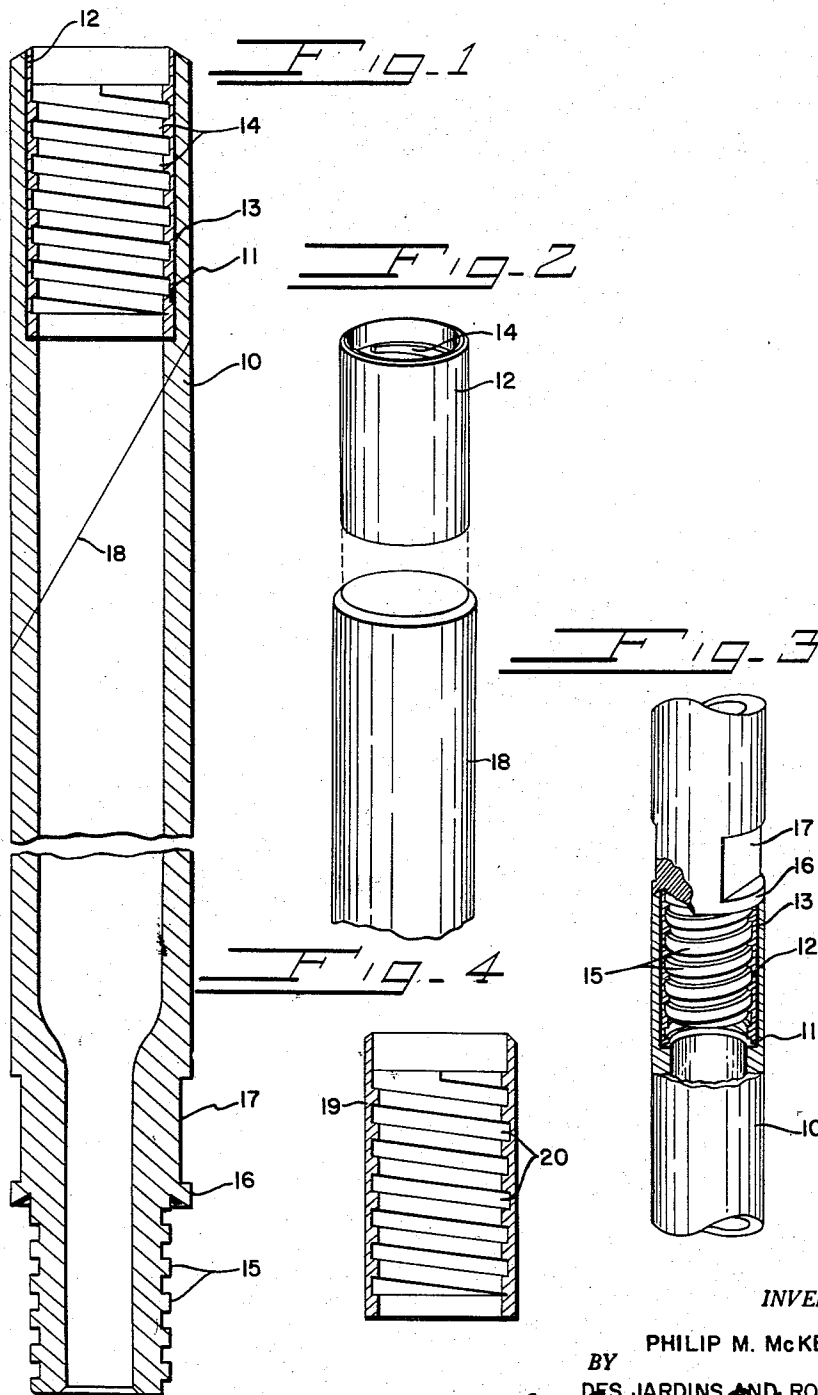


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P. M. McKENNA
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HAVING A REPLACEABLE WEAR ELEMENT
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INVENTOR.

PHILIP M. McKENNA

BY

DES JARDINS AND ROBINSON

By Clarence B. Desjardins
HIS ATTORNEYS

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CEMENTED CARBIDE DRILL ROD PIPE COUPLING HAVING A REPLACEABLE WEAR ELEMENT

Philip M. McKenna, Greensburg, Pa., assignor to Kennametal, Inc., Latrobe, Pa., a corporation of Pennsylvania

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The present invention relates to an improved drill rod and, more particularly, to the composition and construction of drill and core rods to provide an improved drill assembly offering many advantages.

As used here and in the claims, a drill rod, core rod, and any like elongated member which is linked to companion members to form a drill assembly or string are all designated by the term "drill rod." Heretofore, it has been the practice to make a drill rod from various steel compositions. The use of steel has introduced several problems. It has been found, for example, that a drill string or assembly of steel rods whips or lashes excessively during the rotary drilling thereby making the assembly most difficult to handle. Further, the mating ends of steel drill rods are often found to be so rammed together, another outgrowth of such extensive whipping, that binding occurs. It is then extremely difficult to disassemble a string, and considerable time may be expended to disjoin, if possible, two inter-connecting drill rods which have been jammed together by such binding. Additionally, even after two drill rods are eventually separated, the threads of one or both may be found to be damaged by the tight union, jamming, or forced separation of the drill rods. In this case, the rod is no longer safely usable, and the entire rod should be scrapped.

In the present invention, all of the foregoing objections are overcome, and in addition the present drill rod has an increased useful life and a drill assembly of the present rods can operate at a higher rotary speed. There is a minimum of whip in the drill assembly and binding between mating rods of such a drill assembly is eliminated. Should the threads of one rod become damaged or worn, the damage or wear is concentrated at one small area of the drill rod which is removable and replaceable. Thus the major portion of the drill rod is not lost for continued service. Moreover, the present drill rods are quickly and easily assembled and disassembled.

In accordance with the present invention, a drill rod is composed of a hard and dense material such as a cemented carbide, for example, tungsten or titanium carbide. Unexpectedly, a drill rod of these materials has been found to produce little whip or lash when assembled in a drill string. At the same time, the drill string can drill through comparable materials at a faster rate than drill rods made of steel. Heretofore, cemented tungsten carbide and titanium carbide were thought not suitable for such applications because strain concentrations are created in hard carbide constructions at the union of drill rods when there is only limited movement allowable. In such cases the elastic limit of the hard carbide is reached or exceeded at localized areas. The present invention, however, contemplates a novel manner of inter-fitting companion drill rods of a hard dense carbide material which overcomes this drawback of localized strain concentrations. In the instant drill rod, a softer metal portion is provided which connects to the hard dense material of a companion rod. The softer metal reduces local strain. Also, any wear or tendency to bind that

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may take place is concentrated on the softer metal which readily deforms in preference to the hard dense carbide. Thus binding is actually prevented, and the present drill rods can always be easily assembled and disassembled from the drill string.

In the preferred form, the softer metal portion is in the form of an insert or sleeve which is removable, so that should the insert become worn or damaged, a new insert may replace the old. In this manner, there is no loss of or damage to the major portion of the drill rod that houses the insert, and the rod can, therefore, safely continue in active use. If desired, the insert of a companion rod may be specially shaped as an aid in preventing the creation of the strain concentration in the carbide material and to insure a proper alignment of the mating threads.

It is, therefore, a principal object of the present invention to provide a drill rod adapted to produce with other like rods a drill assembly having a minimum of whip and capable of fast drilling speed.

A further object is to provide a drill assembly of hard cemented carbide rods having means to prevent the formation of strain concentrations at the unions of the rods.

A further object is to prevent binding between adjacent drill rods in a drill string by providing a softer metal portion in one rod which deforms to accommodate a mating part of a denser metal portion in a companion rod.

A still further object is to provide drill rods which can be easily assembled and disassembled from a drilling string.

A still further object is to provide a drill rod having a replaceable portion for coupling with a companion rod, so that upon wear or damage to the replaceable portion, the major portion of the drill rod is not lost for continued service.

Other objects and advantages are apparent from the following description which is directed to embodiments of the invention and is not intended to limit the claims.

In the accompanying drawings:

Figure 1 is a longitudinal section of a drill rod embodying the present invention;

Figure 2 is a fragmentary, perspective view of a drill rod and illustrates the manner in which an insert of the present invention is placed within the drill rod;

Figure 3 is a fragmentary, perspective view, partially in section, of two drill rods of the present invention coupled together; and

Figure 4 is a longitudinal section of a modified insert or sleeve.

Referring to the drawings, a tubular drill rod 10 of Figure 1 has an annular recess 11 at one end. A tubular insert 12 fits in the recess and a cement or sealant 13 holds the insert 12 to the rod 10. The insert or sleeve 12 is internally threaded, preferably with a square type of thread as at 14, to receive the male threads of a companion rod. In this regard, the rod 10 itself has male square threads 15 and an abutting flange 16 at the opposite end. The male threads may be cut by electrical erosion methods known in the art. A suitable wrench engages lands or flats 17 for turning the rod 10. Because the drill rods may reach appreciable lengths, the rod may be made in sections and spliced along the line 18 adjacent the insert pocket or recess 11. To unite these sections of the drill rod, the edges thereof are ground, nickel-treated and then brazed.

In accordance with the present invention, the drill rod 10 is composed of a hard dense metallic carbide such as cemented tungsten carbide or cemented titanium carbide in order to realize a minimum of whipping and a fast drilling speed. When the objective in a drill rod is the greatest stiffness possible, cemented tungsten carbide is

recommended since it provides a maximum stiffness for any given size. However, when weight is a consideration, cemented titanium carbide is preferred since it provides a maximum stiffness for a given weight. Drill rods of cemented titanium carbide, therefore, are well suited to angular drilling or substantially horizontal drilling where the ever growing length and weight of the drill assembly presents problems not met in vertical drilling.

Cemented carbides of tungsten and titanium having a specific gravity in excess of 5.0 and a Young's modulus of elasticity exceeding 50 million pounds per square inch have been found to provide the unexpected results of present invention. The carbides may be cemented with cobalt or nickel. Cobalt is the preferred cementing agent and ordinarily comprises 5 percent to 15 percent of the alloy. The insert 12 may be made of mild steel.

One of the advantages of my drill rod is that the insert 12 may be replaced when worn or damaged without loss of the balance of the drill rod for further service. To facilitate this replacement, the cement or seal 13 which holds the insert 12 in place can preferably be made to lose its adhesive properties. Heat is one convenient form of accomplishing this, and for this reason, resins are favored for use as the cement 13, although the action of the cement is purely a mechanical one. For example, a high-melting thermoplastic resin, that is, one having an initial flow point at about 350° F. to 500° F. may be used, since in this temperature range there is no damage to the properties of the metals.

In particular, however, the epoxy resins have been found to be ideally suited to seal the insert 12 in the recess 11 of the drill rod. These resins are formed by the reaction of epichlorohydrin with the condensation product of phenol and acetone. The properties of the epoxy resins are modified by substitution of the free hydroxyl groups by various organic radicals. The epoxy resins have excellent corrosion resistance including resistance to acids, alkalis, gasoline and oils such as might be met under drilling conditions. The epoxy resins also have excellent dimensional stability, a low shrinkage factor, good impact resistance, and adhere excellently to metals. A shear strength as high as 3000 pounds per inch is readily obtained with epoxy adhesives.

While the epoxy resins are generally regarded as thermosetting, the proportions of the above identified reactants can be varied to produce resins ranging from fluid liquids to high-melting solids. Accordingly, to describe this property of the cement 13 of losing its adhesive qualities and to avoid the use of the term "thermoplastic," which might be considered misdescriptive of epoxy resins, in the claims, the cement 13 has been described as having an "initial flow-point" in connection with a temperature or temperature range.

As has been previously noted, cemented hard carbides are subject to the creation of concentrated strains when there is only limited movement available. While the softer steel of the insert 12 alleviates the concentration of strains satisfactorily, a modification may be used to facilitate this result. In Figure 4, the wall of an insert 19 has been weakened as at 20 by extending the depth of the cut of the thread. Accordingly, the insert 19 can be stretched or compressed somewhat by entering male threads of a companion hard carbide rod to assure their accommodation without seriously weakening the resulting union between the threads.

In practice, an insert or sleeve 12 or 19 is bonded in the recess 11 by the cement 13, while the cement is fluid, and usually under accompanying pressure. During assembly of the rods, the male threads 15 of one hard carbide rod engage the female threads 14 of a steel insert. Because of the difference of hardness, the carbide threads 15 virtually cut their way into the insert 12. Any misalignment between the mating parts is not a disadvantage as with ordinary drill rods, but actually produces an advantage in that the carbide thread cuts a seat for itself

to provide a tighter union between the mating drill rods. Yet such a tight union is accompanied by little local strain even though only a limited amount of movement is available for the carbide rods, because the softer metal of the insert yields to the hard carbide composition. When the rods are to be disassembled, there is no binding since the hard carbide teeth can again cut through any impediment provided by the soft steel insert to a disconnecting turn to a rod.

Any wear resulting from frequent interfitting of companion rods takes place on the inserts 12 or 19. The insert may then be readily replaced with a similar part without loss of the drill rods. The latter is heated to at least an initial flow point of the cement or sealant 13, if it is flowable as described, and the insert removed by a suitable tool. A new insert is then placed within the drill rod and cemented as before. A drill string composed of these rods has a prolonged useful life and unexpectedly provides a minimum of whip, because of the modulus of elasticity of the metal carbide, with accompanying faster drilling speed.

The apparatus described herein is susceptible of considerable variation without departing from the spirit of my invention, and therefore the invention is claimed broadly as indicated by the appended claims.

Having thus described my invention, what I claim as new and useful and desire to secure by United States Letters Patent, is:

1. A hollow drill rod adapted to be connected to other like rods to form a drill assembly, said rod consisting essentially of a hard metal cemented carbide selected from the class consisting of tungsten carbide and titanium carbide and having integrally formed male threads adjacent one end, said cemented carbide being characterized by a specific gravity in excess of 5.0 and a Young's modulus of elasticity in excess of 50 million pounds per square inch to provide an improved drill assembly having materially reduced whip and a long life, an insert of a softer metal secured to the rod at its other end having female threads to receive the male threads of a companion rod, whereby the threads of the softer metal are subject to deformation upon mating with the threads of the metal carbide to provide a fit which is tight and yet accompanied by little local strain.

2. A hollow drill rod adapted to be connected with other like rods to form a drill assembly, said rods consisting essentially of cemented carbide selected from the class consisting of tungsten carbide and titanium carbide and having integrally formed male threads adjacent one end and a seating portion adjacent the other end, said cemented carbide being characterized by a specific gravity in excess of 5.0 and a Young's modulus of elasticity in excess of 50 million pounds per square inch to provide an improved drill assembly having materially reduced whip and a long life, a replaceable insert of a softer metal secured to the rod in said seat and having female threads to receive the male threads of a companion rod whereby any wear resulting from frequent interfitting of the companion rods takes place on the threads of the softer metal insert and replacement of said insert materially prolongs the useful life of said rod.

3. A hollow drill rod adapted to be connected to other like rods to form a drill assembly, said rod consisting essentially of a cemented carbide selected from the class consisting of tungsten carbide and titanium carbide and having integrally formed male threads adjacent one end and a recess extending generally longitudinally of the rod, said cemented carbide being characterized by a specific gravity in excess of 5.0 and a Young's modulus of elasticity in excess of 50 million pounds per square inch to provide an improved drill assembly having materially reduced whip and a long life, a replaceable insert of a softer metal than said cemented carbide to seat in the recess, said insert having internal female threads to receive the male threads of a companion rod, and a

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cement to seal the insert in the recess, the threads of the softer metal being subject to deformation upon mating with the threads of the cemented carbide to produce a fit which is tight and yet accompanied by little local strain, and any wear resulting from frequent interfitting of the companion rods taking place on the threads of the softer metal insert enabling the insert to be replaced without loss of the drill rod.

4. A hollow drill rod as claimed in claim 3 wherein the carbide is cemented with cobalt, and the cement for sealing the insert is a flowable material having an initial flow point above about 350° F.

5. A hollow drill rod as claimed in claim 3 wherein the carbide is cemented with 5 percent to 15 percent cobalt, and the cement for sealing the insert is an epoxy resin having an initial flow point in the range of 400° to 500° F.

6. A hollow drill rod adapted to be connected to other like rods to form a drill assembly, said rod consisting essentially of a cemented carbide selected from the class consisting of tungsten carbide and titanium carbide and having integrally formed male threads adjacent one end, said cemented carbide being characterized by a specific gravity in excess of 5.0 and a Young's modulus of elasticity in excess of 50 million pounds per square inch to provide an improved drill assembly having materially reduced whip and a long life, a tubular insert of a softer metal secured to the rod at its other end and having internal female threads to receive the male threads of a companion rod, whereby the threads of the softer metal are subject to deformation upon mating with the threads of the cemented carbide to provide a fit which is tight and

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yet accompanied by little local strain, a wall of said tubular insert being weakened at least at one point to permit stretching or compression of the tubular insert and thereby facilitate the reception of the male threads of a companion rod.

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