May 15, 1956 S. C. MOORE 2,745,685

RESILIENT DRILL COLLAR JOINT

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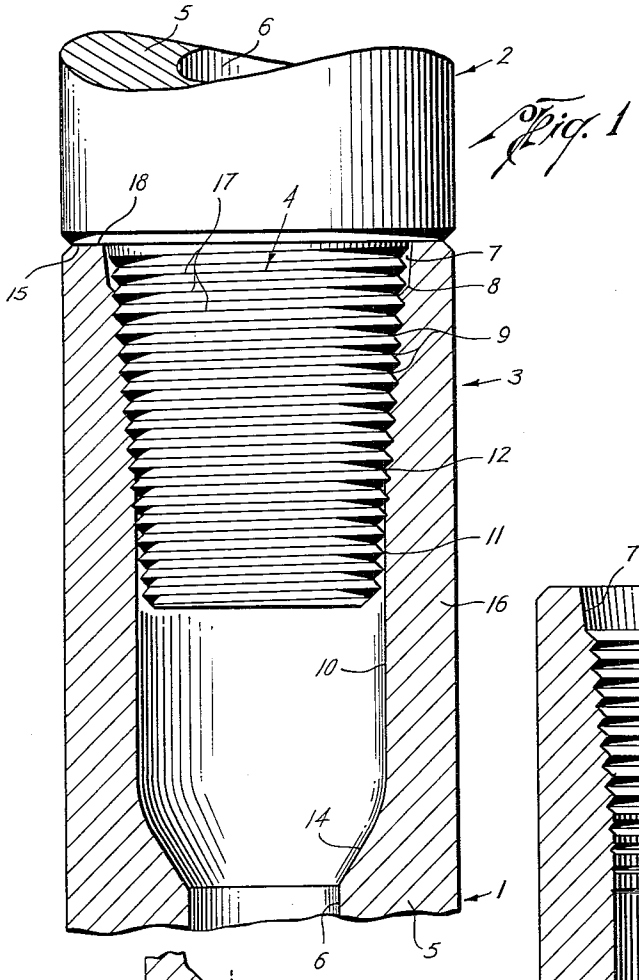

Fig. 1

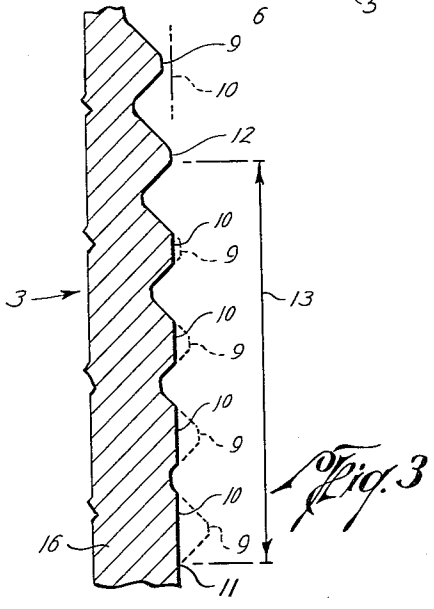

Fig. 3

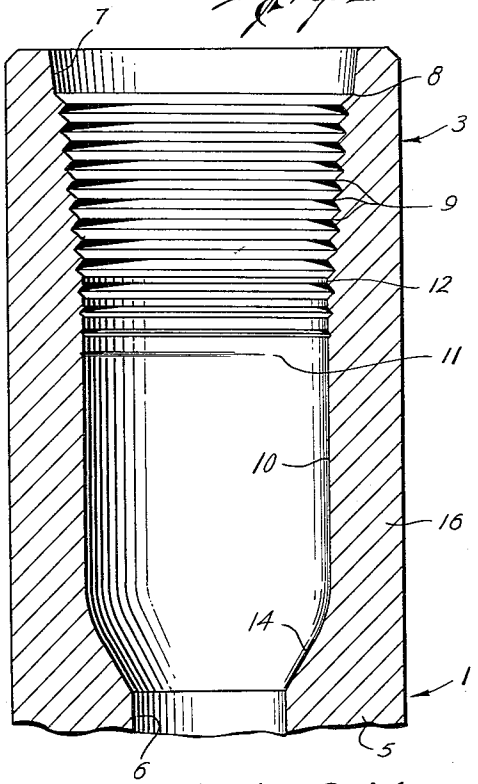

Fig. 2

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Fig. 4

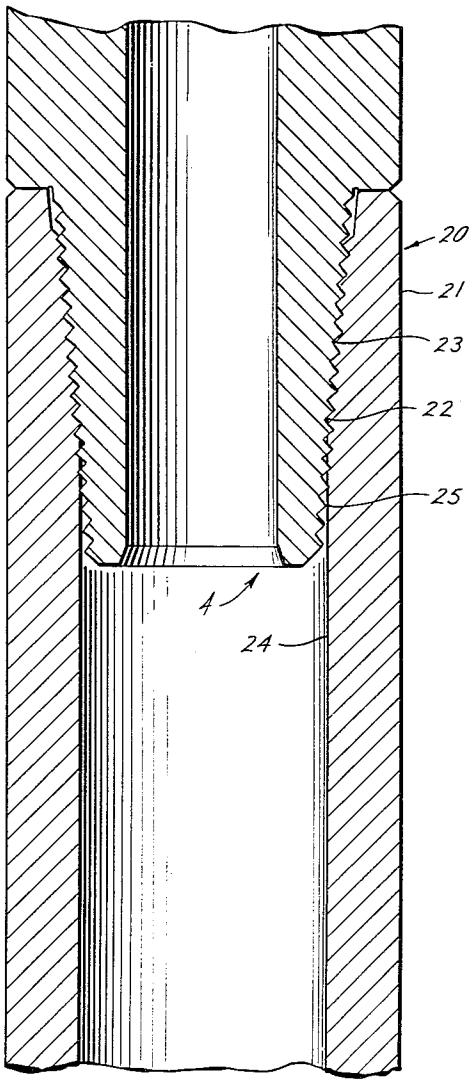
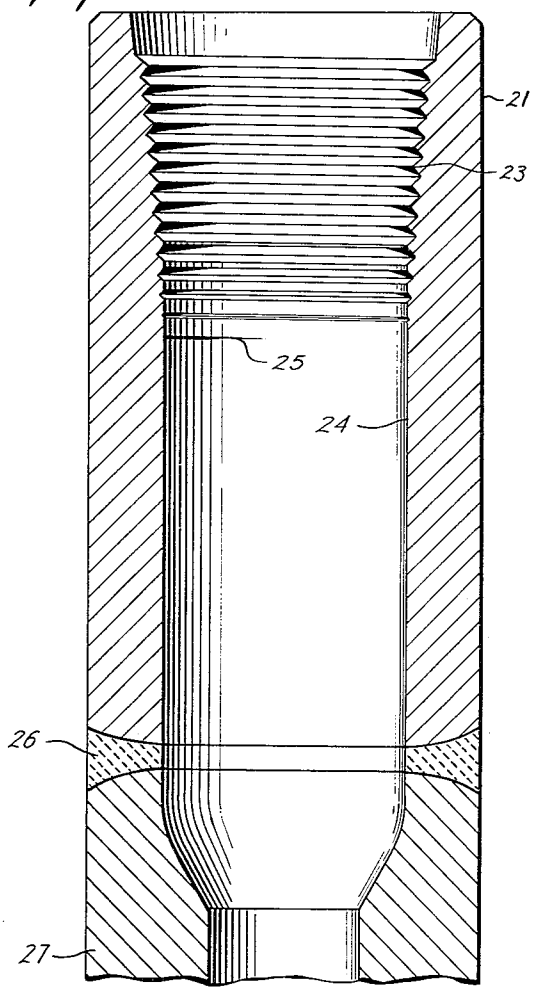


Fig. 5



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RESILIENT DRILL COLLAR JOINT

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Application February 15, 1952, Serial No. 271,773

2 Claims. (Cl. 285—146)

This invention relates to improvements in drill collars and particularly in threaded joints employed for coupling drill collars together.

A drill collar, as conventionally employed in rotary drilling strings, consists of a length of heavy thick-walled pipe. One or more such drill collars are ordinarily installed in a rotary drilling string and usually form the section of the drill string immediately above the bit. The massive construction of conventional drill collars is employed to provide a concentration of weight as near as possible to the bit which serves to improve the cutting action of the bit and assists in keeping the bit drilling in a vertically straight line to thereby reduce the danger of drilling crooked holes. Since the external diameter of the drill collars is necessarily limited by the size of the bore hole being drilled by a particular sized bit, the desired weight is obtained by making the wall of the drill collars as thick as possible, thereby reducing the diameter of the bore with respect to that of the ordinary sections of drill pipe forming the major portion of the drill string into which the drill collars are connected. The bore of the drill collars, will, of course, form a part of the bore of the drill string through which drilling fluid is circulated through the well bore.

Drill collars are conventionally coupled together by connections composed of a threaded male or pin member receivable in a female or box member of generally standardized form and dimensions. In one common form of drill collar, one end thereof will be counterbored to form a box member which is provided internally with an inwardly tapering section of threads. The other end of the drill collar will be reduced in diameter to provide a mating externally threaded tapering pin member, the base of the pin member being surrounded by an annular shoulder adapted to seat on the upper end of the box member when the joint is fully made up. The box member on one drill collar will thus be adapted to receive the pin member on the next drill collar and to form therewith an externally flush joint.

In such conventional standard joints, the threads of the box member will ordinarily extend to the bottom thereof which connects to the relatively narrow bore of the drill collar by a relatively short inwardly tapering wall section. The pin member will ordinarily be of lesser length than the threaded section of the box member so that the last few box threads adjacent the bottom of the box will not be engaged by the pin. These unengaged threads constitute the point of least rigidity in a properly assembled joint, and accordingly, are at the point of greatest flexure and stress in bending. The notch effect of the thread roots under this condition of bending stress accelerates fatigue failures. This condition is aggravated by corrosion and erosion of the exposed threads by the drilling fluid which is circulated through the bore of the drill collars.

Accordingly, it is a primary object of this invention to provide an improved drill collar joint which will

eliminate or greatly reduce the described undesirable characteristics of conventional joints.

In accordance with one embodiment of this invention, an improved box member construction for a drill collar joint may be provided by providing a cylindrically bored smooth-walled extension of the tapered threaded socket of the box member, the extension having an internal diameter substantially equal to root diameter of the last thread in the socket so that the last thread will vanish in the inner wall of the extension, and having a length such as to extend well beyond the point of vanishment of the last thread. This construction provides an increased length of minimum strength wall section beyond the threads so that flexure will occur over a relatively extended length of wall section rather than at a point, as in conventional joints, thus reducing the stress concentration and thereby substantially increasing the life of the joint. The threaded section of the pin member may be lengthened sufficiently to cover the last vestige of thread in the box member, thus preventing exposure of the threads of the box member and thereby greatly reducing or eliminating corrosion in the thread roots of the box member.

Other and more specific objects and advantages of this invention will become apparent from the following detailed description when read in conjunction with the accompanying drawings which illustrate several useful embodiments in accordance with this invention.

In the drawings:

Fig. 1 is a longitudinal view of an assembled joint in accordance with one embodiment of this invention, the box member being shown in longitudinal section and the inserted pin member in elevation;

Fig. 2 is a longitudinal sectional view of the box member of the embodiment shown in Fig. 1;

Fig. 3 is an enlarged detail of the last threads of the box member, the dotted lines indicating the portions of the crests of these last threads which have been removed in boring out the desired extension of the box member and causing the last thread to vanish in the wall of the bored out section.

Fig. 4 is a longitudinal sectional view of a joint assembly wherein a box member construction in accordance with this invention is formed in a sub element and is shown connected to a drill collar pin member; and

Fig. 5 is a longitudinal sectional view of a box member constructed in accordance with this invention in a sub element which is welded to the end of a drill collar to form the female member of the drill collar joint.

Figs. 1, 2 and 3 illustrate a drill collar joint in accordance with one embodiment of this invention. In Fig. 1, a pair of generally conventional drill collars, designated 1 and 2, are shown threadedly connected together. Collar 1 is provided with a generally tubular female or box member, designated generally by the numeral 3, and collar 2 is provided with a generally tubular male or pin member, designated generally by the numeral 4. It will be noted that the body portion of each of the drill collars has a relatively thick wall 5 and a relatively narrow bore 6. To form box member 3, one end of drill collar 1 is counter-bored to form an inwardly and downwardly tapering frusto-conical socket 7. The wall of which, beginning at a point 8 spaced slightly from the outer end of the drill collar, is machined to form a series of threads 9 which may be of any suitable or standard thread form conventionally employed for drill collar joints. The length of the threaded section formed by threads 9 may be varied but will usually conform substantially to oil industry standards. The number of threads per inch and their taper from top to bottom of the section are likewise variable but will usually conform to industry standards. It will be evident that the internal diameter

of the threaded portion of socket 7 at any point along the threaded section thereof, will normally be substantially larger than bore 6 of the drill collar.

The lower end of tapered socket 7 is bored out to form a cylindrical extension 10 having a diameter corresponding generally to the root diameter of the last thread, whereby the last of the threads 9 will be caused to vanish into the wall of extension 10, the extension being continued longitudinally for some distance beyond the point of vanishment of the last vestige of thread, indicated at 11. Due to the inward taper of socket 7, in order to cause the last thread to vanish, the cylindrical bore will be started from a point, indicated at 12, along the thread section in advance of the lower end thereof which will correspond in diameter to that of the root of the last thread. In boring the extension, progressively larger portions of the crests of the remaining threads beyond point 12 will be cut away until the last thread segment has vanished in the wall of extension 10. The manner in which the crests of the last few threads are cut away to form extension 10 and to cause the last thread to vanish is illustrated in enlarged detail in Fig. 3, the section of threads so affected being included in the spread indicated by the arrowed line 13. Cylindrical extension 10 is continued for some distance beyond point of vanishment 11 of the last thread. This distance may vary widely, depending generally on the diameter of the drill collar but will usually be at least two inches. By way of example in a standard drill collar 6¼ inch outside diameter—2¼ inch inside diameter employing a standard 4 inch connection, extension 10 was made to have a length of about 3 inches beyond the point of vanishment of the last thread. The outer end of extension 10 is smoothly merged, as at 14, into the smaller diameter bore 6 of the drill collar. The upper end of box member 3 terminates in an upwardly facing annular shoulder 15.

By enlarging the bore of the drill collar in forming extension 10, as described, it will be seen that box member 3 will be provided with an elongated wall section 16 extending well beyond the last vestige of thread and which is relatively much thinner than wall 5 of the drill collar and will thus provide an elongated relatively flexible member over which the bending stresses to which the joint is subjected in use will be relatively widely distributed and will thereby obviate undesirable stress concentration at a point or over a relatively restricted area as in more conventional joints.

The pin member 4 is provided with a series of threads 17 which match threads 9, the pin member being tapered to correspond to the taper in the box member. The diameter of the base of pin member 4 is made less than the external diameter of drill collar 2 to thereby provide a downwardly facing annular shoulder 18 which is adapted to seat on shoulder 15 when the joint is fully made up, threads 17 being cut to extend from shoulder 18 to the opposite end of the pin member in order that the pin member may be completely inserted in the box member. Pin member 4 will normally be made to such a length that the inner end of the pin member will engage and completely cover the last vestige of thread in the box member. In order to assure complete coverage of the last vestige of thread in the box member, the pin member will preferably be made somewhat longer than the threaded section of the box member, and the inner end of the pin member may, therefore, extend into extension 10 slightly beyond point 11, as indicated in somewhat exaggerated form in Fig. 1. By reason of the taper of pin member 4, a small amount of clearance will exist between the wall of extension 10 and those threads 17 extending beyond point 11. By thus engaging and covering the very last vestige of threads 9 with the pin, threads 9 will be fully protected against the corrosive and erosive action of drilling fluid circulated through the joint and the notch effect of the root of the last thread in the box member will be substantially eliminated.

Fig. 4 illustrates the joint construction in accordance with this invention as employed in forming a connection between a drill collar and a sub. A sub is a tubular sleeve which may be employed, if desired, to form an extended connection with pin members on the adjacent drill collars. Alternatively, the pin members may be provided on both ends of the sub for connection to the box members of the adjacent drill collars.

In the modification illustrated in Fig. 4, a sub, designated generally by the numeral 20, and composed of relatively thin wall tubing, is provided with a box member 21 constructed in accordance with the principles described above with respect to box member 3, that is, the bore 24 of the sub will be cylindrically enlarged, beginning, as at point 22 along threads 23 of box member 21, to a diameter such as to cause the last of the threads 23 to vanish in the wall of bore 24, as at 25. In this modification the enlarged bore 24 may extend throughout the length of the sub, the opposite end of the sub (not shown) being provided with a similar box member having its last thread also vanishing in the wall of bore 24. Box member 21 is shown connected to a drill collar pin member which may be substantially identical in all respects to pin member 4 of the embodiment illustrated in Figs. 1, 2 and 3 and is, therefore, likewise designated generally by the numeral 4. It will be understood that pin member 4 will be of such length as to cover the last vestige of thread in box member 21.

Sub 21 may be of any desired length. In any event, the enlarged diameter of bore 24 should extend substantially beyond point 25 so as to provide the desired elongated flexible wall section beyond the point.

Fig. 5 illustrates another modification in which one end of a relatively thin-walled sub having a box member substantially identical in all respects with that illustrated in Fig. 4, is connected by welding, as at 26, to one end of a drill collar 27. So much of the sub may thus be connected to the drill collar as may be desired in order to provide a portion having the enlarged bore 24 of sufficient length to impart the requisite flexible extension beyond the point of vanishment of the last thread.

It will be understood that various alterations and additional modifications may be made in the details of the illustrative embodiments within the scope of the appended claims but without departing from the spirit of this invention.

What I claim and desire to secure by Letters Patent is:

1. A threaded connection assembly for joining a pair of relatively thick-walled drill collars, said assembly including mating box and pin elements on the adjacent ends of said drill collars, said box element comprising an inwardly tapering socket in an end of one of the drill collars communicating with the bore thereof, a series of threads on the inner wall of said socket, the portion of said bore adjacent the last of said threads being cylindrically enlarged to a diameter corresponding to the root diameter of said last thread whereby to cause said last thread to vanish into the wall of enlarged portion of said bore and to reduce the normal wall thickness of said one of said drill collars at the point of vanishment of said last thread, said cylindrically enlarged portion extending longitudinally along said one of said drill collars for a substantial distance beyond the point of vanishment of said last thread and thereafter merging on a smooth curvature into the thicker walled portion of the drill collar whereby said cylindrically enlarged portion forms a longitudinally extending relatively resilient connection between the threaded socket and said thicker walled portion, said pin element having external threads matching those in said box element and having a corresponding taper, the length of said pin element being such that when fully inserted in said box element the threads on said pin element will engage and fully cover

said last thread at least to its said point of vanishment.

2. A box connection element for a relatively thick-walled tubular drill collar member forming a part of a rotary drilling string and normally subjected to bending stresses, comprising, an inwardly tapering socket in one end of said tubular member communicating with the bore thereof, a series of threads on the inner wall of said socket, and means for reducing concentration and notch effect of said bending stresses at the last of said threads, said means comprising, a cylindrically enlarged section of said bore adjacent the last of said threads having a diameter corresponding to the root diameter of said last thread whereby to cause said last thread to vanish into the wall of said enlarged section and to reduce the normal wall thickness of said tubular member at the point of vanishment of said last thread, said enlarged section extending longitudinally along said member for a substantial distance beyond the point of vanishment of said last thread and merging on a smooth curvature into the thicker-walled portion of said member whereby said cylindrically enlarged section forms a longitudinally extended relatively resilient connection between the threaded socket and the thicker-walled portion of said member.

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