

June 5, 1934.

F. J. HINDERLITER

1,961,763

TOOL JOINT

Filed June 12, 1930

2 Sheets-Sheet 1

Fig. 1.

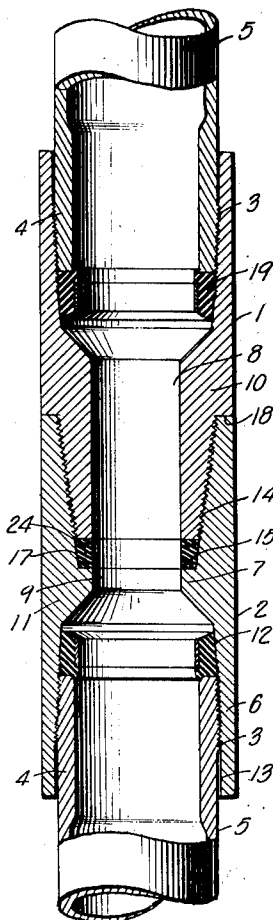


Fig. 2.

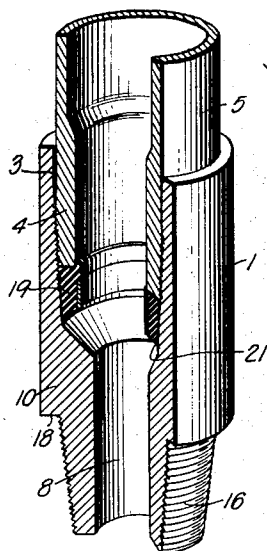


Fig. 5.

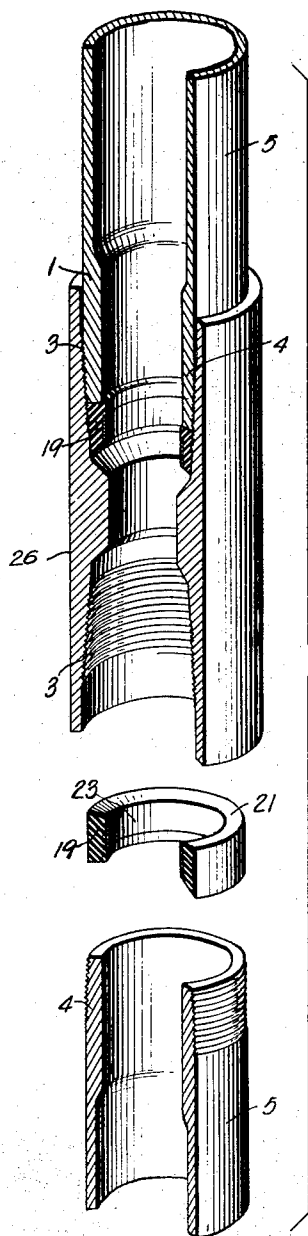


Fig. 3.

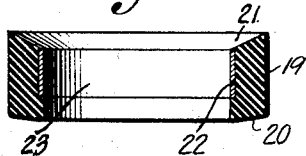
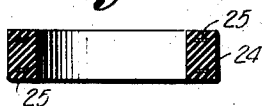


Fig. 4.



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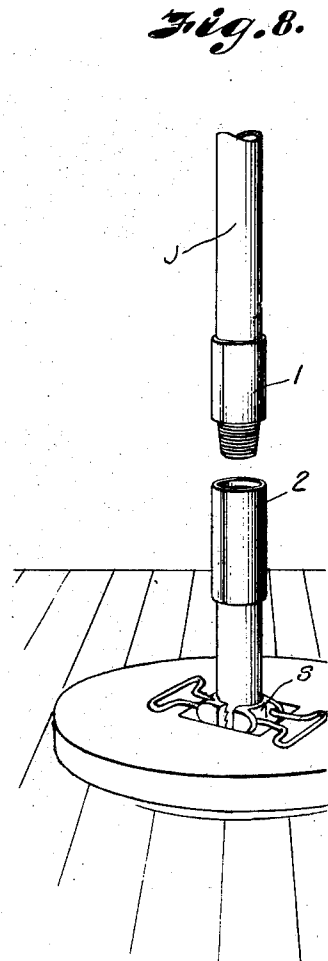
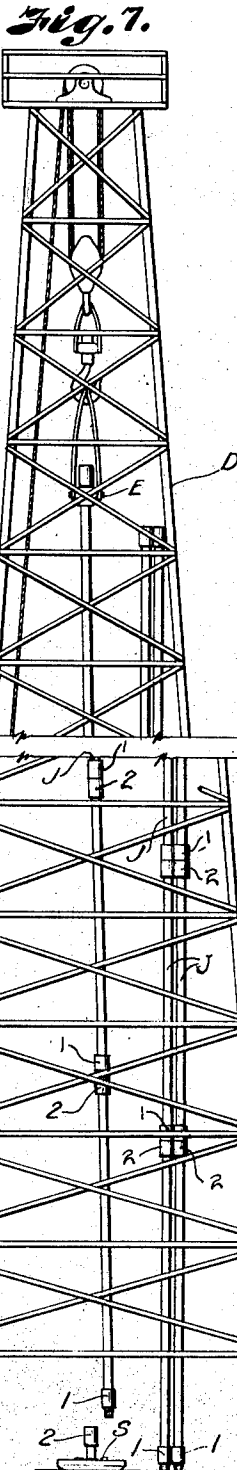
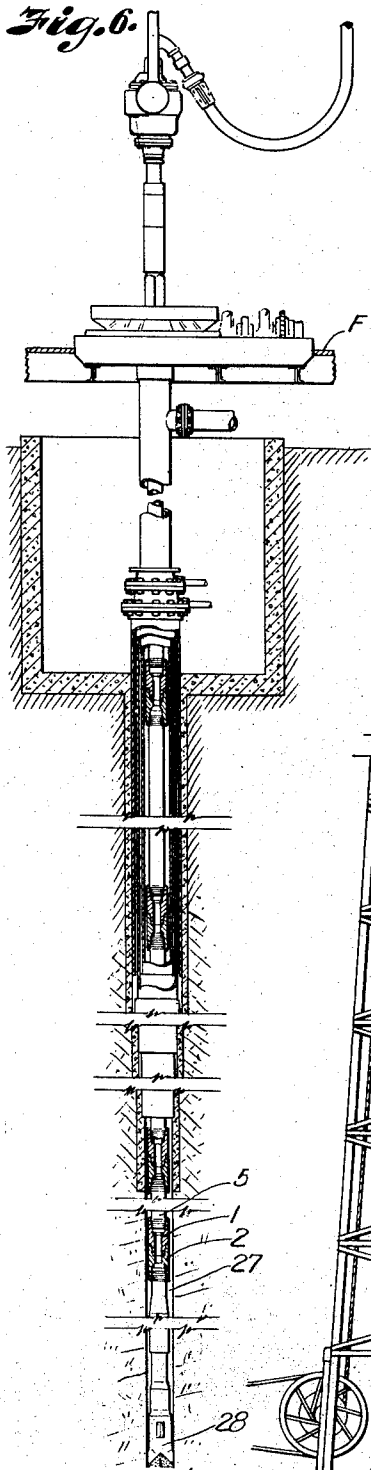
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UNITED STATES PATENT OFFICE

1,961,763

TOOL JOINT

Frank J. Hinderliter, Tulsa, Okla.

Application June 12, 1930, Serial No. 460,712

7 Claims. (Cl. 235-146)

My invention relates to tool joints, and more particularly to a device of that character for coupling the sections of drill pipe employed in rotary well drilling equipment, the present application
5 constituting a continuation in part of my pending application Serial No. 420,419 and No. 447,258.

In rotary drilling the bit is suspended in the well hole on a tubular rod, known as drill pipe
10 and formed in sections which are connected by coupling devices known as tool joints, to provide a continuous passage through which mud-laden fluid is delivered for cleaning the bit, softening the formation and flushing the drillings from
15 the well hole. The fluid, being delivered through the pipe under high pressure, is inclined to seek outlet through the joints and when a leak occurs the fine sand carried in suspension in the fluid grinds the metal over which it flows and rapidly
20 eats away the wall of the joint, short circuiting the fluid and thus interfering with the drilling operation.

It is the object of my invention to obviate such interference with the drilling operation and the
25 loss incident to such damage to the equipment by sealing the pipe sections in the joints to prevent initial escape of fluid at the joints and thus obviate the destructive effects resulting from continued leakage.

In accomplishing this and other objects of the invention, I have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a central longitudinal section of a tool
30 joint embodying my improvements and portions of drill pipe connected thereby.

Fig. 2 is a perspective view of disassembled members of the joint in spaced relation and cut
35 away to illustrate their construction.

Fig. 3 is an enlarged detail view of a pipe-joint packing member in central longitudinal section.

Fig. 4 is a similar view of the pin-box packing member.

Fig. 5 is a view similar to Fig. 2, illustrating the invention applied to a pipe collar.

Fig. 6 is a view of part of a string of drill pipe as it appears in a well, showing the pipe sections connected by tool joints and the pipe string connected with a drill pipe and the operating tool
50 known as a "grief stem", by tool joints and coupling collars.

Fig. 7 illustrates removal of drill pipe from a well and racking of stands of drill pipe in a der-
55 rick.

Fig. 8 illustrates application of a stand of drill pipe to the part of a string in a well.

Referring in detail to the drawings:

A tool joint as ordinarily constructed includes pin and box members 1, 2, each including, at its
60 outer end, a socket 3, for receiving the end 4 of a drill pipe section 5 and having an intermediate, tapered wall portion 6 extending from near the outer end of the socket to near the base thereof, and terminating at its inner end in a reducing
65 throat 7 leading to channel 8, 9 in sleeve portions 10, 11 of the respective joint members. The tapered wall portion 3 of each socket member is threaded from its outer end to near the throat 7 to cooperate with threads on the tapered end of
70 a pipe section, leaving an unthreaded portion 12 at the inner end of the socket, the outer ends 13 of the socket wall being unthreaded and of sufficient interior diameter to provide play of the pipe section and prevent shearing.
75

The inner end of the box member 2 includes a tapered socket 14 terminating in a transverse shoulder 15 within the collar portion 11, and threaded from its outer end to near the shoulder for cooperation with the threads on the pin 16
80 of the pin member 1 of the joint, the inner end 17 of the socket wall being left smooth. The base of the pin is inset, forming a shoulder 18 for abutting against the inner end of the box member and limiting projection of the pin into
85 the box socket.

With such construction projection of the pipe sections into the joint members is unlimited except by restriction of the sockets, thereby enabling extremely tight connections of the pipes
90 with the joints, but projection of the pin into the box socket is limited by the shoulder 18, thereby insuring against binding of the joint, and facilitating separation of the pipe at the joint when required during the drilling operation.
95

If the parts constructed as described, are without flaw and assembled accurately, they will usually confine the drilling fluid without leakage, but should the threads on the joint or pipe be imperfectly formed or have become distorted in
100 transport or should the parts be improperly assembled, the fluid, because of the high pressures employed, will be forced from the line through the passage afforded by the imperfect connection, and particularly will this occur in the pin
105 members where the flow is first restricted. When such a leak occurs, sand particles in the fluid grind the surfaces over which they pass, wearing away the metal and rapidly opening the outlet until such quantity of the fluid is short
110

circuited into the return line as to seriously interfere with the drilling operation.

To prevent such leakage I provide the packing of my invention which in its preferred form includes the following elements assembled in the joint as I will now describe.

Referring first to the preferred form of packing for sealing the connections between the pipe sections and joint members within the pin and box sockets, 19 designates a rubber or like ring having an exterior diameter to fit easily into either of the like sockets 3 to a point near the base of the socket, where it will extend about equally over the threads in the socket and over the smooth surface 12, and having an interior diameter slightly less than that of the pipe sections and greater than the reduced channel 8, 9 in the pin and box members, the outer edge 20 of the ring being slightly convex and the inner edge 21 more markedly concave for purposes presently described. At its concave edge the ring is inset for a part only of its depth to form a seat 22 for a stiffening ring 23, preferably of rigid metal, having an interior diameter corresponding with that of the ring so that their surfaces are coextensive.

The ring 24 for sealing the connection between the pin and box of the joint, also composed of rubber or like material, is of a thickness approximately equal to the width of the seat 15 in the socket 14 of the box member so that its interior diameter corresponds to the diameter of the channel 8—9, and of a depth to be compressed against the seat 15 by the end of the pin 16 when the pin is fully threaded into the box socket 14, i. e., until the shoulder 18 on the pin member engages the edge of the box member (Fig. 1). Embedded in the ring 24 are a number of flat stiffening rings 25, preferably of rigid metal, arranged in spaced relation and with their faces parallel with the edges of the ring, for maintaining the general contour of the ring and preventing its collapse under heavy pressure on its opposite edges.

With the parts constructed as described, the pipe socket rings are inserted into their sockets, with the concave faces directed inwardly and the pipe sections screwed into the sockets to contact with the outer convex edges of the rings, the flat edges of the pipe sections first engaging the high parts of the rings adjacent their inner diameters and advancing into the socket, distorting the material outwardly to first contact with the wall of the socket and into the threads in such wall, at the same time pushing the ring inwardly into the converging base of the socket and compressing the body of the ring between the wall of the socket and the stiffening and retaining ring 23.

With the pipe sections connected to the joint members, when the joint members are to be coupled a packing ring 24 is located in the seat 15 of the box member and the pin on the pin member threaded into its socket in the box member, the end of the pin engaging the ring as the pin reaches its set position and compressing the ring laterally against the wall of the socket, so that when travel of the pin is interrupted by engagement of the shoulder 18 with the end of the box member, an effective seal has been established between the pin and box members, the stiffening rings embedded in the packing ring preventing the latter from collapsing inwardly under the lateral distortion due to the extreme pressure.

When the parts are so assembled, drilling fluid

circulating in the pipe unit under high pressure, engaging the concave faces of the outer rings of the joint, presses such portions of the rings firmly against the walls of the sockets to promote the sealing effect.

With the sealing rings constructed, assembled, and functioning as described, the threaded connections and any defects in the material at the joints are sealed by the rings to preclude bypassing of the fluid; high pressure on the fluid being converted to an aid in maintaining the joint instead of promoting its destruction in the manner common to such joints of ordinary construction.

The form of coupling illustrated in Fig. 5 is employed for connecting certain types of drills with the drill pipe in connection with a tool joint and for connecting the pipe with the operating or "grief stem" at the top of the well, also in connection with a tool joint.

In the figures of the drawings illustrating use of my invention, 27 (Fig. 6) designates a well hole in process of formation by a bit 28 attached to the lower section 5 of a string of drill pipe by a tool joint and collar; the individual sections of the pipe being coupled by tool joints 1—2; the upper pipe section being shown connected with the operating tool or "grief stem" S by a tool joint and collar.

In Figs. 7 and 8, D designates a derrick having a floor F, S a spider in the drilling table T suspending part of the string of pipe in the well, and E an elevator whereby the pipe is let into and removed from the well, here shown as suspending a stand of pipe which has been either just disconnected from the string for racking on the derrick floor or picked up from the rack for application to the string as in the usual pulling or letting in operation incident to a replacement or repair.

In using the invention, a drill bit is attached to a section of drill pipe which is let into the well hole and rotated by usual operating mechanism to advance the hole, a part of the weight of the pipe being sustained by the elevator E suspended from the crown block of the derrick in accordance with common practice, to avoid sticking the bit or too rapid drilling which would result from operation of the drill under full weight of the pipe.

When the first section of pipe carrying a box member 2 at its upper end has been sunk in the hole formed by the drill bit, a second section of similar pipe carrying a pin joint member at its lower end is connected with the pipe in the well by threading the pin into the box to extend the length of the pipe. Drilling is then resumed, and other sections of pipe are added as the drilling progresses.

As the well hole deepens, strata are encountered which rapidly dull or otherwise affect the bit so that it is frequently necessary to pull the pipe out of the hole for replacement or repair of the bit. When the wells are relatively shallow pulling and replacement of the pipe is not a serious matter, but when the hole is extended to great or substantial depths delay in separating and again connecting each individual section from and to the string would seriously delay the operation.

Consequently it has become the universal practice to divide the string of drill pipe into stands, each consisting of as many sections of pipe as can be raised together in the derrick, and to sep-

arate and assemble the stands instead of the individual pipe sections.

While the collar type of coupling provides a secure connection for the pipe sections, it would be impractical for use as a joint connection because of delay incident to the threading and unthreading operations, of liability of the fine threads to jam when the pipe sections are set in the collar, and liability of the threads of the mating members to weld from heat generated by friction during the threading operation.

Consequently the different connection or tool joint, is employed for connecting the pipe joints or sections, each tool joint including pin and box members connected respectively with upper and lower sections of pipe by the relatively fine threads (about eight to the inch) and connected together by coarse threads (about four or five to the inch) so that the joints may be connected or disconnected by about five revolutions of one member relative to the other, as distinguished from the approximately twenty-four turns required for making or breaking the connection between a pipe section with a collar. The coarser threads of the tool joint are also much less liable to distortion from impact of one member with the other during the setting operation, and overheating will not occur during the relatively short assembling operation.

During drilling of a well with rotary tools, mud laden fluid is circulated down through the drill pipe and bit and up the well hole to wash the bit and remove cuttings from the hole. When the hole is shallow circulation may be maintained with relatively low pump pressure but as the hole deepens greater pressures are required, the present practice in drilling wells to depths of six thousand feet and more requiring pressures up to and exceeding one thousand pounds to the square inch. Fluid circulated at pressures ranging from a few hundred pounds up to the extremely high pressures will seek outlet from the drill pipe through any defective joint or coupling, and any minute leak through a joint or coupling is rapidly increased from grinding of the walls of the connection by fine sand in the fluid. When this occurs the fluid by-pass through the leak and circulation in the part of the hole below the leak is stopped, permitting the cuttings and solid matter in the fluid to precipitate and settle about the bit and lower portion of the drill pipe, locking or "freezing" the pipe in the hole and frequently causing loss of the well.

It is to obviate such loss and to overcome the disadvantages above recited that I have devised the improvements herein disclosed.

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

1. A device of the character described for use with drill pipe adapted for conducting fluid under high pressure including a coupling member having a tapered socket, a packing ring slidable in the socket in response to thrust of a pipe member threaded into the socket and having a concaved inner end exposed to pressure of fluid flowing through the coupling member.

2. A device of the character described for use with drill pipe adapted for conducting fluid under pressure including a coupling member having a tapered socket, a packing ring compressible against the tapered wall of the socket

by thrust of a pipe section inserted into the socket to protect the coupling member against wear incident to escape of fluid between the coupling member and an inserted pipe section, said compressible ring having a recess in its inner circumferential face and a relatively rigid reinforcing band in said recess.

3. A device of the character described for use with drill pipe adapted for conducting fluid under pressure including a coupling member having a tapered socket, a packing ring compressible against the tapered wall of the socket by thrust of a pipe section inserted into the socket to protect the coupling member against wear incident to escape of fluid between the coupling member and an inserted pipe section, and means inside of and comprising a component of said ring for restraining inward bulging of the ring under compression.

4. A device of the character described for use with drill pipe adapted for conducting fluid under pressure including a coupling member having a tapered socket, a packing ring slidable in the socket in response to thrust of a pipe member threaded into the socket and having a concaved inner end exposed to pressure of fluid flowing through the coupling member, and means inside of and comprising a component of said ring for restraining inward bulging of the ring under compression.

5. A device of the character described for use with drill pipe adapted for conducting fluid under pressure, including a coupling member having a tapered socket, a packing ring slidable in the socket in response to thrust of a pipe member threaded into the socket and having a concaved inner end exposed to pressure of fluid flowing through the coupling member, and means inside of and comprising a component of said ring for restraining inward bulging of the ring under compression, said means comprising a relatively rigid band seated on the inner circumferential side of the ring adjacent its concaved end.

6. A device of the character described for use with drill pipe adapted for conducting fluid under pressure including a coupling member having a tapered socket, a packing ring compressible against the tapered wall of the socket by thrust of a pipe section inserted into the socket to protect the coupling member against wear incident to escape of fluid between the coupling member and an inserted pipe section, and a relatively rigid reinforcing means in and comprising a component of said ring.

7. A device of the character described for use with drill pipe adapted for conducting fluid under pressure including a coupling member having a tapered socket, a packing ring compressible against the tapered wall of the socket by thrust of a pipe section inserted into the socket to protect the coupling member against wear incident to escape of fluid between the coupling member and an inserted pipe section, and means inside of and comprising a component of said ring for restraining inward bulging of the ring under compression, said means comprising a band of lesser thickness than that of said ring; whereby said ring is restrained against inward bulging for a portion only of its inner side.

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