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(54) Title: POWER-DRIVEN DIRECT DRIVE RATCHET/WRENCH TOOL

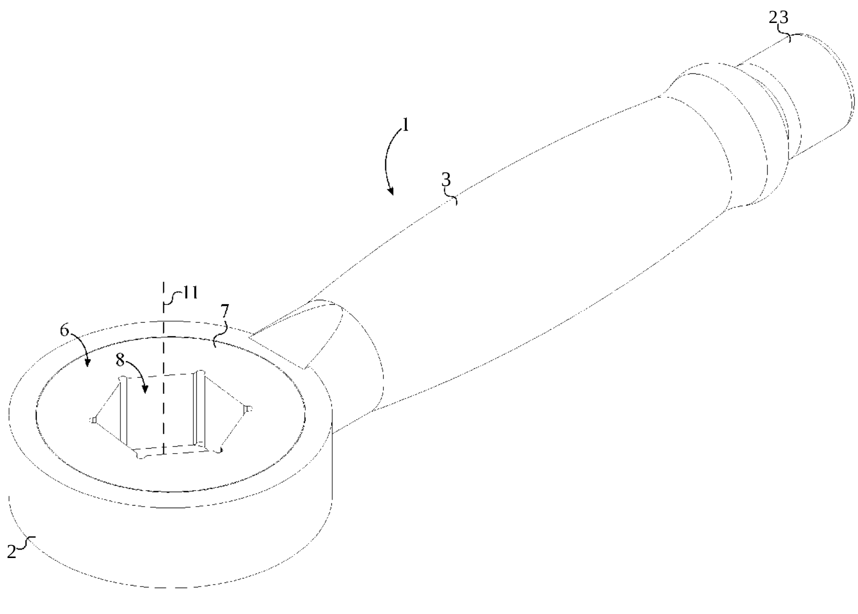

FIG. 1

(57) Abstract: A power driven direct drive ratchet/wrench tool allows a user to tighten and loosen fasteners in tight spaces efficiently and effectively. The tool includes a tool housing, a fastener-engagement body, a spur gear, a drive shaft, and a plurality of drive pins. The tool housing acts as the structural element and includes a ratchet head, a tubular handle, and a gear-receiving cavity. The ratchet head is terminally connected to the tubular handle. The gear-receiving cavity laterally traverses into the ratchet head and houses the spur gear and the fastener-engagement body. The drive shaft is rotatably mounted within the tubular handle. The plurality of drive pins is connected to a proximal base of the drive shaft, about a rotation axis of the drive shaft. In order to transmit torque, an at least one arbitrary pin from the plurality of drive pins is mechanically engaged to the spur gear.

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[Continued on nextpage]

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Power-Driven Direct Drive Ratchet/Wrench Tool

The current application claims a priority to the U.S. Provisional Patent application serial number 62/328,102 filed on April 27, 2016.

FIELD OF THE INVENTION

The present invention relates generally to power tools, ratchets and wrenches to be specific. In particular, the present invention is a power-driven direct drive ratchet/wrench tool which allows a user to speed up the process of tightening or loosening an external object such as a screw, bold, nut, and other similar fasteners, where space and access to the external object is limited.

BACKGROUND OF THE INVENTION

Traditional wrench-type tools used for tightening and loosening fasteners provide users with a mechanical advantage in order to allow the user to apply a significantly large amount of torque to the fastener. In certain cases, the amount of torque is still insufficient and the user must then turn to powered wrench-type tools. These types of tools are powered by an external source, such as a pneumatic driver, and apply said force onto the fastener. Power driven tools significantly increase the torque provided and the time required to tighten or loosen as fastener. One of the main downsides of power driven tools is their relative size. Because of the machinery and technology required for the operation of these types of tools, the resulting tool is bulky and hard to maneuver, especially in low clearance areas. Therefore, there is a need for a power-driven tool which provides the benefits of power driven tools without the associated large profile.

The objective of the present invention is to create a power-driven tool to speed up the process of twisting, turning or loosening an object, i.e. bolt, screw, nut etc., where direct/frontal access is limited or restricted by other conventional tools. The present invention utilizes a unique drive train which effectively transmits torque onto the fastener and allows for the reduction of the overall profile of the tool.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of the present invention.

FIG. **2** is an exploded perspective view of the present invention.

FIG. **3** is a cross-section view of the present invention.

FIG. **4** is a detailed view about circle A from FIG. **3.**

DETAIL DESCRIPTIONS OF THE INVENTION

All illustrations of the drawings are for the purpose of describing selected versions of the present invention and are not intended to limit the scope of the present invention.

The present invention is an attachment for a power tool. More specifically, the present invention is a direct drive ratchet/wrench tool powered by an external power tool which allows a user to speed up the process of tightening and loosening a fastener, especially if the fastener is in a hard to reach area with little to no clearance. The present invention may be utilized with and by a variety of external power tools including, but not limited to, electric drivers and pneumatic drivers.

Referring to FIG. **1** and FIG. **2,** the present invention comprises a tool housing **1,** a drive shaft **12,** a spur gear **9,** a plurality of drive pins **17,** and a fastener-engagement body **6.** The tool housing **1** acts as the structural element of the present invention and comprises a ratchet head **2,** a tubular handle **3,** and a gear-receiving cavity **5.** The ratchet head **2** is a cylindrical housing which encloses and supports the spur gear **9** and the fastener-engagement body **6**. Similar to traditional wrench designs, the ratchet head **2** is a terminally connected to the tubular handle **3**. The gear-receiving cavity **5** laterally traverses into the ratchet head **2** to receive the spur gear **9** and the fastener-engagement body **6**. More specifically, the gear-receiving cavity **5** intersects a lumen **4** of the tubular handle **3** and is orientated perpendicular to the tubular handle **3**. The spur gear **9** transmits torque from the drive shaft **12** to the fastener-engagement body **6**, which in turn transmits said torque onto an external object such as a bolt, screw, nut, or other similar fastener. As a result, the spur gear **9** is rotatably mounted within the gear-receiving cavity **5**; additionally, the spur gear **9** comprises a first face **10.** The fastener-engagement body **6** acts as the interface element of the present invention to physically engage and apply a torque force onto the external object. The fastener-engagement body **6** is adjacently connected to the spur gear **9**, opposite the ratchet head **2**. More specifically, the fastener-engagement body **6** is connected onto the first face **10** of the spur gear **9**.

The drive shaft **12** and the plurality of drive pins **17** transfer torque and rotation motion from the external power tool to the spur gear **9**. The drive shaft **12** is an elongated cylinder composed of a strong material such as steel. Referring to FIG. **2** and FIG. **3**, the drive shaft **12** is concentrically and rotatably mounted within the tubular handle **3**. It is preferred that the drive shaft **12** is rotatably mounted within the tubular handle **3** through the use of multiple bearings. The plurality of drive pins **17** engages the spur gear **9** to transfer torque smoothly, contrary to traditional use of offset gears. Because the plurality of drive pins **17** is used, the tool housing **1** and the overall profile of the present invention can be reduced to a considerably slimmer design. For efficient transfer of torque, a rotation axis **11** of the spur gear **9** is oriented perpendicular to a rotation axis **15** of the drive shaft **12.** In alternative embodiments of the present invention, the rotation axis **11** of the spur gear **9** may be oriented at an obtuse or an acute angle relative to the rotation axis **15** of the drive shaft **12.** To accommodate for this orientation different types of gear designs may be used for the spur gear **9**. The plurality of drive pins **17** is radially distributed about the rotation axis **15** of the drive shaft **12** with each of the plurality of drive pins **17** being perpendicularly connected to a proximal base **16** of the drive shaft **12;** wherein the proximal base **16** is positioned adjacent to the ratchet head **2**. This positions the plurality of drive pins **17** directly next to the spur gear **9**. In order to transfer torque, an at least one arbitrary pin from the plurality of drive pins **17** is mechanically engaged to the spur gear **9**, wherein the arbitrary pin represents any one from the plurality of drive pins **17.** The spur gear **9** in conjunction with the plurality of drive pins **17** produce more torque than traditional off-set gear driven tools.

The plurality of drive pins **17** is able to transfer torque to the spur gear **9** through a continuous partial engagement. In other words, only a certain number from the plurality of drive pins **17** is, at one point, engaged with the spur gear **9.** To achieve this, the spur gear **9** must be specifically positioned relative to the plurality of drive pins **17.** In particular, the first face **10** of the spur gear **9** is positioned coincident with the rotation axis **15** of the drive shaft **12.** As a result, the arbitrary pin, the pin from the plurality of drive pins **17** that is engaged to the spur gear **9**, is always traveling with a lateral velocity of the same direction. In other words, the arbitrary pin is located in the lower half of the drive shaft **12,** below the rotation axis **15** of the drive shaft **12.** This ensures that the lateral force translated from the arbitrary pin to the spur gear **9** is always in the same direction, regardless of the magnitude. This prevents the spur gear **9** from locking up and ensures maximum torque transfer from the drive shaft **12** to the spur gear **9.**

Referring to FIG. **4,** each of the plurality of drive pins **17** comprises a fixed end **18,** a tooth body **19,** and a free end **20.** The fixed end **18** is connected onto the proximal base **16.** To ensure a smooth engagement between each of the plurality of drive pins **17** and the teeth of the spur gear **9**, the tooth body **19** is tapered from the fixed end **18** to the free end **20.** The tapered feature takes into account the fact that the plurality of drive pins **17** is rotating about the rotation axis **15** of the drive shaft **12,** which is oriented perpendicular to the rotation axis **11** of the spur gear **9.** It is preferred that there are three pins within the plurality of drive pins **17** that are equally distributed about the rotation axis **15** of the drive shaft **12** as seen in FIG. **2.** Furthermore, it is preferred that each of the plurality of drive pins **17** is truncated conical shape. The truncated conical shape compliments the tooth design of the spur gear **9.**

In one embodiment of the present invention, referring to FIG. **2,** the fastener-engagement body **6** acts similar to a wrench socket and comprises a torque-transferring portion **7** and a fastener-receiving cavity **8.** This embodiment is designed for bolts, nuts, and other similar fasteners that require a socket to engage the fastener. The torque-transferring portion **7** is a cylindrical extrusion which transfers torque from the spur gear **9** onto the external object. The torque-transferring portion **7** is concentrically and adjacently connected to the spur gear **9,** opposite the ratchet head **2.** The torque is applied to the external object through the fastener-receiving cavity **8.** The fastener-receiving cavity **8** is complimentary shaped to interlock with the external object and laterally traverses through the torque-transferring portion **7** and the spur gear **9.** For example, referring to FIG. **2,** the fastener-receiving cavity **8** may be hexagonal shaped to engage with traditional hexagonal shaped bolts and nuts. In general, the size, shape, and depth of the fastener-receiving cavity **8** may vary to accommodate a variety of different fasteners. The fastener-receiving cavity **8** is positioned collinear with the rotation axis **11** of the spur gear **9** in order to efficiently transfer torque from the spur gear **9** to the external object. Referring to FIG. **3,** the torque-transferring portion **7** is also laterally offset from the proximal base **16** in order to provide clearance for the plurality of drive pins **17.**

In another embodiment of the present invention, the fastener engagement body is similar to a drill bit, wherein the fastener-receiving cavity **8** is replaced with a drive bit. The drive bit is adjacently connected to the torque-transferring portion **7** with a central axis of the drive bit being positioned collinear with the rotation axis **11** of the spur gear **9.** This embodiment is designed for fasteners such as screws and other fasteners with slotted engagement heads. The cross section and shape of the drive bit may vary to accommodate a variety of fastener designs.

The present invention is attached to the external power tool through an attachment body **23** and an engagement bore **24,** similar to traditional tools. The attachment body **23** is a cylindrical extrusion that is positioned opposite to the plurality of drive pins **17,** across the drive shaft **12.** Additionally, the attachment body **23** is terminally connected to the drive shaft **12.** The engagement bore **24** receives the external power tool to allow the external power tool to rotate the drive shaft **12** and therefore rotate the fastener-engagement body **6.** More specifically, the engagement bore **24** traverses into the attachment body **23,** opposite the drive shaft **12.** Additionally, in order to ensure that the drive train of the present invention is balanced, the engagement bore **24** is positioned collinear with the rotation axis **15** of the drive shaft **12.** The shape, width, height, and depth of the engagement bore **24** may vary in order to be compatible with a variety of external power tools. In the preferred embodiment of the present invention, the engagement bore **24** has a rectangular shape with either a quarter of an inch width or three eights of an inch width as these sizes are the most common coupling bits on today's market. In an alternative embodiment of the present invention, the external surface of the attachment body **23** may be used as the mating element for the external power tool. For example, the external surface may be hexagonal in shaped.

In one embodiment, the present invention also utilizes a clutch-type mechanism in order to limit the amount of torque applied to the external object, thus preventing over tightening as well as prevent the fastener-engagement body **6** from stripping the head of the external object. The clutch-type mechanism comprises a recoiling mechanism **25** and a toothed clutch coupling **27.** In this embodiment, the drive shaft **12** comprises a front shaft **13** and a rear shaft **14.** The front shaft **13** is positioned adjacent to the ratchet head **2** and is rotatably attached within the tubular handle **3.** The rear shaft **14** received the torque from the external power source and passes said torque to the front shaft **13.** Thus, the rear shaft **14** is positioned adjacent to the front shaft **13,** opposite to the ratchet head **2.** Additionally, the rear shaft **14** is rotatably and slidably attached within the tubular handle **3.** The rear shaft **14** is slidably attached within the tubular handle **3** in order to allow the rear shaft **14** to engage and disengage the front shaft **13** under specific circumstances through the toothed clutch coupling **27,** i.e. the magnitude of torque being passed through the drive shaft **12.** Thus, the toothed clutch coupling **27** is mechanically integrated in between the front shaft **13** and the rear shaft **14.** The toothed clutch coupling **27** may be positioned into two states, an engaged state and a disengaged state. In the engaged state, the rear shaft **14** is mechanically connected to the front shaft **13,** thus allowing torque to be transferred between the rear shaft **14** and the front shaft **13.** In the disengaged state, the rear shaft **14** is able spin relative to the front shaft **13,** thus no torque is transferred from the rear shaft **14** to the front shaft **13.**

The recoiling mechanism **25** continuously applies a force onto the rear shaft **14** which pushes the rear shaft **14** into the front shaft **13,** forcing the toothed clutch coupling **27** into the engaged state. In particular, the recoiling mechanism **25** is operatively coupled between the rear shaft **14** and the tubular handle **3,** wherein the recoiling mechanism **25** is used to bias the rear shaft **14** towards the front shaft **13.** As a result, the toothed clutch coupling **27** is in the engaged state by default and becomes disengages only when the torque difference between the rear shaft **14** and the front shaft **13** reaches a specific limit. In particular, when the torque difference between the front shaft **13** and the rear shaft **14** reaches the specific limit, the toothed clutch coupling **27** slips and allows the relative motion between the rear shaft **14** and the front shaft **13.** This ensures that the external object does not experience a high magnitude of torque as this can lead damage the external object; i.e. stripping of the external object.

One type of recoiling mechanism **25** comprises a compression spring **26.** The compression spring **26** is concentrically positioned about the rear shaft **14,** within the tubular handle **3.** A first end **28** of the compression spring **26** is connected to the rear shaft **14,** adjacent to the front shaft **13.** The second end **29** of the compression spring **26** is terminally connected to the tubular handle **3,** opposite the ratchet head **2.** As a result, the compression spring **26** applies an axial force onto the rear shaft **14** that pushes the rear shaft **14** into the front shaft **13,** thus engaging the toothed clutch coupling **27.**

In this embodiment of the present invention, the front shaft **13** and the rear shaft **14** are rotatably mounted within the tubular handle **3** through a first bearing **21** and a second bearing **22.** More specifically, the first bearing **21** is concentrically mounted about the front shaft **13,** within the tubular handle **3.** Additionally, the first bearing **21** is positioned adjacent to the proximal base **16.** Resultantly, the front shaft **13** is rotatably attached to the tubular handle **3** by the first bearing **21,** thus allowing the front shaft **13** to rotate freely relative to the tubular handle **3.** In a similar fashion, the second bearing **22** is concentrically mounted about the rear shaft **14** within the tubular handle **3.** The second bearing **22** is positioned in between the front shaft **13** and the recoiling mechanism **25.** Resultantly, the rear shaft **14** is rotatably mounted to the tubular handle **3** by the second bearing **22,** thus allowing the rear shaft **14** to rotate freely relative to the tubular handle **3.**

Although the invention has been explained in relation to its preferred embodiment, it is to be understood that many other possible modifications and variations can be made without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. A power driven direct drive ratchet/wrench tool comprises:

a tool housing;

a fastener-engagement body;

a spur gear;

a drive shaft;

a plurality of drive pins;

the tool housing comprises a ratchet head, a tubular handle, and a gear-receiving cavity;

the ratchet head being terminally connected to the tubular handle;

the gear-receiving cavity laterally traversing into the ratchet head, intersecting a lumen of the tubular handle;

the gear-receiving cavity being oriented perpendicular to the tubular handle;

the spur gear being rotatably mounted within the gear-receiving cavity;

the fastener-engagement body being adjacently connected to the spur gear, opposite the ratchet head;

the drive shaft being concentrically and rotatably mounted within the tubular handle;

the plurality of drive pins being radially distributed about a rotation axis of the drive shaft;

each of the plurality of drive pins being perpendicularly connected to a proximal base of the drive shaft; and

at least one arbitrary pin from the plurality of drive pins being mechanically engaged to the spur gear.

2. The power driven direct drive ratchet/wrench tool as claimed in claim 1 comprises:

a recoiling mechanism;

a toothed clutch coupling;

the drive shaft comprises a front shaft and a rear shaft;

the front shaft being positioned adjacent to the ratchet head;

the front shaft being rotatably attached within the tubular handle;

the rear shaft being positioned adjacent to the front shaft, opposite the ratchet head;

the rear shaft being rotatably and slidably mounted within the tubular handle;

the toothed clutch coupling being mechanically integrated in between the front shaft and the rear shaft; and

the recoiling mechanism being operatively coupled between the rear shaft and the tubular handle, wherein the recoiling mechanism is used to bias the rear shaft towards the front shaft.

3. The power driven direct drive ratchet/wrench tool as claimed in claim 2 comprises:

the recoiling mechanism comprises a compression spring;

the compression spring being concentrically positioned about the rear shaft, within the tubular handle;

a first end of the compression spring being connected to the rear shaft, adjacent to the front shaft; and

a second end of the compression spring being terminally connected to the tubular handle, opposite the ratchet head.

4. The power driven direct drive ratchet/wrench tool as claimed in claim 2 comprises:

a first bearing;

a second bearing;

the first bearing being concentrically mounted about the front shaft within the tubular handle;

the first bearing being positioned adjacent to the proximal base;

the front shaft being rotatably mounted to the tubular handle by the first bearing;

the second bearing being concentrically mounted about the rear shaft within the tubular handle;

the second bearing being positioned in between the front shaft and a recoiling mechanism; and

the rear shaft being rotatably mounted to the tubular handle by the second bearing.

5. The power driven direct drive ratchet/wrench tool as claimed in claim 1 comprises:

an attachment body;

an engagement bore;

the attachment body being positioned opposite to the plurality of drive pins, across the drive shaft;

the attachment body being terminally connected to the drive shaft;

the engagement bore traversing into the attachment body, opposite the drive shaft; and

the engagement bore being collinear with the rotation axis of the drive shaft.

6. The power driven direct drive ratchet/wrench tool as claimed in claim 1 comprises:

the spur gear comprises a first face;

the fastener-engagement body being connected onto the first face; and

the first face being positioned coincident with the rotation axis of the drive shaft.

7. The power driven direct drive ratchet/wrench tool as claimed in claim 1, wherein a rotation axis of the spur gear is oriented perpendicular to the rotation axis of the drive shaft.

8. The power driven direct drive ratchet/wrench tool as claimed in claim 1 comprises:

the fastener-engagement body comprises a torque-transferring portion and a fastener-receiving cavity;

the torque-transferring portion being concentrically and adjacently connected to the spur gear, opposite the ratchet head;

the torque-transferring portion being laterally offset from the proximal base;

the fastener-receiving cavity laterally traversing through the torque-transferring portion and the spur gear; and

the fastener-receiving cavity being collinear with a rotation axis of the spur gear.

9. The power driven direct drive ratchet/wrench tool as claimed in claim 1 comprises:

each of the plurality of drive pins comprises a fixed end, a tooth body, and a free end;

the fixed end being connected onto the proximal base; and

the tooth body tapering from the fixed end to the free end.

10. The power driven direct drive ratchet/wrench tool as claimed in claim 1, wherein each of the plurality of drive pins is truncated conical shape.

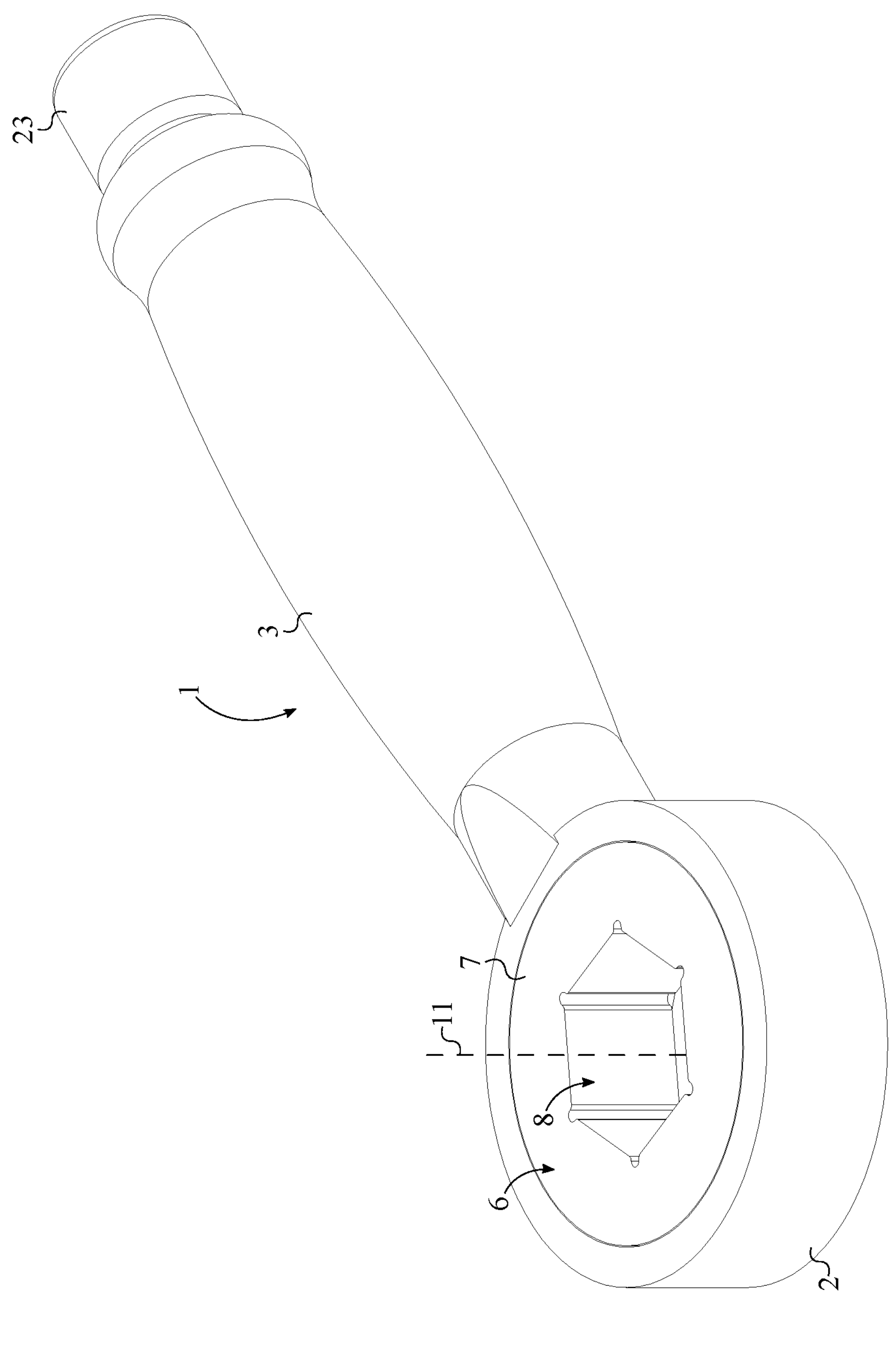


FIG. 1

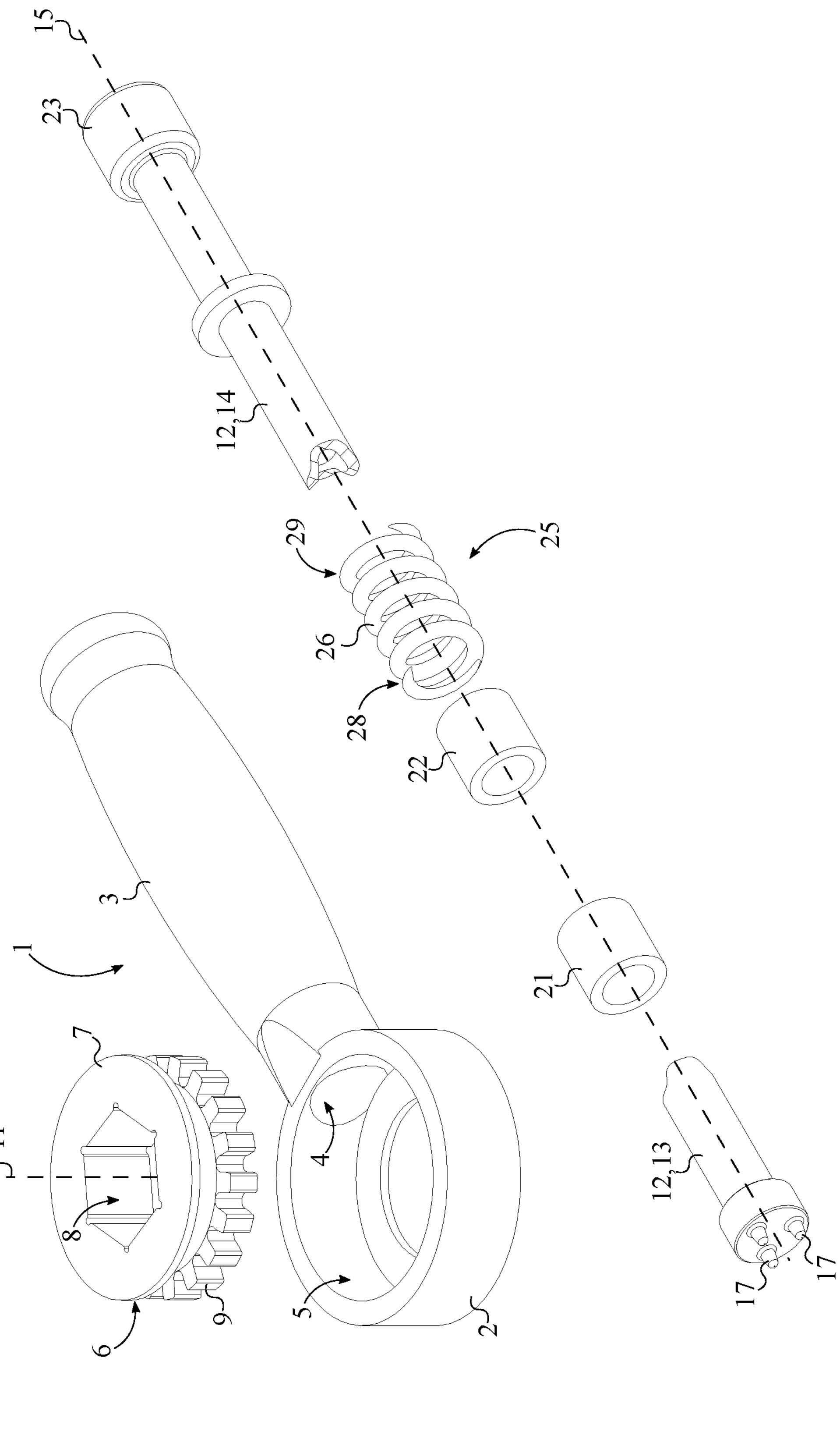


FIG. 2

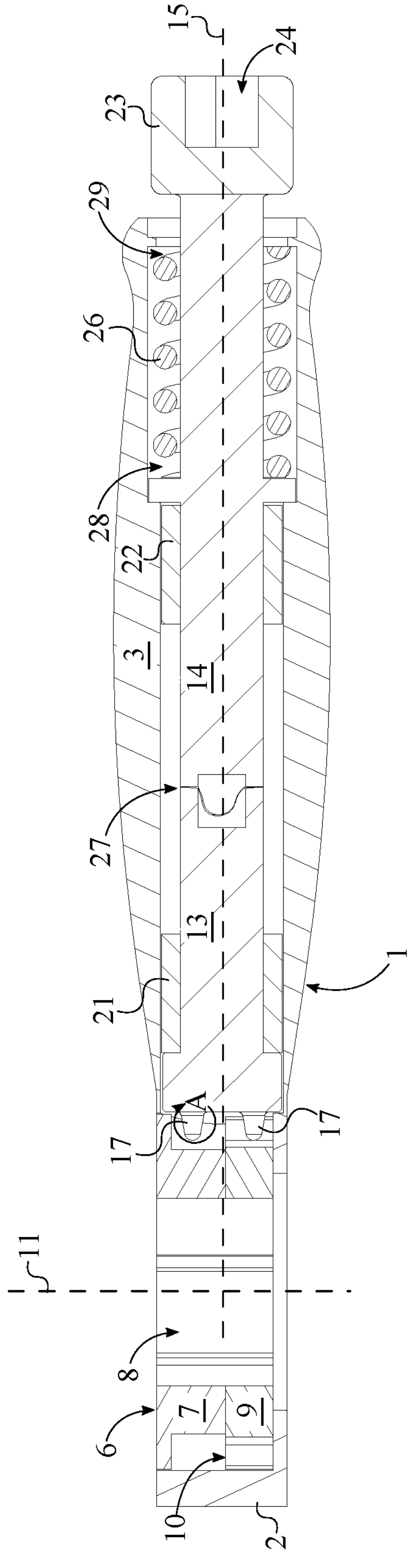
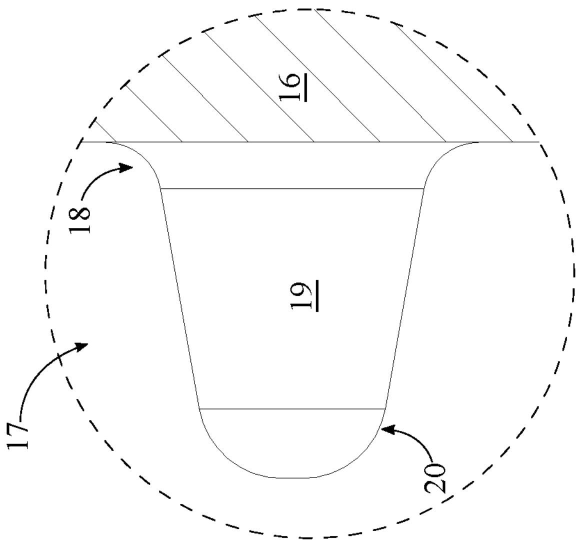


FIG. 3



DETAIL A

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB 2017/052453

A. CLASSIFICATION OF SUBJECT MATTER

B25B 13/46 *(2006.01)*

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B25B 13/00, 13/46, 15/00, 15/04, 17/00, 17/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatSearch (RUPTO internal), USPTO, PAJ, Esp@cenet, DWPI, EAPATIS, PATENTSCOPE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6314839 B1 (JAMES M. CARTER) 13.11.2001	1-10
A	SU 312753 A1 (NALCHA B. I. et al.) 31.08.1971	1-10
A	WO 2007/058961 A1 (BRYSON BRADLEY M. et al.) 24.05.2007	1-10
A	US 2578686 A (TUBING APPLIANCE CO., INC) 18.12.1951	1-10
A	RU 17880 U1 (LISITSA YURY VALENTINOVICH) 10.05.2001	1-10

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 July 2017 (05.07.2017)	17 August 2017 (17.08.2017)

Name and mailing address of the ISA/RU:	Authorized officer
Federal Institute of Industrial Property, Berezhkovskaya nab., 30-1, Moscow, G-59, GSP-3, Russia, 125993 Facsimile No: (8-495) 531-63-18, (8-499) 243-33-37	E. Gvozdikova Telephone No. 8-499-240-25-91