling with a different ratio of relative depths. Furthermore, those skilled in the art will appreciate that the present invention can be threaded first and then rolled to form the groove.

The presently preferred embodiment includes a head 60 provided with a torque transferring structure 61 and a flange 62.. As used herein, a torque transferring structure 61 is any structure which allows a torque to be transferred to shaft 20 of the present invention. The torque transferring structure 61 is used to rotate the shaft 20 and tighten or loosen the threaded connection between the present invention and another structure. Alternatively, the torque transferring structure 61 is a recessed area such as will fit a screw driver.

Those skilled in the art will appreciate that torque may be transferred via any of a plurality of structures and that any such structure can be used without departing from the spirit of the present invention. Any structure which allows a torque to be transferred to the shaft 20 of the present invention is a torque transferring structure within the scope of the present invention.

FIG. 3 depicts the hollow shaft element of an alternative embodiment of the present invention. In the alternative embodiment of FIG. 3, a surface with a plurality of threads 40 defines an inner section 24 which accommodates a threaded rod 25. Within the surface with a plurality of threads 40, a groove 50 is provided through which fluid flows. As depicted in FIG. 3, the alternative embodiment is preferably provided with a torque transferring structure 60, which is in the form of a roughened gripping surface 62. However, as noted above, those skilled in the art will appreciate that torque may be transferred through other structures, such as a recessed area 61, as depicted in FIG. 4 and previously discussed. FIG. 4 depicts the outer surface 26 of the hollow shaft element of the alternative embodiment of the present invention with an alternative torque transferring structure 60.

FIG. 5 depicts a second alternative embodiment of the present invention. As illustrated in FIG. 5, a surface with a plurality of threads 40 defines an inner section 24 which accommodates a threaded rod. Within the surface with a plurality of threads 40, a groove is provided through which fluid flows. In the alternative embodiment depicted in FIG. 5, an opening 27 is provided which accommodates a fluid conveying structure, such as a nozzle (not shown). Those skilled in the art will appreciate that the opening 27 may be defined in the outer surface 26. As illustrated in FIG. 5, the inner section 24 accommodates a threaded rod.

FIG. 6 depicts a third alternative embodiment of the present invention configured as a coupler 11. The coupler 11 depicted in FIG. 6 is composed of an outer surface 26 and a surface with a plurality of threads 40 which defines an inner section 24. The inner section 24 accommodates at least one threaded rod 25, preferably two threaded rods. Within the threaded surface 40, a groove 50 is provided through which fluid flows. As depicted in FIG. 6, the coupler 11 is preferably provided with a torque transferring structure 60.

The term "comprising" as used in this specification and claims means "consisting at least in part of"; that is to say when interpreting statements in this specification and claims which include "comprising", the features prefaced by this term in each statement all need to be present but other features can also be present. Related terms such as "comprise" and "comprised" are to be interpreted in similar manner.

While this invention has been particularly shown and described with references to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A fluid connector for conducting fluid, comprising:
   a) an elongated shaft and a head including a torque transferring structure and;
   b) the shaft including a plurality of shaft sections between the head and a free end of the shaft and being substantially solid along its entire length;
   c) a first shaft section comprising an outer surface that is threaded;
   d) a second shaft section located between the threaded section and the head and comprising an outer surface that is unthreaded and generally cylindrical in shape;
   e) a third shaft section located between the second shaft section and the head and comprising an outer surface that is unthreaded and generally cylindrical in shape
   f) the outer surface of the third shaft section is provided with a diameter that is greater than a diameter of the outer surface of the second shaft section; and
   g) a plurality of longitudinally extending grooves that are provided on the first shaft section.

2. The fluid connector for conducting a fluid according to claim 1, wherein the plurality of longitudinally extending grooves extend from the first shaft section into the outer surface of the second shaft section.

3. The fluid connector of claim 1, further comprising:
   a) a fourth shaft section, located between the second and the third unthreaded sections, comprising an outer surface that is unthreaded and generally frust-conical in shape; and
   b) the grooves extend into immediately adjacent relationship with the frusto-conical section.

4. The fluid connector of claim 1, further characterized in that the threads are provided with a thread depth and the grooves are provided with a groove depth, wherein the thread depth is at least half that of the groove depth.

5. The fluid connector of claim 1, further characterized in that the threads are provided with a thread depth and the grooves are provided with a groove depth, wherein the thread depth is less than the groove depth.

6. The fluid connector of claim 1 further characterized, in that the grooves are provided with a spiral shape.

7. The fluid connector of claim 1 further characterized, in that the grooves are equally spaced from each other.

8. A fluid connector for conducting fluid, comprising:

a) an elongated shaft and a head that includes a torque transferring structure;

b) the shaft including a plurality of shaft sections between the head and a free end of the shaft and being substantially solid along its entire length;

c) a first shaft section comprising an externally threaded section;

d) a second shaft section located between the threaded section and the end and comprising an outer surface that is unthreaded section and generally cylindrical in shape;

e) a third shaft section located between the second shaft section and the head and comprising an outer surface that is unthreaded and generally cylindrical in shape;

f) the outer surface of the third shaft section is provided with a diameter that is greater than a diameter of the outer surface of the second shaft section;

g) a fourth shaft section located between the second shaft section and the third shaft section and comprising an outer surface; and

h) a plurality of longitudinally extending grooves that are provided on the first shaft section.

9. The fluid connector of claim 8, further characterized in that the grooves are provided with a spiral shape.

10. The fluid connector of claim 8, further characterized in that the threads are provided with a thread depth and the grooves are provided with a groove depth, wherein the thread depth is at least half that of the groove depth.

11. The fluid connector according to claim 8, further characterized in that the threads are provided with a thread depth and the grooves are provided with a groove depth, wherein the thread depth is less than the groove depth.

12. The fluid connector for conducting a fluid according to claim 8, wherein the plurality of longitudinally extending grooves extend from the first shaft section into the outer surface of the second shaft section.

13. The fluid connector according to claim 8, wherein the plurality of longitudinally extending grooves extend from the first shaft section into the outer surface of the second shaft section and terminate adjacent to the fourth shaft section.

14. The fluid connector according to claim 9, wherein the outer surface of the fourth shaft section is unthreaded and generally frusto-conical in shape.

15. The fluid connector of claim 14, further characterized in that the grooves are provided with a spiral shape.

16. The fluid connector of claim 14, further characterized in that the threads are provided with a thread depth and the grooves are provided with a groove depth, wherein the thread depth is at least half that of the groove depth.

17. The fluid connector according to claim 14, further characterized in that the threads are provided with a thread depth and the grooves are provided with a groove depth, wherein the thread depth is less than the groove depth.

18. The fluid connector for conducting a fluid according to claim 14, wherein the plurality of longitudinally extending grooves extend from the first shaft section into the outer surface of the second shaft section.

19. The fluid connector according to claim 14, wherein the plurality of longitudinally extending grooves extend from the first shaft section into the outer surface of the second shaft section and terminate adjacent to the fourth shaft section.

20. A fluid connector for conducting fluid, comprising:

a) an elongated shaft and a head that includes a torque transferring structure;
b) the shaft including a plurality of shaft sections between the head and a free end of the shaft;
c) a first shaft section comprising an outer surface that is threaded;
d) a second shaft section located between the threaded section and the head and comprising an outer surface that is unthreaded;
e) a third shaft section located between the second shaft section and the head and comprising an outer surface that is unthreaded;
f) the outer surface of the third section is provided with a diameter that is greater than a diameter of the outer surface of the second shaft section; and
g) a plurality of longitudinally extending grooves are provided on the first shaft section.

21. The fluid connector according to claim 20, wherein the outer surface of the first shaft section is generally cylindrical in shape.

22. The fluid connector according to claim 20, wherein the outer surface of the second shaft section is generally cylindrical in shape.

23. The fluid connector according to claim 20, wherein the outer surface of the second shaft section is generally frusto-conical in shape.

24. The fluid connector for conducting a fluid according to claim 20, wherein the plurality of longitudinally extending grooves extend from the first shaft section into the outer surface of the second shaft section.

25. The fluid connector according to claim 20, wherein the plurality of longitudinally extending grooves extend from the first shaft section into the outer surface of the second shaft section and terminate adjacent to the third shaft section.

26. The fluid connector according to claim 20, further comprising a fourth shaft section that is provided with an outer surface.

27. The fluid connector according to claim 20, further comprising a fourth shaft section that is provided with an outer surface that is generally frusto-conical in shape.

28. The fluid connector of claim 20, further characterized in that the grooves are provided with a spiral shape.

29. The fluid connector of claim 20, further characterized in that the threads are provided with a thread depth and the grooves are provided with a groove depth, wherein the thread depth is at least half that of the groove depth.

30. The fluid connector according to claim 20, further characterized in that the threads are provided with a thread depth and the grooves are provided with a groove depth, wherein the thread depth is less than the groove depth.

31. A method for fabricating a bolt, comprising:

a) providing a metal rod;
b) providing a die:
c) extruding the metal rod through use of the die;
d) cold forming the metal rod, at least in part, to provide a shaft and a head, so that:
   i) the head includes a torque transferring structure;
   ii) the head includes a flange located adjacent to the torque transferring structure;
   iii) a generally cylindrical surface is located adjacent to the flange;
   iv) located adjacent to the generally cylindrical surface is a surface that extends from the generally cylindrical surface towards an axis of the bolt:
e) rolling a threaded surface into the shaft; and
f) providing a plurality of grooves so that the grooves extend from an end of the bolt.

32. The fluid connector according to claim 1, 8, or 20 and substantially as herein described with reference to any embodiment disclosed.

33. The method according to claim 31 and substantially as herein described with reference to any embodiment disclosed.

34. A fluid connector for conducting fluid substantially as herein described with reference to any embodiment shown in the accompanying drawings.

35. A method for fabricating a bolt substantially as herein described with reference to any embodiment shown in the accompanying drawings.

MACLEAN-FOGG COMPANY

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FIG. 1

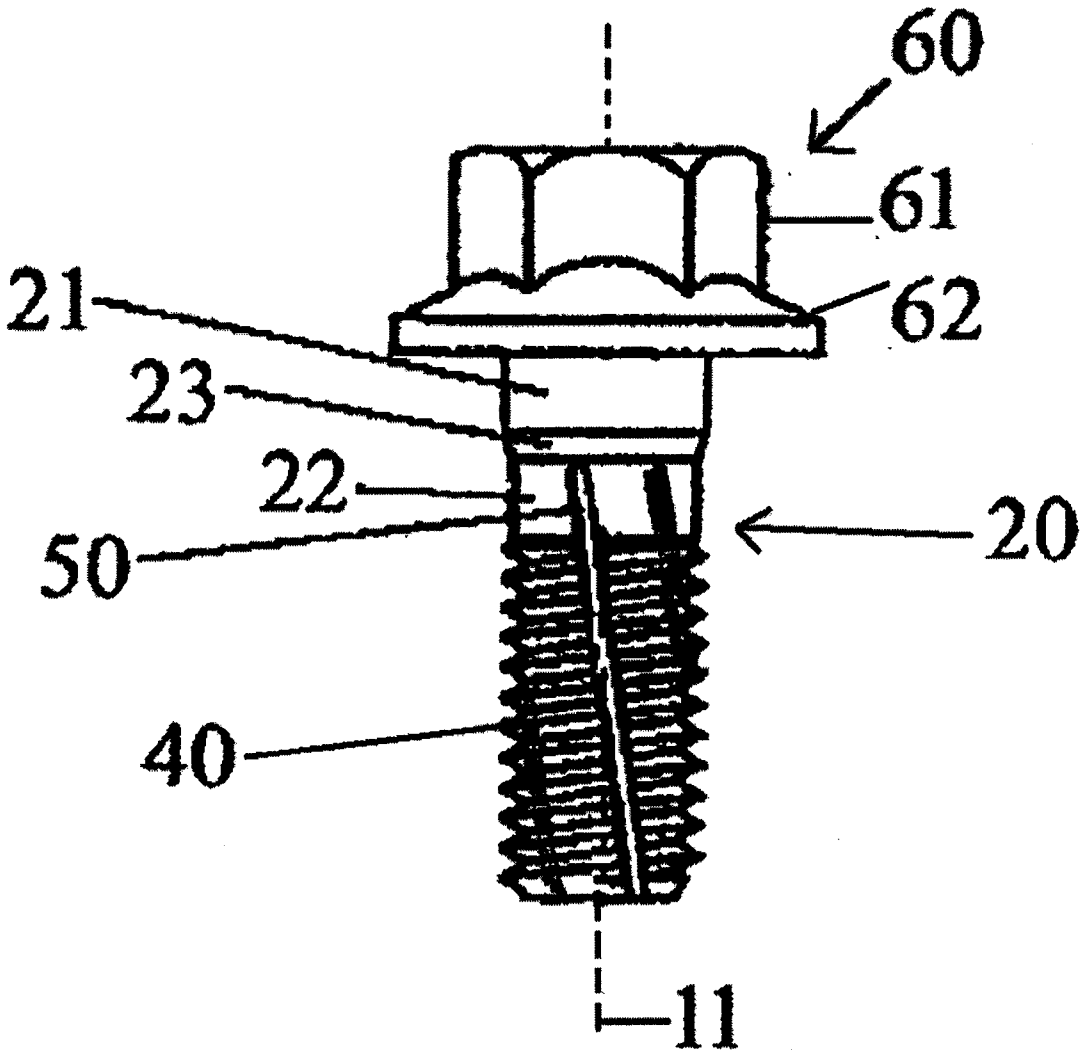

FIG. 2

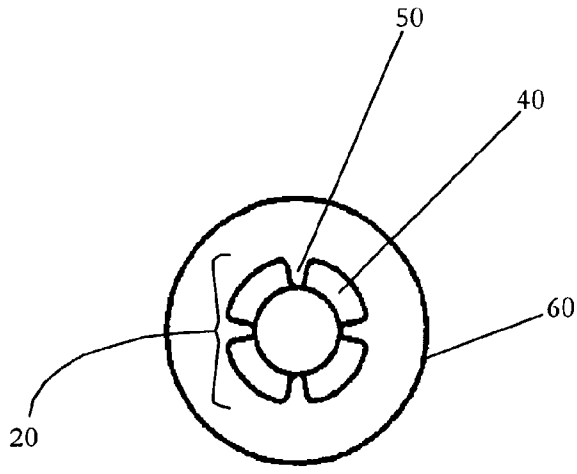

FIG. 3

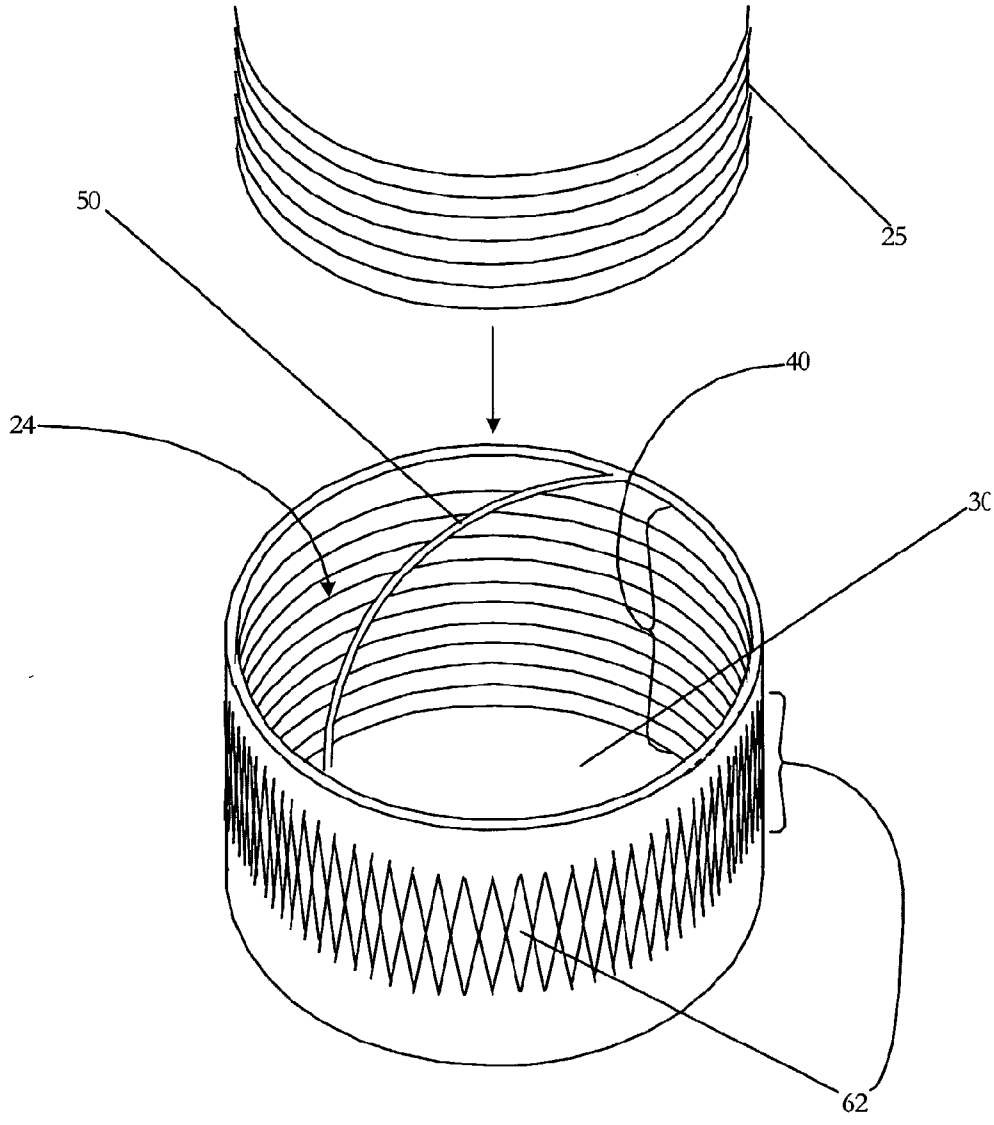

FIG. 4

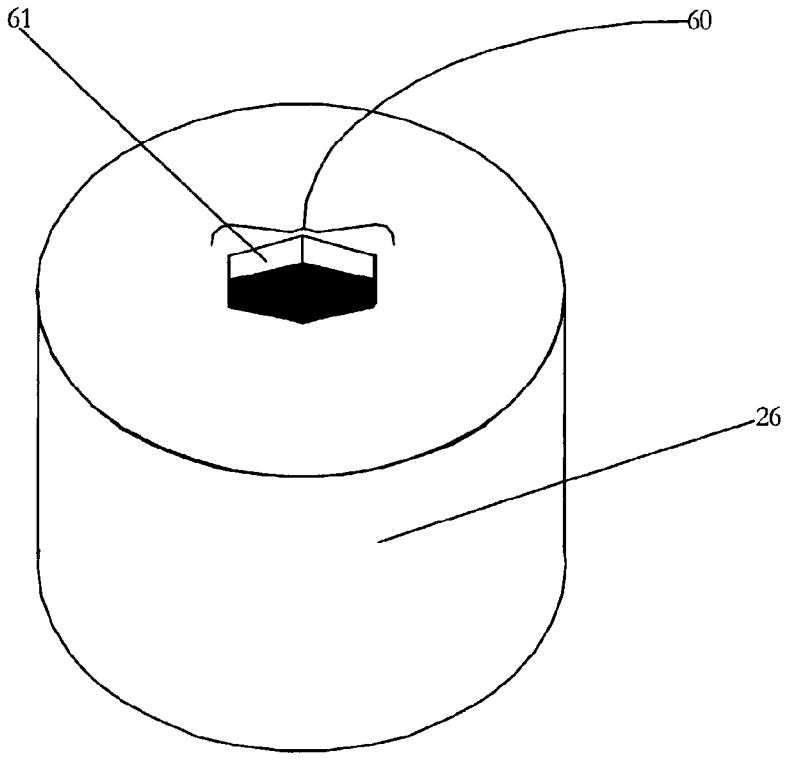

FIG. 5

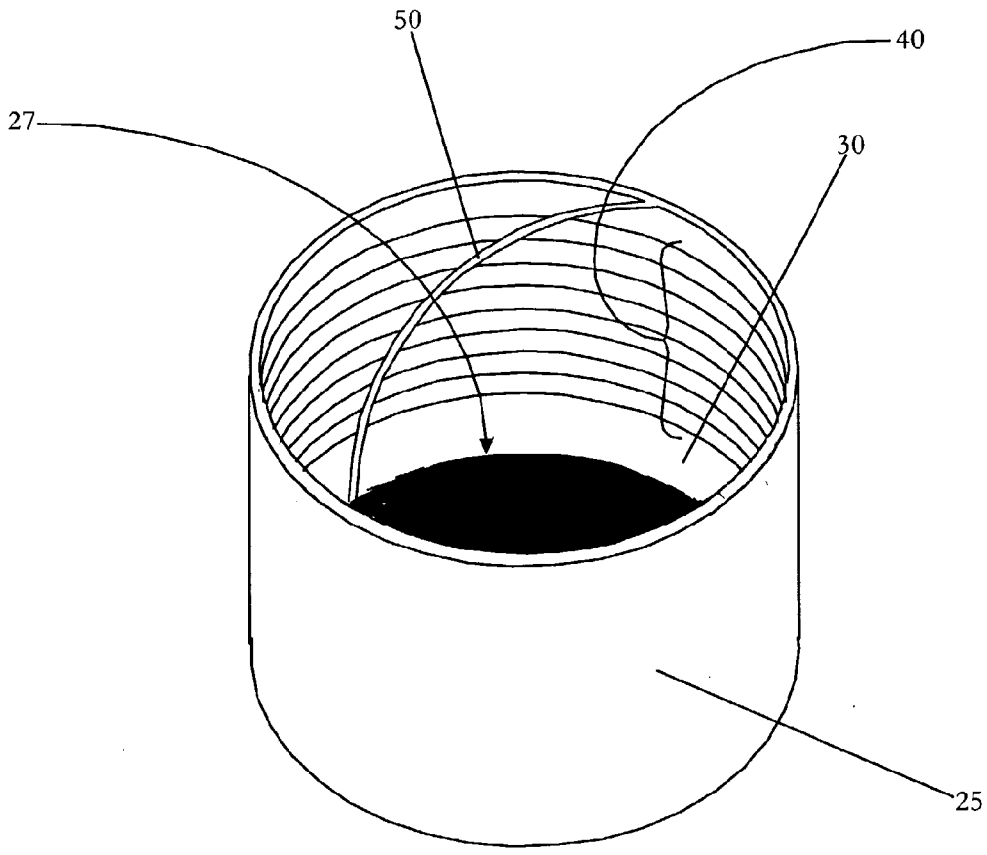

FIG. 6