

(19)



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(11)

EP 0 963 503 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

11.07.2001 Bulletin 2001/28

(21) Application number: **98902096.1**

(22) Date of filing: **29.01.1998**

(51) Int Cl.7: **E21B 19/16**

(86) International application number:
PCT/GB98/00281

(87) International publication number:
WO 98/37304 (27.08.1998 Gazette 1998/34)

(54) **POWER TONG**

KRAFTZANGE

CLE DE VISSAGE A COMMANDE PNEUMATIQUE

(84) Designated Contracting States:
DE FR GB IT NL

(30) Priority: **19.02.1997 US 802629**

(43) Date of publication of application:
15.12.1999 Bulletin 1999/50

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EP 0 963 503 B1

Description

[0001] During the construction, maintenance and repair of oil and gas wells various operations require the connection and disconnection of successive lengths of threaded tubulars such as pipe, casing, or tubing. Tools known as tongs are used to "make" and "break" such connections.

[0002] Certain known power tongs have a body, a rotary rotatably mounted in said body and at least one active jaw which, in use, is pushed against a pipe in the rotary and grips it for rotation with the rotary. In one common arrangement the pushing action is generated by a cam member which is bolted to the rotary and is shaped so that the active jaw is cammed against the pipe on rotation of the rotary relative to the active jaw in one sense and is released on rotation of the rotary relative to the active jaw in the opposite sense.

[0003] With known power tongs high torques, for example 50,000 ft.lbs, are often applied to tubulars.

[0004] It will be appreciated that if the active jaw is not applied to the tubular with sufficient force the tubular will slip.

[0005] Because activation of the active jaw relies on rotation of the rotary relative to the active jaw there is a period when the active jaw may become entrained with the rotary and rotate a small distance relative to the tubular before the active jaw is fully applied. Whilst this is of little consequence for many types of tubulars this is extremely detrimental for certain tubulars, particularly those which have special surface coating which may be torn away.

[0006] In PCT/EP92/00648 the present applicant discloses a tong having a rotary with an active jaw which can be applied by hydraulic rams prior to rotating the rotary. However, this arrangement cannot readily be adapted to the myriad of tongs in the field which rely on cams to displace the active jaw into engagement with the tubular.

[0007] According to the present invention there is provided a power tong for rotating a tubular in wellbore operations, the power tong comprising

an outer case,
a rotary rotatably mounted in the outer case for rotating a tubular,
apparatus for rotating the rotary to rotate the tubular,
at least one active jaw movably mounted on the rotary and displaceable relative thereto to grip the tubular,
the at least one active jaw having a gripping element for contacting the surface of the tubular,
and wherein one of said active jaw and said rotary is provided with a cam and the other with a cam follower,

characterized by

pre-load apparatus interconnected directly or indirectly between the at least one active jaw and the rotary for, in use, displacing said active jaw with respect to said rotary so that the active jaw is cammed into gripping engagement with the tubular and so inhibit relative rotation between said active jaw and said tubular on subsequent rotation of said rotary.

[0008] The gripping element may be formed as an integral part of the jaw although the jaw will normally comprise a jaw holder on which the gripping element is mounted.

[0009] Further features are set out in Claim 2 *et seq.*

[0010] For a better understanding of the present invention reference will now be made, by way of example, to the accompanying drawings, in which:-

Fig. 1 is a simplified plan view of one embodiment of a tong in accordance with the present invention;
Fig. 2A is a simplified plan view of the active jaw holder and the two passive jaw holders which form part of the tong shown in Fig. 1;

Fig. 2B is a simplified plan view of the active and passive jaws which form part of the tong shown in Fig. 1 and which comprise the active and passive jaw holders shown in Fig. 2A with their respective gripping elements mounted thereon;

Fig. 2C is a section taken on line 2C-2C of Fig. 2A;
Fig. 2D is a section taken on line 2D-2D of Fig. 2A;
Fig. 3A is a simplified plan view of an alternative jaw assembly being applied to a tubular (shown in cross-section);

Fig. 3B is a front view of a gripping element which forms part of a passive jaw shown in Fig. 3A;

Fig. 3C is a section of a detail of Fig. 3A;

Fig. 3D is a front view of the detail of Fig. 3C;

Fig. 4A shows the jaw assembly of the tong of Fig. 1 mounted on a tubular before the application of preloading force;

Fig. 4B shows the jaw assembly of the tong of Fig. 1 mounted on a tubular after the application of preloading force;

Fig. 5A is a side view of a second embodiment of a gripping element;

Fig. 5B is a plan view of the gripping element shown in Fig. 5A;

Fig. 6A is a side view of a third embodiment of a gripping element;

Fig. 6B is a plan view of a gripping element shown in Fig. 6A; and

Fig. 7 is a perspective view of a modified active jaw.

[0011] Referring to Fig. 1 of the drawings there is shown a power tong which is generally identified by the reference numeral 1.

[0012] The power tong 1 comprises an outer case 2 which accommodates a rotary 3 which can be rotated by a hydraulic motor 4.

[0013] The rotary 3 accommodates a jaw assembly 5

which comprises two passive jaws 6 and 7 and an active jaw 8.

[0014] The passive jaws 6 and 7 and the active jaw 8 each comprise a jaw holder and a gripping element removably mounted thereon.

[0015] As shown in Fig. 2A the passive jaw 6 and 7 and the active jaw 8 comprises jaw holders 9, 10 and 11 respectively each of which is provided with stops 12 to inhibit circumferential displacement of their respective gripping elements 13, 14, 15 (Fig. 2B).

[0016] As can be seen from Fig. 2D the jaw holder 9 is provided with holes 16 to facilitate attachment of the gripping element 13. Similarly, the active jaw 8 is provided with holes 17 to facilitate attachment of the gripping element 15 (Fig. 2C). In addition, the active jaw 8 is provided with two aligned bores 18, each of which can accommodate a pin which is held in position by a circlip 20 which supports a cam follower in the form of a roller 19 shown in dotted lines in Figs. 2B and 2C.

[0017] Figures 3A-3D show an alternative jaw assembly to the jaw assembly shown in Figs. 2A-2D. Parts having similar features to parts shown in Figs. 2A-2D have been identified by the same reference numeral with the addition of an apostrophe. The essential difference is that the gripping elements 13', 14', 15' are mounted on respective carriers 21, 22, 23 which are mounted on their respective jaw holders 9', 10', 11'.

[0018] The carrier 21, 22 and 23 protect the jaw holder 9', 10' and 11' in the event that the gripping elements 13', 14', 15' are worn down.

[0019] Each carrier 21, 22, 23 is provided with dovetail keys 24 which slide in corresponding dovetail slots 24a in their corresponding jaw holder.

[0020] Similarly, each gripping element 13', 14', 15' is provided with dovetails 25 which slot into corresponding dovetail slots in their respective carriers.

[0021] Turning now to Figs. 4A and 4B the passive jaws 6, 7 are bolted to the rotary 3 which is provided with a cam 26 having a camming surface 27.

[0022] The active jaw 8 is mounted in the rotary 3 with its rollers (cam followers) 19 engaging the camming surface 27.

[0023] A first hydraulic piston and cylinder assembly 28 is pivotally connected between the passive jaw 6 and one end of the active jaw 8 whilst a second hydraulic piston and cylinder assembly 29 is pivotally connected between the passive jaw 7 and the active jaw 8.

[0024] The first hydraulic piston and cylinder assembly 28 and the second hydraulic piston and cylinder assembly 29 are connected to a control system which comprises hydraulic lines 30 and 31, a spool valve 32 operable by a lever 33, a reservoir 34, a bleed valve 35, a pump 36 actuable by an air supply 37, a pneumatic accumulator 38, and non-return valves 39.

[0025] As shown in Fig. 4A the air supply 37 is switched off and the active jaw 8 is shown spaced from the tubular 40.

[0026] For the purpose of this explanation it will be

assumed that it is desired to tighten ("make up") a joint by rotating tubular 40 clockwise. Air supply 37 is actuated and pump 37 pumps hydraulic fluid through hydraulic line 30 to expand the second piston and cylinder assembly 29. At the same time hydraulic fluid in the first piston and cylinder 28 returns to the reservoir 34 via hydraulic line 31. Contraction of the first piston and cylinder 28 is facilitated by a return spring in the first piston and cylinder assembly 28 as shown. The expansion of the second piston and cylinder assembly 29 displaces the active jaw 8 relative to the cam surface 27 so that the rollers 19 roll along the cam surface 27. This urges the active jaw 8 against the tubular 29 with a force determined by the pressure of the air supply or a pressure relief valve (not shown) in parallel with bleed valve 35.

[0027] At this point the active jaw 8 and the passive jaws 6 and 7 are in full engagement with the tubular 40. The rotary 3 may then be rotated to rotate the tubular 40.

[0028] The control system may be mounted on the rotary 3 for rotation therewith, the air supply 37 being connected to the pump 36 as and when needed, the pneumatic accumulator 38 helping compensate for any seepage.

[0029] In order to release the active jaw 8, the bleed valve 35 may be opened to allow hydraulic fluid to flow through hydraulic line 30 back to the reservoir 34.

[0030] If it were desired to unscrew ("break") a joint then, starting from the position shown in Fig. 4A the spool valve 32 would be displaced to the right and the pump 36 actuated. The first piston and cylinder assembly 28 would expand and the second piston and cylinder 29 assembly contract. The anti-clockwise movement of the active jaw 8 relative to the rotary 3 would cause the rollers 9 to roll along the cam surface 27 and the active jaw 8 to be urged into gripping engagement with the tubular 40 prior to activation of the rotary 3.

[0031] The gripping elements 13, 14, 15 may take the form of teeth although they preferably comprise the applicants "non-making jaws". A particularly suitable gripping element is disclosed in applicants co-pending PCT application PCT/GB97/ (based on GB97/01939).

[0032] The gripping elements can be made of a wide variety of materials, for example aluminium, zinc, copper, brass, bronze or soft steel. Optional teeth may be provided. The surface of the gripping elements may be covered to conform generally to the shape of the tubular, for example as shown in Figs. 5A and 5B or of a tighter radius of curvature as shown in Figs. 6A and 6B. If desired the gripping elements may be flexible or may comprise a plurality of rigid elements laid side by side. Although not recommended, it is conceivable that the gripping element could be formed integral with a jaw holder.

[0033] Fig. 7 shows a modified active jaw 8" which, in addition to comprising a jaw holder 11" and a gripping element 15" is also provided with rods 41 and 42 to facilitate attachment of the first and second piston and cylinder assemblies thereto.

[0034] Various modifications to the arrangement dis-

closed within the scope of the appended claims are envisaged, for example the first piston and cylinder assembly 28 and the second piston and cylinder 29 could be replaced by a single double acting piston and cylinder assembly. Similarly, a single piston and cylinder assembly could be used and moved from the position of the first piston and cylinder assembly 28 and the second piston and cylinder assembly 29 for breaking or making joints as desired.

Claims

1. A power tong (1) for rotating a tubular (40) in well-bore operations, the power tong comprising

an outer case (2),
a rotary (3) rotatably mounted in the outer case (2) for rotating a tubular (40),
apparatus (4) for rotating the rotary (3) to rotate the tubular (40),
at least one active jaw (8) movably mounted on the rotary (3) and displaceable relative thereto to grip the tubular (40),
the at least one active jaw (8) having a gripping element (15) for contacting the surface of the tubular (40),
and wherein one of said active jaw (8) and said rotary (3) is provided with a cam (27) and the other with a cam follower (19),

characterized by
pre-load apparatus (28, 29) interconnected directly or indirectly between the at least one active jaw (8) and the rotary (3) for, in use, displacing said active jaw (8) with respect to said rotary (3) so that the active jaw is cammed into gripping engagement with the tubular (40) and so inhibit relative rotation between said active jaw (8) and said tubular (40) on subsequent rotation of said rotary (3).

2. A power tong as claimed in Claim 1, further comprising
at least one passive jaw (6) secured to the rotary (3) for facilitating the gripping of the tubular (40).
3. A power tong as claimed in Claim 1 or 2, wherein said pre-load apparatus (28) comprises a first piston and cylinder assembly (28).
4. A power tong as claimed in Claims 2 and 3, wherein said first piston and cylinder assembly (28) acts between said active jaw (8) and said passive jaw (6).
5. A power tong as claimed in Claim 2 or Claim 3 or 4 when appended to Claim 2, further comprising
a second passive jaw (7) secured to the rotary

(3) for facilitating the gripping of the tubular (40).

6. A power tong as claimed in Claim 5, wherein said pre-load apparatus further comprises
a second piston and cylinder assembly (29) arranged to act between said active jaw (8) and said second passive jaw (7).
7. A power tong as claimed in any preceding claim, further comprising
a control system for selectively activating the pre-load apparatus and selectively controlling the application of a pre-load to the at least one active jaw (8).
8. A power tong as claimed in Claim 7 when appended directly or indirectly to Claim 5, wherein said control system comprises a control valve (32) for permitting fluid to flow from a fluid reservoir (34) under pressure to a selected one of the first and second piston and cylinder assemblies (28, 29) and for selectively permitting fluid from the other of said piston and cylinder assemblies (28, 29) to flow back to the fluid reservoir (34).
9. A power tong as claimed in any preceding claim, wherein said active jaw (8') comprises a jaw holder (11'), a carrier (23) mounted on said jaw holder (11') and a gripping element (15') mounted on said carrier (23).
10. A power tong as claimed in Claim 9, wherein said gripping element (15') is releasably connected to the carrier (23).
11. A power tong as claimed in Claim 9 or 10, wherein the carrier (23) is releasably connected to the jaw holder (11').
12. A power tong as claimed in any preceding claim, wherein the gripping element (15') is flexible for conforming to an exterior shape of the tubular (40).

Patentansprüche

1. Bohrgestängezange (Kraftzange) (1) zum Drehen eines Rohrabschnitts (40) bei Arbeitsgängen in einem Bohrloch, wobei die Bohrgestängezange folgendes aufweist:

ein Außengehäuse (2),
eine Rotarykomponente (3), die drehbar in dem Außengehäuse (2) angebracht ist, um einen Rohrabschnitt (40) zu drehen,
eine Vorrichtung (4) zur Drehung der Rotarykomponente (3), um den Rohrabschnitt (40) zu drehen,

wenigstens eine aktive Spannbacke (8), die beweglich auf der Rotarykomponente (3) angebracht ist und im Verhältnis zu dieser verschiebbar ist, um den Rohrabschnitt (40) zu halten,

wobei die wenigstens eine aktive Spannbacke (8) ein Halteelement (15) zum Kontaktieren der Oberfläche des Rohrabschnitts (40) hat, und bei der eine der Komponenten aktive Spannbacke (8) und Rotarykomponente (3) mit einem Nocken (27) und die andere mit einem Nockenstößel (19) versehen ist,

gekennzeichnet durch

eine Vorspannvorrichtung (28, 29), die direkt oder indirekt zwischen die wenigstens eine aktive Spannbacke (8) und die Rotarykomponente (3) eingefügt ist, um bei der Anwendung die aktive Spannbacke (8) im Verhältnis zu der Rotarykomponente (3) zu verschieben, so daß die aktive Spannbacke zum Halteeingriff mit dem Rohrabschnitt (40) gebracht wird und so eine relative Drehung zwischen der aktiven Spannbacke (8) und dem Rohrabschnitt (40) beim anschließenden Drehen der Rotarykomponente (3) unterbunden wird.

2. Bohrgestängezange nach Anspruch 1, die außerdem folgendes aufweist:

wenigstens eine passive Spannbacke (6), die an der Rotarykomponente (3) befestigt ist, um das Halten des Rohrabschnitts (40) zu erleichtern.

3. Bohrgestängezange nach Anspruch 1 oder 2, bei der die Vorspannvorrichtung (28) eine erste Kolben-Zylinder-Baugruppe (28) umfaßt.

4. Bohrgestängezange nach Anspruch 2 und 3, bei der die erste Kolben-Zylinder-Baugruppe (28) zwischen der aktiven Spannbacke (8) und der passiven Spannbacke (6) wirksam ist.

5. Bohrgestängezange nach Anspruch 2 oder Anspruch 3 oder 4 in Abhängigkeit von Anspruch 2, die außerdem folgendes aufweist:

eine zweite passive Spannbacke (7), die an der Rotarykomponente (3) befestigt ist, um das Halten des Rohrabschnitts (40) zu erleichtern.

6. Bohrgestängezange nach Anspruch 5, bei der die Vorspannvorrichtung außerdem folgendes aufweist:

eine zweite Kolben-Zylinder-Baugruppe (29), die so angeordnet ist, daß sie zwischen der aktiven Spannbacke (8) und der zweiten passiven Spannbacke (7) wirksam wird.

7. Bohrgestängezange nach einem der vorhergehenden Ansprüche, die außerdem folgendes aufweist:

ein Steuerungssystem zur selektiven Aktivierung der Vorspannvorrichtung und zur selektiven Steuerung der Ausübung einer Vorspannung auf die wenigstens eine aktive Spannbacke (8).

8. Bohrgestängezange nach Anspruch 7 in direkter oder indirekter Abhängigkeit von Anspruch 5, bei der das Steuerungssystem einen Steuerschieber (32) aufweist, um den Fluß von Fluid aus einem Fluid-Behälter (34) unter Druck zu einer ausgewählten der ersten und zweiten Kolben-Zylinder-Baugruppen (28, 29) zu erlauben und um selektiv das Zurückfließen von Fluid aus der anderen der Kolben-Zylinder-Baugruppen (28, 29) zum Fluid-Behälter (34) zu erlauben.

9. Bohrgestängezange nach einem der vorhergehenden Ansprüche, bei der die aktive Spannbacke (8') eine Spannbackenhalterung (11'), einen Mitnehmer (23), der auf der Spannbackenhalterung (11') angebracht ist, und ein Halteelement (15') aufweist, das auf dem Mitnehmer (23) angebracht ist.

10. Bohrgestängezange nach Anspruch 9, bei der das Halteelement (15') lösbar mit dem Mitnehmer (23) verbunden ist.

11. Bohrgestängezange nach Anspruch 9 oder 10, bei welcher der Mitnehmer (23) lösbar mit der Spannbackenhalterung (11') verbunden ist.

12. Bohrgestängezange nach einem der vorhergehenden Ansprüche, bei der das Halteelement (15') flexibel ist, um sich einer Außenform des Rohrabschnitts (40) anzupassen.

Revendications

1. Clé de vissage à commande pneumatique (1) pour la mise en rotation d'un matériel tubulaire (40) au cours d'opérations de forage de puits, la clé de vissage à commande pneumatique comprenant

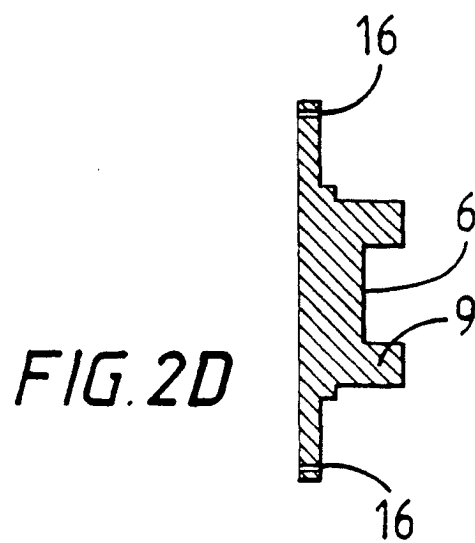
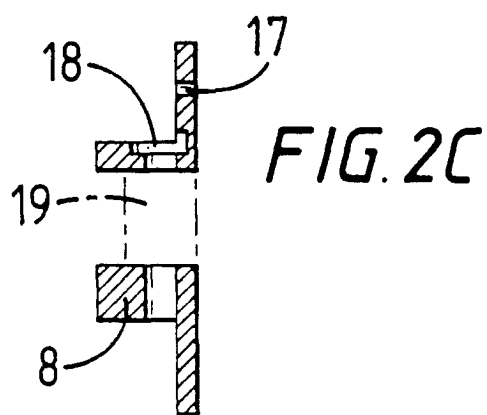
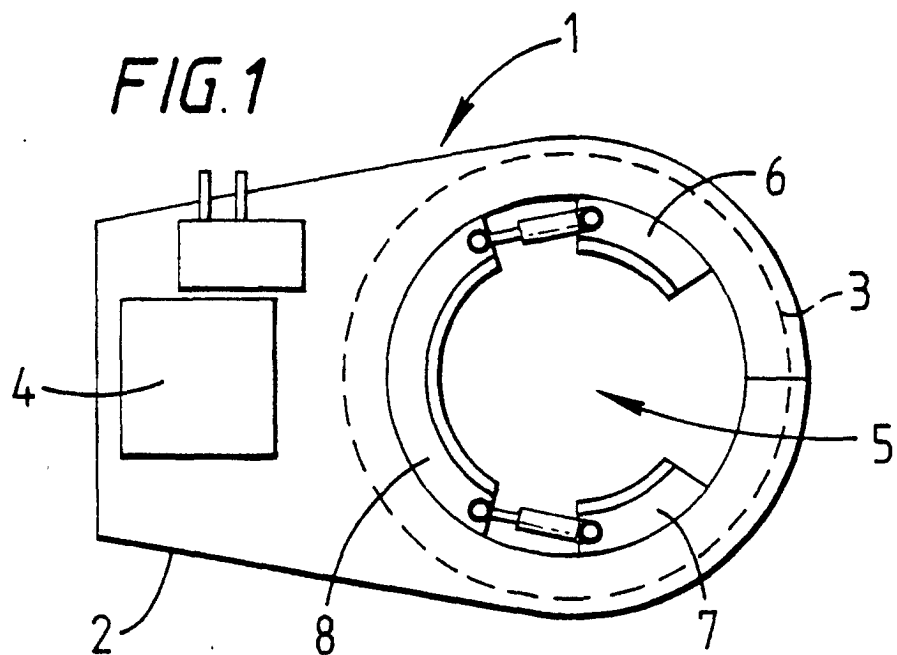
un boîtier externe (2),

un élément rotatif (3), monté par rotation dans le boîtier extérieur (2) pour faire tourner un matériel tubulaire (40),

un dispositif (4) pour mettre en rotation l'élément rotatif (3) pour faire tourner le matériel tubulaire (40),

au moins une mâchoire active (8), montée de manière mobile sur l'élément rotatif (3) et pouvant être déplacée par rapport à celui-ci pour saisir le matériel tubulaire (40),

- la au moins une mâchoire active (8) comportant un élément de préhension (15) pour contacter la surface du matériel tubulaire (40),
- un desdits éléments, ladite mâchoire active (8) ou ledit élément rotatif (3), comportant une came (27), l'autre élément comportant un galet de came (19),
- caractérisée par un dispositif de précharge (28, 29) interconnecté directement ou indirectement entre la au moins une mâchoire active (8) et l'élément rotatif (3) pour déplacer en service ladite mâchoire active (8) par rapport audit élément rotatif (3), de sorte que la mâchoire active est engagée en préhension par came dans le matériel tubulaire (40), pour empêcher ainsi une rotation relative entre ladite mâchoire active (8) et ledit matériel tubulaire (40) lors de la rotation ultérieure dudit élément rotatif (3).
2. Clé de vissage à commande pneumatique selon la revendication 1, comprenant en outre au moins une mâchoire passive (6) fixée à l'élément rotatif (3) pour faciliter la préhension du matériel tubulaire (40).
 3. Clé de vissage à commande pneumatique selon les revendications 1 ou 2, dans laquelle ledit dispositif de précharge (28) comprend un premier assemblage à piston et cylindre (28).
 4. Clé de vissage à commande pneumatique selon les revendications 2 et 3, dans laquelle ledit premier assemblage à piston et cylindre (28) agit entre ladite mâchoire active (8) et ladite mâchoire passive (6).
 5. Clé de vissage à commande pneumatique selon la revendication 2 ou les revendications 3 ou 4, dépendant de la revendication 2, comprenant en outre une deuxième mâchoire passive (7) fixée à l'élément rotatif (3) pour faciliter la préhension du matériel tubulaire (40).
 6. Clé de vissage à commande pneumatique selon la revendication 5, dans laquelle ledit dispositif de précharge comprend en outre un deuxième assemblage à piston et cylindre (29), agencé de sorte à agir entre ladite mâchoire active (8) et ladite deuxième mâchoire passive (7).
 7. Clé de vissage à commande pneumatique selon l'une quelconque des revendications précédentes, comprenant en outre un système de commande pour actionner sélectivement le dispositif de précharge et pour commander sélectivement l'application d'une précharge à la au moins une mâchoire active (8).
 8. Clé de vissage à commande pneumatique selon la revendication 7, dépendant directement ou indirectement de la revendication 5, dans laquelle ledit système de commande comprend une soupape de commande (32) pour permettre l'écoulement de fluide d'un réservoir de fluide (34) sous pression vers un assemblage sélectionné du premier et du deuxième assemblage à piston et cylindre (28, 29) et pour permettre sélectivement le retour du fluide de l'autre desdits assemblages à piston et cylindre (28, 29) vers le réservoir de fluide (34).
 9. Clé de vissage à commande pneumatique selon l'une quelconque des revendications précédentes, dans laquelle ladite mâchoire active (8') comprend un dispositif de retenue de mâchoire (11'), un support (23), monté sur ledit dispositif de retenue de mâchoire (11') et un élément de préhension (15') monté sur ledit support (23).
 10. Clé de vissage à commande pneumatique selon la revendication 9, dans laquelle ledit élément de préhension (15') est connecté de manière détachable au support (23).
 11. Clé de vissage à commande pneumatique selon les revendications 9 ou 10, dans laquelle le support (23) est connecté de manière détachable au dispositif de retenue de mâchoire (11').
 12. Clé de vissage à commande pneumatique selon l'une quelconque des revendications précédentes, dans laquelle l'élément de préhension (15') est flexible en vue de son adaptation à une forme externe du matériel tubulaire (40).



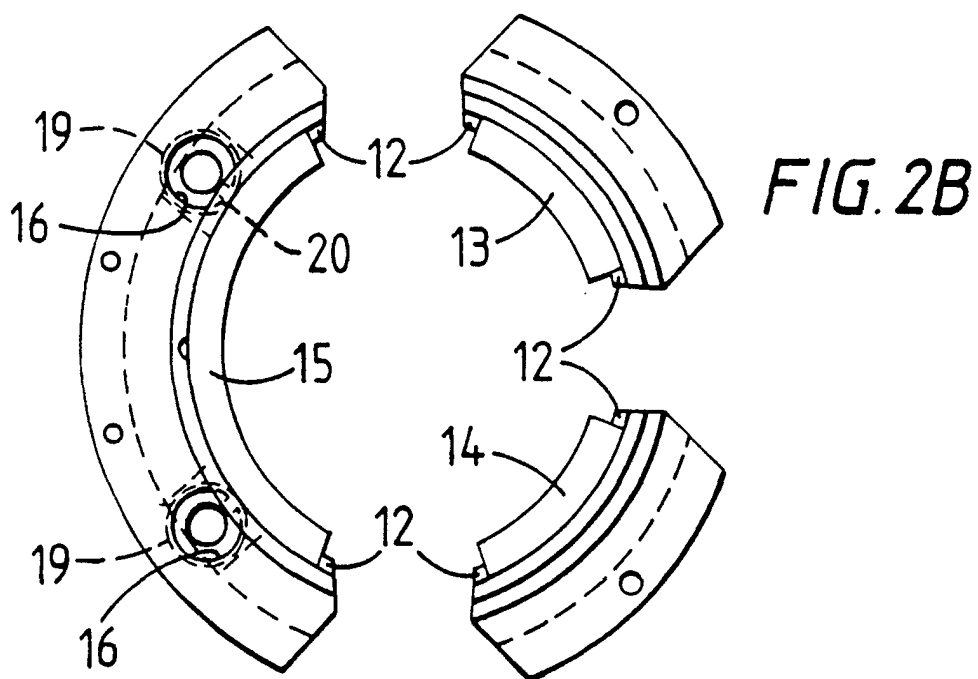
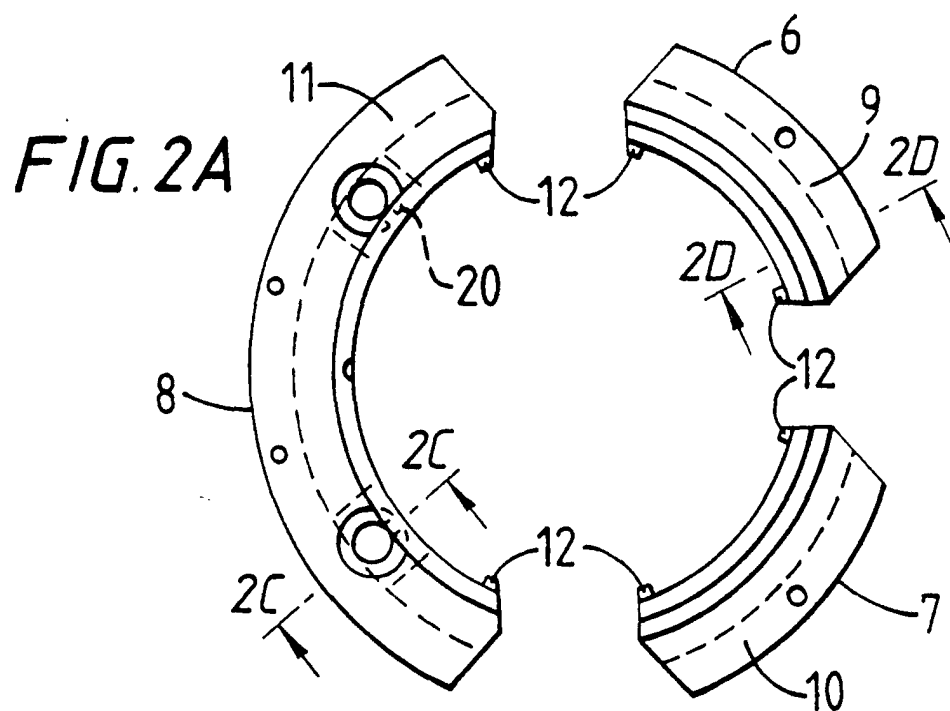


FIG. 3A

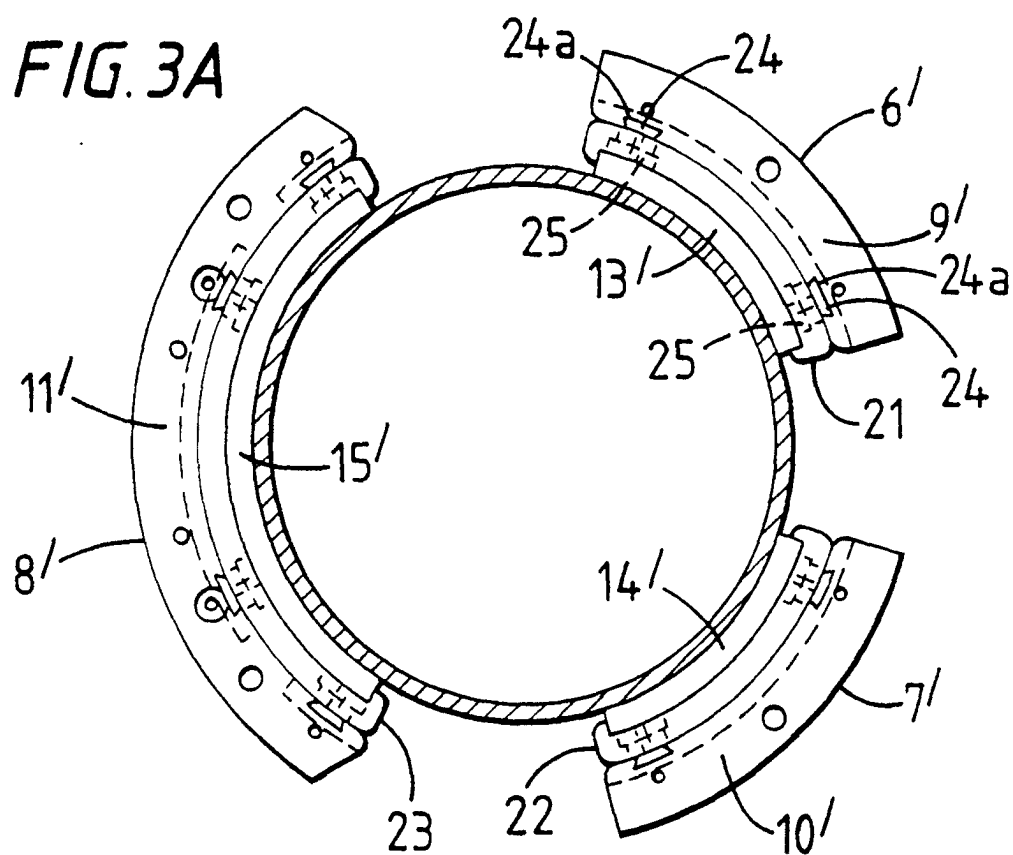


FIG. 3B

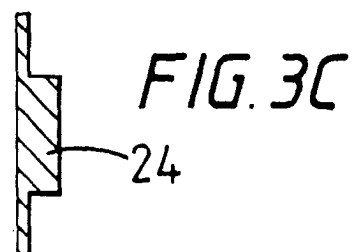
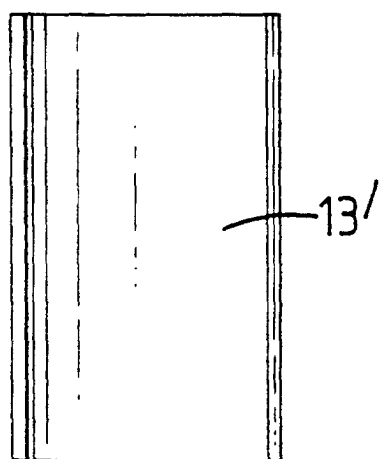


FIG. 3D

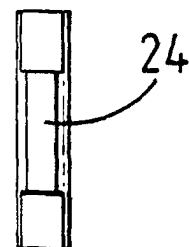


FIG. 4A

