Aug. 12, 1952 J. S. MYHRE 2,606,778

ROCK DRILL ROD JOINT

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Fig. 1

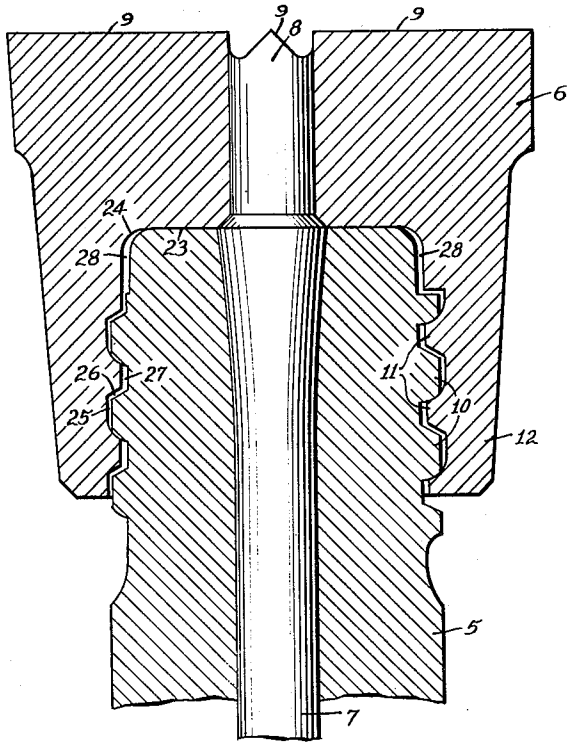


Fig. 2

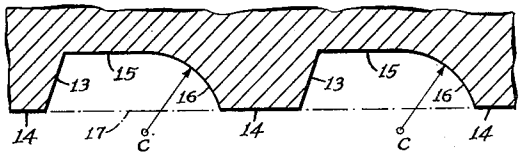


Fig. 3

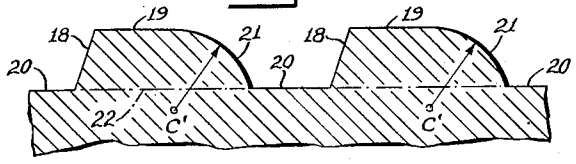
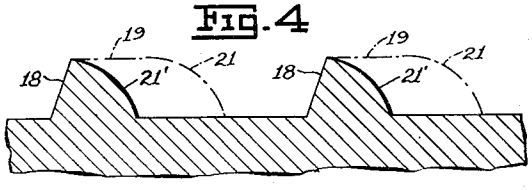


Fig. 4



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ROCK DRILL ROD JOINT

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This invention relates to rock drills and provides an improved design of screw thread for securing detachable rock bits to drill rods. The invention further provides an improved drilling procedure, in rock-drilling operations involving the use of detachable screw-threaded bits, characterized in that each bit, as it becomes dulled from use, is replaced with only a new previously unused bit.

Detachable bits for rock drills first gained commercial acceptance about twenty years ago. Prior to that time commercial rock-drilling operations were performed with a drill rod having the bit formed integrally at one end. By far the greater weight of steel in such drills was employed in making the long drill rod, and only a small portion was required to make the integral bit at the end of the rod. Since it was uneconomical to discard the entire drill rod when the bit became dulled, it was the practice to recondition worn drills by sharpening the bit as many times as possible before discarding the drill.

It was long recognized that if a satisfactory detachable bit could be produced, the drill rod could be saved and only the bit discarded when the latter wore out. After a considerable period of development, reasonably satisfactory detachable bits were finally produced. Various means for securing such bits to the drill rod were devised, but the screw-thread mode of attachment has proved most satisfactory.

In developing the detachable bit, the idea of reconditioning the bit several times before discarding it was carried over from the practice that prevailed previously when integral drill rods and bits were commonly used. It was reasoned that if it were economical to recondition integral bits several times before discarding them, it would also be economical to recondition detachable bits several times before discarding them.

As a result of long experience with detachable bits used under a wide variety of conditions it has become apparent to me that, whatever economies are achieved by reconditioning detachable bits, are offset by the disadvantages inherent in this practice. These disadvantages may be summarized as follows:

(1) Even the best presently available detachable bits are likely to jam on the drill rod, particularly after they have been reconditioned and reused several times. The customary practice in using detachable bits has involved replacing the bit on the drill rod fairly frequently at the scene of drilling operations, as at the working face of a mine. Conditions there are far from ideal for removing the bit if it has become jammed very

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tightly on the drill rod. The removal of jammed bits under such conditions consumes the time of the drilling crew, resulting in loss of production, and creates an attitude of exasperation on the part of the drilling crew which impairs their productive effort.

(2) After a bit has once been used, its threads are never in as good condition as when the bit was new. The repeated hammer blows to which the bit is subjected in use tend to deform the relatively thin bit skirt and the threads formed thereon. If the bit threads are deformed when the bit is attached to the drill rod, some corresponding deformation of the drill rod threads may be caused during use of the drill, and at the same time a little further deformation of the bit threads may occur. When this same bit, after resharpening, is attached to another drill rod on which the threads have been slightly, but differently, deformed, serious jamming of the bit on the rod may occur. Thus the common practice of using reconditioned bits with slightly deformed threads, and using them after each reconditioning on a (probably) different drill rod, is a major cause of jamming and of deformation of the drill rod threads. Deformation of the drill rod threads in this manner may necessitate replacement of the drill rod long before it becomes otherwise unserviceable.

(3) Repeated attachment of reconditioned bits, each with slightly but differently deformed threads, to a given drill rod results in excessive, and particularly in uneven wear of the drill rod threads. This leads to the necessity of replacing the drill rod sooner than would be necessary if such excessive and uneven wear on its threads did not occur, and does so even though the drill rod threads are not otherwise deformed.

(4) It has been fairly common practice to leave the drill rods at the scene of drilling operations, and to carry only the detachable bits back and forth to the reconditioning shop. This practice often resulted in leaving drill rods with their threads exposed at the scene of drilling operations for considerable periods of time, as overnight or over a week-end. Mechanical injury to and corrosion of such unprotected drill rod threads may easily lead to loss of the drill rod sooner than should be the case.

(5) Even before the drill rod must be discarded on account of deformation, uneven wear, corrosion or other damage to its threads, it becomes a costly tool to use because of the increased tendency for bits to jam on it.

Because of the foregoing disadvantages to the

practice of reconditioning drill bits several times before discarding them, it has become evident that greater true economy can be realized by keeping the bit on the drill rod until it is completely worn out, and then replacing it only with a new bit. The threads of the bit are always in the best condition when it is new, and new bits consequently are easy to attach to the drill rod. Such deformation as occurs to the threads of a new bit during use is not likely to deform or otherwise damage the drill rod threads. Removal of a bit that has been attached only once to a drill rod that has never received any but new bits is much easier than removal of a bit that has been reconditioned and reused several times, perhaps each time on a different drill rod. When the bit is removed only after it has been finally worn out and is ready to be discarded, it is easy to mount a new bit on the drill rod immediately after removing the old bit. As a result, the drill rods are not left lying in moist or corrosive atmospheres, or in places where the drill rod threads might be injured, without having their threads protected by a bit attached to the rod.

Based on the foregoing findings, which are the result of long experience with practical commercial use of detachable rock drill bits, the invention provides the improvement, in rock-drilling operations involving the use of screw-threaded detachable bits and drill rods, which comprises replacing each bit as it becomes dulled from use on the drill rod only with a new previously unused bit.

The advantage of saving the drill rod after the bit has worn out, which is the major advantage in use of detachable bits, is of course retained in the new practice of removing the bit from the rod only after the bit has been finally worn out and is not to be reconditioned. In fact, this advantage is achieved to an even greater degree, because injury to the drill rod threads is minimized and the drill rod accordingly can give longer service.

The screw threads heretofore designed for attaching rock bits to drill rods have been developed with the idea that the bit would be reconditioned and reused several times before being discarded. I have found that these heretofore known thread designs are not entirely satisfactory for use in conjunction with a drill primarily intended to be attached only once to the drill rod and discarded after it has worn out. The present invention therefore provides an improved screw-threaded attachment for securing a rock bit to a drill rod, which is well adapted to the practice of discarding each bit after it has once been removed from a drill rod.

In the assembly of a rock drill and bit in accordance with the invention, one of the components of the assembly (usually the drill rod) is provided with a male thread that in profile has a substantially flat forward face, a substantially flat horizontal crest, a substantially flat horizontal root, and a rearward face that is curved about a center of curvature lying below the root line of the thread. The corresponding female thread on another component of the assembly (usually the bit) has in profile a substantially flat rearward face, a substantially flat horizontal crest, a substantially flat horizontal root, and a forward face curved about a center of curvature lying above the crest line of the thread. It is best to form the male and female threads to such dimensions relative to one another that the forward face, crest, and root of the male thread is spaced from contact with the rearward face, root and crest, respectively, of the female thread when the elements are screwed firmly together. The curved rearward face of the male thread and the curved forward face of the female thread then provide the only areas of contact between the mating threads. Curvature of the contacting areas of the mating threads in the manner described serves to center the externally threaded element accurately in the internally threaded recess of the other element, thus insuring maintenance of proper clearance at the proper places about the thread and elsewhere in the joint between drill rod and bit.

In a thread of the character described, such wear that occurs on the drill rod thread is confined to its curved rearward face. By making the male thread on the drill rod with a wide flat horizontal crest, the thread can wear considerably without changing its basic contour, but only its width, and hence without impairing its ability to receive and securely hold replacement bits. Since in accordance with the practice herein described, only new bits are tightened on the drill rod, there is little danger that the wear accompanying repeated bit replacement will seriously alter the basic profile of the drill rod thread.

The invention is described below with reference to the accompanying drawings, in which

Fig. 1 is a cross section through the threaded end of a drill rod and through a bit attached thereto;

Figs. 2 and 3 are cross sections showing, on an enlarged scale, the profile of female and male threads configured in accordance with the invention; and

Fig. 4 is a cross section indicating the extent to which the male thread on the drill rod may wear before the drill rod need be discarded.

The rock drill assembly shown in section in Fig. 1 comprises a drill rod 5 (only the threaded end portion of the drill rod is shown) to which a bit 6 is attached by means of interengaging screw threads. The drill rod is shown as formed with the usual axial water passage 7 registering with a similar water passage 8 in the bit so that water may be pumped into the hole being drilled while drilling operations are proceeding. The bit is formed with the usual sharp cutting edges 9.

The screw-thread attachment of the bit to the drill rod is effected by male threads 10 formed on the drill rod engaging with corresponding female threads 11 formed interiorly of the bit skirt 12 (the bit skirt defines a recess or socket in which the threaded end of the drill rod 5 is received).

The profile contour of the helical female thread formed in the bit skirt is shown on an enlarged scale in Fig. 2. This thread has a substantially flat rearward face 13, a substantially flat crest 14, a substantially flat root 15, and a curved forward face 16. The curvature of the forward face 16 is substantially that of the arc of a circle, having its center of curvature C lying at a point above the crest line of the thread. (In referring to the center curvature C as being "above" the crest line of the thread, I mean that it lies at a point in space beyond the boundary of the metal, defined by the crest line, in which the thread is formed.) The crest line of the thread is of course the projection 17 of the line defining the flat crest of the threads. The arrows in Fig. 2 indicate the radius of curvature of the thread forward face 16.

The helical male thread formed on the drill rod 5 is shown in profile on an enlarged scale in

Fig. 3. This thread generally corresponds to the female thread shown in Fig. 2. It has a substantially flat forward face 18, a substantially flat crest 19, and a substantially flat root 20. The rearward face 21 of the male thread is curved through the arc of a circle about a center of curvature C' lying below the root line of the thread. (In stating that the center of curvature C' lies "below" the root line of the thread, I mean that it lies on that side of the root line that is toward the body of metal on which the thread is formed.) The root line of the thread is of course the projection 22 of the flat thread root 20. The radius of curvature of the rearward face 21 of the male thread (indicated by the arrows in Fig. 3) should be substantially the same as the radius of curvature of the forward face 16 of the female thread.

The flat rearward face 18 of the male thread and the corresponding flat forward face 13 of the female thread are shown as sloping at an angle of about 75° to the horizontal crest and root lines of the respective threads. Such sloping of these faces simplifies cutting of the thread and makes it stronger, but is not a necessary characteristic of the new thread.

When the bit is screwed down and tightened on the drill rod, the end 23 of the drill rod seats firmly against the bit at the bottom 24 of the bit socket. Tightening of the bit on the drill rod thus causes the rearward curved faces of the male threads to bear against the curved forward faces of the female threads. The threads are so dimensioned, however, that the crest, forward face, and root of the male thread are spaced from the root, rearward face, and crest of the female thread, respectively, by small clearances 25, 26 and 27. With these clearances established, and with the end of the drill rod properly seated at the bottom of the bit socket, the percussive shock applied to the drill rod will not be transmitted to the bit through the threads. It will instead be transmitted through the end 23 of the drill rod where it seats at the bottom of the bit socket. Accordingly, the possibility of damage to the threads from percussive shock applied to the drill rod is minimized.

In consequence of the curvature of the rearward face 21 of the male thread and the corresponding curvature of the forward face of the female thread, the act of tightening the bit on the drill rod automatically causes the bit to center itself on the drill rod and establish uniform clearances 25 and 27 completely about the peripheries of the threads between their respective roots and crests. This results, of course, from the fact that as the bit is tightened on the rod, the curved face of the male thread at any one point tends to slide along the contacting curved face of the female thread in a direction away from the female thread, and a balance is reached when the extent of such sliding is substantially the same all about the periphery of the threads. Were it not for the centering action of the curved thread faces, the looseness of the thread fit which is necessary to establish the clearances 25, 26 and 27 would make it extremely difficult to center the bit on the drill rod. Consequently the clearances could not be established uniformly about the periphery of the thread, and there would always be a possibility that at some points no clearance at all would exist. Lack of proper clearances, or off-center clearances, can very well result in damage to the threads by the percussive shock to which the drill is subjected in use. Such lack of proper clearances may also lead to non-uniform wear of the drill rod threads, so that ultimately almost any bit will become jammed on the drill rod after it has been in use a short while.

It will be noted that a clearance 28 is maintained between the side of the drill rod at its extreme end and the skirt 12 near the bottom of the bit socket. Maintenance of this clearance is important in order to prevent percussive shock transmitted through the drill rod to the bit from causing any significant deformation of the comparatively thin-walled bit skirt. Such deformation, if substantial, may lead to jamming of even a new bit on the drill rod. The curvature of the contacting surfaces of the male and female threads serves to insure that this important clearance will be maintained uniformly about the periphery of the drill rod.

Repeated replacements of bits on the drill rod 5 unavoidably causes wear of the drill rod threads. However, when only new bits, with threads in good condition, are used as replacements, such wear is substantially uniform along the full length of the thread, and will affect only the curved rearward face 21 of the drill rod male thread. The thread herein described is well designed to accommodate such uniform wear. Fig. 4 indicates the extent to which such wear can occur before the drill rod need be discarded on account of thread wear. The dotted line in Fig. 4 indicates the original position of the curved rearward face 21 when the drill rod was new, while the solid line indicates the position of the rearward face 21' when maximum permissible wear has occurred. Since the crest 19 of the thread was initially flat and quite wide, the wear that occurs on the curved rearward face 21 does not alter the basic contour of the thread, but only its width, as measured along the crest. The actual dimension of thread width is not important (so long as it is wide enough to possess adequate strength), as the forward face 18 of the thread does not make contact with the corresponding face of the mating thread, nor does the crest 19 make contact at the root of the corresponding thread. Thus it is evident that a drill rod formed with the new thread herein described, and particularly if used in conjunction with only new replacement bits, in accordance with the new practice of the invention, can accommodate a very great mount of thread wear before the drill rod need be replaced. Whatever insignificant amount of wear occurs on the bit thread during use may be neglected, as in accordance with the practice herein described the bit will be used only once.

Threads formed in accordance with the invention may be either right-hand or left-hand, as required. The direction of the thread should be such that when the drill is in use the bit tends to tighten on the drill rod. Since rock drills usually are rotated in a counter-clockwise direction (as seen looking along the drill rod toward the bit) during drilling operations, a left-hand thread is generally employed.

I claim:

1. A rock drill assembly comprising a drill bit and a drill rod secured together by interengaging male and female screw threads, characterized in that said male thread in profile has a substantially flat forward face, a substantially flat horizontal crest, a substantially flat horizontal root, and a rearward face curved convexly about a center of curvature lying below the root line of the thread, and said female thread in profile having a substantially flat rearward face, a substantially flat horizontal crest, a substantially flat

horizontal root, and a forward face curved concavely at the same radius of curvature as the rearward face of the male thread about a center of curvature lying above the crest line of the thread.

2. A rock drill assembly comprising a drill bit and a drill rod secured together by interengaging male and female screw threads, characterized in that said male thread in profile has a substantially flat forward face, a substantially flat horizontal crest, a substantially flat horizontal root, and a rearward face curved convexly about a center of curvature lying below the root line of the thread, and said female thread in profile having a substantially flat rearward face, a substantially flat horizontal crest, a substantially flat horizontal root, and a forward face curved concavely at the same radius of curvature as the rearward face of the male thread about a center of curvature lying above the crest line of the thread, the forward face, crest and root of said male threads being spaced from contact with the rearward face, root and crest, respectively, of the female thread when the threaded elements are screwed firmly together, the curved rearward face of said male thread and the curved forward face of said female thread then providing the only areas of contact between the mating threads.

3. A drill rod for a rock drill formed with a male thread at one end thereof, characterized in that said thread in profile has a substantially flat forward face, a substantially flat horizontal crest, a substantially flat horizontal root, and a rearward face circularly curved convexly about a center of curvature lying below the root line of the thread.

4. A bit for a rock drill formed with a drill rod socket and provided with a female thread for engagement with a male-threaded drill rod, characterized in that said female thread in profile has a substantially flat rearward face, a substantially flat horizontal crest, a substantially flat horizontal root, and a forward face circularly curved concavely about a center of curvature lying above the crest line of the thread.

5. A drill rod for a rock drill formed with a male thread at one end thereof for engagement with an internally threaded bit, said male thread being characterized by having in profile a wide flat horizontal crest and a rearward face circularly curved convexly about a center of curvature lying below the root line of the thread, and said thread further being characterized by being of such size relative to the internal bit thread with which it mates that its forward face, crest and root do not make contact with the adjacent surfaces of the bit thread when a bit is tightened on the rod, whereby such wear as occurs on the male thread due to repeated replacement of bits is confined to the rearward face thereof, and whereby considerable such wear can occur without altering the basic contour of the thread, but only its width, and hence without impairing its ability to receive and securely hold replacement bits.

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