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

(11) EP 1 637 286 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
12.12.2007 Bulletin 2007/50

(51) Int Cl.:
B25B 23/00 *(2006.01)*

(21) Application number: **05250005.5**

(22) Date of filing: **05.01.2005**

(54) **Hand tool having an adjustable head with joint lock mechanism**

Handwerkzeug mit einem einstellbarem Kopf und einem Mechanismus zur Verriegelung des Gelenks desselben

Outil à main avec une tête ajustable et système de blocage de l' articulation de cette tête

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR

(30) Priority: **20.09.2004 CN 200420092793**

(43) Date of publication of application:
22.03.2006 Bulletin 2006/12

(73) Proprietor: **Lea Way Hand Tool Corporation**
Nantun District
Taichung City 408 (TW)

(72) Inventor: **Lin, Yu-Cheng**
Taichung City 408
Taiwan (TW)

(74) Representative: **Nicholls, Michael John et al**
J.A. Kemp & Co.
14, South Square
Gray's Inn
London WC1R 5JJ (GB)

(56) References cited:
EP-A- 0 377 777
GB-A- 273 914
US-A1- 2001 000 092
US-B1- 6 405 621

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 1 637 286 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates to a hand tool having an adjustable head with a joint lock mechanism, especially a hand tool with an adjustable angle head and easier, more secure positioning.

[0002] Conventional hand tools with an adjustable head, for example, as disclosed in TW421111, corresponding to US6,295,898, and TW488349, comprise a head and a handle. The head has a convex portion which can be pivotally coupled to a concave portion of the handle. Teeth are disposed along the surface of the convex portion to engage a ball received in an aperture formed in an inner wall of the concave portion. A stop member is disposed between the head and the handle. A positioning portion is formed at a rear side of the stop member and is coupled to a front end of the handle. A toothed portion formed at a front side of the stop member is engageable with a toothed surface portion formed along the surface of one side of the convex portion. When the stop member is slid to a predetermined position, the adjustment and positioning of the head at a certain angle can be more securely and conveniently done. However, with this kind of wrench, the ball is of a circular shape and cannot ensure secure engagement, and similar to the configuration of a ball and a toothed portion of a convex portion, the toothed portion of the stop member and the toothed surface portion of the handle may be worn out after use for a long period, which can therefore cause inconvenience when in use and reduce the life time of the hand tool.

[0003] TW478444 has disclosed a wrench wherein a through hole is formed in the centre of a shaft and threads are formed on a wall of the through hole at a bottom of the shaft to receive an operation rod. A handle is mounted at a bottom end of the operation rod and rotates synchronously with the operation rod. A concave portion formed at a top end of the shaft is coupled to a head and secured by a screw. A retainer is received in the through hole of the shaft with its one end coupled to the top end of the operation rod and an arc shaped concave portion formed on the other end. A rotatable worm supported by a retainer is disposed in the concave portion of the shaft and a groove fitted with a clip is formed at a protrusion of the worm at one end. A worm gear is disposed at an extension end of the head and engages the worm. The other end of the worm is coupled to a pivotal block and a crane to actuate the worm gear and the worm such that the head can be rotated at any angle. Again, with this configuration, the worm and the worm gear may be worn out after use for a long period, which causes the local structure to be loose and unable to be positioned properly. In addition, it is likely that the clip, operation rod, the retainer or the pivotal block and the crane might become loose and make the wrench un-useable.

[0004] EP-A-0 377 777, GB-A-273,914 and US 2001/0000092 A1 disclose spanners with adjustable angle heads locked and unlocked by a button actuating an engaging mechanism.

[0005] From the above, it is necessary for the industry to provide a hand tool having an adjustable head with a joint lock mechanism, which offers convenient and secure angle adjustment and positioning and can overcome the defects mentioned in the prior art.

[0006] US-B1-6,405,621 discloses a hand tool with an adjustable angle head, on which the pre-characterizing portion of claim 1 is based.

[0007] It is an object of the present invention to provide a hand tool having an adjustable head with a joint lock mechanism, easier and more secure positioning.

[0008] The present invention provides a hand tool as defined in claim 1.

[0009] The invention will be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 illustrates an exploded view of a handle tool having an adjustable head with a joint lock mechanism according to the present invention;
Fig. 2 illustrates a locally enlarged plan view thereof;
Fig. 3 illustrates a sectional view thereof along line A-A in Fig. 2 showing a pull button in a locked state;
Fig. 4 illustrates a sectional view thereof along line A-A in Fig. 2 showing the pull button in an unlocked state;
Fig. 5 illustrates a locally enlarged side view thereof;
Fig. 6 illustrates a sectional view thereof along line B-B in Fig. 5 showing the pull button in a locked state;
Fig. 7 illustrates a sectional view thereof along line B-B in Fig. 5 showing the pull button in an unlocked state;
Fig. 8 illustrates a sectional view thereof along line A-A in Fig. 2 showing the head inclining 0° with respect to a handle;
Fig. 9 illustrates a sectional view thereof along line A-A in Fig. 2 showing the head inclining 11.25° with respect to the handle;
Fig. 10 illustrates a sectional view thereof along line A-A in Fig. 2 showing the head inclining 25° with respect to the handle;
Fig. 11 illustrates the head rotating at multiple angles; and
Fig. 12 illustrates a different pattern formed on the pull button.

Detailed Description of the Invention

[0010] Fig. 1 illustrates an exploded view of a handle tool having an adjustable head with a joint lock mechanism according to the present invention. A wrench 10 comprises a head 20, a handle 30 and a joint lock mechanism 40. A convex portion 21 is formed at a rear end of the head 20 and a through hole 22 is formed through the convex portion 21. A concave portion 31 is formed at a front end of the handle 30 and two through apertures 32 are formed at opposite sides thereof where one of the

through apertures 32 is threaded to receive a screw 24 for pivotally coupling the head 20 to the handle 30. A first aperture 33 is formed at the front end of the handle 30 and substantially extends along the length thereof, and a second aperture 34 is formed at one side of the handle 30 and perpendicularly intersects the first aperture 33.

[0011] A joint lock mechanism 40 comprises a first engaging device disposed at the rear end of the head 20, a second engaging device received in the first aperture 33 formed at the front end of the handle 30, a first elastic device and a pull button 45 comprising a knob portion 451 and an engaging portion. The first engaging device has a plurality of slots 23 formed equidistantly along the surface of the convex portion 21 and the slots 23 preferably extend parallel to the axis of the through hole 22. In general, the surface of the convex portion 21 can be an arc of 180°, or of any other suitable shape. In this preferred embodiment, nine slots are formed so that the angle between two adjacent slots is 22.5°. Preferably, the second engaging device is a pin 42 and the first elastic device is a first spring 41. An engaging portion, which is a protrusion 43 of a substantially arc shape, is formed at a front end of the pin 42. As illustrated in Fig. 3, the first spring 41 is received at and abuts a bottom end of the first aperture 33 and biases the pin 42 with a forward force such that the protrusion 43 of the pin 42 can be pushed to engage any of the slots 23. A pair of slots 44 is formed at the opposite sides of the pin 42 between the front and the rear ends of the pin 42. The engaging portion of the pull button 45 comprises two hooks 452 disposed beneath the knob portion 451 and extending along the second aperture 34 to engage the corresponding pair of slots 44 such that the pull button 45 can be pulled to actuate the pin 42 to move along the first aperture 33. The knob portion 451 can be of a shield design formed with a plurality of anti-slip teeth thereon or with a pattern consisting of a word "LOCK", a side-view mark of the head and a double arrow crossing the side-view mark (referring to Fig. 12). Alternatively, the pin 42 can be formed with a through slot between the front and the rear ends thereof (not shown in figure) and the engaging portion of the pull button 45 can be a hook extending along the second aperture 34 to engage the through slot (not shown in figure) such that the pull button 45 can be pulled to actuate the pin 45 to move along the first aperture 33.

[0012] The joint lock mechanism 40 further comprises a positioning device 50 having a positioning element, preferably a positioning plate 51, and a second elastic device, preferably a second spring 52. The positioning plate 51 is received in a front portion 331 of the first aperture 33 having a larger diameter (referring to Fig. 3), which can be formed by reaming a stepped aperture at the front end of the first aperture 33, while a rear portion 332 thereof has a smaller diameter (referring to Fig. 3). A pair of slots 46 is disposed at the front end of the pin 42 and the positioning plate 51 is received in the slots 46. The positioning plate 51 has a shape substantially matching that of the protrusion 43 so as to guide the protrusion 43 to engage one of the plurality of slots 23. The second spring 52 is positioned behind the positioning plate 51 with its front end abutting the positioning plate 51 with a forward force and its rear end abutting a shoulder portion 333 formed between the front portion 331 and the rear portion 332, such that protrusions 53 of the positioning plate 51 and the protrusion 43 of the pin 42 can together engage one of the plurality of slots 23.

[0013] Figs. 2 and 5 illustrate a locally enlarged plan view and a locally enlarged side view of the hand tool according to the present invention, respectively. From Figs. 3 and 6, it can be seen that when the pull button 45 is in a locked state, each of the protrusion 43 of the pin 42 and the protrusions 53 of the positioning plate 51 can moveably engage one of the plurality of slots 23, whereas only the protrusions 53 of the positioning plate 51 can moveably engage one of the plurality of slots 23 when the pull button 45 is in an unlocked state. Therefore, when the pin 42 disengages the head 20 in the unlock state, the head 20 can pivotally rotate with respect to the handle 30 and also be prevented from rotating due to gravity. As illustrated in Figs. 8 to 10, when an external force drives the head 20 to a certain angle, the head 20 can be bent and positioned to a predetermined angle. Fig. 11 illustrates the head rotating to multiple angles.

[0014] From the above descriptions, it is apparent that the present invention provides a hand tool having an adjustable head with a joint lock mechanism and has easier and more secure positioning over the prior art. While the invention has been described in terms of several preferred embodiments, those skilled in the art will recognise that the invention can still be practiced with modifications, within the scope of the appended claims.

Claims

1. A hand tool (10) having an adjustable head (20) with a joint lock mechanism (40), comprising:

the head (20) having a rear end, the rear end having a convex pivotal portion (21);

a handle (20) having a front end, the front end having a concave pivotal portion (31), the handle (30) having a first aperture (33) longitudinally extending from the front end thereof, and a second aperture (34) formed perpendicularly intersecting the first aperture (33);

a fastening device (24) disposed through the convex pivotal portion (21) and the concave pivotal portion (31) such that the fastening device (24) is pivotally coupled to the convex pivotal portion (21) while being fixedly coupled to the concave pivotal portion (31); and

the joint lock mechanism (40) disposed between the rear end of the head (20) and the front end of the handle (30), the joint lock mechanism further comprising:

a first engaging device (23) disposed at the rear end of the head (20), the first engaging device (23) having a plurality of slots (23) formed equidistantly along the surface of the convex pivotal portion (21);
a second engaging device (42) received in the first aperture of the front end of the handle, the second engaging device (42) having a front end and a rear end, and the second engaging device (42) having at least one engaging portion (43) formed at the front end thereof;
a pull button (45) having a knob portion (451) and an engaging portion (452) beneath the knob portion (451), the engaging portion (452) extending along the second aperture (34) and engaging the second engaging device (42);
a first elastic device (41) received in the first aperture (33) and abutting the second engaging device (42) with a forward force such that the front end of the second engaging device (42) is pushed to engage the first engaging device (23); **characterised in that** the joint lock mechanism (40) further comprises:

a positioning device (50) having a positioning element (51) and a second elastic device (52), the positioning element (51) disposed at the front end of the first aperture (33) and having a shape substantially matching that of the engaging portion (43) of the second engaging device (42) so as to guide the engaging portion (43) of the second engaging device (42) to engage one of the plurality of slots (23); the second elastic device (52) positioned behind the positioning element (51) and abutting the positioning element (51) with a forward force.

2. The hand tool (10) according to claim 1, wherein the first aperture (22) has a front portion (331) having a larger diameter and a rear portion (332) having a smaller diameter which forms a shoulder portion (333) in between, and the second elastic device (52) is disposed in the front portion (331) with its front end abutting the positioning device (51) and its rear end abutting the shoulder portion (333).

3. The hand tool (10) according to claim 1 or 2, wherein the second engaging device (42) include a pair of slots (44) formed at opposite sides between the front and the rear ends thereof, and the engaging portion (452) of the pull button (45) comprises two hooks (452) engaging the pair of slots (44) such that the pull button (45) is adapted to actuate the second engaging device (42) to move along the first aperture (33).

4. The hand tool (10) according to claim 1 or 2, wherein the second engaging device (42) has a through slot formed between the front and the rear ends thereof, and the engaging portion of the pull button (45) is a hook engaging the through slot such that the pull button (45) is adapted to actuate the second engaging device (42) to move along the first aperture (33).

5. The hand tool (10) according to any one of the preceding claims, wherein the surface of the convex pivotal portion (21) is an arc.

6. The hand tool (10) according to any one of the preceding claims, wherein the knob portion (451) has a surface formed with a plurality of anti-slip teeth.

7. The hand tool (10) according to any one of the preceding claims, wherein the knob portion (452) has a surface formed with pattern consisting of a word "LOCK", a side-view mark of the head (20) and a double arrow crossing the side-view mark.

Patentansprüche

1. Handwerkzeug (10) mit einstellbarem Kopf (20) und einem Mechanismus (40) zur Verriegelung des Gelenks desselben, umfassend:

den Kopf (20) mit einem hinteren Ende, wobei das hintere Ende einen konvexen, schwenkbaren Abschnitt (21) aufweist;
einen Griff (20) mit einem vorderen Ende, wobei das vordere Ende einen konkaven, schwenkbaren Abschnitt (31) aufweist, wobei der Griff (30) eine erste Öffnung (33), die sich längs von dessen vorderem Ende erstreckt, und eine zweite Öffnung (34) aufweist, die sich mit der ersten Öffnung (33) senkrecht schneidet;
eine Befestigungsvorrichtung (24), die derart durch den ersten konvexen, schwenkbaren Abschnitt (21) und den konkaven, schwenkbaren Abschnitt (31) angeordnet ist, dass die Befestigungsvorrichtung (24) schwenkbar an den konvexen, schwenkbaren Abschnitt (21) gekuppelt ist, während sie starr an den konkaven, schwenkbaren Abschnitt (31) gekuppelt ist; und
den Mechanismus (40) zum Verriegeln des Gelenks, der zwischen dem hinteren Ende des Kopfs (20) und dem vorderen Ende des Griffs (30) angeordnet ist, wobei der Mechanismus zum Verriegeln des Gelenks ferner folgendes umfasst:

eine erste Eingriffsvorrichtung (23), die am hinteren Ende des Kopfs (20) angeordnet ist, wobei die erste Eingriffsvorrichtung (23) mehrere Schlitze (23) aufweist, die abstandsgleich entlang der Oberfläche des konvexen, schwenkbaren Abschnitts (21) ausgebildet sind;
eine zweite Eingriffsvorrichtung (42), die in der ersten Öffnung des vorderen Endes des Griffs aufgenommen ist, wobei die zweite Eingriffsvorrichtung (42) ein vorderes Ende und ein hinteres Ende aufweist und die zweite Eingriffsvorrichtung (42) zumindest einen Eingriffsabschnitt (43) aufweist, der an ihrem vorderen Ende ausgebildet ist;
einen Zugknopf (45) mit einem Höckerabschnitt (451) und einem Eingriffsabschnitt (452) unter dem Höckerabschnitt (451), wobei sich der Eingriffsabschnitt (452) entlang der zweiten Öffnung (34) erstreckt und die zweite Eingriffsvorrichtung (42) in Eingriff nimmt;
eine erste elastische Vorrichtung (41), die in der ersten Öffnung (33) aufgenommen ist und derart mit einer Vorwärtskraft an die zweite Eingriffsvorrichtung (42) anstößt, dass das vordere Ende der zweiten Eingriffsvorrichtung zur Ineingriffnahme der ersten Eingriffsvorrichtung (23) geschoben ist; **dadurch gekennzeichnet, dass** der Mechanismus (40) zur Verriegelung des Gelenks ferner folgendes umfasst:

eine Positionierungsvorrichtung (50) mit einem Positionierungselement (51) und einer zweiten elastischen Vorrichtung (52), wobei das Positionierungselement (51) am vorderen Ende der ersten Öffnung (33) positioniert ist und eine Form aufweist, die im Wesentlichen mit der des Eingriffsabschnitts (43) der zweiten Eingriffsvorrichtung (42) zum Führen des Eingriffsabschnitts (43) der zweiten Eingriffsvorrichtung (42) zur Ineingriffnahme eines der mehreren Schlitze (23) zusammenpasst; wobei die zweite elastische Vorrichtung (52) hinter dem Positionierungselement (51) angeordnet ist und das Positionierungselement (51) mit einer Vorwärtskraft anstößt.

2. Handwerkzeug (10) nach Anspruch 1, wobei die erste Öffnung (22) einen vorderen Abschnitt (331) mit einem größeren Durchmesser und einen hinteren Abschnitt (332) mit einem kleineren Durchmesser aufweist, der einen Schulterabschnitt (333) dazwischen ausbildet, und die zweite elastische Vorrichtung (52) in dem vorderen Abschnitt (331) angeordnet ist, wobei ihr vorderes Ende an die Positionierungsvorrichtung (51) anstößt und ihr hinteres Ende an den Schulterabschnitt (333) anstößt.

3. Handwerkzeug (10) nach einem der Ansprüche 1 oder 2, wobei die zweite Eingriffsvorrichtung (42) ein Paar Schlitze (44) enthält, die auf gegenüberliegenden Seiten zwischen ihrem vorderen und hinteren Ende ausgebildet sind, und der Eingriffsabschnitt (452) des Zugknopfs (45) zwei Haken (452) umfasst, die das Paar Schlitze (44) derart in Eingriff nehmen, dass der Zugknopf (45) geeignet ist, die zweite Eingriffsvorrichtung (42) zum Bewegen entlang der ersten Öffnung (33) zu betätigen.

4. Handwerkzeug (10) nach einem der Ansprüche 1 oder 2, wobei die zweite Eingriffsvorrichtung (42) einen Durchgangsschlitz aufweist, der zwischen ihrem vorderen und hinteren Ende ausgebildet ist, und der Eingriffsabschnitt des Zugknopfs (45) ein Haken ist, der den Durchgangsschlitz derart in Eingriff nimmt, dass der Zugknopf (45) geeignet ist, die zweite Eingriffsvorrichtung (42) zum Bewegen entlang der ersten Öffnung (33) zu betätigen.

5. Handwerkzeug (10) nach einem der vorhergehenden Ansprüche, wobei die Oberfläche des konvexen, schwenkbaren Abschnitts (21) ein Bogen ist.

6. Handwerkzeug (10) nach einem der vorhergehenden Ansprüche, wobei der Höckerabschnitt (451) eine Oberfläche aufweist, die mit mehreren Gleitschutzzähnen ausgebildet ist.

7. Handwerkzeug (10) nach einem der vorhergehenden Ansprüche, wobei der Höckerabschnitt (452) eine Oberfläche mit einem Muster, das aus dem Wort "LOCK" besteht, eine Seitenansichtsmarkierung des Kopfs (20) und einen zweispitzigen Pfeil aufweist, der die Seitenansichtsmarkierung kreuzt.

Revendications

1. Outil à main (10) ayant une tête ajustable (20) avec un mécanisme de verrouillage d'articulation (40), comprenant :

la tête (20) ayant une extrémité arrière, l'extrémité arrière ayant une partie centrale convexe (21) ;
une poignée (20) ayant une extrémité avant, l'extrémité avant ayant une partie centrale concave (31), la poignée (30) ayant une première ouverture (33) s'étendant longitudinalement depuis l'extrémité avant de celle-ci, et une seconde ouverture (34) formée perpendiculairement

croisant la première ouverture (33) ;
un dispositif de fixation (24) disposé à travers la partie centrale convexe (21) et la partie centrale concave (31) de telle sorte que le dispositif de fixation (24) est couplé de manière pivotante à la partie centrale convexe (21) tout en étant couplé de manière fixe à la partie centrale concave (31) ; et
le mécanisme de verrouillage de l'articulation (40) disposé entre l'extrémité arrière de la tête (20) et l'extrémité avant de la poignée (30), le mécanisme de verrouillage de l'articulation comprenant en outre :

un premier dispositif de prise (23) disposé à l'extrémité arrière de la tête (20), le premier dispositif de prise (23) ayant une pluralité de fentes (23) formée de manière équidistante le long de la surface de la partie centrale convexe (21) ;
un second dispositif de prise (42) reçu dans la première ouverture de l'extrémité avant de la poignée, le second dispositif de prise (42) ayant une extrémité avant et une extrémité arrière, et le second dispositif de prise (42) ayant au moins une partie de prise (43) formée à l'extrémité avant de celui-ci ;
un bouton-tirette (45) ayant une partie de poignée (451) et une partie de prise (452) sous la partie de poignée (451), la partie de prise (452) s'étendant le long de la seconde ouverture (34) et venant en prise avec le second dispositif de prise (42) ;
un premier dispositif élastique (41) reçu dans la première ouverture (33) et aboutant le second dispositif de prise (42) avec une force avant de sorte que l'extrémité avant du second dispositif de prise (42) est poussée pour venir en prise avec le premier dispositif de prise (23) ; **caractérisé en ce que** le mécanisme de verrouillage de l'articulation (40) comprend en outre:

un dispositif de positionnement (50) ayant un élément de positionnement (51) et un second dispositif élastique (52), l'élément de positionnement (51) étant disposé à l'extrémité avant de la première ouverture (33) et ayant une forme correspondant sensiblement à celle de la partie de prise (43) du second dispositif de prise (42) de manière à guider la partie de prise (43) du second dispositif de prise (42) pour venir en prise avec une fente parmi la pluralité de fentes (23) ; le second dispositif élastique (52) positionné derrière l'élément de positionnement (51) et venant en butée contre l'élément de positionnement (51) avec une force avant.

2. Outil à main (10) selon la revendication 1, dans lequel la première ouverture (22) dispose d'une partie avant (331) ayant un diamètre plus important et une partie arrière (332) ayant un diamètre moins important qui forme une partie d'épaulement (333) entre les deux, et le second dispositif élastique (52) est disposé dans la partie avant (331) avec son extrémité avant venant en butée contre le dispositif de positionnement (51) et son extrémité arrière venant en butée contre la partie d'épaulement (333).

3. Outil à main (10) selon la revendication 1 ou 2, dans lequel le second dispositif de prise (42) comprend une paire de fentes (44) formée au niveau de côtés opposés entre les extrémités avant et arrière de celui-ci, et la partie de prise (452) du bouton-tirette (45) comprend deux crochets (452) venant en prise avec la paire de fentes (44) de telle sorte que le bouton-tirette (45) est adapté pour actionner le second dispositif de prise (42) pour se déplacer le long de la première ouverture (33).

4. Outil à main (10) selon la revendication 1 ou 2, dans lequel le second dispositif de prise (42) a un trou traversant formé entre les extrémités avant et arrière de celui-ci, et la partie de prise du bouton-tirette (45) est un crochet venant en prise avec le trou traversant de telle sorte que le bouton-tirette (45) est adapté pour actionner le second dispositif de prise (42) pour se déplacer le long de la première ouverture (33).

5. Outil à main (10) selon l'une quelconque des revendications précédentes, dans lequel la surface de la partie centrale convexe (21) est un arc.

6. Outil à main (10) selon l'une quelconque des revendications précédentes, dans lequel la partie de poignée (451) a une surface formée d'une pluralité de dents antidérapantes.

7. Outil à main (10) selon l'une quelconque des revendications précédentes, dans lequel la partie de poignée (452) a une surface formée avec un motif consistant en un mot « VERROUILLAGE », une marque sur le côté latéral de la tête (20) et une double flèche croisant la marque sur le côté latéral.

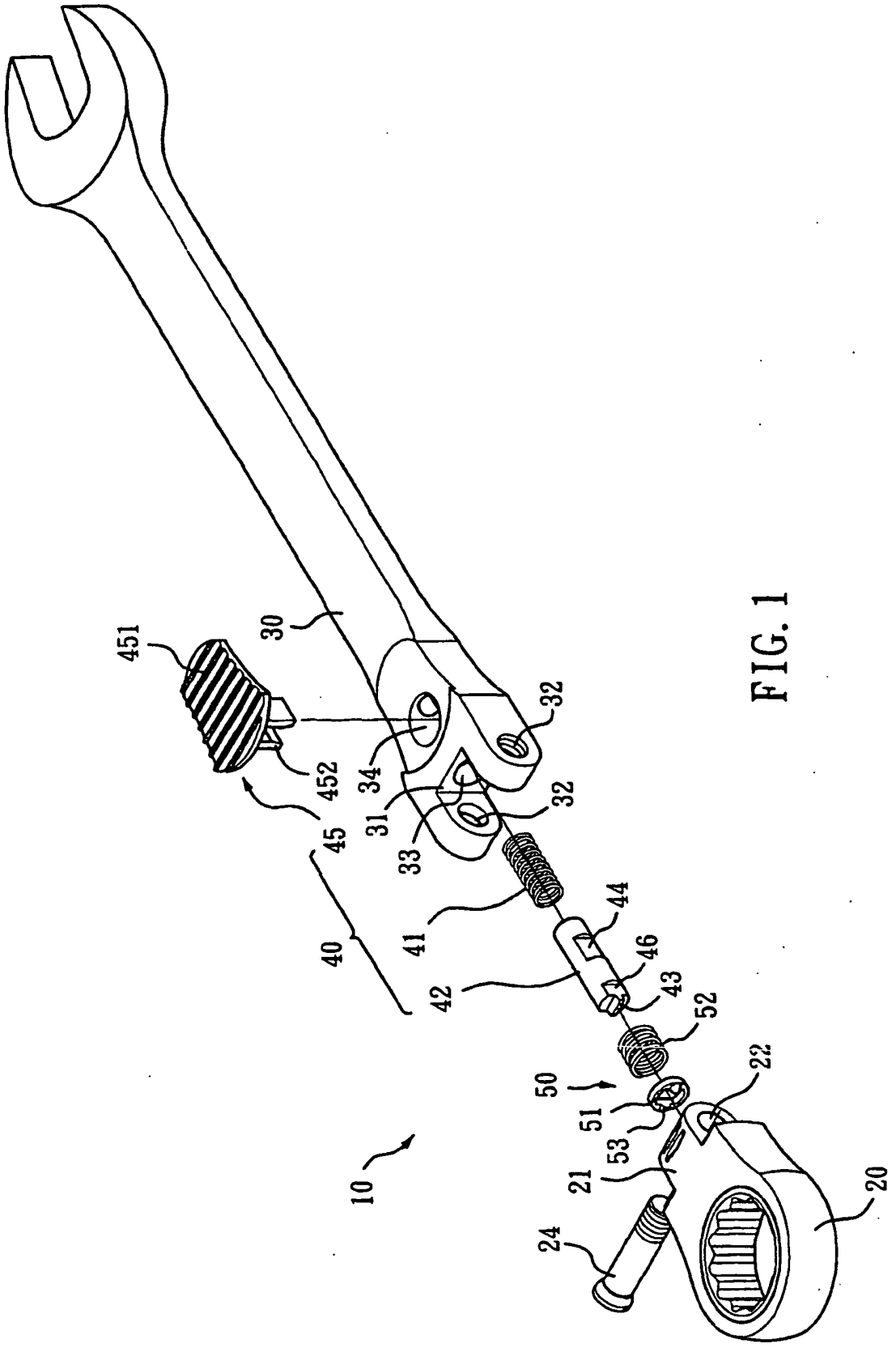

451
30
32
452
34
31
32
45
33
40
41
44
46
42
43
52
50
22
51
53
21
20
24
10

FIG. 1

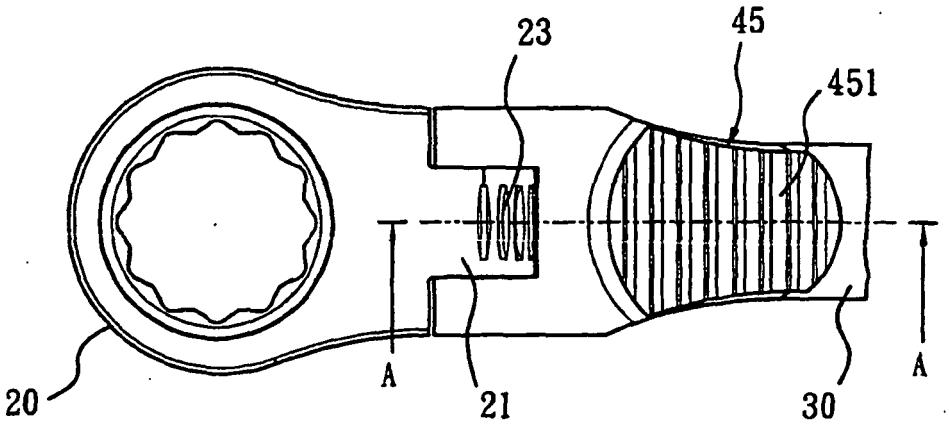


FIG. 2

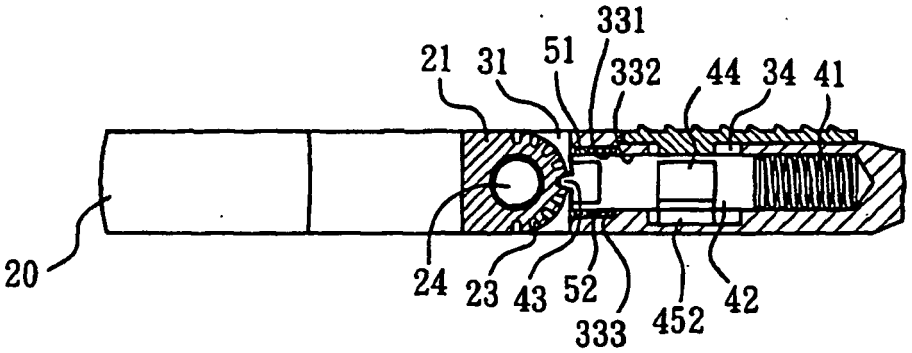


FIG. 3

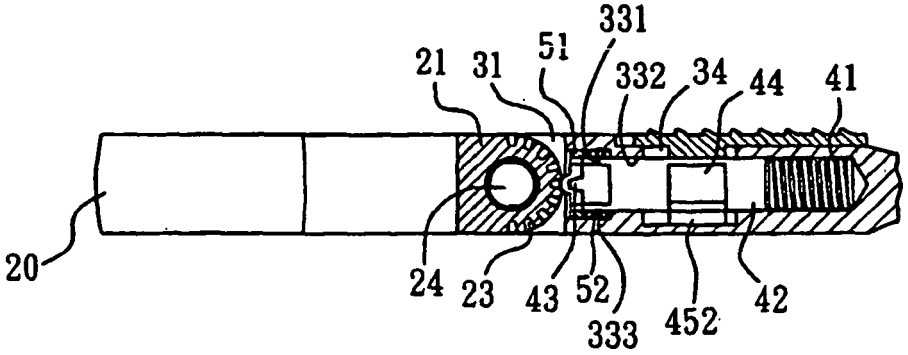


FIG. 4

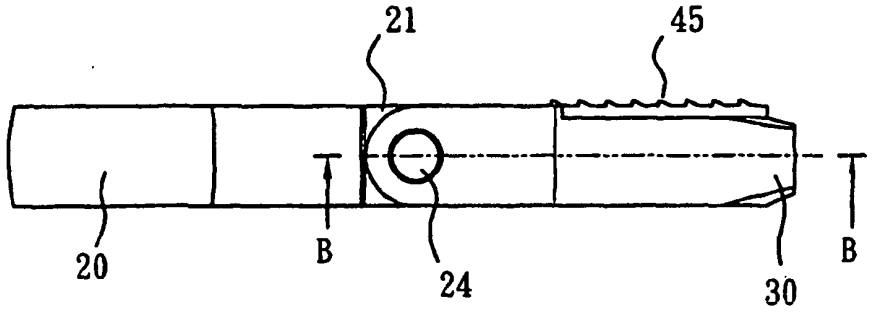


FIG. 5

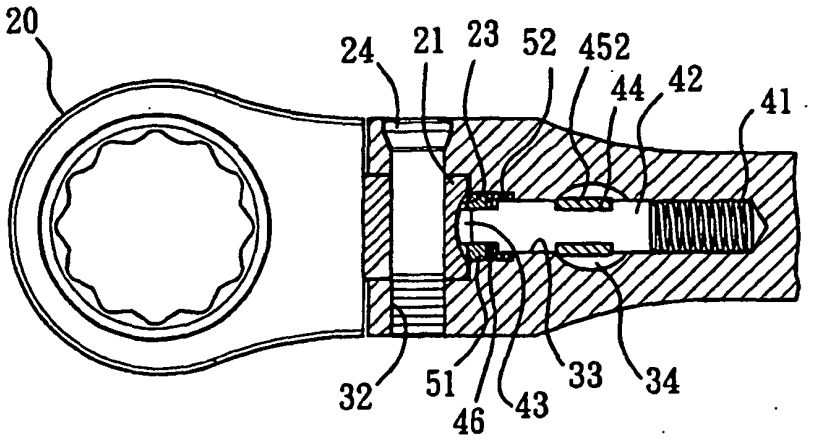


FIG. 6

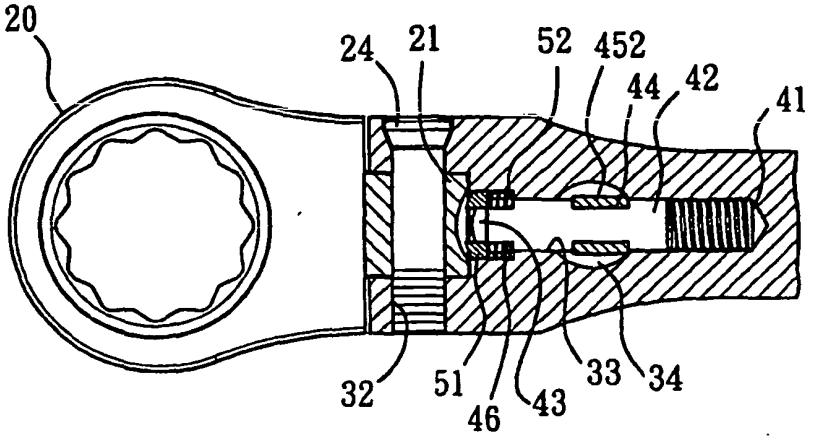


FIG. 7

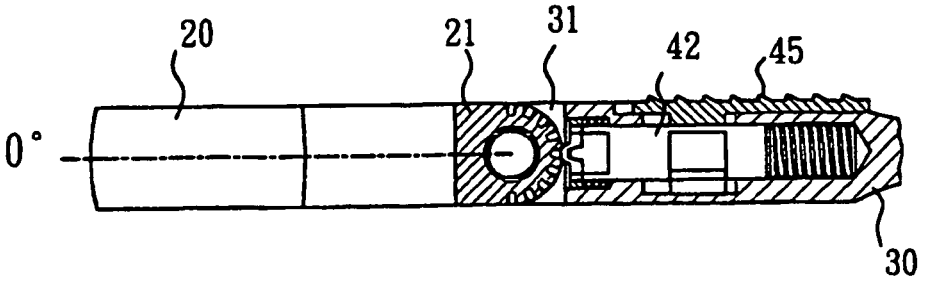


FIG. 8

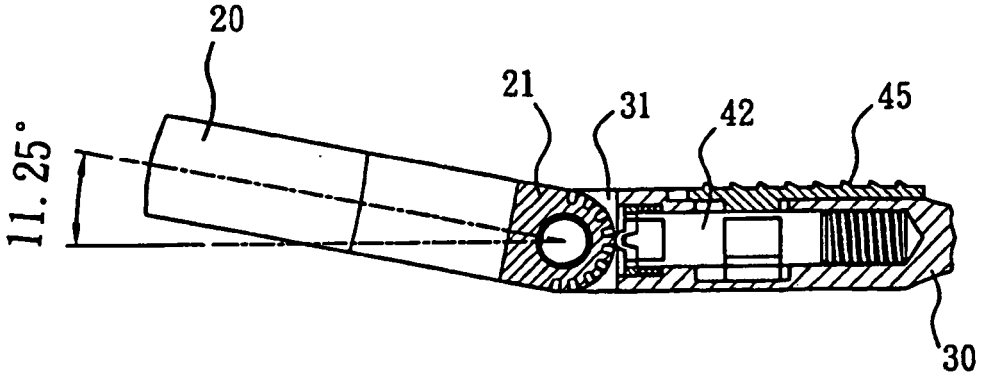


FIG. 9

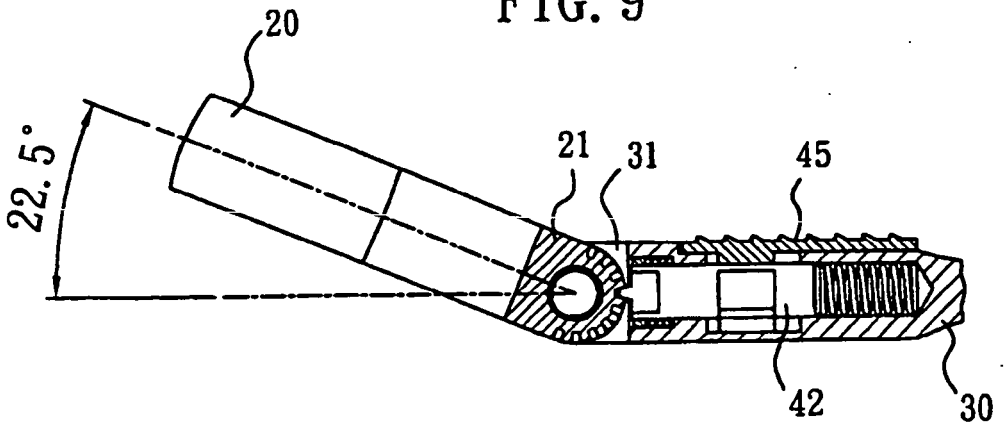


FIG. 10

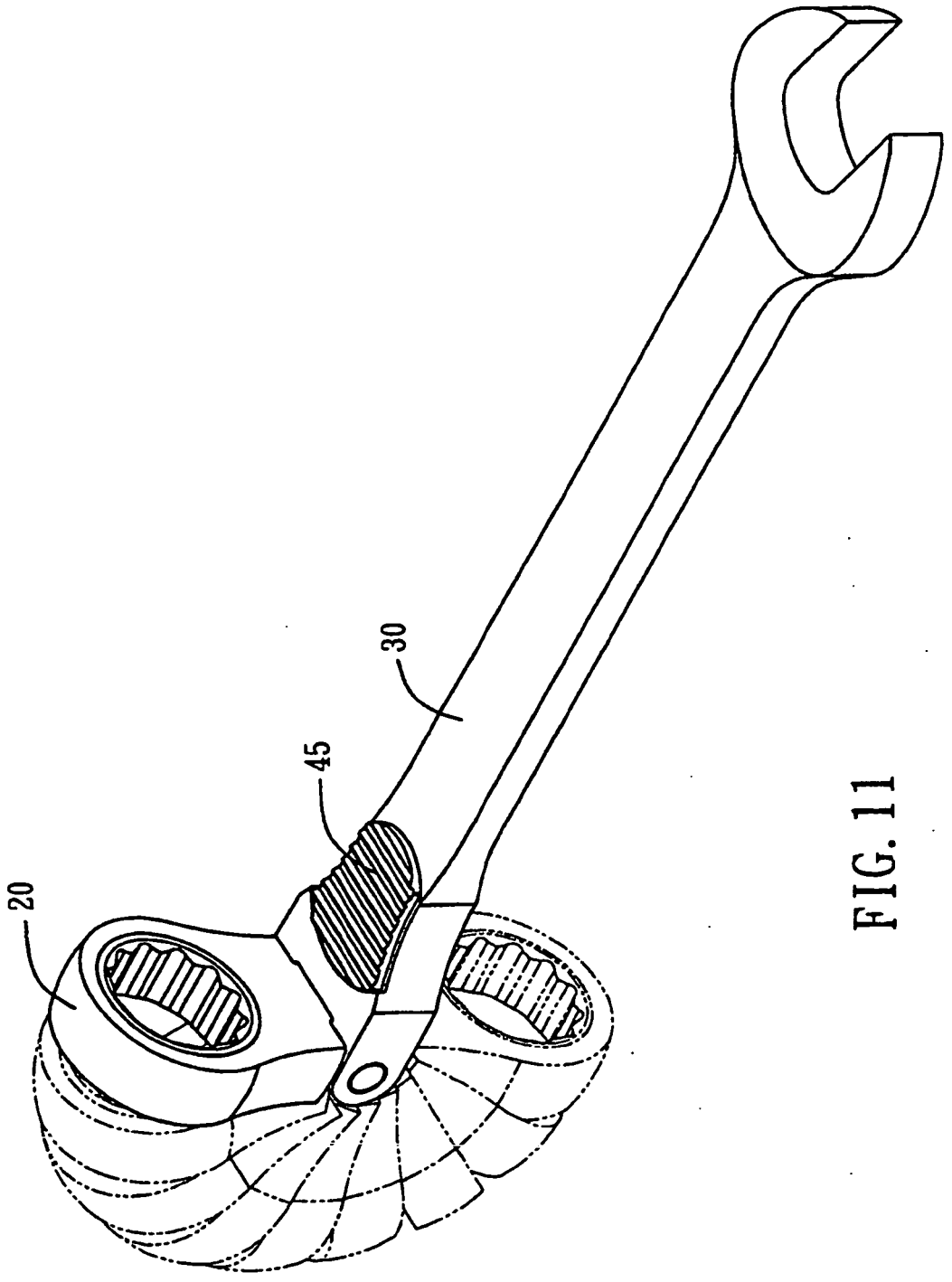


FIG. 11

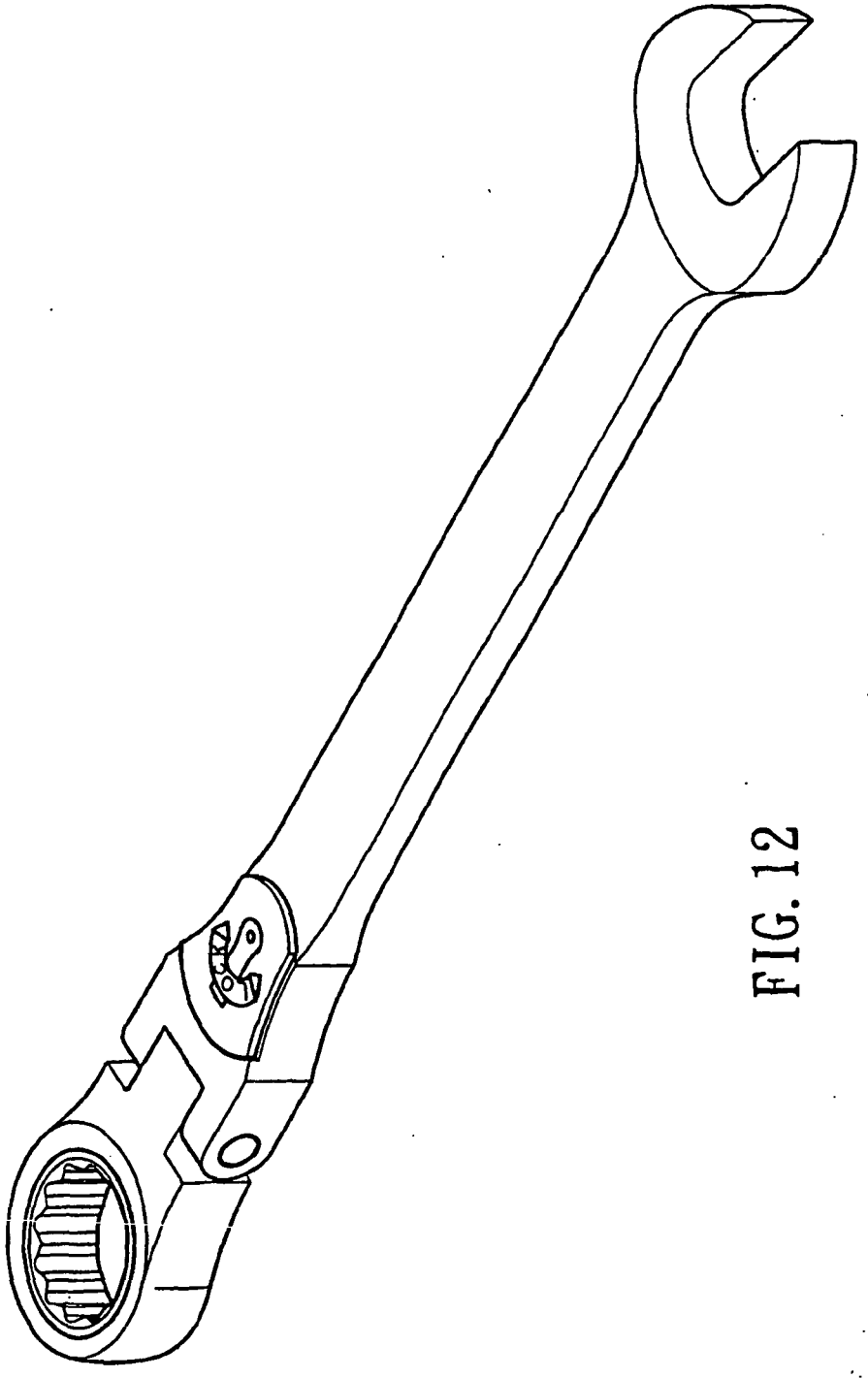


FIG. 12

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

- TW 421111 **[0002]**
- US 6295898 B **[0002]**
- TW 488349 **[0002]**
- TW 478444 **[0003]**
- EP 0377777 A **[0004]**
- GB 273914 A **[0004]**
- US 20010000092 A1 **[0004]**
- US 6405621 B1 **[0006]**