Nov. 3, 1970 H. C. P. FISCHER ET AL 3,537,738

DRILL ROD FOR LONG HOLE DRILLING IN THE GROUND

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Fig.1

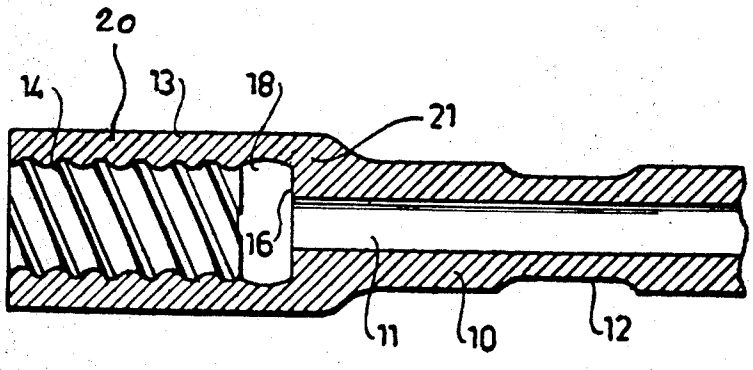
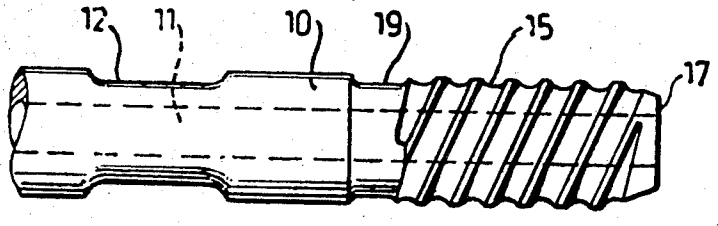


Fig.2



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DRILL ROD FOR LONG HOLE DRILLING IN THE GROUND

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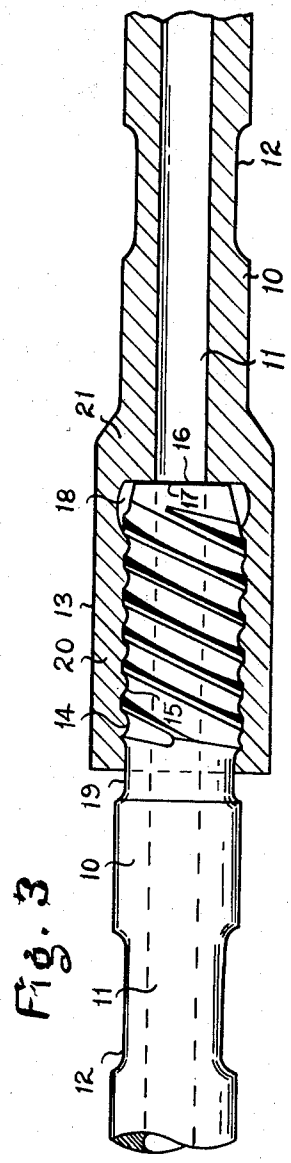


Fig. 3

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ABSTRACT OF THE DISCLOSURE

Extension drill rod for percussion drilling having at one end a cylindrical external thread with an external diameter that is in the main the same as the external diameter of the main part of the rod, and at the other end having a socket portion with an internal cylindrical thread matching the said external thread, the external diameter of the socket portion being greater than the external diameter of the main part of the rod. The rod has a coaxial flushing channel. Each rod is characterized by the following combination of features:

(a) the thread has a wave-shaped, high-pitched longitudinal profile;
(b) the socket portion is forged integrally in one piece with the rod;
(c) the bottom of the socket portion constitutes an annular plane abutment surface, the end surface of the externally threaded end having an abutting matching annular plane abutment surface and the width between the inner and outer edges of the abutment surfaces being approximately equal to the radius of the flushing channel; and
(d) the abutment surfaces and the threads form the only axial abutments between two adjacent rods when they are screwed together.

The present invention relates to a drill rod for percussion drilling of long holes in the ground, for instance in solid rock, the rod being composed of a series of shorter rods, or so-called extension rods, which are coupled together with threaded connections. Previously it has been usual to provide both ends of the extension rods with external threads and couple them together by means of separate, internally threaded coupling sleeves. According to the invention the extension rods have an external thread only at one end, the other end being provided with an internally threaded sleeve portion, which is integral with the rod. This implies that the number of parts in the drill rod is diminished and that the connections are more rigid than in conventional rods.

SUMMARY

The invention consists in an extension drill rod for percussion drilling having at one end a cylindrical external thread with an external diameter that is in the main the same as the external diameter of the main part of the rod, and at the other end having a socket portion with an internal cylindrical thread matching the said external thread, the external diameter of the socket portion being greater than the external diameter of the main part of the rod. The rod has a coaxial flushing channel. Each rod is characterized by the following combination of features:

(a) the thread has a wave-shaped, high-pitched longitudinal profile;
(b) the socket portion is forged integrally in one piece with the rod;
(c) the bottom of the socket portion constitutes an annular plane abutment surface, the end surface of the externally threaded end having an abutting matching annular plane abutment surface and the width between the inner and outer edges of the abutment surfaces being approximately equal to the radius of the flushing channel; and
(d) the abutment surfaces and the threads form the only axial abutments between two adjacent rods when they are screwed together.

Additional advantages and closer details of the invention appear from the following specification with drawing figures which show:

FIG. 1 a longitudinal section of one end of an extension rod comprising an internally threaded sleeve,

FIG. 2 a longitudinal plan view of the other end of the other end of the same extension rod said end having an external thread, and

FIG. 3 is a view showing two extension rods in coupled-together relation.

The extension rod **10** shown in FIGS. 1 and 2 has a centrally situated cylindrical flushing channel **11** for leading a flushing medium, usually air or water, along the drill rod. The illustrated extension rod has a cylindrical outside and in order to hold the rods when they are being coupled together they are provided with wrench grips **12**. The rods may instead have a polygonal outside, in which case no separate wrench grips are needed.

The end of the rod shown in FIG. 1 has a widened sleeve portion **13**, which usually is formed by forging. The portion **13** has a bore with an internal thread **14**. The other end of the extension rod, shown in FIG. 2, has an external thread **15**. The internal and external threads match each other, so that an arbitrary number of extension rods can be coupled together and form a long drill rod by screwing the external rod thread **15** of each rod into the internal sleeve thread **14** of the adjacent rod. During drilling the extension rods are added one at a time at the rear end of the drill rod as the drilling proceeds. The fore end of the drill rod is provided with a drill bit and the rear end is provided with a shank adapter for connection to the drilling machine. The bit and the shank adapter may be of any known type and as they form no part of the invention they are not illustrated.

The threads may be of any type suitable for drill rods for percussion drilling. They should have a relatively high pitch, usually at least 10 mm. In a longitudinal section the thread flanks may have different inclinations (buttress threads) or the same inclination. The longitudinal thread section may have a wholly rounded contour. Another possibility is that only the flanks are rounded, the tops being flat. The thread may have one, two or more entries.

A suitable type of thread in the present connection is one having equally inclined rounded flanks and flattened tops, contact between the coupled threads being established only at the flanks but not between the tops and the bottoms. The thread has two or more entries and has thus a high pitch. This type of thread is especially suitable because even if the drilling torque is high, and the threads are tightly screwed together, it is nevertheless relatively easy to separate them.

The annual bottom surface **16** of the sleeve portion

13 should match the end surface 17 of the rod shaped end, said surfaces being in contact with each other when the threads are screwed together, as is shown in FIG. 3. In order to make sure that this contact is established the threads should have a cylindrical shape, i.e. a constant distance from the drill rod axis. The surfaces 16 and 17 are suitably plane but they may have some other shape, for instance conical. Usually the width between the outer and the inner edges of the annular contact surfaces 16 and 17 is approximately equal to the radius of the flushing channel, said radius in general being 6–8 mm. That end of the extension rod which bears external threads 15 is somewhat beveled or tapered adjacent end surface 17, for easy entry into the sleeve member of another (similar) extension rod, so that the actual area of the contact between surfaces 16 and 17 is usually ⅓–⅔ of the total solid cross section area of the rod.

The extension rods are usually 2–4, often about 3 meters long. Each thread has a length which is up to 10%, often 2–6% of the length of the extension rod. In other words it can be said that the length of each thread is 2–4, preferably 2.5–4 times the diameter of the rod. A common length of the thread is about 10 cm. The rod thread 15 should have a diameter, measured between opposite tops, which is equal to or slightly smaller than the rod diameter in case the rod is cylindrical or the diameter of the inscribed cylinder in case the rod is polygonal. This thread dimension permits rethreading when the original thread is worn out, and provides at the same time as great a wall thickness as possible of the threaded rod portion. The tops of the external thread will lie approximately flush with the outer surface of the rod.

The wall of the sleeve portion should have a thickness which is at least ¼ of the rod diameter and a cross section area which is at least as great as the solid area of the rod. The sleeve portion 13 has a portion 20 surrounding the thread 14 which is larger than the rod and usually has a cylindrical outside. This portion 20 is connected to the rod by a tapering portion 21, the distance between the bottom surface 16 and the end of said tapering portion being approximately equal to or somewhat greater than the radius of the rod.

The integral sleeve according to the invention implies several advantages in comparison with separate coupling sleeves. The integral sleeve gives a greater rigidly and less bending of the rod. It is shorter and has a smaller mass, thus lessening the energy losses during drilling. When detaching a joint it has earlier been a problem to make the sleeve remain on the desired rod. In vertical drilling it is desirable that the sleeve remains on the lower rod. With an integral sleeve this is no problem, as the sleeve always can be placed on the upper end of the lower rod. A separate sleeve has a certain play along the threads and moves back and forth during drilling causing wear of the thread, but this does of course not occur with an integral sleeve. Furthermore the number of rod parts is reduced by the use of integral sleeves and the coupling of the joints is facilitated.

In order to make the threads more wear resistant it is suitable to harden a surface layer of the threads to a higher hardness than the underlying material.

The extension rods according to the invention should be made of a material which has a high fatique resistance, and to this end alloyed steels capable of tough hardening and case hardening are used. Common alloys for this purpose are low alloyed chromium-nickel or chromium-molybdenum steels. As an example of an analysis of a suitable chromium-nickel steel can be mentioned 0.25% C, 0.50% Mn, 0.25% Si, 1.2% Cr, 0.25% Mo and 3.0% Ni, the remainder being iron, and analysis of a suitable chromium-molybdenum steel being 0.25% C, 0.30% Si, 0.60% Mn, 3.2% Cr and 0.55% Mo, and the remainder iron.

The suitable steel cannot be welded, and consequently the extension rods according to the invention have to be made in one piece, the sleeve portion being formed by forging the end of the rod to the desired shape, after which the thread is machined.

Very satisfactory results have been obtained by the present invention, the drilling holes being more straight and the efficiency of the drill being better than in previous conventional drill rods, the connection and disconnection of the extesion rods also being substantially simplified. The drill rod according to the invention has a penetration rate which is considerably larger than the penetration rate of conventional rods for percussion drilling.

In some cases the externally threaded end may be slightly widened by forging, so that the external thread has its tops somewhat outside the outer surface of the rod.

We claim:

1. A percussion drill string constituted by a plurality of individual drill rods normally coupled together in end to end relation, each said drill rod having at one end a cylindrical external thread with an external diameter that is in the main the same as the external diameter of the main part of the rod, and at the other end having a socket portion with an internal cylindrical thread matching the said external thread, the external diameter of the socket portion being greater than the external diameter of the main part of the rod, the rod further having a coaxial flushing channel, each said drill rod being further characterized by the following combination of features:
   (a) the thread has a wave-shaped high pitched longitudinal profile;
   (b) the socket portion is forged integrally in one piece with the rod and the wall thereof has a cross-sectional area which is at least as great as is the solid cross-sectional area of the rod;
   (c) the bottom of the socket portion constitutes an annular abutment surface, the end surface of the externally threaded end having an abutting matching annular abutment surface, the area of said abutment surfaces amounting to from ⅓ to ⅔ of the solid cross-sectional area of the rod;
   (d) said abutment surfaces and said threads form the only axial abutments between two adjacent rods when they are screwed together.

2. An extension drill rod for percussion drilling having at one end a cylindrical external thread with an external diameter that is in the main the same as the external diameter of the main part of the rod, and at the other end having a sleeve portion with an internal thread matching the said external thread, the external diameter of the sleeve portion being greater than the external diameter of the main part of the rod, the rod further having a coaxial flushing channel, said extension drill rod being further characterized by the following combination of features:
   (a) the thread has a wave-shaped, high-pitched longitudinal profile;
   (b) the sleeve portion is forged integrally in one piece with the rod;
   (c) the bottom of the sleeve portion constitutes an annular abutment surface, the end surface of the externally threaded end having an abutting matching annular abutment surface;
   (d) said abutment surfaces and said threads form the only axial abutments between two similar rods when they are screwed together.

3. Extension rod as defined in claim 2 in which the annular abutment surfaces are plane.

4. An extension drill rod for percussion drilling having at one end a cylindrical external thread with an external diameter that is in the main the same as the external diameter of the main part of the rod, and at the other end having a socket portion with an internal cylindrical thread matching the said external thread, the ex-

ternal diameter of the socket portion being greater than the external diameter of the main part of the rod, the rod further having a coaxial flushing channel, each said drill rod being further characterized by the following combination of features:

(a) the thread has a wave-shaped, high-pitched longitudinal profile;

(b) the socket portion is forged integrally in one piece with the rod;

(c) the bottom of the socket portion constitutes an annular plane abutment surface, the end surface of the externally threaded end having an abutting matching annular plane abutment surface and the width between the inner and outer edges of said abutment surfaces being approximately equal to the radius of said flushing channel;

(d) said abutment surfaces and said threads form the only axial abutments between two adjacent rods when they are screwed together.

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