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Power-driven torque intensifier

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(56) Related Art
US 6058810 A (JUNKERS) A May 2000
US 5816121 A (YOSHIMIZU et al.) 6 October 1998
US 5490439 A (MATSUMURA et al.) 13 February 1996

ABSTRACT OF THE DISCLOSURE

A torque intensifying tool for tightening and loosening threaded connectors has at least one torque intensifier means having a torque intensifier housing portion, having input means and having a first output means and a second output means, a drive operatively connected with the input means for transmitting a torque from the drive through the intensifying means to a threaded connector, so that in one mode of operation the torque intensifier housing portion together with the first and the second output means turn in the same direction and the same speed and torque as the input means, and in another mode of operation the torque intensifier housing portion together with one of the first and second output means receives a turning force in one direction while the other one of the first and second output means receives an equal turning force in the opposite direction at a lower speed but higher torque than the input means, and so that one of the first and second output means turns in the one mode and in the another mode while the other of the first and second output means turns in the one mode and reacts in the another mode.

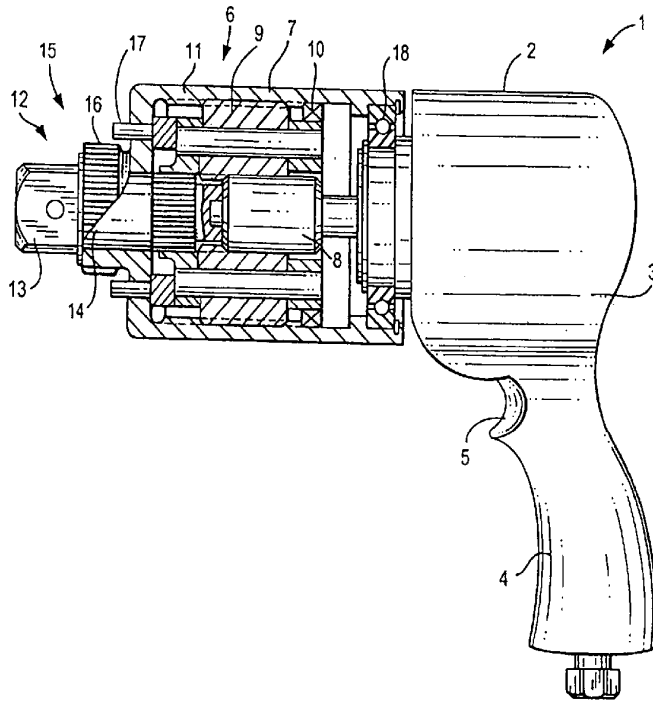


FIG. 1a

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AUSTRALIA
Patents Act 1990

UNEX CORPORATION

COMPLETE SPECIFICATION
STANDARD PATENT

Invention Title:

Power-driven torque intensifier

The following statement is a full description of this invention including the best method of performing it known to us:-

BACKGROUND OF THE INVENTION

The present invention relates to a torque intensifying tool.

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In tightening fasteners, once the nut hits the flange surface the turning degree to tighten it up is very little. What the customer wants, on the other hand, is high turning speed so that a nut can be run down or off very fast.

10

The usual impact wrenches, which provide a high run down and run off speed, have the disadvantage that they are not very accurate and very slow once the nut hits the flange face. Torque power tools are torque accurate, but relatively slow in run up and run down of fasteners. Yet, still they are faster than impact guns once the nut is turned on the flange face. Torque power tools usually have an air, electric or hydraulic motor. It turns gears, which reduce the speed but increases the relatively low torque output of the motor. The higher the torque, the larger the gear ratio and obviously the slower the speed with which the nut is turned. It is, therefore, common to have a two speed mechanisms; one for run down and run off and one for the final higher torque.

20

It is known that running a nut down takes usually less torque than running it off due to possible thread corrosion when loosening a nut.

5 This means that the torque derived by means of an air motor used for smaller air wrenches might have to be increased with a small intensifier to increase the turning torque provided by the motor without lowering the run up and run off speed too much. For most hand held torque power tools where the motor housing is independent to the gear housing it becomes important that the free motor-turning torque does not exceed the hand torque resistance or the tool's motor housing can not be held and starts spinning in the hand.

10 There are many motor driven torque multipliers in the market and some of them have two speed mechanisms, some of them react on the bolt tip, others with a reaction arm. What they all have in common is that no matter what torque or speed is applied by them their gear housing turns in the opposite direction to the output shaft. None provides a run
15 down or run off speed where the entire gear housing together with the inner gear assembly and the output drive turn at the same high speed in the same direction.

20 There are also portable power driven tools in the market such as disclosed in US 2,569,244 where a push of the tool onto the fastener increases or decreases the air inlet and thus the torque output. There is, however, none in the market where a push onto the fastener changes from turning the gear housing, its gears and its output shaft in the

5 same direction at the same speed to applying a turning force to the gears and the output shaft in one direction and simultaneously an opposite turning force to the gear housing. There are also portable power driven tools in the market where the torque of the motor can be reduced to increase the motor speed and thus the speed of the tool.

10 Also, the two speed mechanism of motor driven torque multipliers usually works in a way that one or several planet gear stages are disconnected so that merely the remaining ones function. This reduces the gear ratio to obtain a higher speed and lower torque and so that once the nut stalls out all planet gear stages become functional to achieve the higher torque at a lower speed. Nevertheless, the housing still wants to react in the opposite direction to the turning direction of the gears in low ratio and high ratio. In other words, while the drive and the
15 gears receive a turning force in one direction, the housing receives the same turning force in the opposite direction. The problem with that is that a high speed, the gears and the output shaft turn so fast in the gear housing that almost all turning parts require bearings, which makes the tool larger and heavier.

SUMMARY OF THE INVENTION

Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is solely for the purpose of providing a context for the present invention. It is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present invention as it existed before the priority date of each claim of this application.

Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

The present invention provides a torque intensifying tool for tightening and loosening threaded connectors, comprising drive means; at least one torque intensifier means receiving a torque from said drive means and having gear means and a torque intensifier housing portion; a driving element for turning one part of a threaded connector; a reaction element for reacting during the turning of the one part of the threaded connector by said driving element; and means switching the torque intensifying tool between two modes of operation and configured for connecting said driving element to said torque intensifier housing portion with said reaction element and disconnecting said driving element therefrom so that in one mode of operation said driving element operates with a high speed and a low torque and said torque intensifier housing portion is connected with said driving element and said reaction element and said torque intensifier housing portion together with said driving element and said

reaction element turn in one direction, and in another mode of operation said driving element operates with a low speed and a high torque and said torque intensifier housing portion together with said reaction element is disconnected from said driving element so that in the other mode of operation while said driving element receives a turning
5 force in the one direction, said torque intensifier housing portion together with said reaction element receives a turning force in an opposite direction, and so that said driving element turns in said one mode and in said another mode while said reaction element turns in said one mode and reacts in said another mode.

Embodiments of the torque intensifying tool are based on the idea to stop the
10 usual equal, simultaneous but opposite turning of action and reaction when high nut turning speed is required so as to avoid that almost all turning parts require bearings.

In embodiments of the tool, in order for the housing, the gears of the torque intensifier and the input and output means to turn in the same direction at the same speed, the usual equal and opposite turning of parts has to be blocked temporarily. This
15 can be done in many ways. For example, one can block the gears so that they cannot freely turn in the housing, or one blocks the planet gears so that the sun gear cannot turn them, or one blocks the housing and the output shaft so that they cannot turn independently from one another, or one blocks the action drive and the reaction drive or their attachment, or one blocks one part of the fastener with the other if both are to be
20 turned down together and then turned independently from one another, etc.

To achieve the same result without turning the housing, the gears and the output and input shaft together would be quite complex simply because one would have to cut out all or at least all but one gear cage temporarily, whereas in embodiments of the

present invention, the entire intensifier housing is cut off temporarily by merely blocking two usually opposite turning parts.

With embodiments of the tool, during turning of one part of the threaded connector such as a nut and applying an action force, a reaction force can be
5 compensated by reacting against a neighboring object, for example against a neighboring nut, against another part of the threaded connector, for example a washer, against a further part of the threaded connector, for example a sleeve, etc.

The novel features which are considered as characteristic for the present invention are set forth in particular in the appended claims. Embodiments of the
10 invention itself, however, both as to their construction and method of operation, will be best understood from the following detailed description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1 and 1b are views showing a torque intensifying tool for tightening and loosening threaded connectors in accordance with one embodiment of the present invention, wherein Figure 1a is a view
5 showing the tool in one mode of operation and Figure 1b is a view showing the tool in another mode of operation;

Figure 2a-2c are views showing a torque intensifying tool in accordance with another embodiment of the present invention, wherein
10 Figure 2a is a view showing the tool in one mode of operation, Figure 2b is a view showing the tool in another mode of operation, and Figure 2c showing a tool end;

Figure 3 is a view showing a torque intensifying tool for
15 tightening and loosening threaded connectors in accordance with a further embodiment of the present invention; and

Figures 4a-4b are views showing another embodiment of the inventive torque intensifying tool in two different modes of operation.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A torque intensifying tool for tightening and loosening threaded connectors has drive means which are identified as a whole with reference numeral 1. The drive means 1 can have a drive housing 2 and a drive which is identified with reference numeral 3. The drive means 1 can be formed as a motor drive means, in which case it can include a motor. It is also possible that the drive means 1 is formed as manual drive means, for example as a torque wrench. The drive means 1 generate a torque which is to be transmitted for operation. In the embodiment shown in Figures 1a, 1b the drive housing 2 has a handle 4 which is to be held by an operator and provided with switching means 5 for switching the drive means between an inoperative position and an operative position.

The torque intensifying tool in accordance with the present invention further has at least one torque intensifier means which are identified as a whole with reference numeral 6. The torque intensifier means 6 have a torque intensifier housing 7 and gear means connected to the drive means 1. In the embodiment shown in Figures 1a, 1b the gear means include a sun gear 8 having a shaft which forms an input means, planetary gears 9 and a planet cage 10. The torque intensifier housing 7 is provided with an internal gear 11 which extends only over a longitudinal portion of the housing 7.

The torque intensifying tool in accordance with the present invention further has a driving element which is identified as a whole with reference numeral 12 and forms a first output means. The driving element 12 has a driving part 13 which can be formed for example as a square 5 drive and a rear part 14 which is drivingly connected with the torque intensifier means, for example by interengaging splines. The connection of the drive means 1 with the torque intensifier means 6 and the driving element 12 provides transmission of torque from the drive means to the driving element. The torque intensifier means 6 can be configured to 10 provide any desired intensification of a torque generated by the drive means 1.

The torque intensifying tool further has a reaction element which is identified with reference numeral 15 and forms a second output 15 means. The reaction element 15 is provided with means 16 for connecting with an element reacting against a stationary object, for example a reaction arm, for example with splines. The reaction element 15 is non rotatably connected with the torque intensifier housing 7. In the embodiment shown in Figures 1a and 1b, the reaction element 15 is 20 formed integral one-piece with the torque intensifier housing.

The torque intensifying tool has two different modes of operation. In one mode of operation when the torque is transmitted from

the drive means 1 through the torque intensifier means to the driving
element 12 the driving element 12 provides a lower torque and a higher
speed of turning. This is advantageous when it is necessary to turn one
part of the threaded connector, for example a nut, on another part of the
5 threaded connector, for example a bolt, with a high speed until the nut is
seated on a washer or on the face of an application. In this mode of
operation the torque is transmitted from the drive means, through the
torque intensifier housing 7, the gears of the torque intensifier, the second
output means or the reaction element 15, and the first output means or the
10 driving element 12, so that the torque intensifier housing 7 together with
the first output means and the second output means turn in the same
direction and at the same torque and speed as the input means.

In another mode of operation the torque is transmitted from
15 the drive means 1 through the torque intensifier means to the driving
element 12 so that the torque intensifier housing 7 together with the
second output means or the reaction element 15 receives a turning force
in one direction, while the first output means or the driving element 12
receives an equal turning force in the opposite direction at a lower speed
20 but higher torque than the input means.

For switching the tool between these two different modes, in
the embodiment shown in Figures 1a, 1b for example pushing elements

17, formed as pins and the like are provided. When the nut is seated on the washer, the pushing elements 17, which in Figure 1a illustrating one mode of operation extend outwardly beyond the torque intensifier housing 7, are pushed in an axial direction as shown in Figure 1b, and the planet cage 10 which was previously engaged with the internal gear 11 of the torque intensifier housing 7 disengages from the internal gear, so that the first output means or the driving element 12 and the second output means or the reaction element 15 can turn in opposite directions. It is to be understood that different means for switching the torque intensifying tool between two different modes of operation are possible.

In accordance with the present invention in the torque intensifying tool the torque intensifier housing 7 and the drive housing 2 are functionally connected with one another. In particular, the torque intensifier housing 7 can turn relative to the drive housing 2. For this purpose, as shown in Figures 1a, 1b, a part of the drive housing 2, which can contain additional torque intensifier means, can extend into the torque intensifier housing 7 and be supported in the latter through a bearing 18. With this construction, the torque intensifier housing 7 can freely turn relative to the drive housing 2. The drive housing 2 can be formed as an enclosure, as a support, as a frame, etc. for the drive. This also can be done by a switch automatically once the torque required exceeds a given force.

In another embodiment of the present invention which is shown in Figures 2a-2c the first output means is formed as a driving socket 21 which has a portion 22 with a polygonal inner surface to engage the nut and a portion 23 with a polygonal outer shape. The second output means is also formed as a reaction socket having a portion 24 with a polygonal shape for engaging a neighbouring object, for example a washer, and a portion 25 with an inner polygonal opening configured to cooperate with the polygonal portion 23 of the driving socket. The driving socket has a receiving opening 26 in which a square drive 27 of a tool can be received. A spline portion 28 of the tool is received in an inwardly spline adaptor 29 which is non-rotatably connected with the reaction socket.

The driving socket is axially movable relative to the reaction socket. For one mode of operation the portion 23 of the driving socket engages in the portion 25 of the reaction socket so that the sockets become non-rotatably connected with one another as shown in Figure 2a and the torque of the drive means 1 is transmitted through the torque intensifier to the driving socket at the same speed and torque as the input means. In this mode the first and second output means turn.

When as shown in Figure 2b the driving socket is axially displaced for example so that its portion 23 is disengaged from the portion 25 of the reaction socket, the driving socket and the reaction socket are no longer non-rotatably connected with one another in the other mode of operation and they turn in opposite directions with equal turning forces at a lower speed but higher torque than the input means. In this mode the first output means or the driving socket turn, while the second output means or the reaction socket reacts.

In this embodiment in one mode of operation the torque intensifier housing together with the driving socket and reaction socket turn in the same direction and at the same speed and torque as the input means, wherein in the other mode of operation the torque intensifier housing together the reaction socket receives a turning force in one direction while the driving socket receives the turning force in the opposite direction.

It is to be understood that in the other mode the first and second output means can both act as driving means or reaction means in opposite directions depending on the application.

In the embodiment shown in Figure 3 a nut to be tightened or loosened is identified with reference numeral 31, a bolt on which the nut

is to be tightened or loosened is identified with reference numeral 32, and a washer is identified with reference numeral 33 and has a radially outer holding portion 34 and a radially inner portion 35 engageable with the bolt 32. Means is provided for transmitting torque in the two modes of
5 operation. They can be formed for example as connecting pins 36 which engage in aligned openings 38 of the nut and the washer.

In one mode of operation the pins 36 non-rotatably connect the nut with the washer so that they turn together with the same speed
10 and torque as the input means. After the nut is seated on the washer, and a torque increases, the pins 36 are disintegrated, for example sheared off, so that the nut is turned with a higher torque and a lower speed than the input means while the washer provides a reaction.

15 It is to be understood that the at least two modes as described herein are merely examples. Further modes can be added to said one or said other modes and/or said input means and/or output means.

20 While the torque intensifying tool described hereinabove is a two speed tool, the present invention is not limited to merely two speeds but can have multiple speeds, as shown for example in Figures 4a, 4b. For example the drive operatively connected with the input means of the

torque intensifier means can be configured as an intermediate drive housing 50 so that the drive includes for example the drive housing 2 and the intermediate drive housing 50.

5 When two usually opposite turning parts are temporarily connected with one another in the torque intensifier means or at an end thereof and the intermediate drive housing 50, which contains at least one intensifier unit such as for example a planetary gear stage, is connected with the torque intensifier housing so as not to rotate relative to it a), the
10 turning of the torque intensifier housing together with the first and second output means is at a speed and torque of what is derived from the drive housing portion 2. When the torque required to turn the fastener exceeds that torque derived from the drive housing 2 and the intermediate drive housing 50 is non-rotatably connected with the drive housing 2
15 b), and rotatably connected with the torque intensifier housing, the turning of the torque intensifier housing 7 together with the first and second output means is at a lower speed but higher torque of what is derived from the drive housing 2. When the turning friction of the fastener is such that the tool switches from one mode to another, the torque applied to the fastener
20 is one more times increased while the turning speed is further decreased. In Figure 4a the intermediate drive housing portion 50 is non-rotatably connected with the torque intensifier housing 7, while in Figure 4b the

intermediate drive housing 50 is non-rotatably connected with the drive housing 2.

5 It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

10 While the invention has been illustrated and described as embodied in a motor-driven torque intensifier, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

15 Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

20 What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. A torque intensifying tool for tightening and loosening threaded connectors, comprising drive means; at least one torque intensifier means receiving a torque from said drive means and having gear means and a torque intensifier housing portion; a
5 driving element for turning one part of a threaded connector; a reaction element for reacting during the turning of the one part of the threaded connector by said driving element; and means switching the torque intensifying tool between two modes of operation and configured for connecting said driving element to said torque intensifier housing portion with said reaction element and disconnecting said driving element
10 therefrom so that in one mode of operation said driving element operates with a high speed and a low torque and said torque intensifier housing portion is connected with said driving element and said reaction element and said torque intensifier housing portion together with said driving element and said reaction element turn in one direction, and in another mode of operation said driving element operates with a low
15 speed and a high torque and said torque intensifier housing portion together with said reaction element is disconnected from said driving element so that in the other mode of operation while said driving element receives a turning force in the one direction, said torque intensifier housing portion together with said reaction element receives a turning force in an opposite direction, and so that said driving element turns in said one mode
20 and in said another mode while said reaction element turns in said one mode and reacts in said another mode.

2. A torque intensifying tool as defined in claim 1, wherein said driving element is configured as a driving socket for turning one part of the threaded connector, whereas said reaction element is configured as a reaction socket for reacting during the

turning of the one part of the threaded connector, so that in the other mode of operation said torque intensifier housing portion receives a turning force together with said reaction socket while said driving socket receives an equal opposite turning force.

3. A torque intensifying tool as defined in claim 1 or claim 2; and further
5 comprising at least one drive housing portion; and means for functionally connecting said torque intensifier housing portion and said drive housing portion with one another so that said housing portions are turnable relative to one another.

4. A torque intensifying tool as defined in claim 3; and further comprising an intermediate drive housing portion to provide at least three speeds of operation,
10 including a high speed low torque in said one mode when said intermediate drive housing portion is rotatably connected with said at least one drive housing portion and non-rotatably connected with said torque intensifier housing portion, a medium speed higher torque in said one mode when said intermediate drive housing portion is rotatably connected with said at least one drive housing portion and rotatably connected
15 with said torque intensifier housing portion, and at a low speed and highest torque in said another mode when the tool switches from one mode to another.

5. A torque intensifying tool as defined in any one of claims 1 to 4, wherein said intensifier housing portion is formed of one piece with said reaction element.

6. A torque intensifying tool as defined in any one of claims 1 to 4, wherein said
20 intensifier housing portion is connected with said reaction element through connecting means.

7. A torque intensifying tool as defined in any one of the preceding claims; and further comprising means for connecting one part of the threaded connector to another part of the threaded connector and is configured so as to be integral one-piece in said

one mode of operation and to disconnect the parts of the threaded connector from one another to be a two-piece configuration in said another mode of operation.

8. A torque intensifying tool as defined in any one of the preceding claims, wherein said means for switching from the one mode of operation to the other mode of
5 operation and vice versa is configured so that said means for switching operate automatically when the one part of the threaded connector is seated on another part of the threaded connector.

9. A torque intensifying tool as defined in any one of claims 1 to 7, wherein said means for switching from the one mode of operation to the other mode of operation and
10 vice versa is provided with a switch which operates when the one part of the threaded connector is seated on another part of the threaded connector.

10. A torque intensifying tool as defined in any one of claims 1 to 7, wherein said means for switching from the one mode of operation to the other mode of operation and vice versa is configured so that it operates by means of moving the tool
15 in an axial direction of the threaded fastener when the one part of the threaded connector is seated on another part of the threaded connector.

11. A torque intensifying tool as defined in claim 4, wherein a shifting from one speed to another is automatic.

12. A torque intensifying tool as defined in any one of the preceding claims,
20 wherein said drive is configured as a hand torque tool.

13. A torque intensifying tool as defined in any one of the preceding claims, wherein said drive includes a motor with a motor housing.

14. A torque intensifying tool as defined in any one of the preceding claims, wherein said drive includes a motor and at least one intensifier to increase an output torque of said drive.

15. A torque intensifying tool as defined in claim 14, wherein said at least one
5 torque intensifier is configured so as to limit the output torque of said drive so that its reaction force is absorbable by an operator.

16. A torque intensifying tool as defined in any one of the preceding claims, wherein said drive includes a motor-operated torque tool.

17. A torque intensifying tool for tightening and loosening threaded
10 connectors, said tool substantially as hereinbefore described with reference to Figs. 1a and 1b or Figs. 2a to 2c or Fig. 3 or Figs. 4a and 4b of the accompanying drawings.

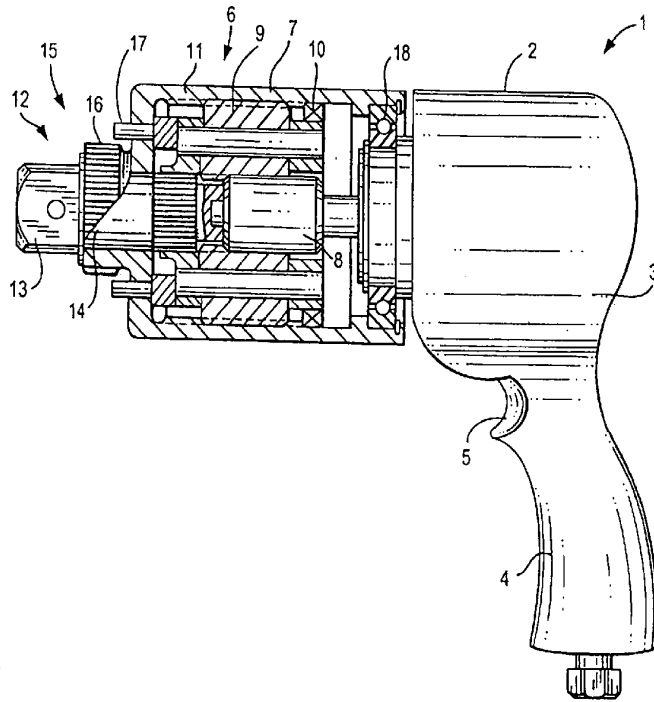


FIG. 1a

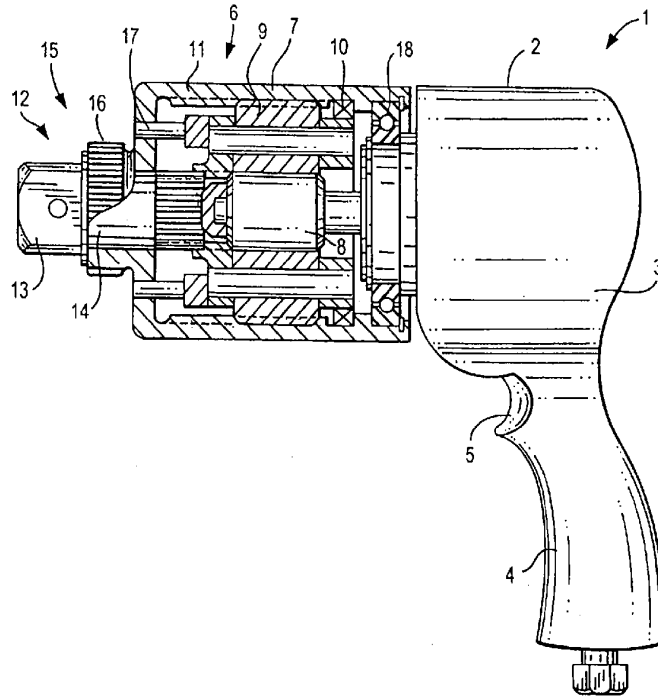


FIG. 1b

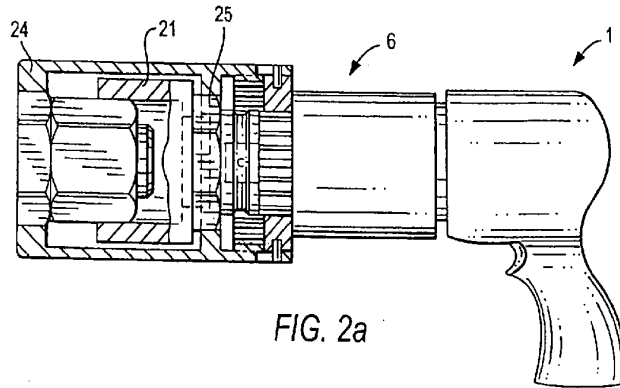


FIG. 2a

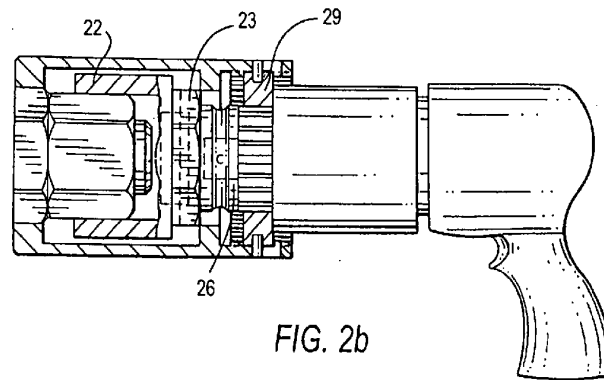


FIG. 2b

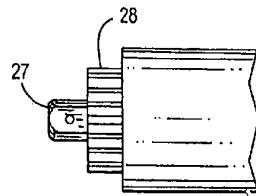


FIG. 2c

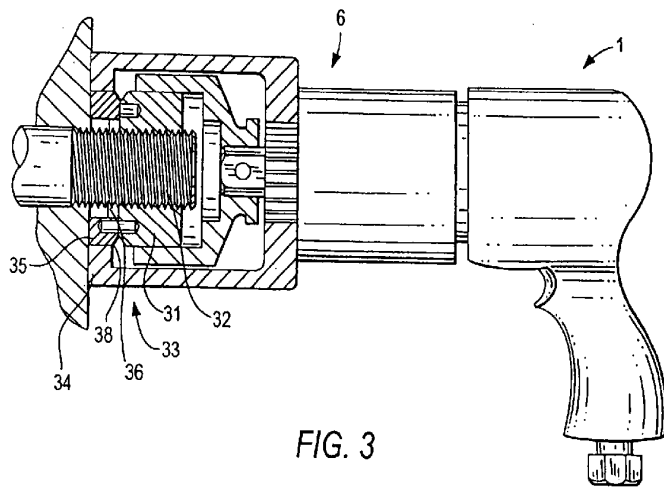


FIG. 3

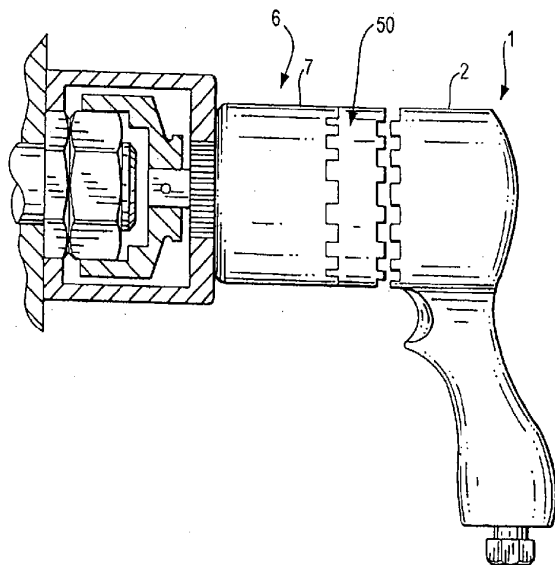


FIG. 4a

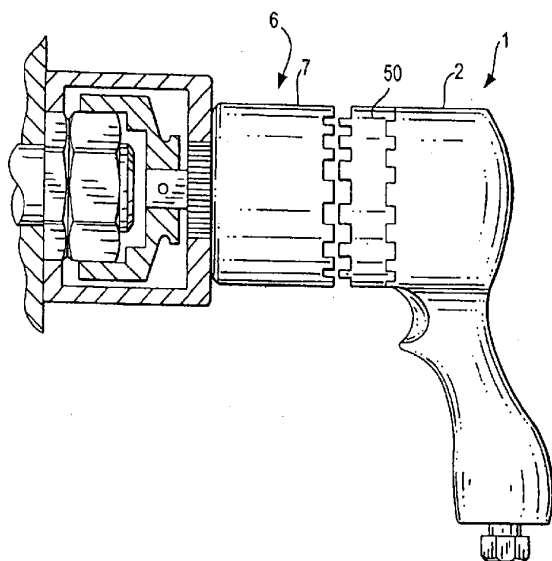


FIG. 4b