March 2, 1971 T. A. PARSSINEN 3,567,254

DRILL STEEL

Filed Dec. 3, 1968

FIG. 1

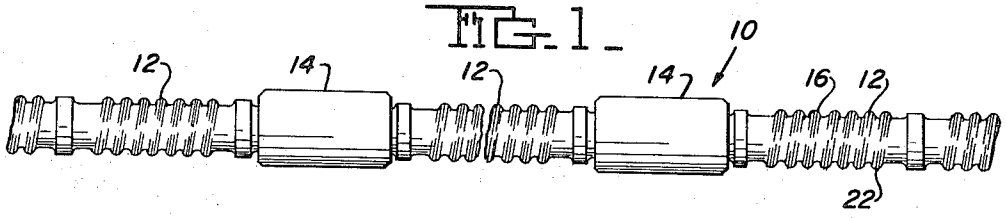


FIG. 2

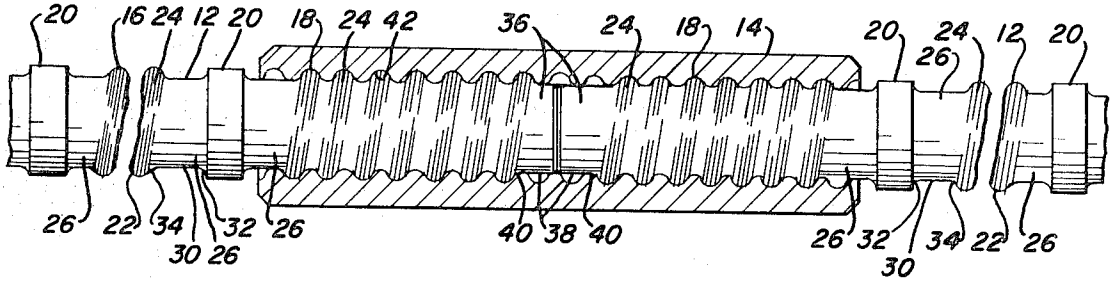


FIG. 3

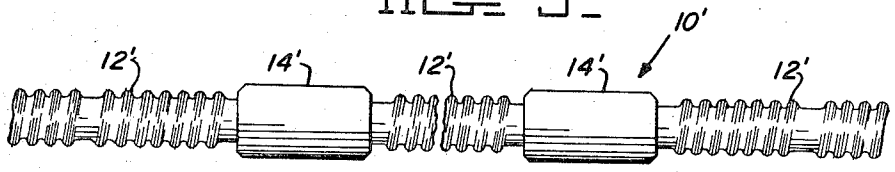


FIG. 4

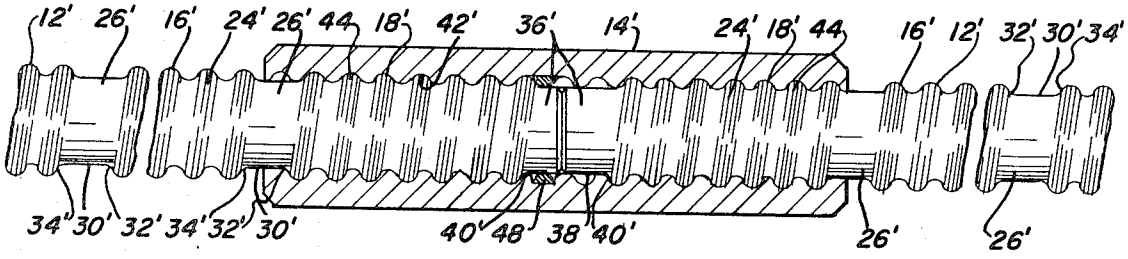
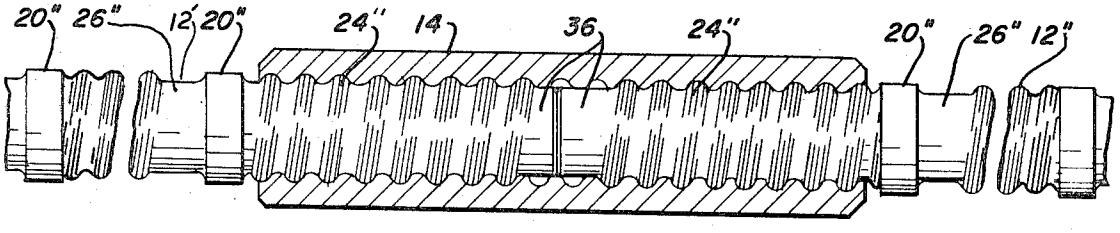


FIG. 5



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United States Patent Office 3,567,254
Patented Mar. 2, 1971

3,567,254

DRILL STEEL

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Filed Dec. 3, 1968, Ser. No. 780,791
Int. Cl. E21b 17/02
U.S. Cl. 287—117 3 Claims

ABSTRACT OF THE DISCLOSURE

A drill steel having an improved threading arrangement thereon wherein a plurality of spaced threaded portions are provided on the drill steel element and separated by unthreaded portions so as to allow removing a worn section of the element and recoupling the element with another of said threaded portions.

Some drill steel strings used with reverse rotation percussion drills, rotary percussion drills, or the like are continuously threaded around the outer periphery thereof and have coupling members which releasably secure adjacent longitudinal sections or sectionals of the string together at the axial ends thereof. The continued pounding and rotating of the string causes the threaded ends of the sectionals which were enveloped by the coupling members to wear, thereby necessitating reconditioning the sectionals by removing the worn sections therefrom and then recoupling the reconditioned sectionals.

The reconditioned recoupled string must have provisions to prevent the coupling portion from running down the string and various structures have been devised for this purpose, none of which has proved completely satisfactory. One of these structures includes using couplings threaded halfway through from each end with the threads purposely mismatched, however, with some thread types under certain conditions the mismatched threads ultimately wear enough to be useless in preventing the problem. Another structure includes the use of a bridge coupling which when interposed between sectional ends results in much of the drilling energy being wasted by dissipation through the coupling and, additionally this excess energy in the coupling causes heating and premature failure thereof.

The drill steel string of the present invention provides threaded relief portions which allow the reconditioning of the worn sections by cutting at such relief portions in such a way as to produce button bearing ends at the reconditioned sectionals.

These and other objects and advantages of this invention will become more readily apparent to those skilled in the art upon the reading of the following detailed description and drawings in which:

FIG. 1 is a side view of a drill steel string and coupling member embodying the principles of this invention;

FIG. 2 is a fragmentary view, partly in section, of the drill steel and coupling member shown in FIG. 1;

FIG. 3 is a side view of another embodiment of a drill steel string and coupling member of this invention;

FIG. 4 is a fragmentary view, partly in section of the drill steel and coupling member shown in FIG. 1; and

FIG. 5 is a fragmentary view, partly in section, of another embodiment of a drill steel string and coupling member of this invention.

Referring to FIG. 1, a hollow elongated drill steel string, generally indicated at **10**, is a type commonly used with reverse rotation rock drills, rotary percussion drills, or other well known drilling equipment and comprises a plurality of hollow elongated generally cylindrical drill steel elements or sectionals **12** which are releasably secured at the axial ends thereof by elongated hollow cylindrical coupling members **14**. Coupling members **14**

additionally secure respective ends of the string **10** to a well known drill (not shown) and a well known drill bit portion (not shown). With such an arrangement as hereinabove described, as the drill steel string **10** progresses further into a drill hole, a drill operator can increase the length of the string **10** by coupling an additional sectional **12** thereto.

Sectionals **12** comprise a plurality of elongated intermediate sections **16** and end sections **18**, each of such sections being separated from one another at the axial ends thereof by collar portions **20**. Sections **16** include: an intermediate portion **22** having threads around the outer periphery thereof, such threads shown as male rope threads **24** which have a major diameter thereof slightly smaller than the outside diameter of collar portion **20**; and recessed or thread relief portions **26** at the axial ends of section **16** axially adjacent the intermediate portion **22** and collar portions **20**.

Thread relief portions **26** resemble a flat bottomed groove about the outer periphery of sections **12** such that a view thereof transverse to the longitudinal axis of a section **12** shows portion **26** comprised of: a flat groove bottom **30** having a diameter thereof equal to or slightly smaller than the minor diameter of threads **24**; and arcuate sides **32** and **34** which radiate outward from the longitudinal ends of bottom **30**, respectively to an end of collar portion **20** and the end of the rope thread **24** which is adjacent relief portion **26**.

The end sections **18** comprise those portions hereinabove described with reference to sections **16** with a primary exception being that a relief portion **36** at the free end of each section **18** is substituted for a relief portion **26** hereinabove described with reference to section **16**. Such a portion **36** comprises a flat groove bottom **38** having a diameter thereof equal to the diameter of bottom **30** which, bottom **38**, extends rearward from the free end of section **18** a distance equal to or less than the longitudinal extent of bottom **30**; and a rear arcuate side **40** which radiates outwardly and rearwardly from the rear end of bottom **38** to the end of the rope thread **24** adjacent relief portion **36**.

Coupling members **14** have female rope threads **42** about the entire inner periphery thereof. Female threads **42** are dimensioned to be engageable with male rope threads **24** of sectionals **12** thereby permitting the coupling of two members **12** by threading end sections **18** into opposite ends of member **14** until bearing contact of such sections occurs intermediate the axial ends of the member **14**. With the sectionals butting together a substantial portion of the drilling energy is passed directly through sectionals **12** to the drill bit (not shown) because of the bearing contact of adjacent coupled sectionals **12**. Additionally, the coupling members **14** are prevented from traveling down the drill steel towards the drill bit by the collar portion **20** for the outside diameter thereof is slightly larger than the major diameter of the female threads **42**. Such tendency to travel occurs as a result of a variety of internal and external forces applied to the drill string **10**.

FIG. 2 shows a preferred coupling arrangement as hereinabove described wherein: the length of member **14** is approximately twice the length of the summation of an intermediate threaded portion **22** and a thread relief portion **36**; and an end of member **14** has the inner periphery thereof in contact with one of the coupled sectionals **12**, which in practice would be that sectional **12** closest to the drill bit (not shown), adjacent a collar portion **20** thereof which, collar portion **20**, restricts any downward travel of member **14** as hereinabove described. It is to be noted that although the maximum length of coupling member **14** is obviously controlled by the length of end

sections **18**, a length thereof less than such maximum length can be used if factors such as thread capacity, moment-deflection considerations and the like are evaluated in obtaining such lesser length.

During a drilling operation drill steel **10** is subjected to a variety of internal and external forces, for example tension and compression forces applied along the longitudinal axis thereof and bending moment applied transverse to the longitudinal axis. As a result of such forces the coupled end sections **18** wear at the threaded portions **22** thereof thereby resulting in the coupling members **14** becoming loose with respect to sectionals **12**. To alleviate the problem of such loose coupling members **14**, the sectionals **12** must be uncoupled and reconditioned at the worn ends thereof.

To recondition the sectionals **12**, the worn section **18** is removed by any suitable cutting technique, for example cold cutting, flame cutting, burning and the like. The cut through the sectional **12** is made at the end of a groove bottom **30** adjacent the arcuate side **32** of the section **16** which is adjacent the worn section **18**. Thus with such removing, the adjacent section **16** is transformed into an end section **18** and the sectionals **12** are then recoupled in a manner hereinbefore described until bearing contact is made. In practice the new sections **18** will have the free ends thereof finished in any suitable manner as by chamfering to insure full bearing when coupled.

FIGS. 3 and 4 illustrate another embodiment of the present invention. Inasmuch as this embodiment resembles the embodiment hereinbefore illustrated, similar elements will be given the same reference numerals primed.

Referring to FIG. 3, a hollow elongated drill steel string generally indicated at **10'** comprises a plurality of elongated hollow generally cylindrical drill steel elements or sectionals **12'** which are releasably secured together at the ends thereof by an elongated hollow coupling member **14'**.

Sectionals **12'** comprise a plurality of elongated intermediate sections **16'** and end sections **18'**, each of such sections being separated from one another at the axial ends thereof by thread relief portions **26'**. Sections **16'** have threads about the outer periphery thereof, such threads shown as male rope threads **24'**. The threads **24'** of adjacent sections **16** are mismatched along the helical path of the thread by substantially one-half turn.

Thread relief portions **26'** resemble a flat bottom groove about the outer periphery of sectionals **12'** such that a view thereof transverse to the longitudinal axis of a sectional **12'** shows portions **26'** comprised of: a flat groove bottom **30'** having a diameter thereof equal to or slightly smaller than the minor diameter of threads **24'**; and arcuate sides **32'** and **34'** which radiate outward from the longitudinal ends of bottom **30'**, respectively to the ends of rope threads **24'** which are adjacent relief portion **26'**.

End sections **18'** include an elongated portion **44** having male rope threads **24'** around the outer periphery thereof; and a thread relief portion **36'** at the free ends thereof. Portion **36'** comprises a flat groove bottom **38'** having a diameter thereof equal to the diameter of bottom **30'** which, bottom **38'** extends rearward from the free end of section **18'** a distance equal to or less than the longitudinal extent of the bottom **30'**; and a rear arcuate side **40'** which radiates outwardly and rearwardly from the rear end of bottom **38'** to the end of a rope thread **24'** adjacent relief portion **36'**.

Coupling members **14'** have female rope threads **42'** about the entire inner periphery thereof with the exception of a zero helix angle thread or inwardly projecting collar portion **48** which is located intermediate the axial ends of member **14'**. Female threads **42'** are dimensioned to be engageable with male rope threads **24'** of sectionals **12'** thereby permitting the coupling of sectionals **12'** by threading end sections **18'** into opposite ends of member **14'** until bearing contact of such sections occur intermediate the axial ends of the member **14'**. With such a coupling arrangement a substantial portion of the drilling energy is passed directly through sectionals **12'** to the drill bit (not shown) because of the bearing contact of adjacent coupled sectionals **12**. Additionally, the coupling members **14'** are prevented from traveling down the drill steel towards the drill bit by the collar portion **48**, for the diameter of the innermost extent thereof is slightly larger than the major diameter of the female threads **42'**. Such tendency to travel occurs as a result of a variety of internal and external forces applied to the drill string **10**.

FIG. 4 shows a preferred coupling arrangement as hereinabove described wherein: the length of member **14** is approximately twice the length of an end section **18'**; and a side **40'** of an end section **18'** is in contact with projection portion **48**, which in practice would be the side **40'** of the end section **18'** closest to the drill bit (not shown). It is to be noted that although the maximum length of the coupling member **14'** is obviously controlled by the length of the end sections **18'**, a length thereof less than such maximum length can be used if factors such as thread capacity, moment deflection and considerations and the like are evaluated in obtaining such lesser length.

Internal and external forces hereinbefore described with reference to drill steel **10** necessitate reconditioning of the sectionals **12'** by initially removing the worn section **18'** by any suitable cutting technique, for example cold cutting, flame cutting, burning and the like. The cut through the sectional **12'** is made at the end of a groove bottom **30'** adjacent the arcuate side **32'** of the section **16'** which is adjacent the worn section **18'**. Thus with such removing, the adjacent section **16'** is transformed into an end section **18'** and the sectionals **12'** are then recoupled in a manner hereinbefore described until bearing contact is made. In practice the new sections **18'** have the free ends thereof finished in any suitable manner to insure full bearing contact when coupled.

FIG. 5 illustrates still another embodiment of the present invention which is quite similar in appearance and operation to the embodiment hereinbefore discussed with reference to FIGS. 1 and 2 with the primary difference between the two embodiments being that the collar portion **20''** has only one thread relief portion **26''** adjacent a side thereof rather than relief portions **26** adjacent both sides of threaded portion **20** as is the case with the embodiment illustrated in FIGS. 1 and 2. The relief portion **26''** is adjacent the side of collar portion **20''** furthest from the coupled end of the sectional **12''**. The absence of a relief portion **26''** on both sides of threaded portion **20** results in the sectional **12''** being capable of only one orientation with regards to an adjacent sectional **12''** rather than a dual orientation which is permitted by the embodiment of sectional **12** illustrated in FIGS. 1 and 2. A worn sectional **12''** is reconditioned in a similar manner as hereinbefore discussed with regards to sectional **12**.

Although preferred embodiments of this invention have been described and illustrated herein, modifications are contemplated such as: the substitution of male and female reverse buttress threads for the rope threads hereinbefore discussed; and the sectionals do not necessarily have to have threaded sections along the entire length thereof but can have plural threaded sections on the end portions of such sectionals or can have alternately threaded and unthreaded sections.

The description herein does not limit the structure of this invention and the invention is defined by the scope of the claims set forth hereinafter.

What is claimed is:

1. A drill string for use with a percussion drill comprising; an elongated drill steel element having at least one end portion on which there are a plurality of axially spaced discrete externally threaded portions separated by unthreaded portions; at least a portion of each of said

unthreaded portions is a collar of the same diameter as full size portions of said drill steel element before threading, and each said unthreaded portions comprises said collar portion spaced from at least one of the adjacent ones of said threaded portions by a recessed unthreaded portion having a diameter not greater than the minor diameter of said threaded portion.

2. A drill string for use with a percussion drill comprising; an elongated drill steel element having at least one end portion on which there are a plurality of axially spaced discrete externally threaded portions separated by unthreaded portions, said drill steel element is coupled to a similar drill steel element in abutting axial aligned relationship by an elongated hollow cylindrical internally threaded coupling element, said coupling element is provided with spaced portions of the internally threaded portion extending inwardly from each end of said coupling and having a helical angle equal to the helical angle of said externally threaded portion, said internally threaded portions being separated by a similarly formed internal thread having a zero helix angle.

3. A drill steel as specified in claim 1 wherein each end of said drill steel element has a reduced diameter unthreaded portion equal in diameter and of no greater length than one of said recessed unthreaded portions.

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U.S. Cl. X.R.

285—355, 390