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(54) **Tube rod**

Bohrgestänge mit Innenrohr

Tige de forage avec conduit intérieur

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(73) Proprietor: **BOART LONGYEAR LIMITED**
Co Clare (IE)

(72) Inventors:
- **Roberts, Nigel**
  Birdhill, County Tipperary (IE)
- **Yao, James**
  Mississauga Ontario Canada L5M 5E5 (CA)

(74) Representative: **Copp, David Christopher et al**
25 The Square
Martlesham Heath
Ipswich, Suffolk IP5 3SL (GB)

(56) References cited:
EP-A- 0 220 147
GB-A- 912 930
GB-A- 2 285 645
US-A- 4 601 491
US-A- 5 535 837

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Description

[0001] This invention relates to a tube rod for rotary/percussive rock drilling, and in particular to the way two tube rods are connected one to the other by threads. Tube rods are conventionally connected end to end by threads which allow rods to be screwed together (and unscrewed) to form a drill string which may consist of a large number of connected rods.

[0002] Tube rods, and drill strings made up from tube rods, operate in a harsh environment. Considerable stresses are built up in the rods, and these usually manifest themselves in cracking of the rods in the area of the threaded joints. This cracking usually leads to failure of the respective rod. It is therefore desirable to design the threaded ends of the rods in a way which will minimise stress build up at any particular point, in particular to minimise stress build up at the bottom of the female threads.

[0003] Document EP 0 220 147 relates to a thread coupling for percussion drilling. The drill rods comprise a male thread and a co-operating female thread. Document GB 2 285 645 relates to a stress relief groove for a drill pipe. The grove is located in the weld neck.

[0004] According to a first aspect of the invention, there is provided a tube rod for percussion rock drilling having threaded ends, the tube rod having a hollow bore and at least one of the ends having a female thread, the major part of the tube rod length between the threaded ends having an outside diameter (the first diameter) and at least part of the or each female threaded end having an outside diameter (the second diameter) which is larger than the first diameter, and an annular groove between the female threaded end and the major part of the tube rod length, the annular groove having a root diameter (the third diameter) which is less than both the first and the second diameter, the hollow bore of the rod having a region between the female threaded end and the major part of the tube rod length where the internal diameter is less than at either side of this region.

[0005] The groove preferably has an asymmetrical profile when seen in cross section parallel to the tube axis, and the flank nearest the threaded end is preferably steeper than the opposite flank.

[0006] The adoption of these features has been shown to result in a reduction in stress build up at the bottom of the female threaded end.

[0007] It is preferred for the female end to be of the second diameter from its end up to the annular groove. However it is within the scope of the invention for the female end to be of the second diameter only in a region surrounding the bottom of the threaded end which is where the major stress concentration occurs, or for the female end to be of the second diameter on both sides of the annular groove.

[0008] In most cases, the rod will have one male threaded end and one female threaded end. However rods with two female threaded ends are conceivable, to be joined end to end by a tubular connector with two male threaded ends.

[0009] The hollow bore of the rod may be reduced in internal diameter at the inner end of the female threaded socket to form a neck, and the bore diameter tapers outwards from the neck to the full bore diameter of the major part of the tube rod length.

[0010] The internal diameter of the rod has a region between the female threaded end and the major part of the tube rod length where the internal diameter is less than at either side of this region. The internal diameter of the tube rod can taper from the major part of the tube rod length down to this region of lesser internal diameter. The internal diameter of the tube rod can also taper from the female threaded end down to this region of lesser internal diameter.

[0011] The female threaded end can have an internal shoulder at right angles to the tube axis, with the internal diameter of the tube rod tapering down from the shoulder to the region of lesser internal diameter. The taper of the internal diameter can be a conical taper but is preferably a radiused taper.

[0012] The neck or region of lesser diameter of the internal bore preferably lies on substantially the same cross-section of the rod as the third (external) diameter of the rod. Preferably the third (external) diameter of the rod lies on a cross-section of the rod which is offset from the centre of the neck or region of lesser diameter in the direction towards the major part of the tube rod length.

[0013] The threaded ends can be initially separate from the rod and can be joined to a length of constant cross section tube by friction welded joints, the length of constant cross section forming the major part of the tube rod length. This is a particularly expedient method of manufacturing which allows standard tube stock to be used for the major part of the rod, with only the ends requiring machining.

[0014] The threaded region of the male end can extend from an annular shoulder, the shoulder being adapted to abut against the end of the female threaded end of another rod when the two rods are screwed together. The male threaded region is preferably shorter than the female threaded recess so that when the male threaded end is screwed into the female threaded end of another rod until the shoulder abuts the end of the other rod, the male end does not reach the bottom of the female recess. This helps to avoid tensile pre-loading of the joint.

[0015] The annular shoulder can be stepped and the mating end of a female threaded end section of another rod can have a shoulder such that when the rods are screwed together, the shoulders interengage to prevent substantial radial movement of one shoulder relative to the other. This helps to prevent relative radial movement at the shoulder

which in turn helps to reduce bending of the assembled string of rods.

[0016] This feature can represent an independent invention, and thus according to a second aspect of the invention, there is provided a tube rod assembly for percussion rock drilling, the assembly including a plurality of rods connected end to end by joints comprising interengaging male and female threads wherein when the joints are assembled, an end of a female threaded component is in contact with an external shoulder on the adjacent male threaded component, the external shoulder having a circumferentially extending stepped land, with part of the end of the female threaded component fitting around the land to hinder relative radial movement between the two ends at the position of the shoulder.

[0017] All the features set out above, either alone or in combination, increase the resistance of the tube rod to cracking, especially cracking at the last thread root at the female end. The addition of the tapered internal bore, the increased outside diameter at the thread portion and the external groove all contribute to dispersing the stresses arising at the thread and internal profile of the female threaded part so that the stresses at these critical region are reduced.

[0018] According to a second aspect of the invention, there is provided a tube rod having threaded ends, at least one of the ends having a female thread, the major part of the tube rod length between the threaded ends having an outside diameter (the first diameter) and the or each female threaded end having an outside diameter (the second diameter) which is larger than the first diameter, wherein between the female threaded end and the major part of the tube rod length there is an annular groove having a root diameter (the third diameter) which is less than both the first and the second diameter, and the internal diameter of the rod having a reduced diameter neck, the narrowest part of which coincides with the location of the third diameter.

[0019] According to a third aspect of the invention, there is provided a tube rod having threaded ends, at least one of the ends having a female thread, the major part of the tube rod length between the threaded ends having an outside diameter (the first diameter) and the or each female threaded end having an outside diameter (the second diameter) which is larger than the first diameter, wherein between the female threaded end and the major part of the tube rod length there is an annular groove having a root diameter (the third diameter) which is less than both the first and the second diameter, and the internal diameter of the rod having a reduced diameter neck, the internal diameter of the rod tapering into the neck from both sides of the neck.

[0020] The invention also extends to a female threaded tube rod end for joining to a length of tube to contribute to the formation of a tube rod as set forth above.

[0021] The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:

Figure 1	shows a tube rod in accordance with the invention, with the central section foreshortened;
Figure 2	is a cross section through the female threaded end;
Figure 3	is a cross section through the male threaded end;
Figure 4	is a cross-section through an alternative male threaded end:
Figures 5 and 6	are cross-sections through two alternative female threaded ends: and
Figure 7	shows a second embodiment of tube rod in accordance with the invention.

[0022] Figure 1 shows a rod which has a central section 10, a female threaded end section 12 and a male threaded end section 14. The central section 10 will typically be 1.5 to 2 metres in length (but can be up to 6 metres long), whilst the male and female threaded end sections will typically each have a length of about 250 millimetres.

[0023] The central section 10 is a tube having a constant cross section over its length. Typically the outside diameter will be about 80 to 90 millimetres, and the inside diameter about 65 to 75 millimetres, leaving a wall thickness of about 15 millimetres.

[0024] The end sections 12 and 14, both of which have a through bore, will be welded to the centre section 10 at 16 and 18. This welding can appropriately be achieved through a friction welding process.

[0025] The female threaded end section 12 shown in Figure 2 will normally be machined from solid material. Suitable steels are a 3% NiCrMo grade steel or a 3% CrMo grade steel. The section 12 has an internally threaded end 20, and a tube end 22 which is to be welded to the centre section 10 at 18. The external and internal diameters of the section 12 at the tube end 22 will be substantially the same as those of the centre section 10.

[0026] The end 20 of the section has an abutment shoulder 24, a mouth 26 into which the male threaded end of another rod will be introduced, a threaded region 28 and a relieved region 30 at the inner end of the thread section.

[0027] Figure 2 illustrates the thread which will be formed on the inner walls of the region 28. This thread will be a

double start trapezoidal thread, of the type well known in connecting tube rods for use in rotary/percussion rock drilling. The root diameter of this thread will be substantially the same as that of the relieved portion 30.

[0028] Beyond the relieved portion 30, the wall thickness of the section 12 becomes thicker and as a result the internal bore diameter becomes less. The bore has a narrow neck at 32, and a tapered transition at 34 from the relieved portion 30 to the neck, and a further conically tapered portion 36 from the neck to the tube end 22. The tapered transition 34 is shown in the form of a conical taper, but may alternatively be a radiused taper (see Figure 6).

[0029] The external surface of the female portion has a diameter in the region 38 which can be the same as that of the central portion 10 or can be larger. The diameter at the end portion 40 is slightly larger than that of the central portion, for example 2% - 6% larger, and when the diameter at the region 38 is larger than the central portion, it can also be 2 - 6% larger.

[0030] Between the first diameter and the second diameter area regions, there is an annular groove 42 which has a root diameter substantially less than either the first or the second diameters. This groove is bounded by a smooth curve, one flank of which closest to the end 24 is steeper than the other flank. Although not shown in this figure, the transition between the steep flank and the surface 24 can be radiused, rather than the sharp edge shown. It will seen from Figure 2 that the base of the groove lies in a cross-sectional plane which incorporates the neck 32. The radius of the base part of this groove 42 can, for example, be 12.5 millimetres. Between the groove 42 and the neck 32 the female threaded section 12 has a greater wall thickness than at any other region of its length.

[0031] The male threaded end section 14 (see Figure 3) has a threaded boss 44 extending from an unthreaded collar 46. The diameter of the collar 46 is the same as that of the female end (the second diameter) so that when the male end is screwed into a female end, there is no step in the external diameter at the joint. However the male end could be of the first diameter and/or could have a diameter ramp at the end to blend into the external diameter of the female end without a step.

[0032] The collar 46 has externally a flat at 48 on which serial numbers or other information can be stamped.

[0033] The right hand end of the portion 14 (as seen in Figure 3) has a tube end 50 which will match the tube end 22 of the female threaded portion and will match the cross section of the central section 10.

[0034] The section has a through bore 52. The threaded portion 44 will have external threads to match the internal threads 28.

[0035] In use, the male end 14 of one rod is screwed into the female end 12 of another rod. The two are screwed together until the shoulder 54 of one male end comes into contact with the shoulder 24 of the female end. There is no contact between the extreme end 56 of the male end and the internal shoulder 58 of the female end.

[0036] In Figures 4 to 7, the same reference numerals are used where they denote parts which are directly equivalent to parts described with reference to Figures 1 to 3.

[0037] Figure 4 shows a male threaded end section 114 which differs from the section shown in Figure 3 by the introduction of a land 155 which engages, when the rods are screwed together, inside the mouth 26 of the adjacent female threaded end section, and forms a close fit in that mouth so as to prevent any significant radial movement between the shoulders 24 and 54. This minimises any tendency to bending in the assembled drill rod string.

[0038] Figure 5 shows an embodiment where both the neck 132 and the groove 142 are elongated as compared with the embodiment shown in Figure 2. This assists in reducing the stress level at the inner end of the threaded region 28, particularly in the part of the threaded region closest to the neck 132.

[0039] Figure 6 shows an embodiment similar to that of Figure 2, but where the tapered transition 34 is replaced by a radiused transition 234.

[0040] The relationship between the various parameters can be as follows, where:

A	represents the external diameter of the central section 10
B	represents the maximum external diameter of the female threaded end section 14
C	represents minimum external diameter of the female threaded end section 14 (at the groove 42)
D	represents the smallest internal diameter of the threaded section 14 (at the throat 32)
E	represents the core diameter of the female thread 28.

[0041] The following relationships hold good for rods in accordance with the invention:

A is less than B
B is up to 150% of E
C is 100 - 130% of E
D is 45 - 60% of E.

[0042] In addition to the features described above which reduce the susceptibility of the rod to stress cracking, the

external surface of the rod can be provided with external helically fluted portions 60, 62 (Figure 7). These fluted portions help to enhance the straightness of holes being drilled, by maintaining some contact with the walls of the hole while allowing flow of drilling fluid and drilling debris past the rod up the hole. The rod is thus held straight in the hole, so that the drill bit is always presented to the rock ahead in the correct orientation.

[0043] There may be one (60) or two (60,62) of these fluted portions on each rod.

[0044] It has surprisingly been found that the formation of the annular groove 42 helps to reduce stress concentrations in the female threaded end, these concentrations otherwise arising in the area of the last thread root and internal recess of the threaded region 28.

[0045] This resistance to failure is enhanced by the increased diameter of the region 40 and by the internal tapered surfaces at 34 and 36.

[0046] These measures cause a dispersion of the overall stress so that the stress of the critical point is reduced.

Claims

1. A tube rod for percussion rock drilling having threaded ends (12,14), the tube rod having a hollow bore and at least one of the ends (12) having a female thread, the major part (10) of the tube rod length between the threaded ends (12,14) having an outside diameter (the first diameter) and at least part of the or each female threaded end having an outside diameter (the second diameter) which is larger than the first diameter, **characterised in that** the tube rod includes an annular groove (42) between the female threaded end and the major part (10) of the tube rod length, the annular groove (42) having a root diameter (the third diameter) which is less than both the first and the second diameter, the hollow bore of the rod having a region (32,24,26) between the female threaded end and the major part (10) of the tube rod length where the internal diameter is less than at either side of this region.

2. A tube rod as claimed in Claim 1, wherein the second diameter is larger than the first diameter by between 2% to 6%

3. A tube rod as claimed in Claim 1 or Claim 2, wherein the groove (42) has an asymmetrical profile when seen in cross section parallel to the tube axis.

4. A tube rod as claimed in Claim 3, wherein the flank of the groove (42) nearest to the threaded end is steeper than the opposite flank.

5. A tube rod as claimed in any preceding claim, wherein one of the ends (12,14) has a female thread (28) and the other end has a male thread (44).

6. A tube rod as claimed in any preceding claim, wherein the hollow bore of the rod is reduced in internal diameter at the inner end of the female thread (28) to form a neck (32), and the bore diameter tapers outwards from the neck (32) to the full bore diameter of the major part of the tube rod length.

7. A tube rod as claimed in any preceding claim, wherein the internal diameter of the tube rod tapers from the major part (10) of the tube rod length down to the region of lesser internal diameter.

8. A tube rod as claimed in any preceding claim, wherein the internal diameter of the tube rod tapers from the female threaded end (28) down to the region of lesser internal diameter.

9. A tube rod as claimed in any preceding claim, wherein the female threaded end (28) has an internal shoulder (58) at right angles to the tube axis, and the internal tube bore tapers from the shoulder (58) down to the region of lesser internal diameter.

10. A tube rod as claimed in any one of Claims 7 to 9, wherein the or each taper of the internal diameter is a conical taper.

11. A tube rod as claimed in any one of Claims 7 to 9, wherein the or each taper of the internal diameter is a radiused taper.

12. A tube rod as claimed in any preceding claim, wherein the neck (32) or region of lesser diameter of the internal bore lies on substantially the same cross-section of the rod as the third (external) diameter of the rod.

13. A tube rod as claimed in Claim 12, wherein the third (external) diameter of the rod lies on a cross-section of the

rod which is offset from the centre of the neck (32) or region of lesser diameter in the direction towards the major part (10) of the tube rod length.

14. A tube rod as claimed in any preceding claim, wherein the threaded ends (12,14) are initially separate from the rod and are joined to a length of constant cross section tube by friction welded joints, the length of constant cross section forming the major part of the tube rod length.

15. A tube rod as claimed in claim 5, wherein the male threaded end (14) has a threaded region (44) extending from an annular shoulder (54), the shoulder (54) being adapted to abut against the end (24) of the female threaded end (12) of another rod when the two rods are screwed together, the male threaded region (44) being shorter than the female threaded recess so that when the male threaded end (14) is screwed into the female threaded end (12) of another rod until the shoulder abuts the end of the other rod, the male end does not reach the bottom of the female recess.

16. A tube rod as claimed in Claim 15, wherein the annular shoulder on the male threaded end section (14) is stepped and the mating end of a female threaded end section (12) of another rod has a shoulder such that when the rods are screwed together, the shoulders interengage to prevent substantial radial movement of one shoulder relative to the other.

17. A tube rod as claimed in any preceding claim, wherein the rod has at least one externally fluted section, the external diameter across the crests of the fluted section being equal to or larger than the second diameter.

18. A tube rod as claimed in Claim 17, wherein the externally fluted section forms the outside diameter of the female threaded end which is of the second diameter.

19. A tube rod assembly for percussion rock drilling, the assembly including a plurality of tube rods as claimed in claim 1 connected end to end by joints comprising interengaging male and female threads (44,28) wherein when the joints are assembled, an end (24) of a female threaded component is in contact with an external shoulder (54) on the adjacent male threaded component, the external shoulder having a circumferentially extending stepped land, with part of the end of the female threaded component fitting around the land to hinder relative radial movement between the two ends at the position of the shoulder.

20. A tube rod as claimed in any preceding claim, wherein

A	represents the first diameter
B	represents the second diameter
C	represents the third diameter
D	represents the smallest internal diameter of the female threaded section
E	represents the core diameter of the female thread in the female threaded end,

and wherein

A is less than B
B is up to 150% of E
C is 100 - 130% of E
D is 45 - 60% of E.

Patentansprüche

1. Bohrgestänge mit Innenrohr für Gesteinsschlagbohren mit Gewindeenden (12, 14), bei dem das Bohrgestänge mit Innenrohr eine Hohlbohrung und mindestens eines der Enden (12) ein Innengewinde hat, wobei der größere Teil (10) der Länge des Bohrgestänges mit Innenrohr zwischen den Gewindeenden (12, 14) einen Außendurchmesser (den ersten Durchmesser) und mindestens ein Teil des Innengewindeendes oder jedes Innengewindeende einen Außendurchmesser (den zweiten Durchmesser) hat, der größer als der erste Durchmesser ist, **dadurch gekennzeichnet, daß** das Bohrgestänge mit Innenrohr eine ringförmige Nut (42) zwischen dem Innengewindeende und dem größeren Teil (10) der Länge des Bohrgestänges mit Innenrohr beinhaltet, wobei die ringförmige

Nut (42) einen Wurzeldurchmesser (den dritten Durchmesser) hat, der kleiner als der erste und der zweite Durchmesser ist, wobei die Hohlbohrung des Bohrgestänges einen Bereich (32, 24, 26) zwischen dem Innengewindeende und dem größeren Teil (10) der Länge des Bohrgestänges mit Innenrohr aufweist, wo der Innendurchmesser kleiner als auf jeder Seite dieses Bereichs ist.

2. Bohrgestänge mit Innenrohr nach Anspruch 1, bei dem der zweite Durchmesser um 2% bis 6% größer als der erste Durchmesser ist.

3. Bohrgestänge mit Innenrohr nach Anspruch 1 oder Anspruch 2, bei dem die Nut (42), im Querschnitt parallel zur Rohrachse betrachtet, ein asymmetrisches Profil hat.

4. Bohrgestänge mit Innenrohr nach Anspruch 3, bei dem die dem Gewindeende am nächsten liegende Flanke der Nut (42) steiler als die gegenüberliegende Flanke ist.

5. Bohrgestänge mit Innenrohr nach einem der vorstehend aufgeführten Ansprüche, bei dem eines der Enden (12, 14) ein Innengewinde (28) und das andere Ende ein Außengewinde (44) hat.

6. Bohrgestänge mit Innenrohr nach einem der vorstehend aufgeführten Ansprüche, bei dem die Hohlbohrung des Bohrgestänges am inneren Ende des Innengewindes (28) einen reduzierten Innendurchmesser hat, um einen Hals (32) zu bilden, und der Bohrungsdurchmesser vom Hals (32) aus nach außen bis zum vollen Bohrungsdurchmesser des größeren Teils der Länge des Bohrgestänges mit Innenrohr kegelig verläuft.

7. Bohrgestänge mit Innenrohr nach einem der vorstehend aufgeführten Ansprüche, bei dem der Innendurchmesser des Bohrgestänges mit Innenrohr vom größeren Teil (10) der Länge des Bohrgestänges mit Innenrohr aus nach unten zum Bereich mit dem kleineren Innendurchmesser kegelig verläuft.

8. Bohrgestänge mit Innenrohr nach einem der vorstehend aufgeführten Ansprüche, bei dem der Innendurchmesser des Bohrgestänges mit Innenrohr vom Innengewindeende (28) aus nach unten zum Bereich mit dem kleineren Innendurchmesser kegelig verläuft.

9. Bohrgestänge mit Innenrohr nach einem der vorstehend aufgeführten Ansprüche, bei dem das Innengewindeende (28) eine in rechten Winkeln zur Rohrachse vorgesehene Innenschulter (58) hat und die Innenrohrbohrung von der Schulter (58) aus nach unten zum Bereich mit dem kleineren Innendurchmesser kegelig verläuft.

10. Bohrgestänge mit Innenrohr nach einem der Ansprüche 7 bis 9, bei dem die oder jede kegelige Ausbildung des Innendurchmessers eine konische Kegelausbildung ist.

11. Bohrgestänge mit Innenrohr nach einem der Ansprüche 7 bis 9, bei dem die oder jede kegelige Ausbildung des Innendurchmessers eine gerundete Kegelausbildung ist.

12. Bohrgestänge mit Innenrohr nach einem der vorstehend aufgeführten Ansprüche, bei dem der Hals (32) oder Bereich mit dem kleineren Durchmesser der Innenbohrung im wesentlichen im gleichen Querschnitt des Bohrgestänges wie der dritte (äußere) Durchmesser des Bohrgestänges liegt.

13. Bohrgestänge mit Innenrohr nach Anspruch 12, bei dem der dritte (äußere) Durchmesser des Bohrgestänges in einem Querschnitt des Bohrgestänges liegt, der vom Zentrum des Halses (32) oder Bereichs mit dem kleineren Durchmesser aus in der Richtung zum größeren Teil (10) der Länge des Bohrgestänges mit Innenrohr hin versetzt ist.

14. Bohrgestänge mit Innenrohr nach einem der vorstehend aufgeführten Ansprüche, bei dem die Gewindeenden (12, 14) zunächst vom Bohrgestänge getrennt sind und durch reibverschweißte Verbindungen zu einer Rohrlänge mit konstantem Querschnitt verbunden werden, wobei die Länge mit konstantem Querschnitt den größeren Teil der Länge des Bohrgestänges mit Innenrohr bildet.

15. Bohrgestänge mit Innenrohr nach Anspruch 5, bei dem das Außengewindeende (14) einen sich von einer ringförmigen Schulter (54) aus erstreckenden Gewindebereich (44) hat, wobei die Schulter (54) so ausgeführt ist, daß sie an das Ende (24) des Innengewindeendes (12) eines anderen Bohrgestänges stößt, wenn die beiden Bohrgestänge miteinander verschraubt werden, wobei der Außengewindebereich (44) kürzer als der Innengewinde-

rücksprung ist, so daß, wenn das Außengewindeende (14) in das Innengewindeende (12) eines anderen Bohrgestänges hineingeschraubt wird, bis die Schulter an das Ende des anderen Bohrgestänges stößt, das Außengewindeende nicht den Boden des Innengewinderücksprungs erreicht.

16. Bohrgestänge mit Innenrohr nach Anspruch 15, bei dem die ringförmige Schulter am Außengewindeendeabschnitt (14) stufenförmig ausgebildet ist und das passende Ende eines Innengewindeendeabschnitts (12) eines anderen Bohrgestänges eine Schulter aufweist, so daß, wenn die Bohrgestänge miteinander verschraubt werden, die Schultern ineinandergreifen, um eine wesentliche radiale Bewegung einer Schulter im Verhältnis zur anderen zu verhindern.

17. Bohrgestänge mit Innenrohr nach einem der vorstehend aufgeführten Ansprüche, bei dem das Bohrgestänge mindestens einen außen gerippten Abschnitt hat, wobei der Außendurchmesser an den Kronen des gerippten Abschnitts gleich groß oder größer als der zweite Durchmesser ist.

18. Bohrgestänge mit Innenrohr nach Anspruch 17, bei dem der außen gerippte Abschnitt den Außendurchmesser des Innengewindeendes bildet, das den zweiten Durchmesser aufweist.

19. Bohrgestängeeinheit mit Innenrohr zum Gesteinsschlagbohren, bei der die Einheit mehrere Bohrgestänge mit Innenrohren nach Anspruch 1 beinhaltet, deren Enden durch Verbindungen miteinander verbunden sind, die ineinandergreifende Außen- und Innengewinde (44, 28) umfassen, wobei, wenn die Verbindungen hergestellt sind, ein Ende (24) eines Innengewindebauteils in Kontakt mit einer Außenschulter (54) am angrenzenden Außengewindebauteil steht, wobei die Außenschulter einen sich am Umfang erstreckenden, stufenförmig ausgebildeten Ansatz hat, wobei ein Teil des Endes des Innengewindebauteils am Ansatz anliegt, um eine relative radiale Bewegung zwischen den beiden Enden an der Position der Schulter zu verhindern.

20. Bohrgestänge mit Innenrohr nach einem der vorstehend aufgeführten Ansprüche, bei dem

A	den ersten Durchmesser repräsentiert;
B	den zweiten Durchmesser repräsentiert;
C	den dritten Durchmesser repräsentiert;
D	den kleinsten Innendurchmesser des Innengewindeabschnitts repräsentiert; und
E	den Kerndurchmesser des Innengewindes im Innengewindeende repräsentiert;

und wobei:

A kleiner als B ist;
B bis zu 150% von E beträgt;
C 100 bis 130% von E beträgt; und
D 45 bis 60% von E beträgt.

Revendications

1. Fleuret tubulaire pour forage à percussion de roches ayant des extrémités filetées (12, 14), le fleuret tubulaire ayant un alésage creux et au moins l'une des extrémités (12) ayant un filetage femelle, la partie principale (10) de la longueur du fleuret tubulaire entre les extrémités filetées (12, 14) ayant un diamètre extérieur (le premier diamètre) et au moins une partie de la ou de chaque extrémité à filetage femelle ayant un diamètre extérieur (le deuxième diamètre) qui est supérieur au premier diamètre, **caractérisé en ce que** le fleuret tubulaire inclut une rainure annulaire (42) entre l'extrémité à filetage femelle et la partie principale (10) de la longueur du fleuret tubulaire, la rainure annulaire (42) ayant un diamètre à fond de gorge (le troisième diamètre) qui est inférieur à la fois au premier et au deuxième diamètres, l'alésage creux du fleuret comportant une région (32, 24, 26) entre l'extrémité à filetage femelle et la partie principale (10) de la longueur du fleuret tubulaire où le diamètre intérieur est inférieur au diamètre de chaque côté de cette région.

2. Fleuret tubulaire selon la revendication 1, dans lequel le deuxième diamètre est plus grand que le premier diamètre de 2 à 6%.

3. Fleuret tubulaire selon la revendication 1 ou 2, dans lequel la rainure (42) a un profilé asymétrique vu en coupe transversale parallèlement à l'axe du tube.

4. Fleuret tubulaire selon 1a revendication 3, dans lequel le flanc de la rainure (42) le plus proche de l'extrémité filetée est plus raide que le flanc opposé.

5. Fleuret tubulaire selon l'une quelconque des revendications précédentes, dans lequel l'une des extrémités (12, 14) a un filetage femelle (28) et l'autre extrémité a un filetage mâle (44).

6. Fleuret tubulaire selon l'une quelconque des revendications précédentes, dans lequel le diamètre intérieur de l'alésage creux du fleuret est réduit sur l'extrémité intérieure du filetage femelle (28) pour former une gorge (32), et le diamètre de l'alésage diminue progressivement vers l'extérieur depuis la gorge (32) pour atteindre le diamètre total de l'alésage de la partie principale de la longueur du fleuret tubulaire.

7. Fleuret tubulaire selon l'une quelconque des revendications précédentes, dans lequel le diamètre intérieur du fleuret diminue progressivement depuis la partie principale (10) de la longueur du fleuret tubulaire jusqu'à la région de diamètre intérieur réduit.

8. Fleuret tubulaire selon l'une quelconque des revendications précédentes, dans lequel le diamètre intérieur du fleuret diminue progressivement depuis l'extrémité à filetage femelle (28) jusqu'à la région de diamètre intérieur réduit.

9. Fleuret tubulaire selon l'une quelconque des revendications précédentes, dans lequel l'extrémité à filetage femelle (28) a un épaulement intérieur (58) à angles droits par rapport à l'axe du tube, et l'alésage intérieur du tube diminue progressivement depuis l'épaulement (58) jusqu'à la région de diamètre intérieur réduit.

10. Fleuret tubulaire selon l'une quelconque des revendications 7 à 9, dans lequel la diminution ou chaque diminution du diamètre intérieur est une diminution conique.

11. Fleuret tubulaire selon l'une quelconque des revendications 7 à 9, dans lequel la diminution ou chaque diminution du diamètre intérieur est une diminution arrondie.

12. Fleuret tubulaire selon l'une quelconque des revendications précédentes, dans lequel la gorge (32) ou région de diamètre réduit de l'alésage intérieur repose sur sensiblement la même section transversale du fleuret que le troisième diamètre (extérieur) du fleuret.

13. Fleuret tubulaire selon la revendication 12, dans lequel le troisième diamètre (extérieur) du fleuret repose sur une section transversale du fleuret qui est décalée par rapport au centre de la gorge (32) ou région de diamètre réduit en direction de la partie principale (10) de la longueur du fleuret tubulaire.

14. Fleuret tubulaire selon l'une quelconque des revendications précédentes, dans lequel au départ les extrémités filetées (12, 14) sont séparées du fleuret, puis assemblées sur une longueur du tube ayant une section transversale constante par des assemblages soudés par friction, la longueur à section transversale constante formant la partie principale de la longueur du fleuret tubulaire.

15. Fleuret tubulaire selon la revendication 5, dans lequel l'extrémité (14) à filetage mâle possède une région filetée (44) s'étendant depuis un épaulement (54) annulaire, l'épaulement (54) étant adapté pour buter contre l'extrémité (24) de l'extrémité (12) à filetage femelle d'un autre fleuret quand les deux fleurets sont vissés ensemble, la région (44) à filetage mâle étant plus courte que l'évidement à filetage femelle de façon que, quand l'extrémité (14) à filetage mâle est vissée dans l'extrémité (12) à filetage femelle d'un autre fleuret jusqu'à ce que l'épaulement touche l'extrémité de l'autre fleuret, l'extrémité mâle n'atteigne pas le fond de l'évidement femelle.

16. Fleuret tubulaire selon la revendication 15, dans lequel l'épaulement annulaire sur la section d'extrémité (14) à filetage mâle est en gradins et l'extrémité appariée d'une section d'extrémité (12) à filetage femelle d'un autre fleuret a un épaulement de sorte que, quand les fleurets sont vissés ensemble, les épaulements coopèrent pour empêcher un mouvement sensiblement radial d'un épaulement par rapport à l'autre.

17. Fleuret tubulaire selon l'une quelconque des revendications précédentes, dans lequel le fleuret a au moins une

section cannelée sur l'extérieur, le diamètre extérieur sur les sommets de la section cannelée étant supérieur ou égal au deuxième diamètre.

18. Fleuret tubulaire selon la revendication 17, dans lequel la section cannelée sur l'extérieur forme le diamètre extérieur de l'extrémité à filetage femelle qui est le deuxième diamètre.

19. Ensemble de fleuret tubulaire pour forage à percussion de roches, l'ensemble comprenant une pluralité de fleurets tubulaires selon la revendication 1 reliés bout à bout par des assemblages comprenant des filetages mâle et femelle (44, 28) coopérant, dans lequel lorsque les assemblages sont assemblés, une extrémité (24) d'un élément à filetage femelle est en contact avec un épaulement (54) extérieur sur l'élément adjacent à filetage mâle, l'épaulement extérieur ayant une lèvre en gradins s'étendant sur la circonférence, une partie de l'extrémité de l'élément à filetage femelle s'adaptant autour de la lèvre pour empêcher un mouvement radial relatif entre les deux extrémités à l'emplacement de l'épaulement.

20. Fleuret tubulaire selon l'une quelconque des revendications précédentes, dans lequel

A représente le premier diamètre
B représente le deuxième diamètre
C représente le troisième diamètre
D représente le plus petit diamètre intérieur de la section à filetage femelle
E représente le diamètre à fond de filet du filetage femelle de l'extrémité à filetage femelle,

et dans lequel

A est inférieur à B
B peut atteindre 150% de E
C correspond à 100 - 130% de E
D correspond à 45 - 60% de E.

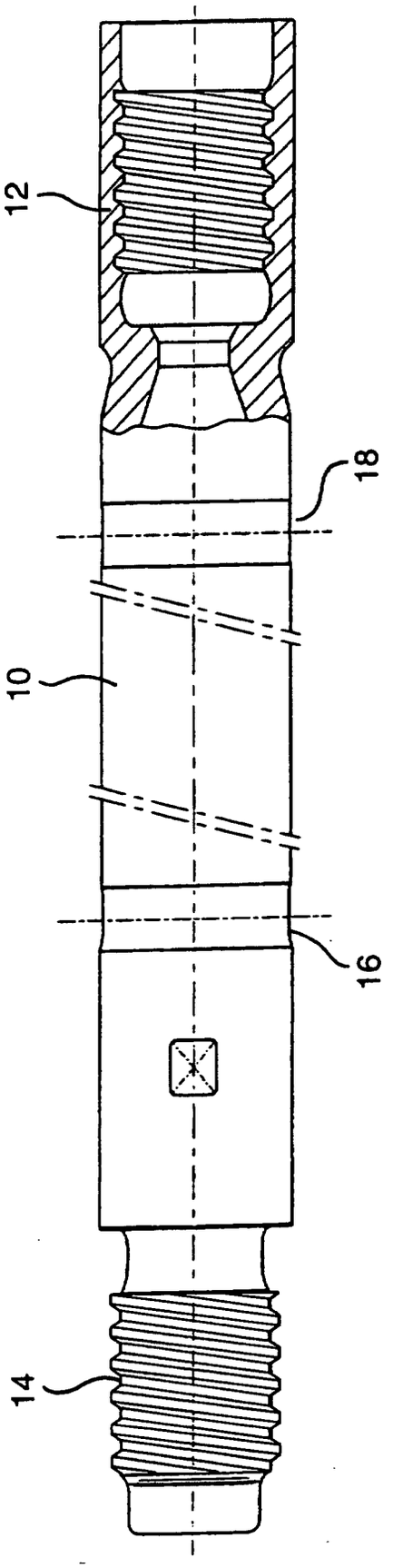

Fig. 1

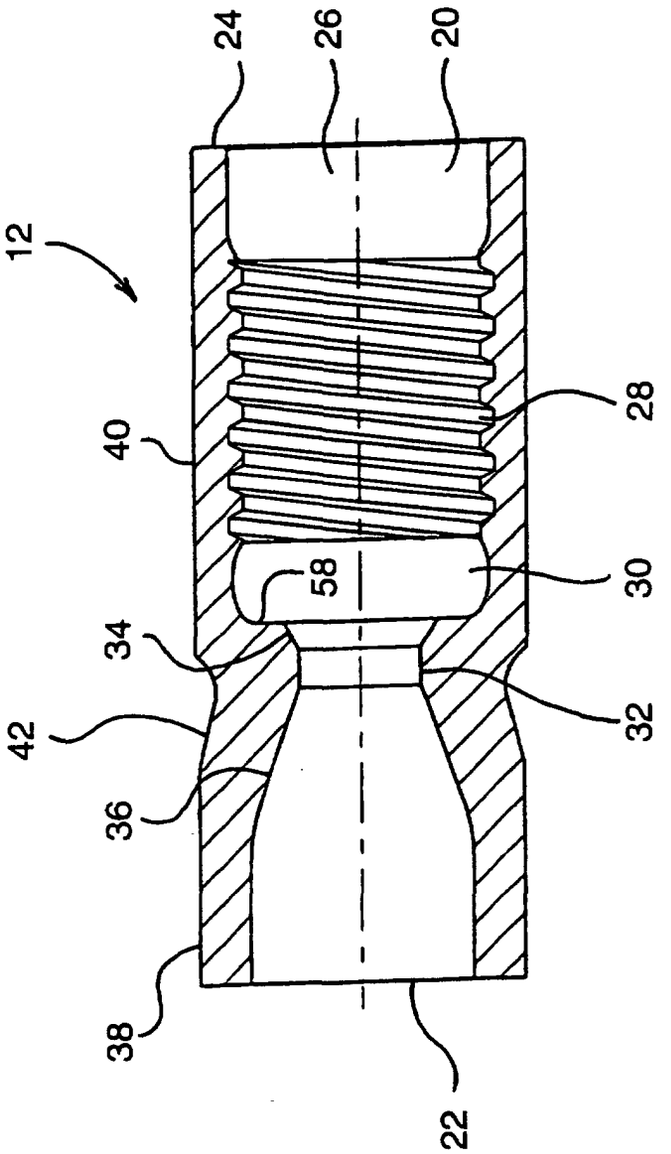

Fig. 2

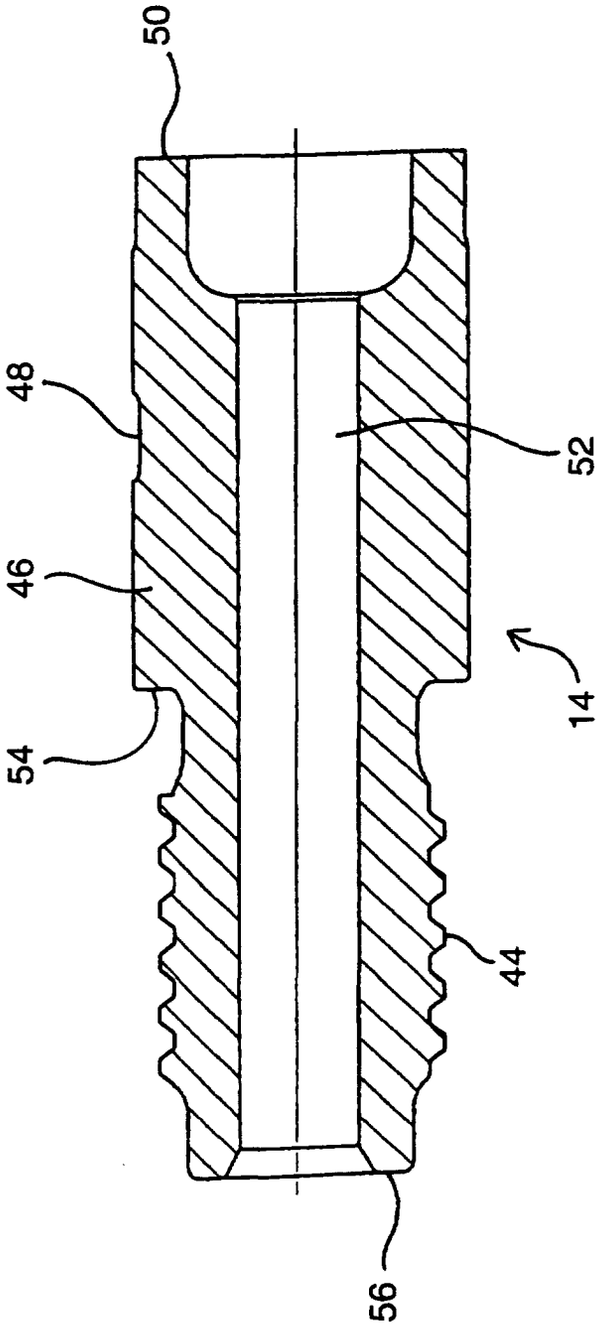

Fig. 3

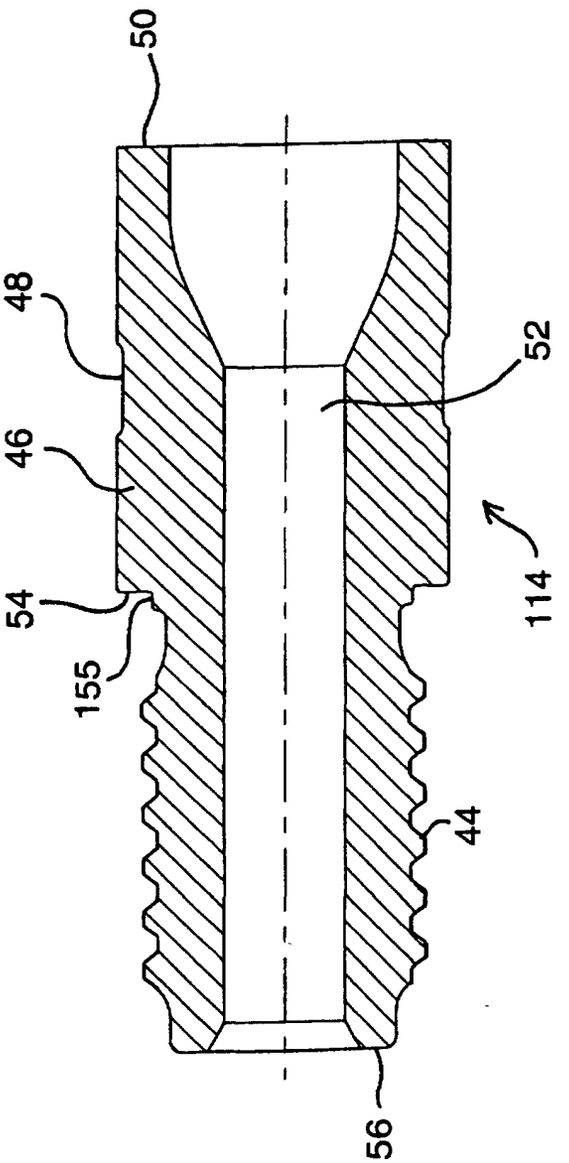

Fig. 4

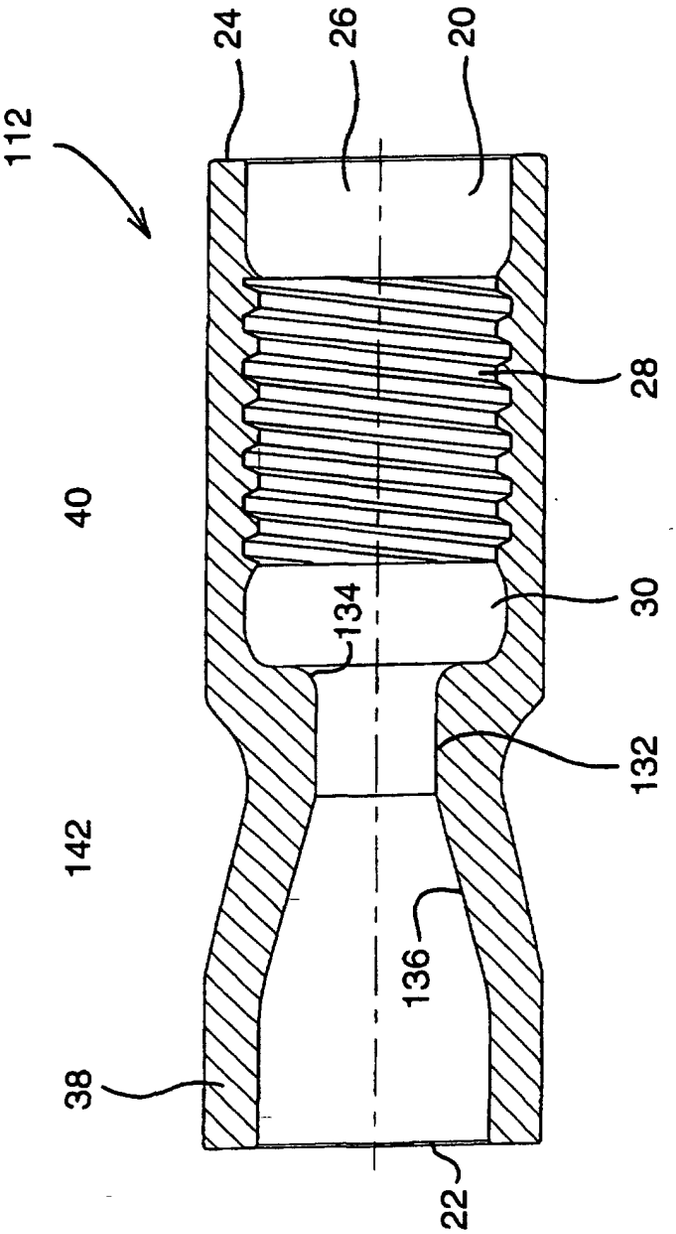

Fig. 5

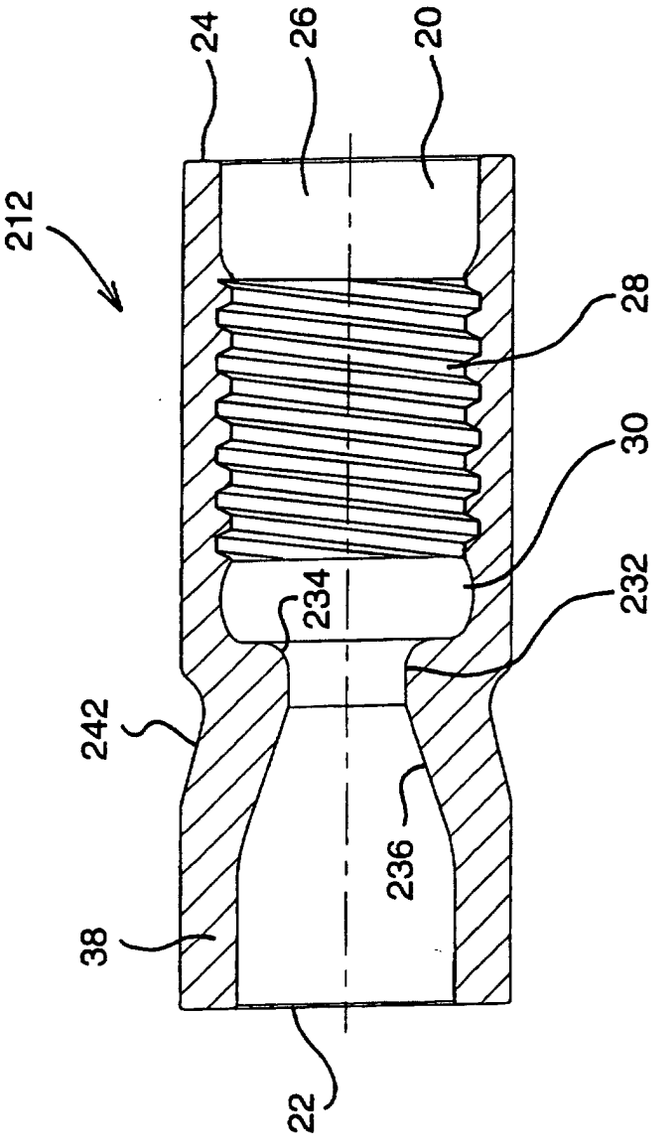

Fig. 6

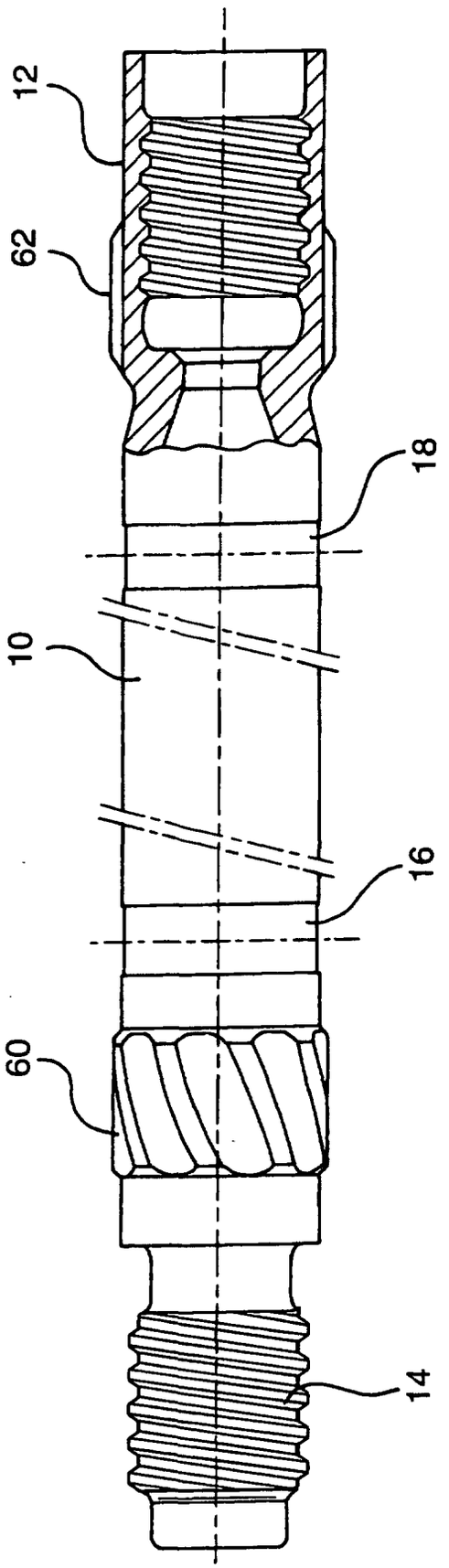

Fig. 7