



EUROPEAN PATENT APPLICATION

(43) Date of publication:
31.05.2023 Bulletin 2023/22

(51) International Patent Classification (IPC):
B25B 13/06 (2006.01) **B25B 13/48** (2006.01)
B25B 23/00 (2006.01) **B25B 27/00** (2006.01)

(21) Application number: **21210697.5**

(52) Cooperative Patent Classification (CPC):
B25B 13/06; B25B 13/488; B25B 23/0035;
B25B 27/0035

(22) Date of filing: **26.11.2021**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(72) Inventors:
• **BRENNAN, Jennifer**
State College, PA 16801 (US)
• **ZHONG, Yuan**
182 30 DANDERYD (SE)
• **BENFIELD, Kent**
GREENSBORO, NC 27409 (US)
• **OLAUSSEN, Lennart**
405 08 GÖTEBORG (SE)

(71) Applicant: **VOLVO TRUCK CORPORATION**
405 08 Göteborg (SE)

(74) Representative: **Kransell & Wennborg KB**
P.O. Box 2096
403 12 Göteborg (SE)

(54) **A TOOL FOR A NUT ON A THREADED ROD OF A SHOCK ABSORBER**

(57) The present invention relates to a tool for a nut on a threaded rod of a shock absorber. The tool comprises a first and a second elongated member, wherein one of an envelope surface (104) of the first elongated member (102) and an inner surface (208) of the second elongated member (202) comprises a radial protruding portion (300), and the other one of the envelope surface (104) and the inner surface (208) comprises an axially extending recess portion (302) extending between a first recess end (304) and a second recess end (306), the radial protruding portion (300) protruding radially towards the axially extending recess portion (302), wherein the first elongated member (102) is axially slidable within the second axially extending member (202) between a first position in which the protruding portion (300) is arranged in abutment with the first recess end (304), and a second position in which the protruding portion (300) is arranged in abutment with the second recess end (306).

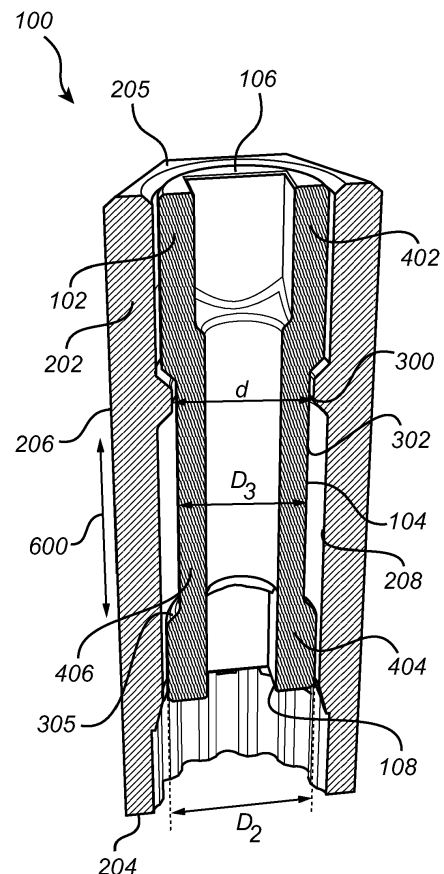


Fig. 3A

Description

TECHNICAL FIELD

[0001] The present invention relates to a tool for a nut on a threaded rod of a shock absorber. The invention also relates to a method of manufacturing such a tool. The tool is applicable for assembling/disassembling of shock absorbers for vehicles. Although the invention will mainly be directed to a shock absorber of a vehicle in the form of a truck, the invention may also be applicable for shock absorbers of other types of vehicles, such as e.g., buses, working machines, and other transportation vehicles.

BACKGROUND

[0002] During assembly of a shock absorber of a vehicle, a nut on a threaded rod of the shock absorber is tightened. In a similar vein, the nut is detached from the threaded rod during disassembly of the shock absorber. The threaded rod is conventionally forming part of the shock absorber and to prevent a rotation of the entire shock absorber when rotating the nut, the threaded rod needs to be held stationary while exerting the nut to a torque load.

[0003] EP 3 608 062 describes a specific tool which is conventionally used for the assembly/disassembly process of a shock absorber. The tool comprises an inner rod member configured to hold the threaded rod, and an outer sleeve configured to engage with the nut. The inner rod and the outer sleeve are exposed to a torque operation by means of a first and a second torque tool.

[0004] Although the tool described in EP 3 608 062 serves the purpose of assembling/disassembling a shock absorber, it is still in need of further improvements. For example, the tool described in EP 3 608 062 comprises a plurality of various components which must be assembled to form the tool. This assembly process can be time consuming, especially if the operator has accidentally lost one of the components.

[0005] It is therefore a desire to provide a tool for a nut on a threaded rod of a shock absorber which reduces the time period until the operator can initiate the assembling/disassembling process of the shock absorber, as well as reducing the risk of accidentally losing components of such a tool.

SUMMARY

[0006] It is thus an object of the present invention to at least partially overcome the above described deficiencies.

[0007] According to a first aspect, there is provided a tool for a nut on a threaded rod of a shock absorber, the tool comprising a first elongated member comprising an envelope surface, the first elongated member comprising a first end portion configured to connect to a first torque

tool, and a second end portion configured to connect to a threaded rod of a shock absorber, and a second elongated member having an axial end configured to connect to a nut threaded to the threaded rod, wherein the first elongated member is at least partially housed by the second elongated member, the second elongated member comprising an outer surface connectable to a second torque tool, and an inner surface facing the envelope surface of the first elongated member, wherein one of the envelope surface of the first elongated member and the inner surface of the second elongated member comprises a radial protruding portion, and the other one of the envelope surface and the inner surface comprises an axially extending recess portion extending between a first recess end and a second recess end, the radial protruding portion protruding radially towards the axially extending recess portion, wherein the first elongated member is axially slidable within the second axially extending member between a first position in which the protruding portion is arranged in abutment with the first recess end, and a second position in which the protruding portion is arranged in abutment with the second recess end.

[0008] The first and second torque tools should be construed as any suitable tool that can expose the respective first and second elongated members to a torque. The torque tool may, for example, be a torque spanner, a fixed or adjustable wrench, etc. Thus, the first torque tool is connectable to the first end portion of the first elongated member, i.e. at the opposite end compared to the connection to the threaded rod. The second torque tool on the other hand is connected to the outer surface of the second elongated member, i.e. the surface facing away from the first elongated member.

[0009] Further, the first and second elongated members may be arranged as tubular cylinders. However, the first elongated member may be arranged as a solid cylinder.

[0010] The present invention is based on the insight that by encapsulating a protruding portion in a recess enables for the use of solely two components to form the tool, namely the first and second elongated members. Thus, the inventors have realized that the first and second recess ends, in combination with the protruding portion efficiently prevents the first elongated member from falling out from the second elongated member at each of the axial end portions of the second elongated member. Thus, and according to an example embodiment, the axially slidable motion of the first elongated member within the second elongated member may be restricted by the radial protruding portion and the first and second recess ends. In further detail, the tool of the present invention can be formed by solely two components where the first elongated member is prevented from falling out from the second elongated member during use. Thus, the nut on the threaded rod can be assembled/disassembled in a more reliable and convenient manner. Furthermore, by using the inner surface of the second elongated member to restrict the axial motion of the first elongated member,

the tool can be centred in a more optimum manner and loads will be distributed to a large surface. Conventionally, a set screw has previously been used to prevent the motion of an inner cylinder, which generates a point load to a small area on the inner cylinder. A reduction of wear of the first elongated member is thus achieved.

[0011] In order to obtain the above described tool, and according to an example embodiment, the second elongated member may preferably be produced in one piece by additive manufacturing around the first elongated member. Thus, second elongated member is preferably formed by a 3D-printing process that enables the protruding portion to be encapsulated in the axially extending recess portion between the first and second recess ends. The first elongated member may also preferably be produced by additive manufacturing.

[0012] According to an example embodiment, a cross-section of the axially extending recess portion may be uniform along its full axial extension. In further detail, the cross-section of the axially extending recess portion is the same throughout its entire extension, thereby allowing the protrusion to slide therein.

[0013] According to an example embodiment, the axially extending recess portion may be free from threads for allowing a pure relative axial motion between the first and second elongated members. Hereby, the relative position between the first and second elongated members can be controlled without the need of providing a relative rotational motion between the first and second elongated members. Obviously, the first elongated member is free to rotate relative to the second elongated member, although without the use of threads.

[0014] According to an example embodiment, the axially extending recess portion may be arranged on the envelope surface of the first elongated member and the radial protruding portion is arranged on the inner surface of the second elongated member.

[0015] According to an example embodiment, the radial protruding portion may extend around the inner surface of the second axially elongated member. Hereby, a uniform load distribution on the radial protruding portion during use can be obtained.

[0016] According to an example embodiment, the radial protruding portion may be integrally formed with the inner surface of the second axially elongated member. Thus, the radial protruding portion and the inner surface are preferably formed in one piece and from the same material.

[0017] According to an example embodiment, the envelope surface may be formed by a first axially extending end section, a second axially extending end section, and an axially elongated mid-section arranged between the first and second axially extending end sections, wherein the first end portion is arranged on the first axially extending end section, the second end portion is arranged on the second axially extending end section, and the axially extending recess portion is arranged on the axially elongated mid-section.

[0018] According to an example embodiment, a cross-section of the elongated mid-section may be smaller than a cross-section of the first and second axially extending end sections, respectively, each of the cross-sections being perpendicular to the axial extension of the mid-section.

[0019] According to an example embodiment, a cross-section defined by the radial protruding portion of the inner surface of the second axially elongated member may be smaller than the cross-section of the first and second axially extending end sections, respectively, wherein the cross-section defined by the protrusion is perpendicular to the elongation of the second elongated member. Hence, the protruding portion is encapsulated in the axial direction between the first and second axially extending end sections. Put it differently, the protruding portion cannot move axially out from the first and second axially extending end sections.

[0020] According to an example embodiment, the first axially extending end section, the second axially extending end section, and the axially elongated mid-section may be formed in one piece. By "formed in one piece" should be construed such that the first axially extending end section, the second axially extending end section, and the axially elongated mid-section are integrally formed with each other and formed by the same material. Thus, the first axially extending end section, the second axially extending end section, and the axially elongated mid-section are together produced as one unit.

[0021] According to an example embodiment, the radial protruding portion may delimit the inner surface of the second elongated member into a first inner surface portion and a second inner surface portion, the first and second inner surface portions being arranged on opposite axial sides of the radial protruding portion. According to an example embodiment, the first axially extending end section may be at least partly housed by the first inner surface portion, and wherein the second axially extending end section is at least partly housed by the second inner surface portion.

[0022] According to an example embodiment, the first axially extending end section may be fully housed by the first inner surface portion in the axial direction when the first elongated member assumes the first position.

[0023] Fully housed should be construed such that the first extending end section is axially arranged within the first inner surface portion and does not axially protrude out from the first inner surface portion. However, and according to an example embodiment, the first axially extending end section may protrude axially from the first inner surface portion in a direction away from the radial protruding portion when the first elongated member transitions from the first position towards the second position.

[0024] According to a second aspect, there is provided a method of manufacturing a tool according to any one of the embodiments described above in relation to the first aspect, the method comprising the steps of providing the first elongated member, and subsequently producing,

by additive manufacturing, the second elongated member axially around the first elongated member.

[0025] By producing the second elongated by additive manufacturing around the first elongated member, the above described radial protruding portion can be efficiently encapsulated within the axially extending recess portion between the first and second recess ends. Also, the second elongated member can be made in one piece thereby eliminating the need of e.g. providing a second elongated member by a plurality of components that need subsequent assembling before use of the tool.

[0026] According to an example embodiment, the method may be preceded by the step of producing, by additive manufacturing, the first elongated member.

[0027] Further effects and features of the second aspect are largely analogous to those described above in relation to the first aspect.

[0028] Further features of, and advantages will become apparent when studying the appended claims and the following description. The skilled person will realize that different features may be combined to create embodiments other than those described in the following, without departing from the scope of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] The above, as well as additional objects, features, and advantages, will be better understood through the following illustrative and non-limiting detailed description of exemplary embodiments, wherein:

Fig. 1 is a lateral side view illustrating an example embodiment of a vehicle in the form of a truck;

Fig. 2 is a perspective view of a tool for connecting a nut on a shock absorber according to an example embodiment,

Figs. 3A - 3B are cut-out views of a tool for a nut on a threaded rod of a shock absorber according to an example embodiment,

Fig. 4 is a cut-out view of a tool for a nut on a threaded rod of a shock absorber according to another example embodiment, and

Fig. 5 is a flow chart of a method of manufacturing the tool in Figs. 3A - 4 according to an example embodiment.

DETAILED DESCRIPTION

[0030] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments are shown. The invention may, however, be embodied in many different forms and should not be construed as

limited to the embodiments set forth herein; rather, these embodiments are provided for thoroughness and completeness. Like reference character refer to like elements throughout the description.

[0031] With particular reference to Fig. 1, there is depicted a vehicle 10 in the form of a truck. The vehicle comprises a traction motor 12 for propelling the wheels of the vehicle. The vehicle 10 further comprises a pair of front wheels 20, a pair of first rear wheels 30 and a pair of second rear wheels 40. As can be seen in Fig. 1, each of the front wheels 20, the first rear wheels 30, and the second rear wheels 40 are each suspended by a respective shock absorber 50, 50', 50". Although Fig. 1 illustrates a similar shock absorber for each of the wheels, it should be readily understood that different types of shock absorbers or damping arrangements may be used for different wheels. Hence, Fig. 1 merely illustrates the presence of shock absorbers for the different wheels of the vehicle 10. Also, the following description will relate to the shock absorber 50 of the front wheels 20.

[0032] Although Fig. 1 illustrates a vehicle 10 in the form of a truck, other vehicles can also be provided with a shock absorber for which the below described tool is applicable. For example, a working machine, a bus, a car, etc. may also be provided with such a shock absorber.

[0033] Reference is made to Fig. 2 which is a perspective view of a tool 100 for connecting a nut on the shock absorber 50 according to an example embodiment. The shock absorber 50 connected or disconnected by fixating/de-connecting the nut 101 to/from a threaded rod 103 of the shock absorber 50. The threaded rod 103 may form part of the shock absorber 50. Hence, when rotating the threaded rod 103, the shock absorber 50 will also rotate. As such, when attaching/detaching the nut 101 to/from the shock absorber 50, the threaded rod 103 should preferably be kept stationary to prevent the shock absorber from rotating.

[0034] In order to hold the threaded rod 103 stationary while at the same time being able to apply a torque on the nut 101, the tool 100 comprises a first elongated member 102 and a second elongated member 202. In particular, the first elongated member 102, which is preferably arranged as an elongated cylinder, is configured to connect to the threaded rod 103, while the second elongated member 202, which is also preferably arranged as an elongated cylinder, is configured to connect to the nut 101. As can be seen in Fig. 2, the first elongated member 102 is housed inside the second elongated member 202. To connect/de-connect the nut 101 from the threaded rod 103, a user 500 is connecting a first torque tool 402 to the first elongated member 102 and a second torque 404 to the second elongated member 202. A torque is applied to the tool 100 by applying a torque on the first 402 and second 404 torque tools in opposite directions. The first torque tool 402 is exemplified as a socket wrench while the second torque tool 404 is exemplified as a fixed spanner. It should however be readily

understood that other types of torque tools may be provided which are different from the illustrated socket wrench and fixed spanner. Hence, the first 402 and second 404 torque tools in Fig. 2 are merely for simplifying the understanding and to present one alternative example.

[0035] In order to describe the tool 100 in further detail, reference is now made to Figs. 3A - 4. In order to simplify the illustrations in Figs. 3A - 4, the nut 101, threaded rod 103 and torque tools 402, 404 have been omitted from these figures.

[0036] Starting with Figs. 3A - 3B, which illustrate, in cross-section, the tool 100 according to an example embodiment. As described above, the tool 100 comprises a first elongated member 102 and a second elongated member 202, where the first elongated member 102 is at least partly housed within the second elongated member 202. In particular, Fig. 3A illustrates the first elongated member 102 in a first position in which it is fully housed within the second elongated member 202 as seen in an axial direction 600 of the tool 100, while Fig. 3B illustrates the first elongated member 102 in a second position in which it is at least partly housed within the second elongated member 202 as seen in the axial direction 600 of the tool 100.

[0037] The first elongated member 102 comprises a first end portion 106 and a second end portion 108. The first 106 and second 108 end portions are arranged on opposite axial ends of the first elongated member 102, wherein the first end portion 106 is configured to connect to the first torque tool 402 (see Fig. 2) and the second end portion 108 is configured to connect to the threaded rod 103 (see Fig. 2). It should be readily understood that the first end portion 106 is schematically illustrated and can be arranged in a wide variety of forms depending on the specific connection to the threaded rod. As indicated above, and as illustrated in Figs. 3A - 3B, the first elongated member is preferably arranged in the form of a first tubular cylinder.

[0038] The second elongated member 202 comprises a first axial end 204 and a second axial end 205, which first 204 and second 205 axial ends are arranged on opposite axial ends of the second elongated member 202. As indicated above, and as illustrated in Figs. 3A - 3B, the second elongated member is a second tubular cylinder. In detail, each of the first 204 and second 205 axial ends are arranged as open end portions. The first axial end 204 is configured to connect and hold the nut 101 threaded to the threaded rod 103 (see Fig. 2). The second axial end 205 is, as already described, open to allow the first elongated member 102 to transition between the first position depicted in Fig. 3A and the second position depicted in Fig. 3B. Furthermore, the second elongated member 202 comprises an outer surface 206 configured to connect with the second torque tool 404 illustrated in Fig. 2. The outer surface 206 is thus an outer surface in the radial direction and is formed as an outer envelope surface of the second elongated member 202.

[0039] Moreover, and referring again to the first elongated member 102, the first elongated member 102 comprises an envelope surface 104 extending between the first 106 and second 108 end portions. The envelope surface 104 is facing an inner surface 208 of the second elongated member 202. As can be seen in Figs. 3A - 3B, the envelope surface 104 of the first elongated member 102 comprises an axially extending recess portion 302. The axially extending recess portion 302 extends between a first recess end 304 and a second recess end 306 of the envelope surface 104. In particular, the envelope surface 104 is formed by a first axially extending end section 402, a second axially extending end section 404 and an axially extending mid-section 406, which mid-section 406 extends between the first 402 and second 404 axially extending end sections. The axially extending recess portion 302 is thus arranged at the mid-section 406, while the first end portion 106 is arranged on the first axially extending end section 402 and the second end portion 108 is arranged on the second axially extending end section 404. Hence, a cross-section, perpendicular to the axial direction 600, of the elongated mid-section 406 is smaller than a cross-section of each of the first 402 and second 404 axially extending end sections.

[0040] According to the exemplified embodiment in Figs. 3A - 3B, the first recess end 304 is arranged as a first tapered portion 303 extending from the axially elongated mid-section in a direction radially away from an axially extending central axis of the first elongated member 102 as well as in a direction towards the first axially extending end section 402. Hence, the first tapered portion 303 is arranged as an interface between the axially elongated mid-section 406 and the first axially extending end section 402. The second recess end 306 is preferably arranged as a second tapered portion 305 extending from the axially extending mid-section in a direction radially away from the axially extending central axis of the first elongated member 102 as well as in a direction towards the second axially extending end section 404. Hence, the second tapered portion 305 is arranged as an interface between the axially elongated mid-section 406 and the second axially extending end section 404.

[0041] Furthermore, and as is depicted in Figs. 3A - 3B, the first extending end section 402, the second axially extending end section 404 and the axially extending mid-section 406 are formed in one piece and of the same material. Further, the cross-section of the axially extending recess portion 302 is preferably uniform along its axial extension between the first 304 and second 306 recess ends. Thus, a uniform thickness of the first elongated member 102 is provided at the axially elongated mid-section 406.

[0042] Referring back to the second elongated member 202. As can be seen in Figs. 3A - 3B, the inner surface 208 of the second elongated member 202 comprises a radial protruding portion 300. The radial protruding portion 300 is arranged at an axial distance from each of the

first 204 and second 205 axial ends of the second elongated member 202. Put it different, the radial protruding portion 300 is arranged at a non-zero distance from the first axial end 204, as well as arranged at a non-zero distance from the second axial end 205. The radial protruding portion 300 is thus protruding radially towards, and faces, the above described axially extending recess portion 302, i.e. the axially elongated mid-section 406 of the first elongated member 102. In yet further detail, the radial protruding portion 300 delimits the inner surface 208 of the second elongated member 202 into a first inner surface portion 220 and a second inner surface portion 222. The first 220 and second 222 inner surface portions are arranged on opposite axial sides of the radial protruding portion 300.

[0043] Preferably, the radial protruding portion 300 extends around the inner surface 208 of the second axially elongated member 202. The radial protruding portion 300 is hence arranged as a collar at the inner surface 208 and extends 360 degrees around the inner surface 208. The radial protruding portion 300 is also preferably integrally formed with the inner surface 208 of the second axially elongated member 202. Hence, the radial protruding portion 300 is formed in one piece with the inner surface 208 and is preferably of the same material as the inner surface 208.

[0044] Furthermore, a cross-section defined by the radial protruding portion 300, which is indicated by a diameter d , is smaller than a cross-section of the first axially extending end section 402, as well as larger than a cross-section of the second axially extending end section 404. The cross-section of the first axially extending end section 402 is indicated by the diameter D_1 and the cross-section of the second axially extending end section 404 is indicated by the diameter D_2 . However, the diameter d , i.e. the cross-section defined by the radial protruding portion 300, is larger than a cross-section of the elongated mid-section, in Fig. 3A indicated with reference D_3 .

[0045] The axially extending recess portion 302 and the radial protruding portion 300 are both preferably free from threads, and the first elongated member 102 is thus free to axially slide within the second elongated member 202. Thus, a pure relative axial motion is allowable between the first 102 and second 202 elongated members. In particular, and by means of the above described geometric properties of the different sections of the first 102 and second 202 elongated members, the first elongated member 102 is axially slidable within the second elongated member 202 between a first position in which the protruding portion 300 is arranged in abutment with the first recess end 304, and a second position in which the protruding portion 300 is arranged in abutment with the second recess end 306. As depicted in Fig. 3A illustrating the first elongated member in the first position, the first axially extending end section 402 is fully housed by the first inner surface portion 220 in the axial direction when the first elongated member 102 assumes the first position. On the other hand, and as

depicted in Fig. 3B, the first axially extending end section 402 protrudes axially from the first inner surface portion 220 in a direction away from the radial protruding portion 300 when the first elongated member 102 assumes the second position.

[0046] As is evident from the above description, the axially slidable motion of the first elongated member 102 within the second elongated member 202 is thus restricted by the radial protruding portion 300 and the first 304 and second 306 recess ends.

[0047] In order to obtain the first elongated member 102 inside the second elongated member 202 as described above and illustrated in Figs. 3A - 3B, at least the second elongated member 202 is produced in one piece by additive manufacturing around the first elongated member 102. By means of this manufacturing method, the radial protruding portion 300 can be encapsulated within the axially extending recess portion 302 between the first recess end 304 and the second recess end 306.

[0048] In order to describe the tool 100 according to another example embodiment, reference is made to Fig. 4. The embodiment depicted in Fig. 4 comprises similar features as the embodiment described above in relation to Figs. 3A - 3B. Thus, the Fig. 4 embodiment also comprises a first elongated member 102 housed within a second elongated member 202, where the first elongated member comprises a first end portion 106 configured to connect to the first torque tool, and a second end portion 108 configured to connect to the threaded rod of the shock absorber. The second elongated member 202 comprises the first axial end 204 configured to connect to the nut.

[0049] The difference between the Fig. 4 embodiment and the embodiment described above in relation to Figs. 3A - 3B is that the radial protruding portion 300 is arranged on the envelope surface 104 of the first elongated member 102, while the axially extending recess portion 302 is arranged on the inner surface 208 of the second elongated member 202. Also, the first 304 and second 306 recess ends are arranged in an opposite manner compared to the embodiment of Figs. 3A - 3B. In detail, the first recess end 304 is arranged at the vicinity of the first axial end 204 of the second elongated member 202, while the second recess end 306 is arranged in the vicinity of the second axial end 205 of the second elongated member 202. Accordingly, the first elongated member 102 is movable within the second elongated member 202, and the motion is restricted by the radially protruding portion 300 and the first 304 and second 306 recess ends.

[0050] The radial protruding portion 300 depicted in Fig. 4 is also encapsulated within the axially extending recess portion 302 between the first 304 and second 306 recess ends. As such, the second elongated member 202 is also in this example embodiment preferably produced in one piece by additive manufacturing around the first elongated member 102. Further features of the embodiment in Fig. 4 are the same as described above in relation to the embodiment depicted in Figs. 3A - 3B.

[0051] Reference is finally made to Fig. 5 which is a flow chart of a method of manufacturing the above described tool 100.

[0052] In a first step S1, the first elongated member is provided. The first elongated member 102 can be produced S1' by additive manufacturing. Thereafter, the second elongated member 202 is produced S2 by additive manufacturing around the first elongated member 102. By this manufacturing method, and as also indicated above, the radial protruding portion 300 can be efficiently encapsulated in the axially extending recess 203 between the first 304 and second 306 recess ends.

[0053] It is to be understood that the present disclosure is not limited to the embodiments described above and illustrated in the drawings; rather, the skilled person will recognize that many changes and modifications may be made within the scope of the appended claims.

Claims

1. A tool (100) for a nut on a threaded rod of a shock absorber, the tool (100) comprising:

- a first elongated member (102) comprising an envelope surface (104), the first elongated member comprising a first end portion (106) configured to connect to a first torque tool, and a second end portion (108) configured to connect to a threaded rod of a shock absorber, and
- a second elongated member (202) having an axial end (204) configured to connect to a nut threaded to the threaded rod, wherein the first elongated member (102) is at least partially housed by the second elongated member (202), the second elongated member (202) comprising an outer surface (206) connectable to a second torque tool, and an inner surface (208) facing the envelope surface (104) of the first elongated member (102),

wherein one of the envelope surface (104) of the first elongated member (102) and the inner surface (208) of the second elongated member (202) comprises a radial protruding portion (300), and the other one of the envelope surface (104) and the inner surface (208) comprises an axially extending recess portion (302) extending between a first recess end (304) and a second recess end (306), the radial protruding portion (300) protruding radially towards the axially extending recess portion (302), wherein the first elongated member (102) is axially slidable within the second axially extending member (202) between a first position in which the protruding portion (300) is arranged in abutment with the first recess end (304), and a second position in which the protruding portion (300) is arranged in abutment with the second recess end (306).

2. The tool according to claim 1, wherein the axially slidable motion of the first elongated member within the second elongated member is restricted by the radial protruding portion and the first and second recess ends.
3. The tool according to any one of the preceding claims, wherein a cross-section of the axially extending recess portion is uniform along its full axial extension.
4. The tool according to any one of the preceding claims, wherein the axially extending recess portion is free from threads for allowing a pure relative axial motion between the first and second elongated members.
5. The tool according to any one of the preceding claims, wherein the axially extending recess portion is arranged on the envelope surface of the first elongated member and the radial protruding portion is arranged on the inner surface of the second elongated member.
6. The tool according to claim 5, wherein the radial protruding portion extends around the inner surface of the second axially elongated member.
7. The tool according to any one of claims 5 or 6, wherein the radial protruding portion is integrally formed with the inner surface of the second axially elongated member.
8. The tool according to any one of claims 5 - 7, wherein the envelope surface (104) is formed by a first axially extending end section (402), a second axially extending end section (404), and an axially elongated mid-section (406) arranged between the first and second axially extending end sections, wherein the first end portion is arranged on the first axially extending end section, the second end portion is arranged on the second axially extending end section, and the axially extending recess portion is arranged on the axially elongated mid-section.
9. The tool according to claim 8, wherein a cross-section of the elongated mid-section is smaller than a cross-section of the first and second axially extending end sections, respectively, each of the cross-sections being perpendicular to the axial extension of the mid-section.
10. The tool according to any one of claims 8 or 9, wherein a cross-section defined by the radial protruding portion of the inner surface of the second axially elongated member is smaller than the cross-section of the first and second axially extending end sections, respectively, wherein the cross-section defined by

the protrusion is perpendicular to the elongation of the second elongated member.

11. The tool according to any one of claims 8 - 10, wherein the first axially extending end section, the second axially extending end section, and the axially elongated mid-section are formed in one piece. 5
12. The tool according to any one of claims 5 - 11, wherein the radial protruding portion delimits the inner surface of the second elongated member into a first inner surface portion and a second inner surface portion, the first and second inner surface portions being arranged on opposite axial sides of the radial protruding portion. 10 15
13. The tool according to according to any one of the preceding claims, wherein the second elongated member is produced in one piece by additive manufacturing around the first elongated member. 20
14. A method of manufacturing a tool according to any one of the preceding claims, the method comprising the steps of: 25
 - providing (S1) the first elongated member, and subsequently
 - producing (S2), by additive manufacturing, the second elongated member axially around the first elongated member. 30
15. The method according to claim 14, wherein the method is preceded by the step of:
 - producing, by additive manufacturing, the first elongated member. 35

40

45

50

55

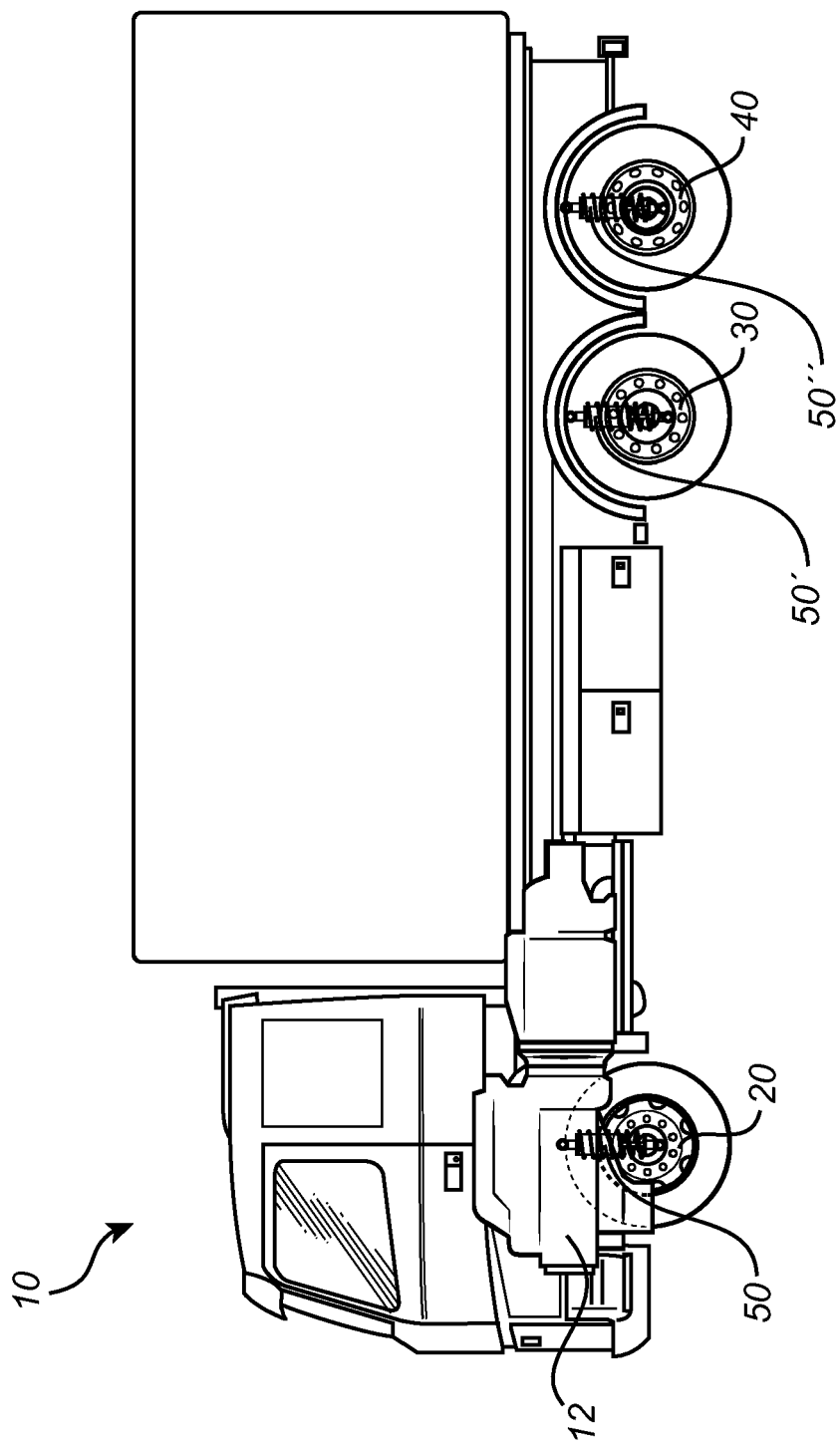


Fig. 1

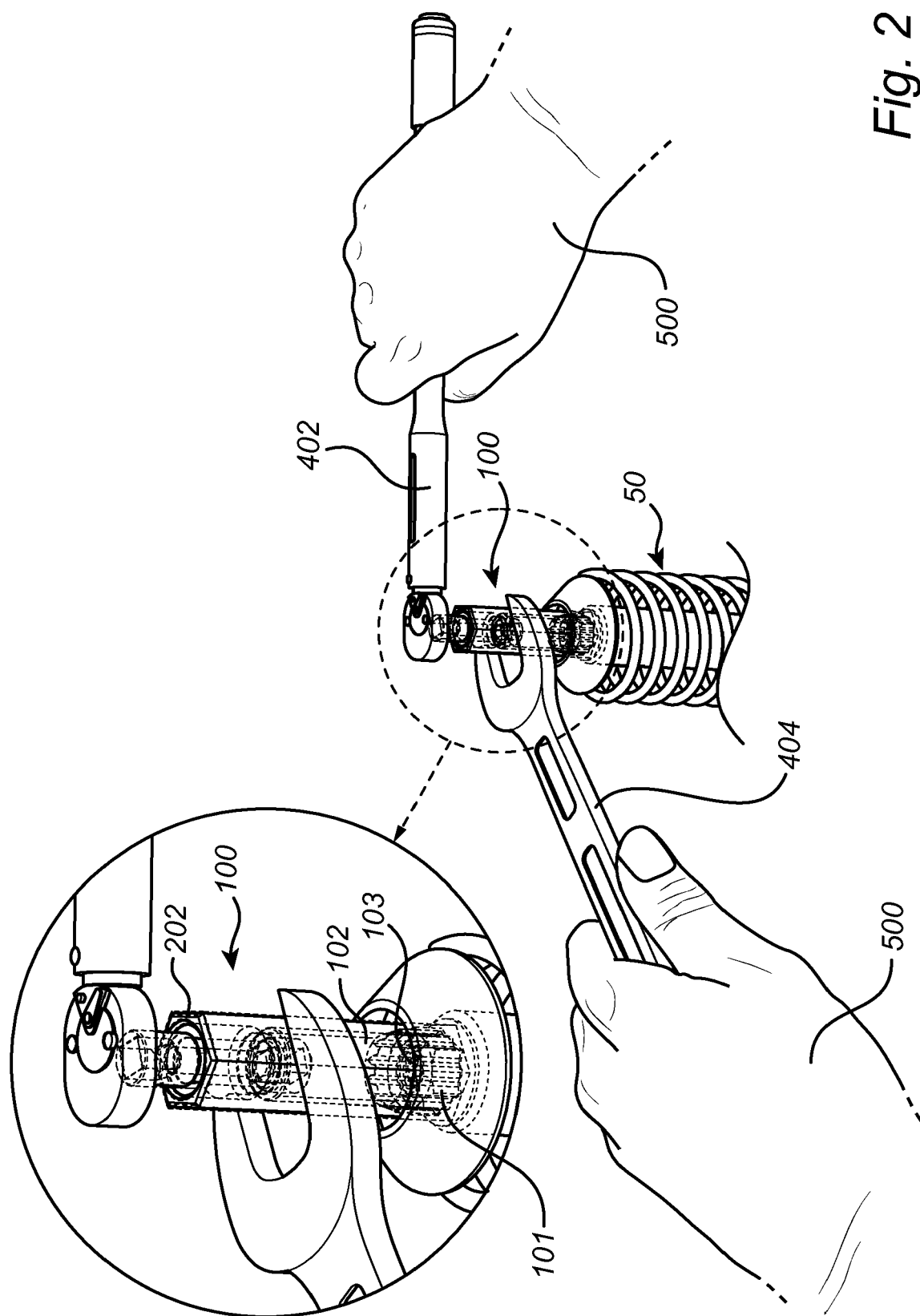


Fig. 2

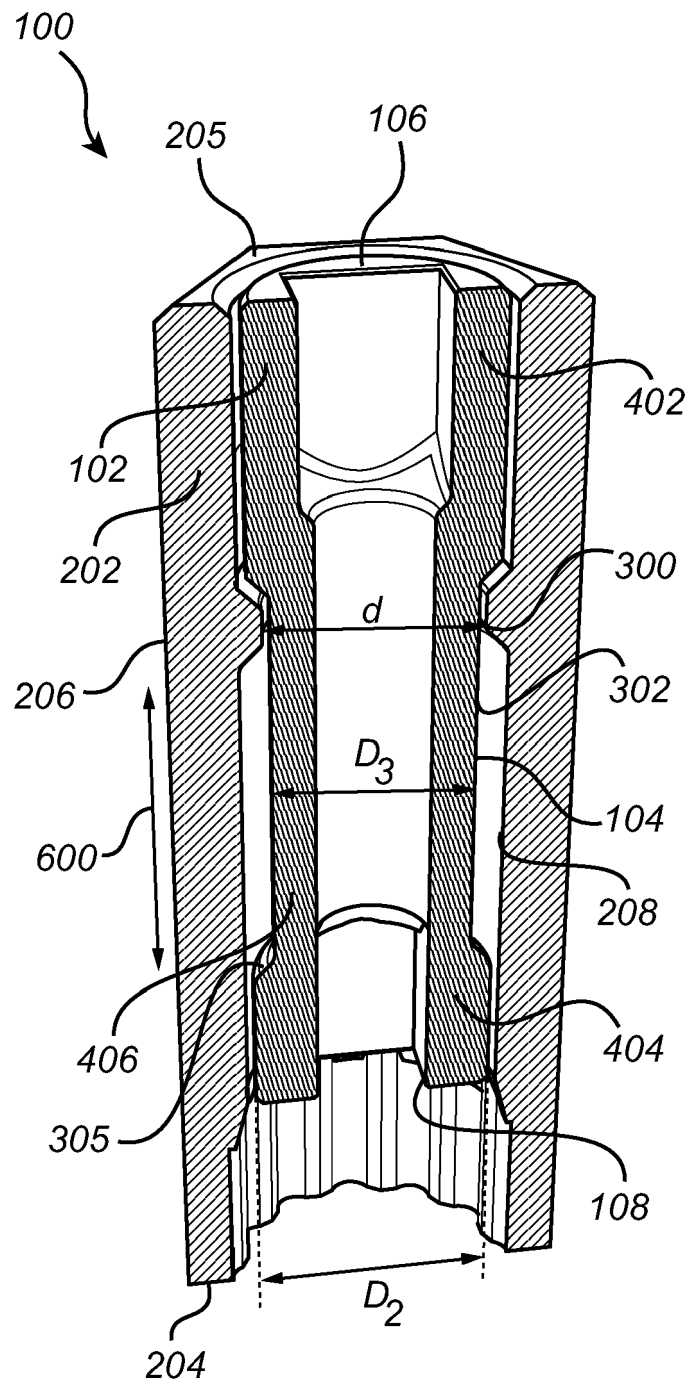


Fig. 3A

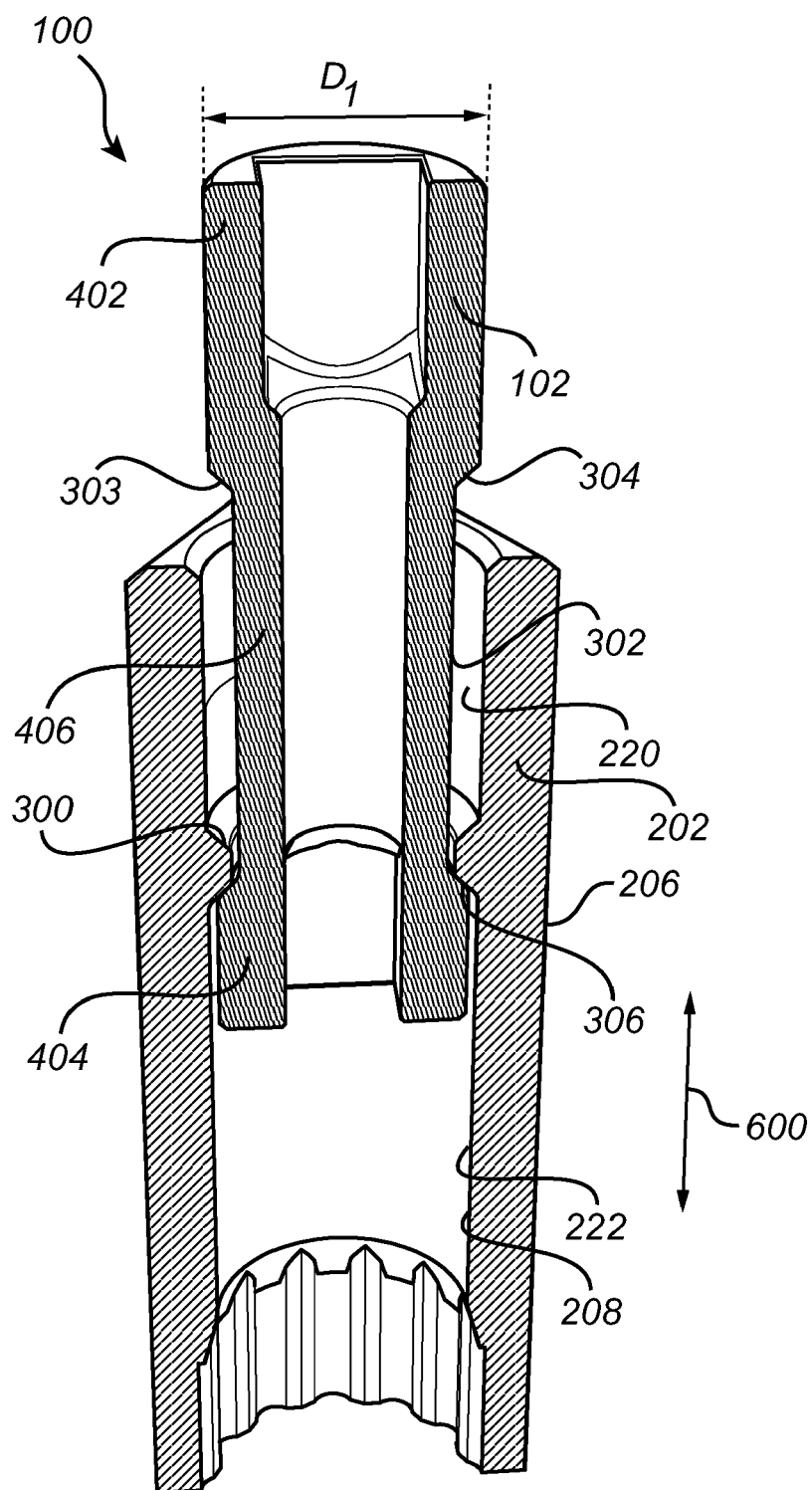


Fig. 3B

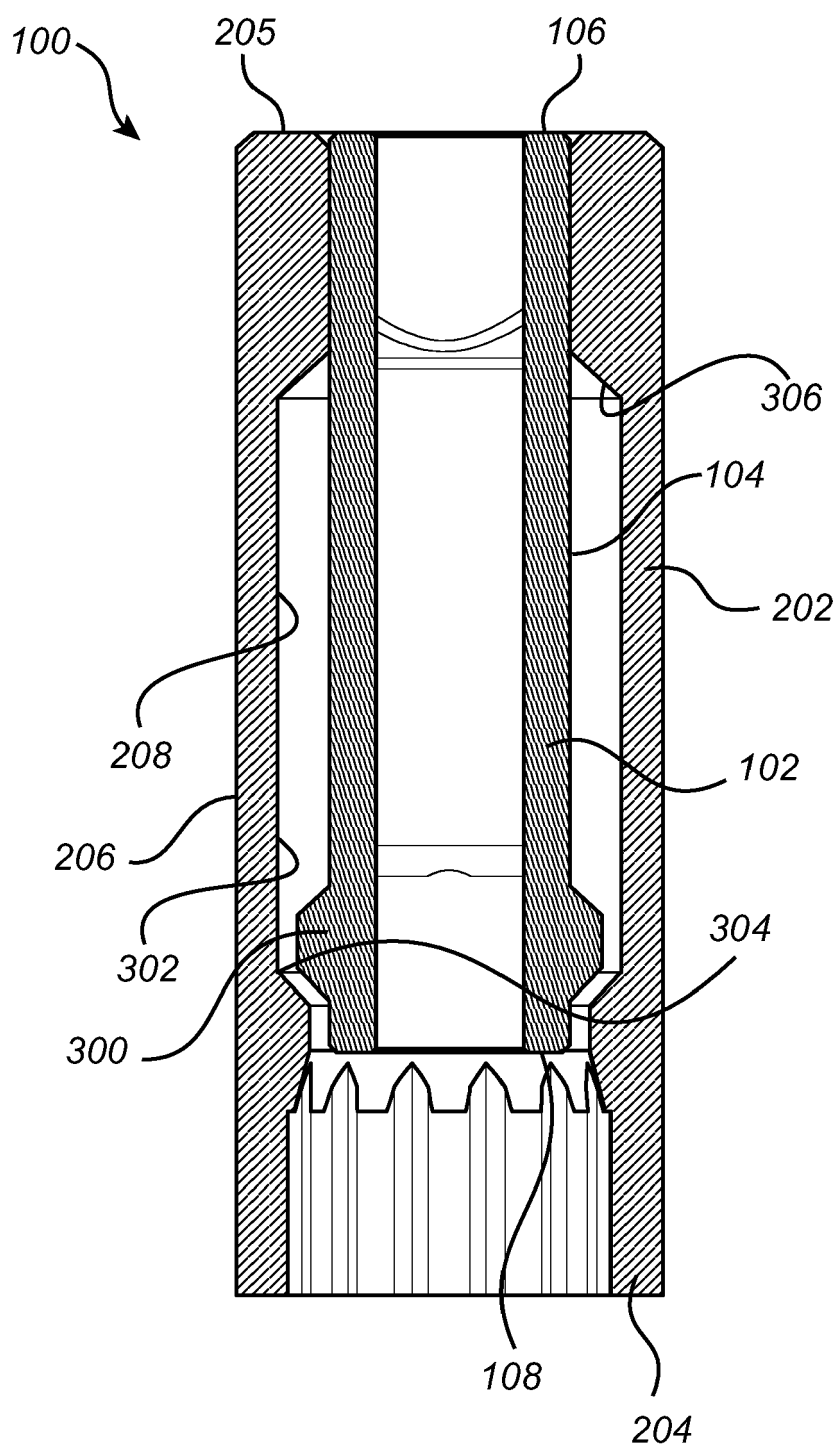


Fig. 4

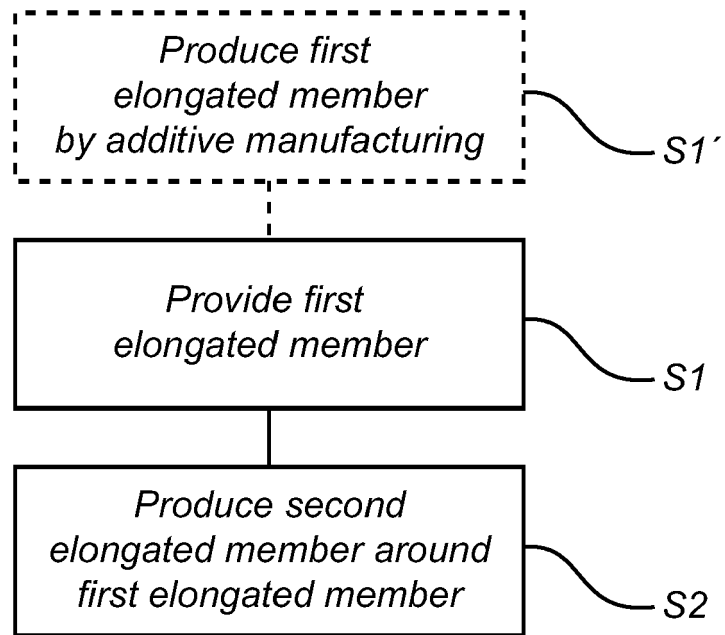


Fig. 5



EUROPEAN SEARCH REPORT

Application Number

EP 21 21 0697

5

10

15

20

25

30

35

40

45

50

55

1

EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 4 329 892 A (DAIGLE VINCENT J) 18 May 1982 (1982-05-18) * column 1, line 52 - column 3, line 9; figures 1-9 *	1-15	INV. B25B13/06 B25B13/48 B25B23/00 B25B27/00
A,D	EP 3 608 062 A1 (LIN HUNG WEI [TW]) 12 February 2020 (2020-02-12) * paragraphs [0008] - [0015]; figures 1-6 *	1-15	
A	US 3 889 558 A (DUNCAN GORDEN E) 17 June 1975 (1975-06-17) * column 1, line 41 - column 2, line 34; figures 1-7 *	1-15	
A	CA 2 572 701 A1 (HONDA MOTOR CO LTD [JP]) 29 June 2008 (2008-06-29) * page 5, line 20 - page 10, line 16; figures 1-9 *	1-15	
A	US 2010/282031 A1 (TAKEDA NORIYUKI [JP] ET AL) 11 November 2010 (2010-11-11) * paragraphs [0012] - [0055]; figures 1-3 *	1-15	TECHNICAL FIELDS SEARCHED (IPC) B25B
A	US 3 916 734 A (SAWAN ANIS S) 4 November 1975 (1975-11-04) * column 2, line 14 - column 3, line 31; figures 1-7 *	1-15	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 12 April 2022	Examiner Pastramas, Nikolaos
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 21 21 0697

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-04-2022

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4329892 A	18-05-1982	NONE	
EP 3608062 A1	12-02-2020	NONE	
US 3889558 A	17-06-1975	NONE	
CA 2572701 A1	29-06-2008	NONE	
US 2010282031 A1	11-11-2010	CN 101945735 A	12-01-2011
		EP 2243597 A1	27-10-2010
		JP 2009196051 A	03-09-2009
		RU 2010138929 A	27-03-2012
		US 2010282031 A1	11-11-2010
		WO 2009104425 A1	27-08-2009
		ZA 201004298 B	31-08-2011
US 3916734 A	04-11-1975	NONE	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 3608062 A [0003] [0004]