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(71) Applicant: **SMITH & NEPHEW, INC.** [—/US]; 1450
Brooks Road, Memphis, Tennessee 38116 (US).

(72) Inventors: **GATTURNA, Roland F.**; 4 Brigantine Pas-
sage, Bourne, Massachusetts 02532 (US). **SANTAN-
GELO, Stephen A.**; 38 Draper Woods Rd., Sturbridge,
Massachusetts 01518 (US).

(74) Agents: **MARAIA, Joseph M.** et al.; Burns & Levinson
LLP, 125 Summer Street, Boston, Massachusetts 02110
(US).

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(54) Title: QUICK DISCONNECT ASSEMBLY AND METHOD OF USE

(57) Abstract:

QUICK DISCONNECT ASSEMBLY AND METHOD OF USE

FIELD OF THE INVENTION

The present disclosure relates to quick disconnect assemblies in general and, more
5 particularly, to a quick disconnect housing and shaft assembly used in a surgical apparatus.

BACKGROUND

A surgical apparatus may contain a shaft inserted into a housing and secured in place
in many ways, such as with a set screw, a locking shaft collar, or a cross-pin fitting into a
10 groove. During a surgical operation, the shaft may need to be detached and removed from the
housing, for example, with a surgical apparatus that has a reusable handle and a single-use
front end. Therefore, it is desirable for the surgical apparatus to have a quick disconnect
mechanism between the housing and shaft that is simple, cost-effective, reliable and easy to
use.

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SUMMARY

The disclosure described herein is a quick disconnect assembly including a generally
tubular housing extending between distal and proximal ends, and a rotatable nut adapted to
secure a threaded shaft. This mechanism can be applied to any surgical construct where a
20 removable component is desired, particularly with reusable and disposable components.
Advantageously, the quick disconnect assembly of this disclosure will accommodate a variety
of shaft lengths and/or configurations. Furthermore, the quick disconnect assembly of this
disclosure provides the ability to slide and lock with a separate axial movement. Both the
shaft and the housing can easily be assembled and disassembled repeatedly. The housing and
25 shaft can further be assembled and disassembled at adjustable positions. The adjustments to
the positions can be of any granularity.

The quick disconnect assembly of this disclosure is furthermore advantageous over the
prior art because current apparatuses require at least one additional mechanical element to
lock the shaft to the nut. The present disclosure uses fewer parts, leading to simplicity,
30 reduced costs, and ease of use for surgeons.

In an embodiment of the quick disconnect assembly of this disclosure, the quick disconnect assembly includes a tubular housing extending along a longitudinal axis between a proximal end and a distal end. The housing includes a cannulation extending between the proximal and distal ends. The cannulation includes a first portion extending from the housing proximal end and a second portion. The second portion is continuous with the first portion, extending from the housing distal end and having a diameter smaller than the first portion.

The housing further includes a cam pin secured to the housing and extending transverse to the longitudinal axis within the first portion. The housing also includes a nut positioned within the housing. The nut includes a first, threaded channel formed through a length of the nut and adapted to threadingly engage a threaded shaft, a second, non-threaded channel extending at a selected angle with respect to the first channel and intersecting the first channel, the second channel having a diameter greater than the threaded shaft, and an arcuate groove formed on an outer surface of the nut and extending between the proximal and distal ends of the nut. The first channel of the nut is oriented such that, when the cam pin engages the groove at about a distal end of the nut, the nut is positioned in a loading position where the second channel extends approximately parallel to the longitudinal axis of the housing. The second channel of the nut is oriented such that, when the cam pin engages the groove at about a proximal end of the nut, the nut is positioned in a locking position where the first channel extends approximately parallel to the longitudinal axis of the housing.

In further embodiments, the housing is tubular. The nut comprises a non-threaded channel. The quick disconnect assembly comprises a threaded shaft threadingly engaged with the first channel of the nut and a nut carrier axially coupled to the nut. Distal advancement of the threaded shaft while the nut is in the loading position engages a distal end of the threaded shaft with a nut carrier and distally advances the nut carrier and nut. The nut is urged from the loading position to the locking position by the distal advancement of the threaded shaft such that threads of the first channel threadingly engage the threads of the threaded shaft. Insertion of the threaded shaft into the nut is not inhibited by the second channel when the nut is in the loading position. The diameter of the second portion of the housing cannulation is selected to prevent distal movement of the nut when the nut is in the locking position. A diameter of the non-threaded channel of the nut is selected to allow passage of the threaded shaft. A clearance inside the housing is selected to allow the nut to rotate into the loading

position but to restrict the nut from rotating into a position that would disengage the threaded shaft from the first channel of the nut.

In an embodiment of the method of connecting a housing and shaft of this disclosure, the method includes: engaging a cam pin secured to a housing with a distal end of a groove
5 formed in the surface of a nut, the nut comprising a first channel in communication with a second channel extending at a selected angle with respect to the first channel and intersecting the first channel, wherein the nut is positioned within a cannulation of the housing such that the second channel of the nut extends approximately parallel to a longitudinal axis of the housing; inserting a threaded shaft into the first channel of the nut; and distally advancing the
10 threaded shaft within the nut until a distal end of the threaded shaft engages with a nut carrier and distally advances the nut carrier and the nut within the cannulation of the housing. The distal advancement of the nut within the cannulation of the housing causes the cam pin to move from the distal end of the groove to the proximal end of the groove. When the cam pin engages the proximal end of the groove, the first channel of the nut extends approximately
15 parallel to the longitudinal axis of the housing and the threaded shaft is lockingly engaged with the threaded channel of the nut. The cannulation of the housing comprises a first portion and a second portion, a diameter of the second portion being smaller than a diameter of the first portion. The diameter of the second portion of the housing cannulation is selected to prevent distal movement of the nut when the threaded shaft is lockingly engaged with the
20 threaded channel of the nut.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing will be apparent from the following more particular description of example embodiments of the disclosure, as illustrated in the accompanying drawings.

25 Figs. 1A is a diagram illustrating an example embodiment of the loading position of present disclosure;

Figs. 1B-D illustrate details of the embodiment of Fig. 1A;

Fig. 1E is a diagram illustrating the transition from the loading to the locking position of the embodiment of Fig. 1A; and

30 Fig. 1F is a diagram illustrating the locking position of the embodiment of Fig. 1A.

DETAILED DESCRIPTION

Examples of the quick disconnect assembly of this disclosure will now be discussed with reference to the figures.

In the description that follows, like components have been given the same reference numerals, regardless of whether they are shown in different examples. To illustrate example(s) in a clear and concise manner, the drawings may not necessarily be to scale and certain features may be shown in somewhat schematic form. Features that are described and/or illustrated with respect to one example may be used in the same way or in a similar way in one or more other examples and/or in combination with or instead of the features of the other examples.

Comprise, include, and/or plural forms of each are open ended and include the listed parts and can include additional parts that are not listed. And/or is open ended and includes one or more of the listed parts and combinations of the listed parts.

Figs. 1A-E illustrate an example embodiment of the quick disconnect assembly 100 of this disclosure and its method of use. The components of the quick disconnect assembly 100 may vary in size, shape or materials and are selected to be suitable to the surgical apparatus of their use.

In Fig. 1A, the quick disconnect assembly 100 generally includes a housing 102 (shown in cross-section), a nut carrier 104, a rotatable nut 108 and a threaded shaft 112. The housing 102 can be a tubular housing extending along a longitudinal axis between a proximal end and a distal end. However, a person of ordinary skill in the art can recognize that the housing 102 can be extrapolated as a housing of another shape in other embodiments. The housing 102 can include a cannulation 116 extending between the proximal and distal ends. The nut carrier 104 and the rotatable nut 108 are positioned within the cannulation 116, as described in more detail below. The nut carrier 104 includes an internal, non-threaded cannulation 124 extending from a proximal to a distal end. The shapes of both of the nut carrier 104 and the rotatable nut 108 can be tubular, but are selected to match the inside shape of the cannulation 116. The threaded shaft 112 may be disposable.

As shown in Fig. 1B, the cannulation 116 can include a first portion 116a and a second portion 116b. The first portion 116a extends from the proximal end of the housing 102. The second portion 116b is continuous with the first portion 116a and extends from the distal end

of the housing 102. The second portion 116b has a diameter smaller than a diameter of the first portion 116a, the diameter being selected to prevent distal movement of the rotatable nut 108. The housing 102 can also include a cam pin 106 secured to the housing 102 and extending traverse to the longitudinal axis within the first portion 116a. The function of the cam pin 106 will be described further below. The nut 108 (Fig. 1A) is disposed within the first portion 116a. The nut carrier 104 (Fig. 1A) is primarily disposed within the second portion 116b but may extend into the first portion 116a.

As shown in Fig. 1C, the rotatable nut 108 includes a first, threaded channel 118 formed through a length of the rotatable nut 108 and adapted to threadingly engage the shaft 112. The rotatable nut 108 includes a second, non-threaded channel 120 extending at a selected angle with respect to the first channel 118 and intersecting the first channel 118 at a midpoint of a center line of the threaded shaft 118. The second channel 120 has a diameter greater than a diameter of the shaft 112, the diameter being selected to allow the shaft 112 to slide in the second channel 120.

As shown in Fig. 1D, the rotatable nut 108 further includes an arcuate groove 122 formed on an outer surface of the rotatable nut 108 and extending between the proximal and distal ends of the rotatable nut 108. The groove 122 is configured to engage the cam pin 106 (Fig. 1B), as further described below.

Returning now to Fig. 1A, the loading position of the quick release assembly of this disclosure is shown. As shown in Fig. 1A, the first channel 118 (Fig. 1C) of the rotatable nut 108 is oriented such that, when the cam pin 106 engages the groove 122 (Fig. 1D) at about a distal end of the nut 108, the cam pin 106 rotates the rotatable nut 108 into the loading, or unlocked, position, along the direction of unlocking rotation 110. In this position, the second channel 120 (Fig. 1C) of the rotatable nut 108 extends approximately parallel to the longitudinal axis of the housing 102.

As shown in Fig. 1E, the shaft 112 is inserted into the housing 102 through the rotatable nut 108, and partially into the cannulation 124 of the nut carrier 104. It is contemplated by this disclosure that a suture may be attached to the shaft 112 prior to insertion. Once the threaded shaft 112 has found its correct depth within the housing 102, the nut carrier 104 will be drawn back distally within the housing 102, causing the rotatable nut 108 to be rotated by the cam pin 106 into the locked position.

Fig. 1F shows the locked position of the quick release assembly of this disclosure. In Fig. 1F, the rotatable nut 108 is oriented such that, when the cam pin 106 engages the groove 122 (Fig. 1D) at about a proximal end of the rotatable nut 108, the cam pin 106 forces the rotatable nut 108 into the locking position as the nut carrier 104 pulls the shaft 112 into the housing 102. The rotatable nut 108 rotates along a direction of locking rotation 114 to turn into the locking position. The nut carrier 104 is driven back distally along the longitudinal axis of the housing 102, where a reduced housing inside diameter (Fig. 1B) captures and locks the rotatable nut 108 in its locked position. In this position, the first channel 116a (Fig. 1C) extends approximately parallel to the longitudinal axis of the housing 102. The nut carrier 104 is then axially coupled to the rotatable nut 108 by means of the shaft 112.

It should be noted that enough clearance inside the housing 102 is required for the nut 108 to rotate into the loading position. At the same time, the clearance inside the housing 102 must also restrict the nut 108 from rotating into a position that would decouple it from the shaft 112.

It should also be noted that insertion of the shaft 112 into the rotatable nut 108 is not inhibited by the second channel 120 when the rotatable nut 108 is in the loading position. As shown in Fig. 1F, distal advancement of the shaft 112 while the rotatable nut 108 is in the loading position engages a distal end of the shaft 112 with the nut carrier 104 and distally advances the nut carrier 104 and rotatable nut 108. The rotatable nut 108 is urged from the loading position to the locking position by the distal advancement of the shaft 112 such that threads of the first channel 118 threadingly engage the threads of the shaft 112.

It is contemplated by this disclosure that the quick disconnect assembly can be configured to allow for the nut to pivot and move along the threaded shaft in small increments without rotating.

While this disclosure has been particularly shown and described with references to example 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 scope of the disclosure encompassed by the appended claims.

CLAIMS

1. A quick disconnect assembly, comprising:

a housing extending along a longitudinal axis between a proximal end and a distal end,

the housing further including:

a cannulation extending between the proximal and distal ends, the cannulation including a first portion extending from the housing proximal end, and a second portion, continuous with the first portion, extending from the housing distal end and having a diameter smaller than a diameter of the first portion; and

a cam pin secured to the housing and extending transverse to the longitudinal axis within the first portion;

a nut positioned within the housing cannulation, the nut comprising:

a first, threaded channel formed through a length of the nut and adapted to threadingly engage a threaded shaft;

a second, non-threaded channel extending at a selected angle with respect to the first channel and intersecting the first channel, the second channel having a diameter greater than a diameter of the threaded shaft;

an arcuate groove formed on an outer surface of the nut and extending between the proximal and distal ends of the nut;

wherein the first channel of the nut is oriented such that, when the cam pin engages the groove at about a distal end of the nut, the nut is positioned in a loading position where the second channel extends approximately parallel to the longitudinal axis of the housing; and

wherein the second channel of the nut is oriented such that, when the cam pin engages the groove at about a proximal end of the nut, the nut is positioned in a locking position where the first channel extends approximately parallel to the longitudinal axis of the housing.

2. The quick disconnect assembly of claim 1, further comprising a threaded shaft

threadingly engaged with the first channel of the nut.

3. The quick disconnect assembly of claim 1, further comprising a nut carrier axially coupled to the nut.

4. The quick disconnect assembly of claim 2, wherein distal advancement of the threaded shaft while the nut is in the loading position engages a distal end of the threaded shaft with a nut carrier and distally advances the nut carrier and nut.

5. The quick disconnect assembly of claim 4, wherein the nut is urged from the loading position to the locking position by the distal advancement of the threaded shaft such that threads of the first channel threadingly engage the threads of the threaded shaft.

6. The quick disconnect assembly of claim 1, wherein insertion of the threaded shaft into the nut is not inhibited by the second channel when the nut is in the loading position.

7. The quick disconnect assembly of claim 1, wherein the housing is tubular.

8. The quick disconnect assembly of claim 1, wherein the diameter of the second portion of the housing cannulation is selected to prevent distal movement of the nut when the nut is in the locking position.

9. The quick disconnect assembly of claim 1, wherein the nut comprises a non-threaded channel.

10. The quick disconnect assembly of claim 9, wherein a diameter of the non-threaded channel of the nut is selected to allow passage of the threaded shaft.

11. The quick disconnect assembly of claim 2, wherein a clearance inside the housing is selected to allow the nut to rotate into the loading position but to restrict the nut from rotating into a position that would disengage the threaded shaft from the first channel of the nut.

12. A method of connecting a housing and shaft, the method comprising:

engaging a cam pin secured to a housing with a distal end of a groove formed in the surface of a nut, the nut comprising a first channel in communication with a second channel extending at a selected angle with respect to the first channel and intersecting the first

channel, wherein the nut is positioned within a cannulation of the housing such that the second channel of the nut extends approximately parallel to a longitudinal axis of the housing;

inserting a threaded shaft into the first channel of the nut;

distally advancing the threaded shaft within the nut until a distal end of the threaded shaft engages with a nut carrier and distally advances the nut carrier and the nut within the cannulation of the housing;

wherein the distal advancement of the nut within the cannulation of the housing causes the cam pin to move from the distal end of the groove to the proximal end of the groove;

wherein, when the cam pin engages the proximal end of the groove, the first channel of the nut extends approximately parallel to the longitudinal axis of the housing and the threaded shaft is lockingly engaged with the threaded channel of the nut.

13. The method of claim 12, wherein the cannulation of the housing comprises a first portion and a second portion, a diameter of the second portion being smaller than a diameter of the first portion.

14. The method of claim 13, wherein the diameter of the second portion of the housing cannulation is selected to prevent distal movement of the nut when the threaded shaft is lockingly engaged with the threaded channel of the nut.

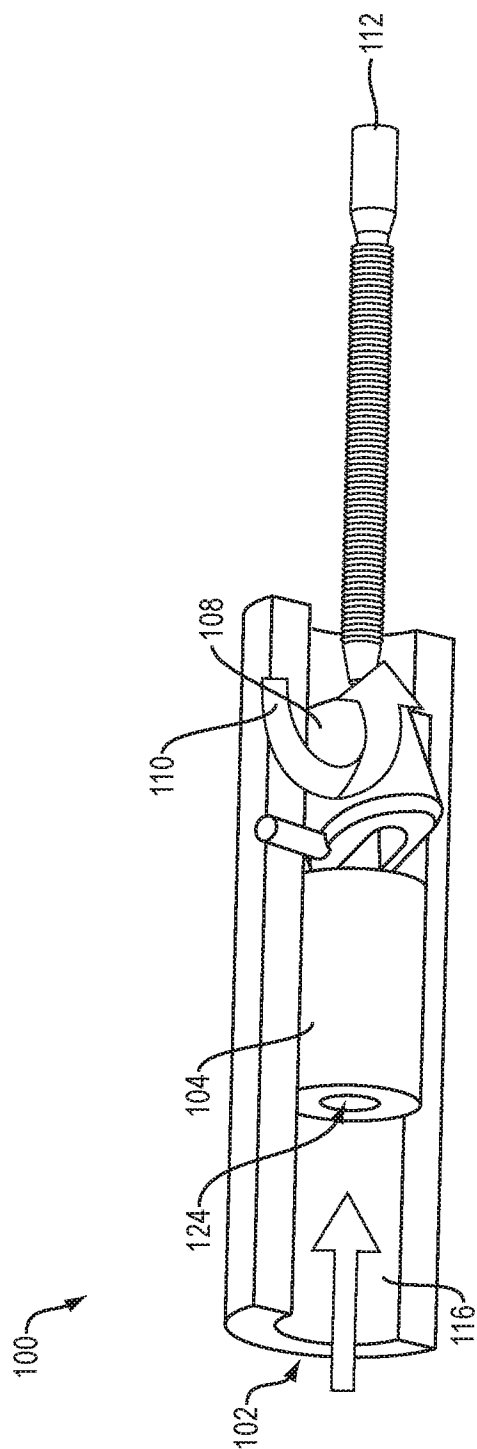
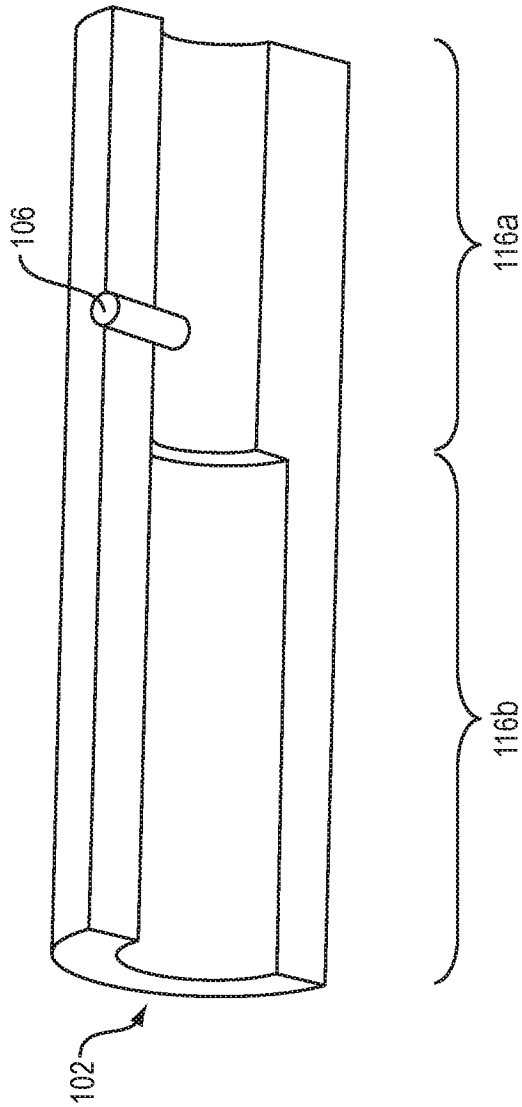


FIG. 1A



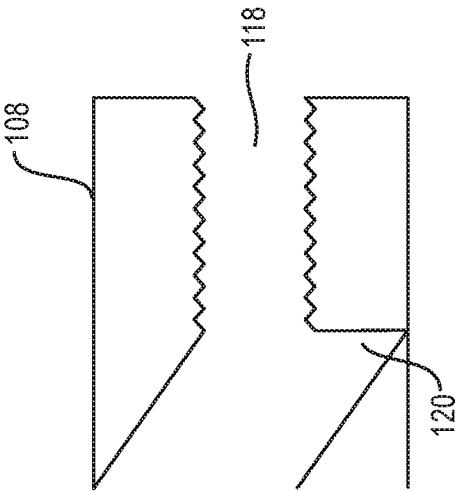


FIG. 1C

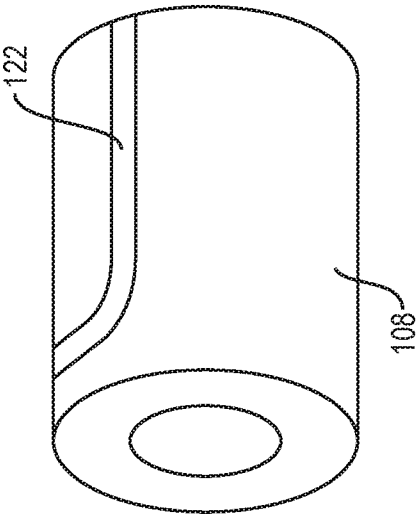


FIG. 1D

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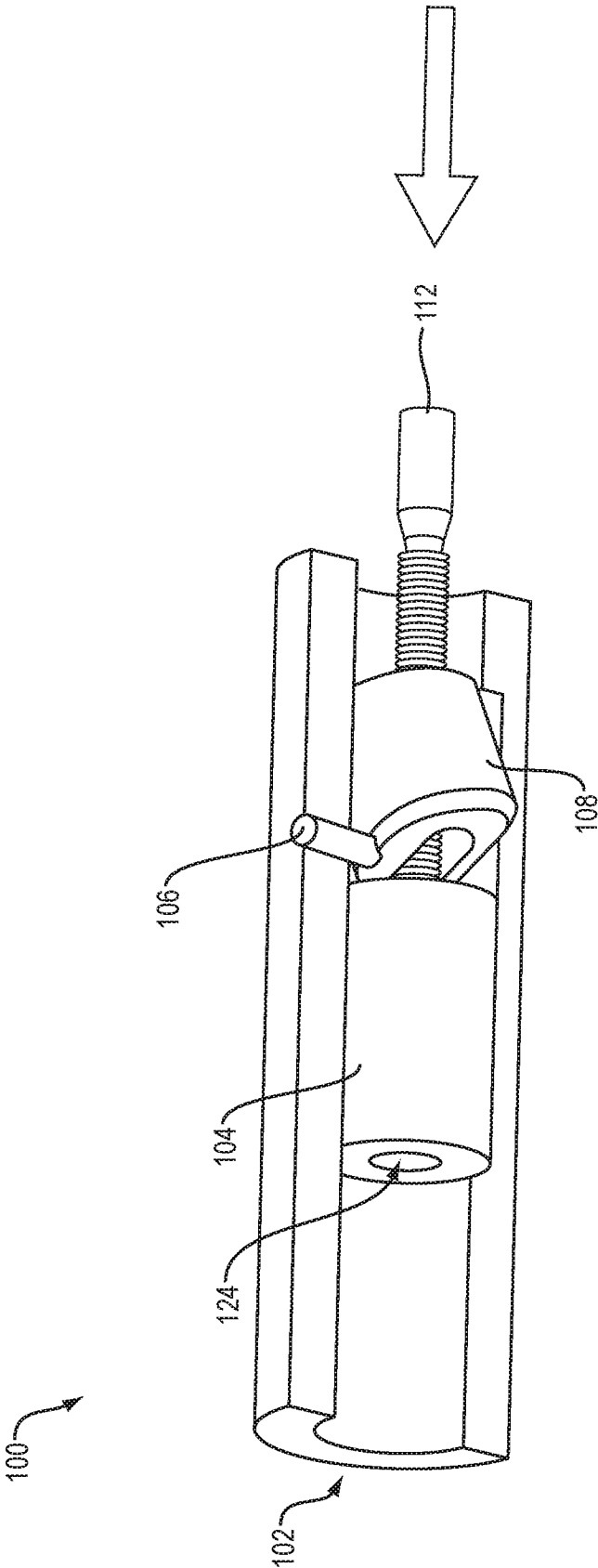


FIG. 1E

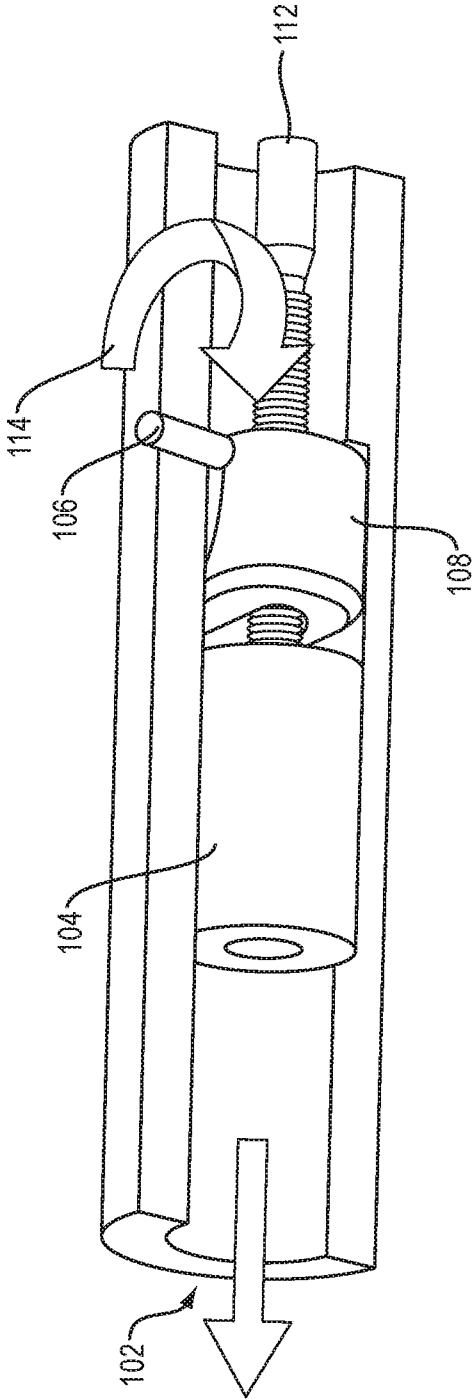


FIG. 1F

PATENT COOPERATION TREATY

PCT

DECLARATION OF NON-ESTABLISHMENT OF INTERNATIONAL SEARCH REPORT

(PCT Article 17(2)(a), Rules 13ter.1(c) and Rule 39)

Applicant's or agent's file reference SN-095PCT	IMPORTANT DECLARATION	Date of mailing(<i>day/month/year</i>) 14 June 2016 (14-06-2016)
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International Patent Classification (IPC) or both national classification and IPC A61B17/00		
Applicant SMITH & NEPHEW, INC.		

This International Searching Authority hereby declares, according to Article 17(2)(a), that **no international search report will be established** on the international application for the reasons indicated below

1. ☒ The subject matter of the international application relates to:
 - a. ☐ scientific theories.
 - b. ☐ mathematical theories
 - c. ☐ plant varieties.
 - d. ☐ animal varieties.
 - e. ☐ essentially biological processes for the production of plants and animals, other than microbiological processes and the products of such processes.
 - f. ☐ schemes, rules or methods of doing business.
 - g. ☐ schemes, rules or methods of performing purely mental acts.
 - h. ☐ schemes, rules or methods of playing games.
 - i. ☐ methods for treatment of the human body by surgery or therapy.
 - j. ☐ methods for treatment of the animal body by surgery or therapy.
 - k. ☐ diagnostic methods practised on the human or animal body.
 - l. ☐ mere presentations of information.
 - m. ☐ computer programs for which this International Searching Authority is not equipped to search prior art.

2. ☒ The failure of the following parts of the international application to comply with prescribed requirements prevents a meaningful search from being carried out:

☐ the description
☒ the claims
☐ the drawings

3. ☐ The failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions prevents a meaningful search from being carried out:

☐ the written form has not been furnished or does not comply with the standard.

☐ the computer readable form has not been furnished or does not comply with the standard.

4. Further comments:

Name and mailing address of the International Searching Authority  European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040 Fax: (+31-70) 340-3016	Authorized officer MASSON, Laetitia Tel: +49 (0)89 2399-8781
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FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 203

A meaningful search for the present application is not possible on the basis of all claims for the following reasons:

Claim 1 defines among other a nut having a first, threaded channel formed through a length of the nut and adapted to threadingly engage a threaded shaft and a second, non-threaded channel extending at a selected angle with respect to the first channel and intersecting the first channel, the second channel having a diameter greater than a diameter of the threaded shaft. Further, the claim defines the orientation of the two channels only with respect to the position of the cam pin with respect to the groove.

The position of the two channels in the nut or with respect to the housing is not sufficiently disclosed, either in the further dependent claims or in the original description and drawings (Article 5 & 6 PCT). Thus, the description lacks a clear and sufficient disclosure with respect to the exact configuration of the two channels. The figures, in particular figure 1A, 1C, lead to understand that the first, threaded channel (118) extends on a proximal length of the nut and the non-threaded channel extends on a distal length of the nut. Thus, in figure 1A it can be supposed that the part of the channel seen near the nut carrier is the non-threaded channel, since no thread is visible, and from figure 1C it is clearly visible a distinct separation of the position of the two channels, with the threaded channel (118) at the right hand side of the figure (or the proximal side(?) of the nut) and the non-threaded channel (120) at the left-hand side of the figure (or the distal side (?) of the nut).

These figures, taken in combination with the description, for example p. 2, l. 21-22 or p. 3, l. 9, which only mention the insertion of the threaded shaft into the first channel (118) of the nut, lead the person skilled in the art to understand that the nut is so oriented inside the housing so that the first threaded channel (118) is at the proximal side of the nut (or of the housing) and the second, non-threaded channel (120) is to be found at the distal side of the nut.

Also, no indication is provided in the description, in the drawings or in the claims that there are inner threads of the nut (108) formed on the proximal first channel (118) on a "top" surface and on the distal second channel (120) at an opposing "bottom" surface. In fact, throughout the description and the claims the second channel (120) is defined as "non-threaded" (see claim 1, page 5, l. 10, etc).

In fact, the description and figures relating to the loading/transitional and locking position are so unclear it seems that a knick in the shaft would appear when the threaded shaft is introduced in the nut. This also is underlined by the fact that the description states that the threaded channel 118 is parallel to the longitudinal axis only in the locking position.

Furthermore, nowhere in the description is disclosed that one of the nut carrier (104) and the housing (102) is fixed and the other is capable of axial movement relative thereto (Article 5 PCT). This feature appears to be essential (Article 6 PCT), in order to obtain a movement of the cam pin in the groove, however it is not described in the application.

Therefore is not clear how the nut carrier can cause the rotatable nut to be rotated since it moves independently from the nut. From the current understanding, if the shaft engages the nut carrier, its advancement would move only the nut carrier distally and not necessarily the nut. Claim 1 lacks also the essential feature of the clearance required by the nut for the rotation (Article 6 PCT).

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 203

In conclusion, since the features regarding the first and second channel are so unclear, it is impossible to determine the subject-matter that may be reasonably expected to be claimed. A solution of a first channel with a threaded part on the bottom surface and a second channel with a threaded part on the top surface cannot be regarded as the obvious choice for the person skilled in the art when the whole description is considered. Therefore no meaningful search can be performed.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.