(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 432 884 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **90311709.1**

(51) Int. Cl.5: **B25B 21/00**

(22) Date of filing: **25.10.90**

(30) Priority: **15.12.89 US 451750**

(43) Date of publication of application:
19.06.91 Bulletin 91/25

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI LU NL SE

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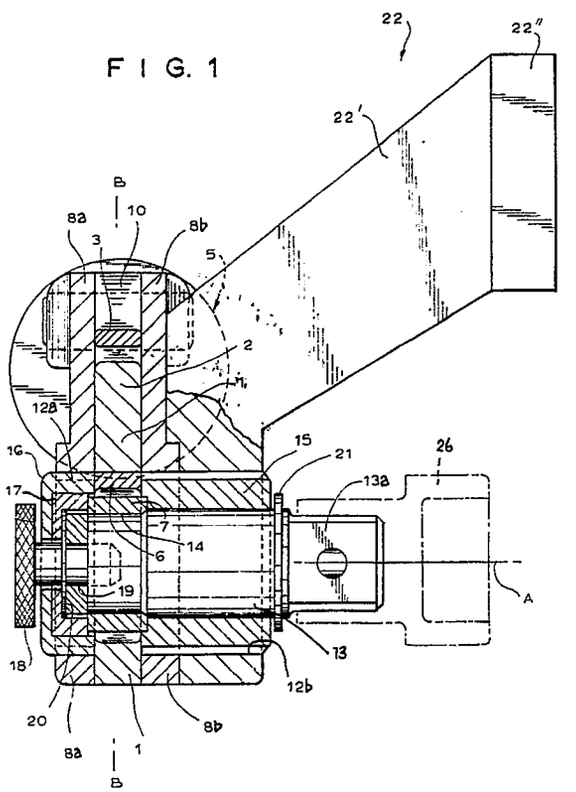
(54) Power wrench.

(57) A power wrench for tightening and loosening threaded connectors, comprises a housing (10), a ratchet mechanism (6, 7) turnable about an axis (A); a power drive (5) arranged to turn the ratchet mechanism about the axis (A). A drive shaft (13) is drivably connected to the ratchet mechanism (6, 7) and is arranged to support means (26) for turning threaded connectors. The drive shaft (13) extends substantially along the axis (A) at one side of a plane (B). The drive shaft (13) is removably connected with the ratchet mechanism (6, 7) so that it can be easily removed from the housing (10) and replaced by a drive shaft of different length to reach threaded connectors located farther from or closer to the plane (B). A reaction member (22) is connected to the housing (10) and extends transversely to the plane (B) substantially in the direction of the axis (A) at the same side of the plane (B) as the drive shaft (13) to transmit reaction torque to an object selected to resist it. The reaction member (22) is also removable from the housing (10) so that it can be replaced by a reaction member of a different size to reach a stationary object located adjacent to the threaded connector to be tightened or loosened but farther from or closer to the plane (B).

FIG. 1



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POWER WRENCH

The present invention relates to a power wrench for tightening or loosening threaded connectors.

More particularly, the invention relates to such power wrenches which operate in conjunction with sockets attached to their drive shaft to tighten or loosen a threaded connector which is spaced from the plane of the tool. In this situation, during tightening or loosening of threaded connectors, the tool is located up and above the threaded connector (a nut, a bolt head, etc.) to be turned, and a reaction arm of the tool reaches down to a neighbouring object. During such operation tremendous twisting forces are generated due to the fact that the tool and the threaded connector are located in different planes and a reaction developed during the operation tends to twist the tool. My U.S. Patent 4,706,527 proposed a solution to this problem. In this reference a spline sleeve extends around the axis of a square drive shaft, and the drive shaft is rotated in it. The splined sleeve is a part of the side plate of the housing, and a reaction member can be attached to it so that the bending and torsional forces would be eliminated. The tool disclosed in this reference however has certain limitations. It cannot be efficiently adjusted for tightening or loosening threaded connectors which are located at considerably differing distances from the plane of the tool. When the tool uses a non-reversible ratchet mechanism, it is not possible to use the same tool both for tightening and loosening the threaded connectors.

Accordingly, it is an object of the present invention to provide a power wrench of the above mentioned general type, which avoids the disadvantages of the prior art.

In keeping with these objects and with others which will become apparent hereinafter, one feature of the present invention resides, briefly stated, in a power wrench for tightening and loosening threaded connectors, comprising a housing, a ratchet mechanism turnable about an axis; a power drive arranged in said housing and connected with said ratchet mechanism via a drive element so as to turn the ratchet mechanism about said axis, said drive element extending in a predetermined plane; a drive shaft drivably connected to the ratchet mechanism and arranged to hold means at a distal end of the drive shaft for turning threaded connectors, said drive shaft extending transversely to said plane substantially along said axis at one side of said plane, which is characterised in that said drive shaft is removably connected with said ratchet mechanism so that said drive shaft can be easily removed from the housing and replaced by a drive shaft of different length to reach threaded connectors located farther from or closer to said plane; a reaction member connected to the housing and extending transversely to said plane substantially in the direction of said axis at the same side of said plane as said drive shaft, and in that said reaction member is also removable from the housing so that it can be replaced by a reaction member of a different size to reach a stationary object located adjacent to the threaded connector to be tightened or loosened but farther from or closer to said plane of said drive element.

When the actuating assembly and the power wrench are designed in accordance with the present invention, the drive shaft is releasably connected with the ratchet mechanism and can be replaced by a drive shaft of a different length to reach differently spaced threaded connectors, or placed at an opposite side of the tool plane to reverse the operation from tightening to loosening and vice versa in the event of the use of non-reversible ratchet mechanism.

In accordance with another advantageous feature of the present invention a guiding sleeve surrounds the drive shaft which is also removable and replaceable by a sleeve of a different length or mountable at the opposite side of the tool plane to be adapted to the respectively sized or mounted drive shaft.

In accordance with still another feature of the present invention, the aforesaid guiding sleeve can be a part of an element which on the other hand serves for guiding the drive shaft and on the other hand serves as a reaction member for reacting against a neighbouring object during tightening or loosening threaded connectors.

Further advantageous features are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, given by way of example and in which:-

Figure 1 is a partially sectioned side view showing an actuating assembly of a power wrench in accordance with the present invention,

Figure 2 is a partially disassembled end view of the actuating assembly of Figure 1 connected with a drive of a power wrench, and

Figure 3 is a partially sectioned view showing another embodiment of the actuating assembly in accordance with the present invention.

A power wrench for tightening or loosening

threaded connectors includes a housing 10 with two housing portions 10' and 10". The power wrench further has a drive element which is identified with reference numeral 1 and is formed as a drive plate. As can be seen from Figure 2, the drive plate 1 has an upper portion 2 which engages in a cup-shaped projection 3 mounted on an end of a piston rod 4 of a power drive 5. The power drive 5 can be formed as a cylinder-piston unit arranged in the housing portion 10' and having the piston connected to the piston rod 4. During a reciprocating movement of the cylinder-piston unit, the drive plate 1 is turned in opposite directions respectively.

The actuating assembly of the invention further includes a ratchet mechanism with a toothed pawl 6 mounted on the drive plate 1 and a ratchet wheel 7 engaged by the pawl. During turning of the drive plate 1 in one direction, the pawl is turned in the same direction, and due to the engagement of the teeth of the pawl and the ratchet wheel, turns the ratchet wheel in the same direction. During turning of the drive plate in the opposite direction, the teeth of the pawl just slide over the teeth of the ratchet wheel without turning the latter. Such a ratchet mechanism constitutes a non-reversible drive mechanism. It is to be understood that the actuating assembly in accordance with the present invention can also use a reversible ratchet mechanism which performs working strokes in both directions such reversible mechanisms being well known in the art.

A supporting element supports the drive plate and is formed by the housing portion 10". It includes for example two side plates 8a and 8b located at opposite sides of the drive plate. The side plates are connected with one another by pins 9 and are also connected with a housing portion 10' of the tool by pins 11. The side plates each have a central opening for supporting respective parts of the tool, as will be explained hereinbelow.

A drive shaft 13 is provided for turning threaded connectors to be tightened or loosened. The drive shaft 13 has a distal end 13a adapted to carry a socket 26 to be fitted on a threaded connector for turning the latter in a respective direction. The ratchet wheel 7 has a central opening 14 through which the proximal end of the drive shaft 13 passes. The ratchet wheel 7 and the drive shaft 13 are connected with one another for joint rotation, for example by the interengaging of cooperating splines or other, preferably polygonal, formations. As can be seen from Figure 1, the drive shaft 13 has an axis A and extends in direction of the axis substantially entirely to one side of a plane B defined by the median plane of the drive plate 1. A small portion at the proximal end projects axially beyond the plane B and is provided with a threaded recess 19.

The major portion of the drive shaft 13 which extends to the right of the plane B is supported in a guiding element 15 which in this embodiment is formed as a guiding sleeve. The guiding sleeve 15 extends in a central opening 12b of the side plate 8b and is removably and non-rotatably connected with the latter, for example by splines or other, preferably polygonal, interengaging formations. The opposite small portion of the drive shaft 13, located at the left side of the plane B is guided in holding means which include a holding element 16 and a holding member 17. The holding element 16 is cup-shaped, and its axial wall extends through the central opening 12a in the side plate 8a and is removably but non-rotatably connected with the latter, for example by splines or other, preferably polygonal, interengaging formations. The holding member 17 is also cup-shaped and its axial wall removably bears against the ratchet wheel 7 surrounding the small left portion of the drive shaft 13. The holding member 17 engages the proximal end of the drive shaft 13 (shown sectioned) for example by splines or other, preferably polygonal, formations. The holding member 17 is slidably received in the holding element 16. A screw 18 is screwed through a central opening in the holding element 16 and the holding member 17 into the threaded recess 19 in the proximal end of the drive shaft 13. It is retained in the central opening in the element 16 and member 17 by a spring clip 20. The guiding sleeve 15 in turn is retained by a spring clip 21.

A reaction member 22 is provided in the tool. The reaction member is arranged on the guiding sleeve 15 and is connected with the latter by interengaging splines or other, preferably polygonal, formations. As can be seen from the drawings, the splines on the guiding sleeve 15 are used for connecting the same to the side plate 8b and to the reaction member. The reaction member includes a reaction shaft 22' which extends substantially in the direction of the axis A and transversely to the plane B. The distal end of the reaction shaft 22' is provided with a reaction part 22" formed so as to reach a neighbouring object capable of absorbing reaction torque during tightening or loosening of a threaded connector. The reaction part 22" extends perpendicular to the axis A.

The operation of the actuating assembly of the power wrench is believed to be clear from the above described construction, but can be summarised as follows:-

When the power drive 5 is activated and the piston rod 4 moves in one direction, the drive plate 1 is turned in one direction and turns the pawl 6, which in turn turns the ratchet wheel 7. The ratchet wheel 7 then turns the drive shaft 13 about axis A which transmits a turning force to the socket 26 (shown in chain lines) attached to the distal end

13a of the shaft. The socket fixed on a threaded connector such as a nut or a bolt head, then turns the threaded connector in a predetermined direction. During a reverse stroke of the drive 5, the pawl teeth slip over the teeth of the ratchet wheel without turning the latter in the opposite direction. By successive turnings of the threaded connector in one direction, it is tightened or loosened. The reaction torque is absorbed via the member 22 to permit the generation of tightening or loosening forces on the connector.

In accordance with the present invention, the drive shaft 13 and the guiding sleeve 15 can be easily removed by unscrewing the screw 18 and moving the drive shaft 13 and the guiding sleeve 15 to the right in Figure 1 of the drawings, withdrawing the drive shaft from the ratchet wheel 7. Upon removal, a new drive shaft 13 of a greater axial length or a smaller axial length can be connected with the ratchet wheel, and a corresponding guiding sleeve 15 of a greater axial length or a smaller axial length can be connected with the right side plate 8b so that a threaded connector located farther from the plane B or closer to the plane B can be turned. The reaction member 22 is also removable and can be replaced by a reaction member of a greater axial length or a smaller axial length to reach a corresponding neighbouring reaction torque-absorbing object as required.

It is also possible to switch the operation of the tool from tightening to loosening or vice versa in the event of the ratchet mechanism being a non-reversible mechanism. In this case the drive shaft 13 with the guide sleeve 15 are removed through plate 8b from the right side of the tool, the holding element 16 and member 17 are removed through plate 8a from the left side of the tool, and the drive shaft 13 with the guide sleeve 15 are then mounted in plate 8a at the left side of the tool, while the holding means 16, 17 are mounted in plate 8b at the right side of the tool. To permit this exchange, the splines on the holding means 16, 17, on the guiding sleeve 15, and in both the side plates 8a and 8b need to be complementary to permit mounting of the holding means on the one hand and the drive shaft with the guiding sleeve on the other hand at the above specified alternative locations. The reaction member 22 is also removed from its engagement with plate 8b and secured on the left side of the plane B to plate 8a (e.g. by being screwed thereto).

Figure 3 shows another embodiment of the present invention. In this embodiment the tool is provided with an element 23. The element 23 has a guiding portion 24 which substantially corresponds to the guiding sleeve 15 of the embodiment of Figure 1. It also has a reaction portion 25 which substantially corresponds to the reaction member 22 of the embodiment of Figure 1. The portions 24 and 25 are of one-piece with one another so that during mounting of the drive shaft 13 on the opposite side (left side) of the plane B, not only the guiding portion 24, but also the reaction portion 25 are mounted on the plate 8a.

While the invention has been illustrated and described as two embodiments of power wrench, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing from the scope of the following claims.

Claims

1. A power wrench for tightening and loosening threaded connectors, comprising a housing (10), a ratchet mechanism (6, 7) turnable about an axis (A); a power drive (3, 4, 5) arranged in said housing (10) and connected with said ratchet mechanism (6, 7) via a drive element (4) so as to turn the ratchet mechanism about said axis (A), said drive element (4) extending in a predetermined plane (B); a drive shaft (13) drivably connected to the ratchet mechanism (6, 7) and arranged to hold means (26) at a distal end of the drive shaft for turning threaded connectors, said drive shaft (13) extending transversely to said plane (B) substantially along said axis (A) at one side of said plane (B), characterised in that said drive shaft (13) is removably connected with said ratchet mechanism (6, 7) so that said drive shaft (13) can be easily removed from the housing (10) and replaced by a drive shaft of different length to reach threaded connectors located farther from or closer to said plane (B); a reaction member (22, 25) connected to the housing (10) and extending transversely to said plane (B) substantially in the'direction of said axis (A) at the same side of said plane as said drive shaft (13), and in that said reaction member (22, 25) is also removable from the housing (10) so that it can be replaced by a reaction member of a different size to reach a stationary object located adjacent to the threaded connector to be tightened or loosened but farther from or closer to said plane (B) of said drive element (4).

2. A power wrench as claimed in claim 1, characterised in that said drive shaft (13) and said reaction member (22, 25) are both connectable with said housing at another side of said plane (B) of said drive element (4) to change the operating direction of the power wrench from tightening to loosening and vice versa.

3. A power wrench as claimed in claim 1 or claim 2, characterised in that guiding means (15, 24) is provided for guiding said drive shaft (13) and extending over at least a portion of said drive shaft, said guiding means (15, 24) being removable so that it can also be replaced by a longer or a shorter guiding means adapted to a different drive shaft, and in that said guiding means can be easily removed from said housing (10) and arranged at another side of said plane (B) to adapt to a drive shaft projecting from the other side of said plane.

4. A power wrench as claimed in claim 3, characterised in that said guiding means is formed as a sleeve (15) which surrounds a portion of said drive shaft (13) and is non-rotatably supported on said housing (10).

5. A power wrench as claimed in claim 3, characterised in that said guiding means has a section (24) surrounding a portion of said drive shaft (13) and is connected with another section (25) extending from said first mentioned section (24) and formed as a reaction member for abutting against a neighbouring object during tightening or loosening threaded connectors.

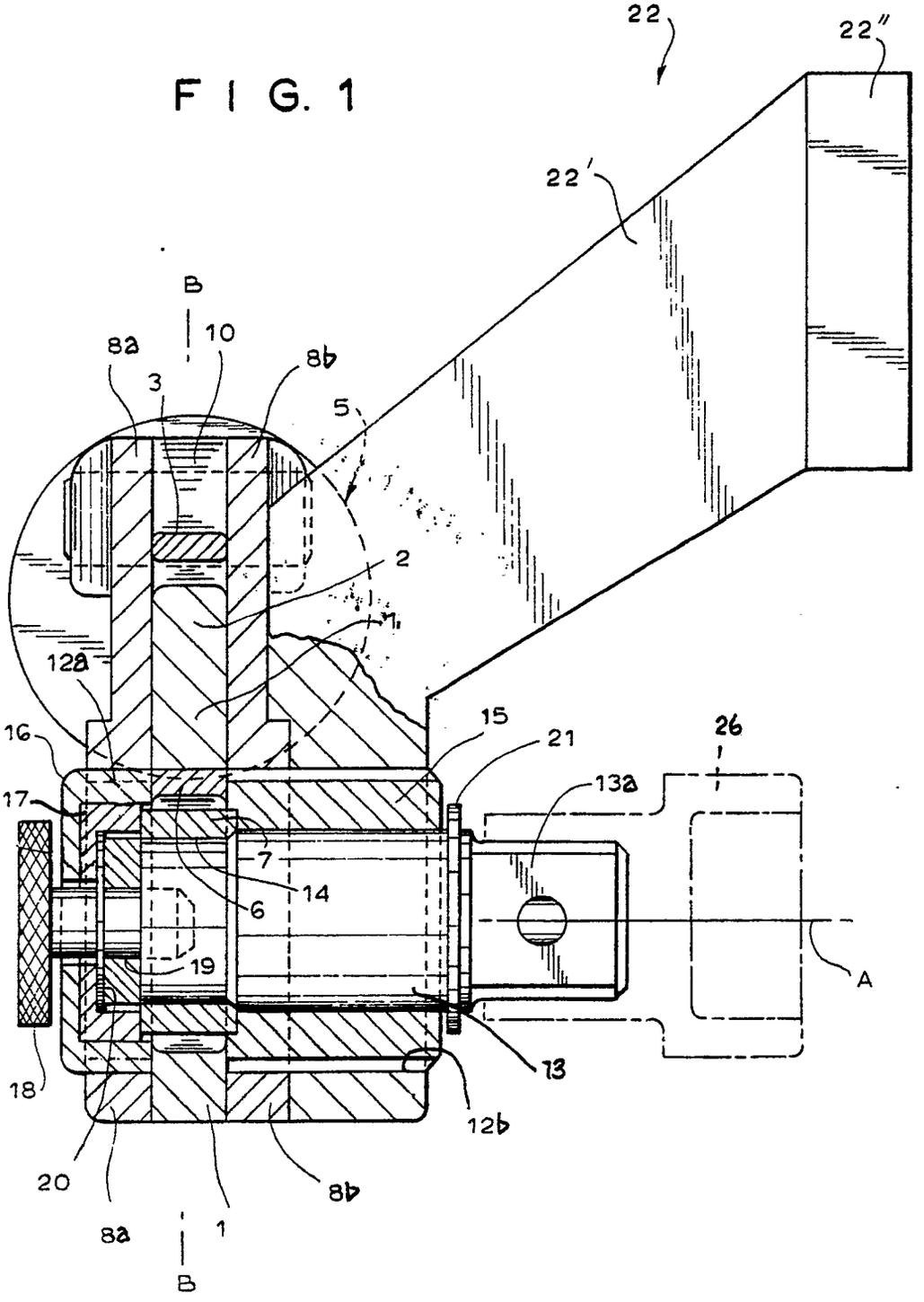
6. A power wrench as claimed in any preceding claim, characterised in that holding means (16, 17, 18) for the drive shaft (13) is arranged at a side of said plane (B) which is opposite to said means (26) and including a holding element which is removably connected with said housing (10) and in that said holding means (16, 17, 18) can be mounted on the housing on the opposite side of said plane (B) when the drive shaft (13) is reversed in the housing.

7. A power wrench as claimed in claim 6, characterised in that said holding means includes a holding member (17) which surrounds another portion of said drive shaft (13) and a screw (18) arranged to engage in a threaded recess (19) in the drive shaft (13).

8. A power wrench as claimed in any preceding claim, characterised in that said ratchet mechanism includes a ratchet wheel (7) having a central opening (14), said drive shaft (13) extending through said central opening (14); the connection between said drive shaft (13) and said ratchet wheel (7) including polygonal formations provided on said drive shaft (13) and in said ratchet wheel (7) and engageable with one another to prevent relative rotation therebetween.

9. A power wrench as claimed in claim 3, characterised in that means (21) is provided for retaining said guiding means (15, 24) relative to said drive shaft (13).

FIG. 1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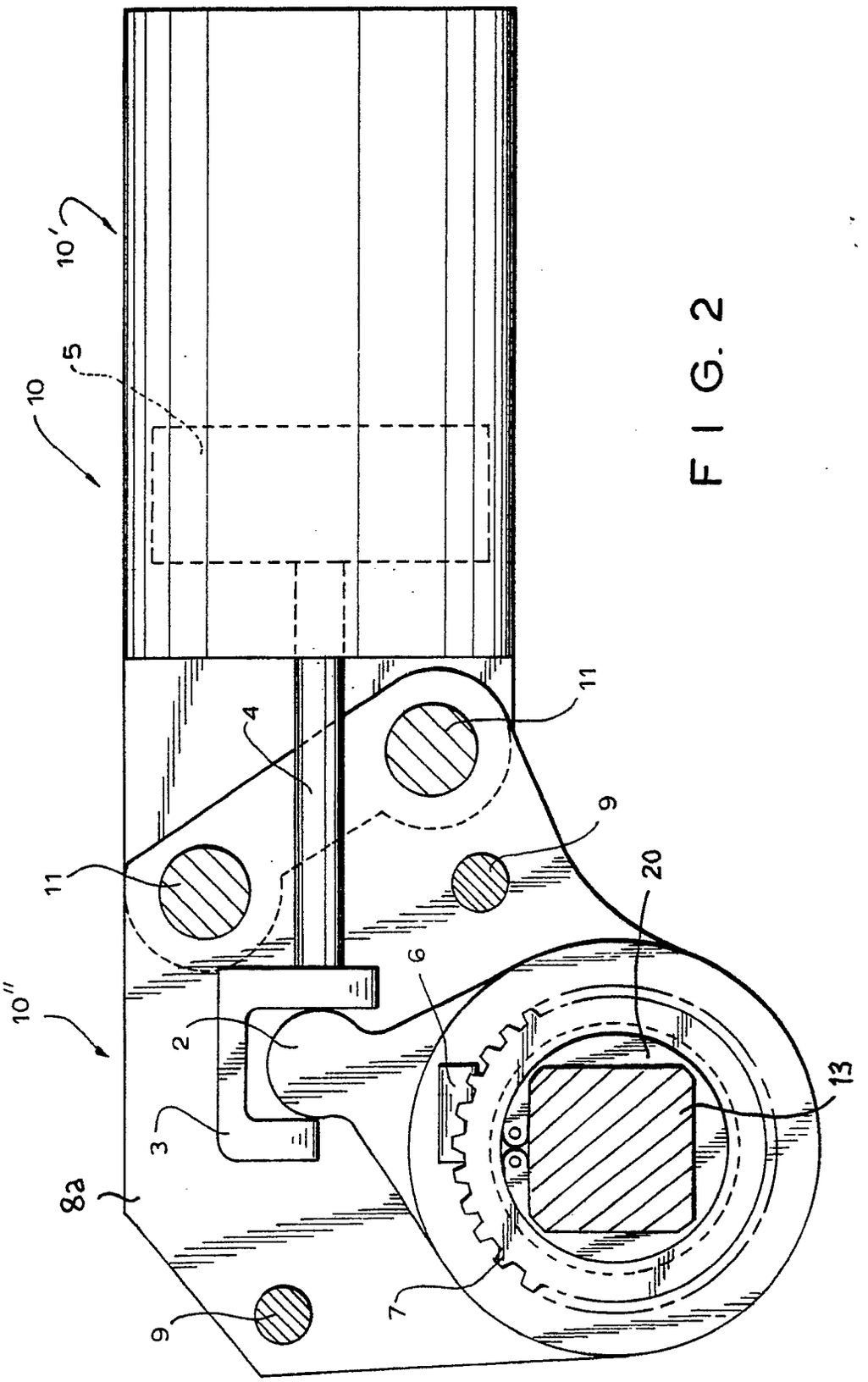

FIG. 2

FIG. 3