March 15, 1932. L. B. BRIDGES 1,849,069

SUCKER ROD

Filed March 16, 1931

Fig. 1.

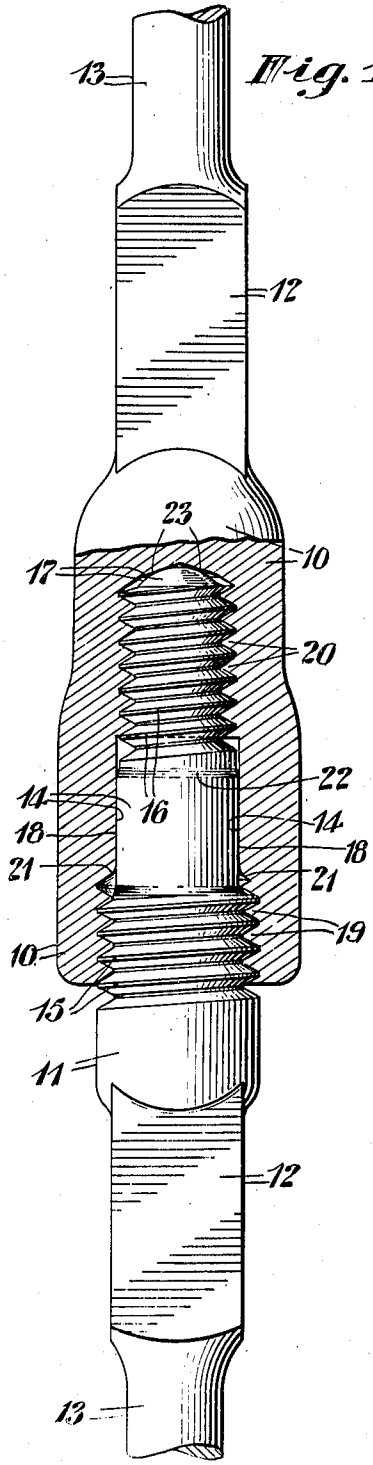


Fig. 2.

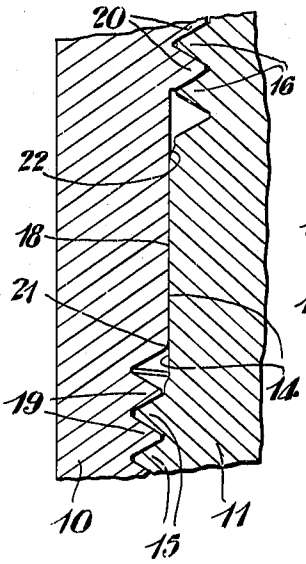
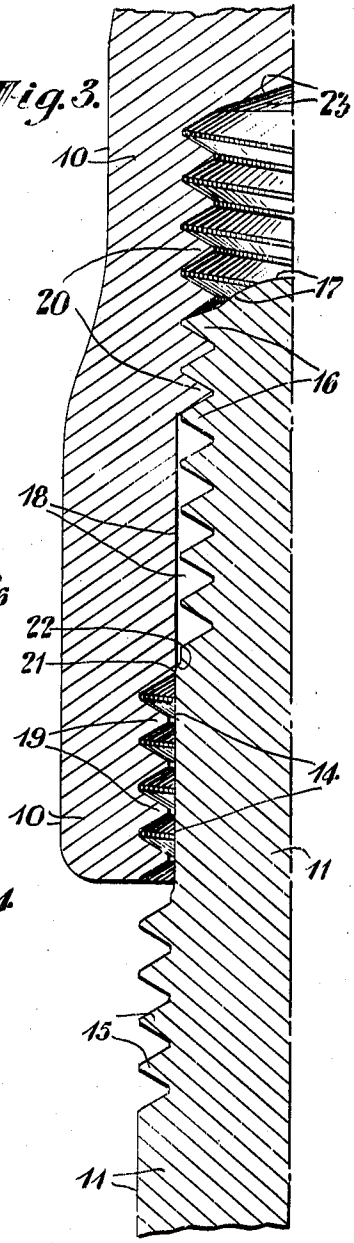


Fig. 3.



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UNITED STATES PATENT OFFICE

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SUCKER ROD

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This invention relates to improvements in sucker rods and other rod-like members made up of screw thread jointed units or sections, and particularly to rod-like members of this type used under conditions in which they are reciprocated endwise and are required to withstand heavy loads subjecting them to severe axial and bending stresses and severe vibration as, for example, in the case of sucker rods of oil well pumps.

The invention has for its main purposes the provision of a simple and efficient separable connection for units or sections of rod-like members of the class above set forth, and the provision of such a connection wherein the units are self-locked against accidental unscrewing and jointed in such a manner as to eliminate or largely reduce rod failures due to fracture in the joints.

Other purposes and advantages of the invention will appear from the following description in detail of the preferred embodiment thereof illustrated in the accompanying drawings.

In the drawings:

Fig. 1 is a view (partly in central longitudinal section) of a portion of an oil well pump sucker rod embodying the invention, the rod being shown in the position it occupies when in a well and the adjacent ends of two rod sections or units being shown fully coupled;

Fig. 2 a fragmentary central longitudinal sectional view showing a portion of the rod joint on a larger scale, the parts being in the fully coupled position shown in Fig. 1; and

Fig. 3 a fragmentary central longitudinal sectional view showing the adjacent ends of the rod sections or units partly coupled, as more fully hereinafter explained.

The sucker rod illustrated in the drawings comprises a plurality of identical metallic rod sections or units, the adjacent ends of two only of which are shown. Each unit or section of the rod has a box 10 at one end and a pin 11 at the opposite end, the box and pin being joined by two squared wrench-receiving portions 12 with the main body portion 13 of the unit. In Fig. 1 a three-quarter inch sucker rod is shown full size, the main body portions of the units having a circular profile and a uniform diameter of three-quarters of an inch.

The pin has an intermediate non-threaded portion with a cylindrical friction locking surface 14, said intermediate portion connecting an externally threaded inner pin portion of greater diameter than the non-threaded portion and an externally threaded outer pin portion of lesser diameter than the non-threaded portion. The two pin threads 15 and 16 are of equal pitch, thread 15 extending to the outer end of the pin portion of largest diameter and thread 16 extending to the outer end of the pin which terminates in a rounded tip or extremity 17.

The chamber or socket of box 10 has an intermediate non-threaded portion with a cylindrical friction locking surface 18, said intermediate portion connecting an internally threaded outer box portion of greater diameter than the non-threaded portion and an internally threaded inner box portion of lesser diameter than the non-threaded portion. The two box threads 19 and 20 are of equal pitch and complementary respectively to pin threads 15 and 16. The box chamber terminates in a conoidal or dished end wall 23 against which pin extremity 17 abuts in the fully coupled position of the rod units with the two pairs of complementary screw threads engaged substantially throughout their lengths.

The threaded portions of the box, like the non-threaded friction locking portions thereof, are cylindrical or non-tapering. When the rod units are in normal condition or disconnected, the major diameter of threads 15 and 19 corresponds with the maximum diameter of the pin and the minor diameter of these threads is slightly greater than the diameter of both locking surface 18 of the box and the locking surface 14 or non-threaded friction locking portion of the pin; the diameter of locking surface 18 or the non-threaded friction locking portion of the box chamber is slightly less than that of surface 14 and slightly greater than the major diameter of threads 16 and 20; the major diameter of threads 16 and 20 is slightly less than the

diameter of surface 14 and of surface 18; and the minor diameter of threads 16 and 20 is preferably the same (or approximately the same) as the diameter of the main cylindrical body portions 13 of the rod units, so that the smallest diameter of the pin is at least as great as the diameter of the main rod body.

The internally threaded outer portion of the box is connected with the surface 18 by a low and slightly rounded or convex annular shoulder forming a cam surface 21, while locking surface 14 is connected with the reduced externally threaded outer portion of the pin by a low and slightly rounded or convex annular shoulder forming a cam surface 22. These cam surfaces may be conoidal surfaces, if desired, and one of them may be omitted if desired, but preferably two cam surfaces are employed.

Preferably, as shown, the threads and locking surfaces of the box and pin are of such length that each two adjacent units are screw threaded coupled throughout two spaced portions of their length and frictionally coupled throughout an intermediate portion of their length, the length of each of said portions being at least equal to the diameter of body portions 13 of the units, the length of the thread connection afforded by the pair of threads 15 and 19 of largest diameter and the length of the friction connection afforded by locking surfaces 14 and 18 being each approximately equal to the diameter of body portions 13, and the length of the thread connection afforded by the pair of threads 16 and 20 of smallest diameter being materially greater than that of the other thread connection, thereby providing a jointed rod of maximum tensile strength secure against accidental unscrewing of its units and highly resisted to fracture in the joints. The leading in ends of the external pin threads and also the leading in ends of the internal box threads are arranged and spaced as shown so that the rod sections or units may be screwed together.

With the above described construction and arrangement, it will be observed, referring particularly to Fig. 3, that, in screwing the adjacent ends of two units together, threads 16 and 20 engage first and screw together for at least one full turn before cam surfaces 21 and 22 come in contact; that as the screwing together effort is continued the advance of the pin into the box by threads 16 and 20 causes cam surface 21 to ride up over cam surface 22 and thus expand the box slightly to permit locking surface 18 to telescope on locking surface 14; that as surfaces 14 and 18 begin to telescope the threads 15 and 19 are lead into engagement by the action of threads 16 and 20 and begin to screw together also, so that substantially all of the interfitting of surfaces 14 and 18 after contact is established therebetween at their leading end is accomplished by continued screwing together of the units with both pairs of threads engaged; and that the screwing together of the units is finally positively arrested by abutment of tip 17 of the pin against end wall 23 of the box with the pairs of threads substantially, but preferably not quite, fully engaged and the pair of cylindrical locking surfaces substantially, but preferably not quite, fully interfitted, as shown in Figs. 1 and 2.

It will be further observed that the outer end face of the box has no abutting or other contact with a shoulder or other part of the rod unit screwed into the box; that there is no abutting contact between shoulders or other parts of the pin and box at either end of the frictionally interfitted portions or at any point between the ends of the three connections; that the abutting contact between the end of the pin and the end wall of the box is between surfaces of such character that development of bending leverage on the pin at this point is eliminated or so nearly eliminated as to avoid danger of development of stresses at this point effective to fracture the pin; and that the sole mutual contacts between coupled units are afforded by two pairs of engaged screw threads, a pair of engaged cylindrical surfaces (one of which is elastically stretched about the other) between the adjacent ends of the pairs of engaged threads, and a pair of endwise abutted surfaces one of which is convex and the other concave.

The difference in normal diameter between locking surfaces 14 and 18 is sufficiently slight to permit surface 18 to be elastically expanded upon surface 14 without exceeding the elastic limit of the metal so that the parts may be repeatedly connected and disconnected without impairing the tight holding characteristic of the friction lock. By providing the frictional connection intermediate the two thread connections and making the length of this frictional connection longitudinally of the joint at least equal to the diameter of body portions 13 of the unit and that of the shorter thread connection rocking or cocking between the pair of threads forming each thread connection is effectually prevented, and a friction connection by friction surfaces tightly gripped under elastic tension and of sufficient area of contact to prevent the possibility of accidental unscrewing of the rod units under the most severe operating conditions is afforded.

The provision of screw thread connections at both ends of the elastically interfitted cylindrical friction surfaces prevents any elongation under heavy axial stresses in tension that would result in loosening of the grip or in play between the frictionally contactive parts of the pin and box, thus avoiding accidental unscrewing of the units and development of fracturing stresses caused by wab-

bling movements between the frictionally telescoped parts that would otherwise occur in service. Furthermore, the box is expanded by radial stress applied along a medial portion of its length instead of at either end, and the resultant effect is to cause the internal threads to take a tighter grip on the external threads than would be the case if the friction connection were at either end of the box.

Any clearance or play between pairs of engaged threads in the joint will be taken up as indicated by the light and heavy lines defining the thread side faces in Fig. 2 by screwing the members together as far as abutments 17 and 23 permit, so that the heavy tensile stresses (the greatest axial stresses on a sucker rod) are taken by tightly engaged thread side faces held in this relation by said abutments and the friction lock 14—18 that prevents an accidental separation of said abutments by preventing unscrewing under vibration and other shocks to which the rod is subjected in service. Under the above conditions, any thrust on the rod in the other direction is taken by the said abutments 17 and 23.

What I claim is:

1. A sucker rod comprising separably jointed units each two adjacent ones of which are coupled and in contact solely by the engagements between two longitudinally spaced pairs of complementary screw threads thereon, an intermediate pair of engaged telescoped cylindrical friction surfaces thereon one elastically expanded upon the other, and a pair of abutted surfaces thereof engaged entirely around the rod axis one of which abutted surfaces is convex and the other conoidal.

2. A sucker rod comprising two units the adjacent end portions of which each has a leading screw thread and a following screw between the ends of which there is a cylindrical friction locking surface, the leading and following threads on one unit being external threads and the locking surface on said unit facing outwardly and having a normal diameter intermediate the major diameter of the leading thread and the minor diameter of the following thread on said unit, the leading and following threads on the other unit being internal threads and the locking surface on said unit facing inwardly and having a normal diameter less than that of the other locking surface and intermediate the minor diameter of the leading thread and major diameter of the following thread on said unit, said units having annular cam surfaces at the leading ends of their respective cylindrical friction locking surfaces correlated to engage and ride across each other only after the units are partly screwed together, and the units being coupled with their friction surface telescoped and the leading and following internal threads engaged respectively with the following and leading external threads.

3. A sucker rod as claimed in claim 2, in which the externally threaded end portion of one unit has a rounded tip at its leading end abutted against an oppositely facing dished surface on the internally threaded end portion of the other unit.

4. A sucker rod as claimed in claim 2, in which the externally threaded end portion of one unit has a rounded tip and the internally threaded end portion of the other unit has a dished surface abutted by said tip with the two pairs of screw threads and the pair of telescoped friction surfaces engaged substantially from end to end, said engagements between the pairs of screw threads, the pair of friction surfaces and between the tip and dished surface being the sole contacts between the coupled units.

5. In a separable joint, the combination of two members one of which has a female end portion with two coaxial internal non-tapered screw threads and an internal cylindrical non-threaded surface located between the adjacent ends of said threads, while the other member has a male end portion extending into said female end portion and provided with two coaxial external non-tapered screw threads with which said internal threads are coupled and also provided with an external cylindrical non-threaded surface located between the adjacent ends of said external threads and of a normal diameter intermediate the normal major diameters of said external threads and exceeding the normal diameter of the internal non-threaded cylindrical surface, said internal cylindrical surface being elastically stretched upon said external cylindrical surface and of a normal diameter intermediate the normal minor diameters of the internal threads, the leading one of which internal threads has a normal minor diameter at least as great as the normal diameters of the external cylindrical surfaces, and one of said end portions of the members having a cam portion between its leading thread and its cylindrical surface for stretching the internal cylindrical surface on to the external cylindrical surface as the members are screwed together.

In testimony whereof I hereunto affix my signature.

LEWIS B. BRIDGES.