**EUROPEAN PATENT SPECIFICATION**

| Date of publication and mention of the grant of the patent: |
| 19.04.2006  Bulletin 2006/16 |

**Application number:** 03703654.8

**Date of filing:** 18.02.2003

| Int Cl.: |
| E21B 17/042 (2006.01) |

**International application number:**

PCT/SE2003/000260

**International publication number:**


**Designated Contracting States:**

AT  IE  SE

**Priority:**

21.02.2002  SE 0200505

**Date of publication of application:**

17.11.2004  Bulletin 2004/47

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**References cited:**

WO-A1-92/17730 SE-C2- 516 730

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Description

Background of the invention

[0001] The present invention relates to a drill member for rock drilling and a method for manufacturing a drill member in accordance with the preambles of the appended independent claims.

Related art

[0002] At percussive top hammer drilling in rock a drill string is intended to be fastened to a shank adapter in a drilling machine via one end surface of a rod or a tube. The other end of the rod or the tube is threaded either to another rod or another tube or a drill bit for percussive drilling. The rod or the tube can also be fastened to the shank adapter or another part with the aid of threaded sleeves. A flush channel runs through the entire drill string in order to lead flush medium to the drill bit for flushing away drill cuttings.

[0003] At the drilling the drill string members, i.e. bits, rods, tubes, sleeves and shank adapters, are subjected to corrosive attacks. This applies especially at drilling below earth where water is used as flush medium and where the environment is moist. Corrosive attacks are especially serious at the most stressed parts, i.e. at thread bottoms and other reductions. In combination with pulsating strain, caused by impact waves and bending stresses, so-called corrosion fatigue arises. This is a usual cause for breakage of the drill string.

[0004] Generally a low alloyed case hardened steel is used in the drill member. The reason for this is that abrasion and wear of the thread portions have for long been limiting the life spans. As the drilling machines and the drill members become better these problems have diminished and corrosion fatigue become a limiting factor.

[0005] The case hardening gives compressive stresses in the surface, which give certain effect against the mechanical part of the fatigue. Corrosion resistance of low alloyed steel is however poor and for that reason corrosion fatigue still occurs easily. The resistance is however not satisfactorily and so breakages often occur.

[0006] In US-A-4,872,515 or US-A-5,064,004 a drill member is shown where a threaded portion has been provided with a metallic material, which is softer than the steel of the drill member. Thereby is intended to solve the problem of frictional damages (pitting) in the threads by covering at least the parts of the thread of the drill member that cooperate with other parts of the threaded connection.

[0007] One method of eliminating corrosion fatigue is to make the rods in stainless steel such as in SE-A-0000521-5. The stainless steel is however relatively soft and consequently has inferior wear resistance than a carburized rod, i.e. it wears out relatively quickly.

[0008] Through SE-C2-515 195 and SE-C2-515 294 thread joints for percussive rock drilling are shown. By covering the thread bottoms of the cylindrical external thread with at least one layer of a material with other electrode potential than the underlying steel an increased tool life for the threaded connection is attained.

Objects of the invention

[0009] One object of the present invention is to considerably improve the resistance to corrosion fatigue in a drill member for percussive rock drilling.

[0010] Another object of the present invention is to considerably improve the resistance to corrosion fatigue at sections with reduced thickness of the material in a drill member for percussive rock drilling.

[0011] Still another object of the present invention is to considerably improve the resistance to corrosion fatigue in thread bottoms in a threaded portion in a drill member for percussive rock drilling.

[0012] Still another object of the present invention is to provide a method for manufacturing a drill member with improved resistance against corrosion fatigue for percussive rock drilling.

Brief description of the drawings

[0013] These and other objects have been achieved by a thread joint and a drill member with features according to the characterizing portions in the appended independent claims with reference to the drawings.

Fig. 1A shows a tube and Fig. 1B shows a rod, both in perspective views.
Fig. 2 shows a blank for extrusion in a perspective view.
Fig. 3 shows an extruded rod in a perspective view.
Fig. 4 shows an axial cross-section of a part machined from the rod in Fig. 3.
Fig. 5A shows an axial cross-section of a male portion according to the present invention after machining of the part according to Fig. 4.
Detailed description of the invention

[0014] The invention relates to a drill member for rock drilling and a method for manufacturing a drill member with a flush channel for percussive drilling with at least one reduction or a portion 40, 40’ with relatively thin thickness of the material, which is performed in homogenous stainless steel in order to considerably improve the resistance against corrosion fatigue. In addition, the flush channel is in one case performed in the same stainless steel and therefore corrosion fatigue therein no longer occurs during rock drilling.

[0015] According to the invention a drill member is provided for percussive drilling, that is, a male portion 19 (Fig. 5A) or a female portion 26 (Fig. 7) equipped with an external thread 16 and an internal thread 16’, respectively. The threads shown are so called cylindrical trapezoidal threads but other thread shapes may be used, for example conical threads or rope threads or a combination of these.

[0016] With reference mainly to Figs. 5A and 5C the drill member 19 has a through flush channel 20, through which a flush medium, generally air or water, is led. The thread 16 comprises thread bottoms 23 and thread crests 24, with thread flanks 21, 22 provided therebetween. The thread bottoms 23 are performed in stainless steel and the thread crests 24 in low alloyed steel.

[0017] The thread 16 has a depth D, which is defined as the perpendicular distance between the thread bottom 23 and the thread crest 24 and the low alloyed portion of the thread crest 18 has a thickness T after machining. The depth D is generally in the range of 1-4 mm and the outer diameter of the rod is 20-70 mm. The ratio T/d is 0.1-1.0, preferably 0.4-0.8. In a preferred embodiment a trapezoidal thread (T38) with a depth D = 2-2.5 mm and a shell 18 with a thickness T of 1-2 mm, preferably around 1.5 mm is used.

[0018] The thread bottom 23 and the stainless portion of the thread flanks 21, 22 have a first width W1, and the thread crest 24 and the low alloyed portion of the thread flanks 21, 22 have a second width W2 (Fig. 5C), where the ratio W1/W2 is 0-0.9, preferably 0.3 - 0.8. The widths W1 and W2 of the thread bottom 23 and the thread crest 24, respectively, can be defined as the largest length of the respective material in the longitudinal direction of the member exposed towards the surroundings. A male portion according to the present invention according to Fig. 5B with a trapezoidal thread (T38) with W1 = 6.1 mm and W2 = 9.5 mm and ratio W1/W2=0.64.

[0019] By making the thread bottoms 23 in one embodiment in stainless steel the male portion 19 has great resistance against corrosion fatigue. The stainless steel has a composition which gives a PRE value >10, preferably 12-17. PRE means Pitting Resistance Equivalent and describes the resistance of the alloy against pitting. PRE is defined according to formula

$$\text{PRE} = \text{Cr} + 3.3(\text{Mo} + \text{W}) + 16\text{N}$$

where Cr, Mo, W and N corresponds to the contents of the members in weight percent.

[0020] That low alloyed steel in the shell 18 has a hardness >500 Vickers, most preferably 650-800 Vickers whereby good wear resistance will be obtained. The hardness can be obtained by making the component in tough hardened steel, by carburizing the surface or by induction surface hardening. The low alloyed steel preferably has a composition in weight%

<table>
<thead>
<tr>
<th>Element</th>
<th>Weight %</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.1-0.7</td>
</tr>
<tr>
<td>Si</td>
<td>0.1-1</td>
</tr>
<tr>
<td>Mn</td>
<td>0.2-2</td>
</tr>
<tr>
<td>Cr</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Ni</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Mo</td>
<td>&lt;2</td>
</tr>
</tbody>
</table>

the rest being Fe and inevitable impurities.

[0021] Male portions or drill members according to the invention are made as follows. In Fig. 1A a tube is shown 11 and in Fig. 1B a rod 12 is shown. The tube 11 and the rod 12 are fitted with fine tolerances, for example by shrink fit,
into each other to form a blank 13 such as is apparent from Fig. 2 and are fixed by circumferential welds 14 at the ends of the blank. In addition the welds 14 give a protection against oxidation at the interface between the tube 11 and the rod 12 at the subsequent heating. The blank 13 is extruded in hot condition to a compound component 15 with diameter that is adapted to the desired dimension of a thread 16 for percussive rock drilling (see Fig. 5A). With "compound component" is here meant an extruded tube or an extruded rod of at least two different materials.

[0022] The compound component in the shown embodiment is made of a rod 15 with a core 17 of stainless steel and a shell 18 of low alloyed steel. From this rod a conventional external thread or male thread for percussive rock drilling 16 is turned, such that thread bottoms are obtained in the stainless core 17. Alternatively, the core 17' consists of low alloyed steel and the shell 18' of stainless steel (Fig. 7). From this rod a conventional inner thread or female thread 16' for percussive rock drilling is turned, such that thread bottoms are obtained in the stainless portion 18'. The thread 16, 16' consequently shall consist of at least two different materials. The machined ends are then friction welded to a hexagonal rod or to a round rod of low alloyed or stainless steel (see Fig. 6) to a drill rod 25 which finally is hardened and annealed.

[0023] A central flush channel is drilled. Alternatively, a tube can replace the rod 12 such that the finished extruded compound component 15 is made of a tube such that one doesn't have to drill a hole. In the latter case the extrusion blank 13 shall have a hole for a mandrel and therefore the rod that will constitute the core instead may be a tube blank or a solid rod that is drilled.

[0024] Both the male portion 19 and the female portion 26 comprise impact transferring surfaces, that is, the end surface 19A and the bottom surface 26A, respectively.

EXAMPLE

[0025] Extrusion blanks 13 were manufactured from tubes 11 of low alloyed steel, with composition 1, outer diameter 77 mm and inner diameter 63 mm and stainless rod 12, with composition 2 and diameter 63 mm. The blanks were heated to 1150°C and were extruded to rods with outer diameter of 43 mm. The diameter for the stainless steel was 35 mm. Investigations in light microscope showed that the metallurgical bond between the low alloyed and the stainless steel was good, see Fig. 5D. From the rods obtained through this procedure male portions 19 were manufactured by means of conventional machining. The thread was of the type T38 with outer diameter 38 mm and had the depth 2.35 mm. These were then case hardened, during which the exposed surfaces of stainless steel were covered by protective coating for avoiding effects of the carbon containing gaseous atmosphere. The male portions were then friction welded to respective ends of a rolled rod 25, which included a flush channel. The male portions have a composition according to 3 below. Subsequently a flush channel was drilled in each male portion and all rods were hardened from 1030°C.

<table>
<thead>
<tr>
<th></th>
<th>%C</th>
<th>%Si</th>
<th>%Mn</th>
<th>%Cr</th>
<th>%Ni</th>
<th>%Mo</th>
<th>%Fe</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.22</td>
<td>0.21</td>
<td>0.57</td>
<td>1.26</td>
<td>2.62</td>
<td>0.22</td>
<td>rest</td>
</tr>
<tr>
<td>2</td>
<td>0.21</td>
<td>0.61</td>
<td>0.46</td>
<td>12.9</td>
<td>0.11</td>
<td>0.02</td>
<td>rest</td>
</tr>
<tr>
<td>3</td>
<td>0.19</td>
<td>0.27</td>
<td>0.45</td>
<td>13.3</td>
<td>0.29</td>
<td>0.02</td>
<td>rest</td>
</tr>
</tbody>
</table>

[0026] Five finished rods were put into in a rig for so called drifter drilling below earth and were drilled until fracture/ wearing-out occurred. The following life spans, measured in so-called drilled meter, were obtained:

<table>
<thead>
<tr>
<th>Rod</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7200 m</td>
</tr>
<tr>
<td>2</td>
<td>6623 m</td>
</tr>
<tr>
<td>3</td>
<td>6888 m</td>
</tr>
<tr>
<td>4</td>
<td>8901 m</td>
</tr>
<tr>
<td>5</td>
<td>6054 m</td>
</tr>
</tbody>
</table>

[0027] Normal tool life for standard drill tubes, that is case hardened low alloyed steel of the same type as the shell 18, is about 5000 m, which shows that the drill member according to the present invention exhibits a sharp increase in tool life.

[0028] The invention relates primarily to drifter rods, i.e. rods with male portions at both ends. One can however imagine also to make drill tubes or MF rods by the method according to the present invention. The latter has both male and female portion (MF=Male-Female).

[0029] In an alternative embodiment the entire thread may be performed in low alloyed steel wherein the stainless
steel does not reach the bottom of the thread in the radial direction. In this way the stainless steel retards corrosion fatigue when the low alloyed steel is broken through by corrosion induced cracks.

Claims

1. A member for percussive rock drilling where flushing water is used, comprising sections with reduced thickness of the material, at least one thread (16;16'), said thread (16;16') comprising thread flanks (21,22) and thread bottoms (23) provided between flanks and thread crests (24), said member (19,26) consisting of at least two different materials, said member being performed in a compound component (15) and the thread bottoms (23) consisting of stainless steel, the thread crests (24) of low alloyed steel and the compound component comprising a flush channel (20;20'), for characterized in that the member (19;26) comprises a core (17;17') and a shell (18;18'), wherein anyone of the core and the shell consists of stainless steel while the other consists of low alloyed steel.

2. The member according to claim 1, characterized in that the low alloyed portion of the thread crest (24) has a thickness (T) and the thread (16;16') a depth (D), wherein 0.1<T/D<1, preferably 0.4<T/D<0.8.

3. The member according to claim 2, characterized in that the depth (D) is 1-4 mm and the thickness (T) 1-2 mm, preferably about 1.5 mm.

4. The member according to claim 2, characterized in that a thread bottom (23) of the thread (16;16') has a first width, W1, and a thread crest (24) has a second width, W2, where the ratio W1/W2 is 0 - 0.9, preferably 0.3 - 0.8.

5. The member according to claim 1, characterized in that the stainless steel (17;17') has a composition which gives a Pitting Resistance Equivalent value >10, preferably 12 - 17 and in that the low alloyed steel (18;18') has a hardness >500 Vickers, most preferably 650-800 Vickers.

6. The member according to claim 5, characterized in that the low alloyed steel has the composition in weight% of:

<table>
<thead>
<tr>
<th>Element</th>
<th>Weight %</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.1-0.7</td>
</tr>
<tr>
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</tr>
<tr>
<td>Cr</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Ni</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Mo</td>
<td>&lt;2</td>
</tr>
</tbody>
</table>

the rest being Fe and inevitable impurities.

7. The member according to claim 1, characterized in that the member (19;26) is firmly connected to an end of a rod or a tube of low alloyed or stainless steel and forms a drill rod (25) and in that the drill rod comprises a through flush channel (20;20').

8. A method for manufacturing a drill member for percussive rock drilling, said member comprising sections with reduced thickness of the material, at least one thread (16;16'), said thread (16;16') comprising thread flanks (21,22) and thread bottoms (23) and thread crests (24) provided between the flanks, said members (19;26) consisting of at least two different materials, characterized in that the method comprises the following steps:

- providing a core (17;17') and a shell (18;18'), wherein anyone of the core and the shell consists of stainless steel while the other consists of low alloyed steel,
- fitting the core (17;17') into the shell (18;18') with close fit in order to create a blank (13),
- welding the ends of the blank (13) in order to fix the core relative to the shell,
- extruding the blank (13) in hot condition to a compound component (15) and
- turning a thread (16;16') for percussive rock drilling from the compound component (15) or a portion thereof, such that thread bottoms (23) are obtained in stainless steel and the thread crests in low alloyed steel.

9. The method according to claim 8, characterized in that the method comprises the following further step:
Patentansprüche

1. Glied zum Gesteinsschlagbohren, bei dem Spülwasser verwendet wird, mit Abschnitten mit verringrigerter Materialdicke, mindestens einem Gewinde (16; 16'), wobei das Gewinde (16; 16') Gewindeflanken (21, 22) und Gewindeböden (23) aufweist, die zwischen den Flanken und Gewindekämmern (24) vorgesehen sind, wobei das Glied (19, 26) aus mindestens zwei unterschiedlichen Materialien besteht und in einer Verbundkomponente (15) ausgeführt ist, die Gewindeböden (23) aus nichtrostendem Stahl bestehen, die Gewindekämme (24) aus niedriglegiertem Stahl und die Verbundkomponente einen Spülkanal (20; 20') aufweist, dadurch gekennzeichnet, daß das Glied (19; 26) einen Kern (17; 17') und einen Mantel (18; 18') aufweist, wobei der Kern oder der Mantel aus nichtrostendem Stahl besteht, während der jeweils andere aus niedriglegiertem Stahl besteht.

2. Glied nach Anspruch 1, dadurch gekennzeichnet, daß der niedriglegierte Abschnitt des Gewindekammes (24) eine Dicke (T) und das Gewinde (16; 16') eine Tiefe (D) hat, wobei 0,1 < T/D < 1, vorzugsweise 0,4 < T/D < 0,8.

3. Glied nach Anspruch 2, dadurch gekennzeichnet, daß die Tiefe (D) 1,4 mm und die Dicke (T) 1-2 mm, vorzugsweise etwa 1,5 mm, betragen.

4. Glied nach Anspruch 2, dadurch gekennzeichnet, daß ein Gewindeboden (23) des Gewindes (16; 16') eine erste Breite W1 hat und ein Gewindekamm (24) eine zweite Breite W2 hat, wobei das Verhältnis W1/W2 0-0,9, vorzugsweise 0,3-0,8, beträgt.

5. Glied nach Anspruch 1, dadurch gekennzeichnet, daß der nichtrostende Stahl (17; 17') eine Zusammensetzung hat, die einen Pitting-Resistance-Equivalent (Lochfraß-Beständigkeit äquivalent)-Wert > 10 gibt, vorzugsweise 12-17 und daß der niedriglegierte Stahl (18; 18') eine Härte > 500 Vickers, am meisten bevorzugt 650-800 Vickers, hat.

6. Glied nach Anspruch 5, dadurch gekennzeichnet, daß der niedriglegierte Stahl die Zusammensetzung in Gew.-% hat

\[
\begin{align*}
C & \quad 0,1-0,7 \\
Si & \quad 0,1-1 \\
Mn & \quad 0,2-2 \\
Cr & \quad < 5 \\
Ni & \quad < 5 \\
Mo & \quad < 2,
\end{align*}
\]

wobei der Rest Fe ist und unvermeidliche Verunreinigungen.

7. Glied nach Anspruch 1, dadurch gekennzeichnet, daß das Glied (19; 26) fest an einem Ende einer Stange oder eines Rohres aus niedriglegiertem oder nichtrostendem Stahl verbunden ist und eine Bohrerstange (25) bildet und daß die Bohrerstange einen durchgehenden Spülkanal (20; 20') aufweist.

8. Verfahren zur Herstellung eines Bohrgliedes für das Gesteinsschlagbohren, wobei das Glied Abschnitte aufweist mit reduzierter Materialdicke, mindestens ein Gewinde (16; 16') aufweist, wobei das Gewinde (16; 16') Gewindeflanken (21, 22) und Gewindeböden (23) und Gewindekämme (24) aufweist, die zwischen den Flanken vorgesehen sind, wobei die Glieder (19; 26) aus mindestens zwei unterschiedlichen Materialien bestehen, dadurch gekennzeichnet, daß das Verfahren die folgenden Schritte aufweist:

- Vorsehen eines Kernes (17; 17') und eines Mantels (18; 18'), wobei der Kern oder der Mantel aus nichtrostendem Stahl besteht, während der jeweils andere aus niedriglegiertem Stahl besteht,
- Einpassen des Kernes (17; 17') in den Mantel (18; 18') in enger Anlage, um einen Rohling (13) zu erzeugen,
- Anschweißen der Enden des Rohlings (13), um den Kern relativ zu dem Mantel zu fixieren,
- Extrudieren des Rohlings (13) in heißem Zustand auf eine Verbundkomponente (15) und
- Drehen eines Gewindes (16; 16') für das Gesteinsschlagbohren aus der Verbundkomponente (15) oder einem
Abschnitt derselben derart, daß die Gewindeböden (23) in nichtrostendem Stahl / und die Gewindekämme in niedriglegiertem Stahl erhalten werden.

9. Verfahren nach Anspruch 8, dadurch gekennzeichnet, daß das Verfahren den folgenden weiteren Schritt aufweist:

- Reibschweißen der Verbundkomponente oder eines Abschnittes derselben an eine Bohrerstange (25) niedriglegierten Stahles oder nichtrostenden Stahles.

Revendications

1. Élément pour le forage de roche par percussion où de l’eau de chasse est utilisée, comprenant des sections ayant une épaisseur réduite de matériau, au moins un filetage (16 ; 16’), ledit filetage (16 ; 16’) comprenant des flancs de filets (21, 22) et des fonds de filets (23) disposés entre les flancs et des crêtes de filets (24), ledit élément (19, 26) étant constitué d’au moins deux matériaux différents, ledit élément étant réalisé en un composant composite (15) et les fonds de filets (23) étant constitués d’acier inoxydable, les crêtes de filets (24) étant constituées d’acier faiblement allié, et le composant composite comprenant un canal de chasse (20, 20’), caractérisé en ce que l’élément (19 ; 26) comprend un noyau (17 ; 17’) et une coquille (18 ; 18’), où l’un quelconque du noyau et de la coquille est constitué d’acier inoxydable, alors que l’autre est constitué d’acier faiblement allié.

2. Élément selon la revendication 1, caractérisé en ce que la partie faiblement alliée de la crête de filet (24) présente une épaisseur (T) et le filetage (16 ; 16’) présente une profondeur (D), avec 0,1 < T/D < 1, de préférence 0,4 < T/D < 0,8.

3. Élément selon la revendication 2, caractérisé en ce que la profondeur (D) est de 1 à 4 mm et l’épaisseur (T) est de 1 à 2 mm, de préférence d’environ 1,5 mm.

4. Élément selon la revendication 2, caractérisé en ce qu’un fond de filet (23) du filetage (16 ; 16’) a une première largeur W1, et une crête de filet (24) a une seconde largeur W2, le rapport W1/W2 étant de 0 à 0,9, de préférence de 0,3 à 0,8.

5. Élément selon la revendication 1, caractérisé en ce que l’acier inoxydable (17 ; 17’) a une composition qui donne une valeur d’équivalence de résistance à la corrosion par piqûres supérieure à 10, de préférence de 12 à 17, et en ce que l’acier faiblement allié (18 ; 18’) a une dureté supérieure à 500 Vickers, de façon davantage préférée de 650 à 800 Vickers.

6. Élément selon la revendication 5, caractérisé en ce que l’acier faiblement allié a une composition en pourcentage en poids

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>de 0,1 à 0,7</td>
<td></td>
</tr>
<tr>
<td>Si</td>
<td>de 0,1 à 1</td>
<td></td>
</tr>
<tr>
<td>Mn</td>
<td>de 0,2 à 2</td>
<td></td>
</tr>
<tr>
<td>Cr</td>
<td>&lt; 5</td>
<td></td>
</tr>
<tr>
<td>Ni</td>
<td>&lt; 5</td>
<td></td>
</tr>
<tr>
<td>Mo</td>
<td>&lt; 2</td>
<td></td>
</tr>
</tbody>
</table>

le reste étant du Fe et des impuretés inévitables.

7. Élément selon la revendication 1, caractérisé en ce que l’élément (19 ; 26) est fermement relié à une extrémité d’une tige ou d’un tube d’acier faiblement allié ou d’acier inoxydable et forme une tige de foret (25) et en ce que la tige de foret comprend un canal traversant de chasse (20 ; 20’).

8. Procédé de fabrication d’un élément de foret destiné au forage de roche par percussion, ledit élément comprenant des sections à épaisseur réduite de matériau, au moins un filetage (16 ; 16’), ledit filetage (16 ; 16’) comprenant des flancs de filets (21, 22) et des fonds de filets (23) ainsi que des crêtes de filets (24) disposées entre les flancs, lesdits éléments (19 ; 26) étant constitués d’au moins deux matériaux différents, caractérisé en ce que le procédé comprend les étapes suivantes:
EP 1 476 634 B1

- fournir un noyau (17 ; 17') et une coquille (18 ; 18'), où l’un quelconque du noyau et de la coquille est constitué d’acier inoxydable, alors que l’autre est constitué d’acier faiblement allié,
- ajuster le noyau (17 ; 17') dans la coquille (18 ; 18') avec un ajustement fin de manière à créer une ébauche (13),
- souder les extrémités de l’ébauche (13) de manière à fixer le noyau par rapport à la coquille,
- extruder l’ébauche (13) dans un état chaud afin d’obtenir un composant composite (15) et
- tourner un filetage (16 ; 16') pour un forage de roche par percussion à partir du composant composite (15) ou d’une partie de celui-ci, pour que les fonds de filets (23) soient réalisés en acier inoxydable et que les crêtes de filets soient réalisées en acier faiblement allié.

9. Procédé selon la revendication 8, caractérisé en ce que le procédé comprend l’étape supplémentaire suivante consistant à :

- souder par frottement le composant composite ou une partie de celui-ci à une tige de foret (25) d’acier faiblement allié ou d’acier inoxydable.