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SLIP JOINT FOR TUBULAR MEMBERS
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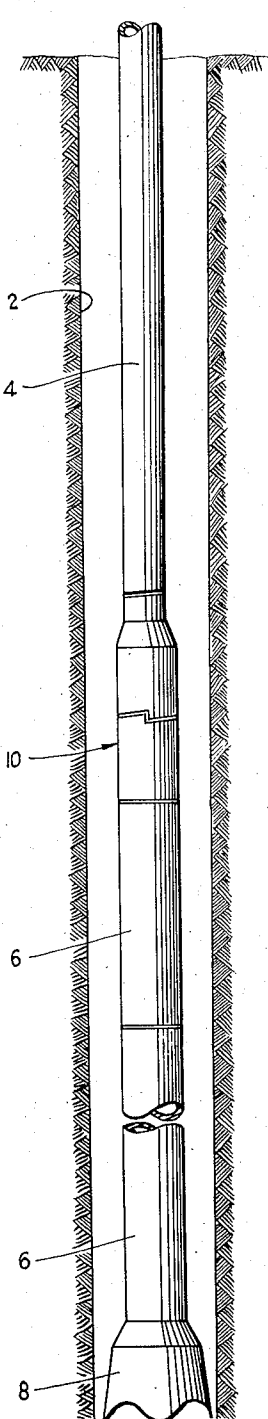


Fig. 1

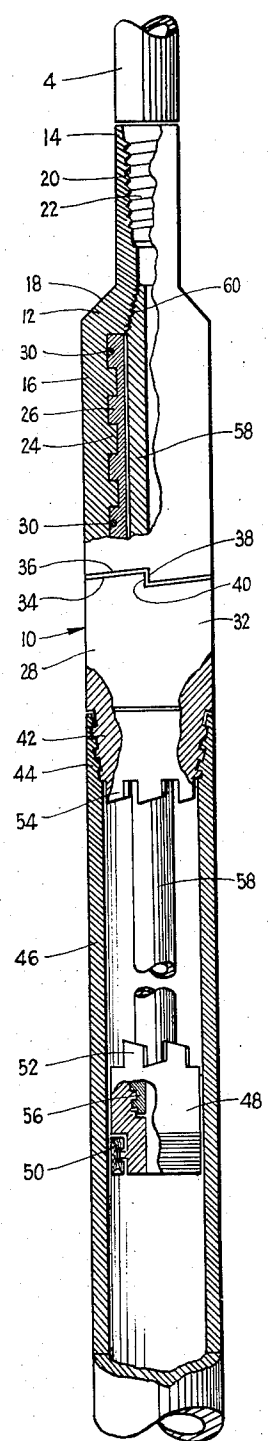


Fig. 2

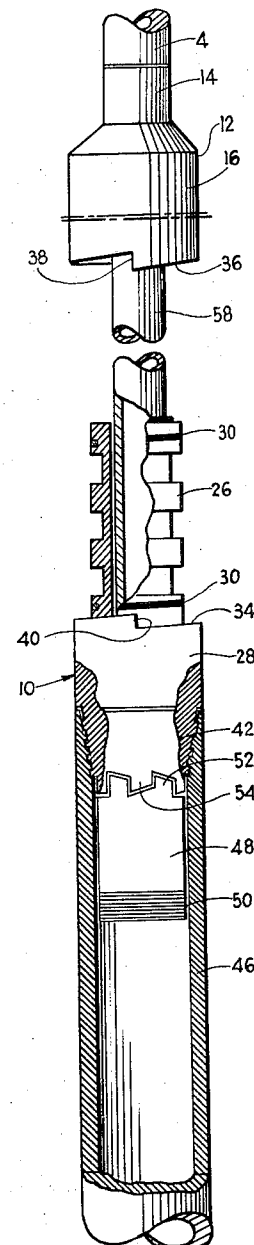


Fig. 3

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SLIP JOINT FOR TUBULAR MEMBERS

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1 Claim. (Cl. 255—28)

This invention relates to improvements in oil well drilling mechanisms, and more particularly to an improved slip joint for insertion in the drilling string of an oil well.

As it is well known in the oil industry, the majority of oil wells, and particularly deep wells, are drilled by the rotary method. In this method, a drill bit is secured on the lower end of a plurality of elongated drill collars and the drill collars are in turn secured to a string of drill pipe. The drill pipe and drill collars are secured in tandem relation to extend downwardly in the well bore. The drill bit is operated by rotating the drilling string, i. e., the drill pipe and drill collars, from the surface of the well. This is ordinarily accomplished by securing the uppermost drill pipe joint to a square shaped elongated member, called a "kelly," and rotating the kelly by an apertured rotary table provided at the surface of the well. As the well bore is drilled, the kelly moves downwardly through the rotary table and is simultaneously rotated thereby. Periodically another joint of drill pipe must be added to the drill string in order to obtain additional depth for the well bore. When this occurs, the kelly is moved upwardly through the rotary table and an additional joint of drill pipe is inserted between the kelly and the previous top joint of drill pipe, whereupon the drilling string is again lowered to continue the drilling operation.

The present invention contemplates a novel slip joint for insertion in the drilling string to overcome the necessity of raising the entire drilling string when adding drill pipe to the string. With this invention the drill bit will remain on the bottom of the well bore during the adding operation, thereby retaining the footage drilled. The slip joint is of telescopic construction with means to provide a continuous flow of circulating mud therethrough, yet retain the mud out of contact with the threaded portions of the device. Also, the slip joint is constructed to permit operation of the drill bit when the joint is expanded.

An important object of this invention is to provide an improved slip joint for drilling strings whereby all footage drilled will be retained.

Another object of this invention is to eliminate the necessity of raising the drill collars and drill bit when adding additional drill pipe.

A further object of this invention is to reduce to a minimum the weight lifted by the surface equipment during drilling of a well bore.

A still further object of this invention is to reduce the time required for drilling a well bore, and particularly a deep well bore.

Another object of this invention is to provide a simple, practical slip joint which may be economically manufactured.

Other objects and advantages of the invention will be evident from the following detailed description, read in conjunction with the accompanying drawings, which illustrate my invention.

In the drawings:

Figure 1 is a vertical sectional view of a well bore hav-

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ing a drilling string therein and having my novel slip joint interposed in the drilling string.

Figure 2 is a vertical sectional view of my novel slip joint in a closed position.

5 Figure 3 is a vertical sectional view of the slip joint in a retracted or expanded position.

Referring to the drawings in detail, and particularly Fig. 1, reference character 2 designates a well bore having a string of drill pipe 4 extending vertically downward therethrough from the surface (not shown). A plurality of drill collars 6 are secured in tandem relation below the drill pipe 4 and have a drill bit 8 secured on the lower end thereof. The drill collars 6 are heavy, rigid, tubular members and are utilized to increase the weight imposed upon the drill bit 8, as well as retain the drill bit 8 in a position to drill vertically, as contrasted with laterally, thereby providing a straight well bore 2.

A novel slip joint, generally indicated at 10, is interposed in the drilling string between the drill pipe 4 and drill collars 6. While the slip joint is shown interposed in the string immediately above the drill collars 6, it is to be understood the joint 10 may be interposed anywhere in the drill string 4. The slip joint 10 comprises an upper tubular sub 12 (Fig. 2) having a small upper end portion 14 and a lower enlarged portion 16. The portions 14 and 16 are connected by a tapered shoulder 18. Internal threads 20 are provided in the upper reduced end portion 14 to receive the usual threaded pin 22 of the lowermost joint of drill pipe 4.

Internal threads 24 are also provided in the lower enlarged portion 16 of the sub 12 and extend substantially the length of the portion 16. The threads 24 are coarse, right-hand threads to receive the upper reduced and threaded portion 26 of a tubular connecting member 28. Spaced packing rings 30 are secured in the outer periphery of the portion 26 of the connecting member 28 in positions to provide seals between the portion 26 and the threads 24. The packing rings 30 are so arranged to provide a seal at each end of the threads 24 when the sub 12 and connecting member 28 are interconnected as shown in Fig. 2.

The main body portion 32 of the connecting member 28 has an enlarged outer diameter substantially equal to the outer diameter of the portion 16 of the sub 12, thereby providing an upwardly facing circumferential shoulder 34 between the portions 26 and 32. The lower end 36 of the upper sub 12 and the shoulder 34 are tapered to provide mating shoulders 38 and 40 respectively. The shoulders 38 and 40 are arranged to engage upon a clockwise rotation of the sub 12 relative to the connecting member 28 when the slip joint 10 is telescoped as shown in Fig. 2 to limit the engagement of the portion 26 of the connecting member 28 with the threads 24. Thus, the shoulders 38 and 40 prevent a tight engagement of the portion 26 with the threads 24 for purposes as will be hereinafter set forth.

The lower end portion 42 of the connecting member 28 is threaded for connection with the upper threaded end 44 of a tubular sleeve 46. The sleeve 46 extends downwardly from the connecting member 28, and its lower end (not shown in detail in Fig. 2) is adapted to connect with the uppermost drill collar 6.

A tubular head 48 is reciprocally disposed in the sleeve 46 and has an outer diameter only slightly less than the inner diameter of the sleeve 46 to provide a loose sliding fit therebetween. A packing ring 50 is secured on the lower end of the head 48 to provide a seal between the head 48 and the inner periphery of the sleeve 46 for purposes as will be hereinafter set forth. Upwardly extending lugs 52 are provided on the upper end of the head 48, and mating downwardly extending lugs 54 are provided on the lower end portion 42 of the connecting

member 28. The lugs 52 and 54 are adapted to engage in one position of the head 48 (Fig. 3) to provide simultaneous rotation of the member 28 and sleeve 46 with the head 48 as will be more fully hereinafter set forth.

The head 48 is threadedly secured to the lower end 56 of a tubular mandrel 58. The mandrel 58 extends upwardly through the sleeve 46 and connecting member 28 into the upper sub 12. The upper end 60 of the mandrel 58 is threadedly secured to the sub 12 substantially opposite the tapered shoulder 18 and between the threads 20 and 24.

Operation

During the usual rotary drilling operation, the slip joint 10 will be interposed between the drill pipe 4 and drill collars 6 as shown in Fig. 1, and the drill pipe 4 will be rotated in a clockwise or right-hand direction from the surface by a kelly and rotary table (not shown) as previously described. The clockwise rotation of the drill pipe 4 will be transmitted to the upper sub 12 of the slip joint 10, and through the medium of the shoulders 38 and 40 to the connecting member 28. Since the connecting member 28 is rigidly connected to the sleeve 46 and the sleeve 46 is rigidly secured to the drill collars 6, the rotary motion will also be transmitted on down to the drill collars 6 and bit 8 to accomplish the drilling action.

As previously noted, the shoulders 38 and 40 are arranged to engage before the upper portion 26 of the connecting member 28 is tightly engaged with the threads 24. Therefore, the connection between the portion 26 and threads 24 will be the loosest connection in the entire drilling string during the usual drilling operation.

When it is desired to add another joint or section of drill pipe 4 to the drilling string, the drill string 4 is rotated counter-clockwise a few turns from the surface. It will be noted that at this time, the drill bit 8 will be resting on the bottom of the well bore 2 and will resist a counter-clockwise rotation. Therefore, the drill bit 8 and all members rigidly secured thereto, i. e., the drill collars 6, sleeve 46 and connecting member 28, will tend to remain stationary. And since the upper sub 12 is tightly secured to the drill pipe 4, the upper portion 26 of the connecting member 28, will be unthreaded from the threads 24 to disconnect the upper sub 12 and connecting member 28.

Rotation of the drill pipe 4 is thus stopped and the kelly raised to provide for adding another joint of drill pipe 4 to the drilling string at the surface of the well. The drill bit 8, drill collars 6, sleeve 46 and connecting member 28 will remain stationary during the raising of the drill pipe 4 and its connected elements (the upper sub 12 and mandrel 58). Thus, the mandrel head 48 is moved upwardly through the sleeve 46; and at the end of its upward movement, the lugs 52 and 54 are engaged (Fig. 3) to again interconnect the upper sub 12 and connecting member 28. Therefore, the drill bit 8 may be rotated in a clockwise direction when the drill pipe 4 is in a raised position, if desired.

When the additional joint of drill pipe 4 is inserted in the drilling string, the drill pipe 4 is lowered and again rotated in a clockwise direction. The mandrel head or piston 48 is thereby moved downwardly through the sleeve 46 until the vertical spaced condition of the separated slip joint is consumed, and the upper end portion 26 of the connecting member 28 is again screwed into the threads 24 until the shoulders 38 and 40 come into engagement as shown in Fig. 2. Whereupon, the normal drilling operation is continued to operate the drill bit 8 and increase the depth of the well bore 2, until it may be necessary to add another section of pipe.

During the entire drilling and drill pipe adding operation, the slip joint 10 does not obstruct the flow of drilling or circulating mud through the drill string. The mud may flow freely through the upper sub 12, mandrel 58, head 48 and lower portion of the sleeve 46 at all times, regardless of whether the slip joint 10 is closed as shown in Fig. 2, or expanded as shown in Fig. 3. However, the mud is retained out of contact with all threads in the slip joint 10 which are likely to be washed-out or become fouled by the mud. The packing rings 30 prevent the mud from contacting the threads 24 when the slip joint 10 is closed as shown in Fig. 2—the slip joint 10 is in this position the majority of the time during operation—and the packing ring 50 retains the mud out of contact with the threads interconnecting the connecting member 28 and sleeve 46.

The use of the slip joint 10 is not limited to the operation just described. For example, and as will be apparent to those skilled in the art, the slip joint 10 may be effectively used in a wash-over string during the recovery of stuck or lost drill pipe, drill collars and drill bits.

From the foregoing, it is apparent that the present invention provides a novel slip joint for drilling strings and the like, wherein all footage made by the drilling string will be retained, and without the necessity of re-drilling or reaming after the addition of drill pipe to the string. The usual cave-ins, occurring when a drill bit is raised for adding drill pipe, are eliminated. Furthermore, it becomes unnecessary to raise the entire drilling string, and particularly the heavy drill collars, when adding drill pipe to the string, thereby saving time, as well as wear on the lifting equipment at the surface.

Changes may be made in the combination and arrangement of parts as heretofore set forth in the specification and shown in the drawings, it being understood that any modification in the precise embodiments of the invention may be made within the scope of the following claims without departing from the spirit of the invention.

I claim:

In a slip joint for a drilling string comprising a tubular sub member adapted to be interposed in the drilling string, internal threads provided in the sub member, a sleeve member of a size complementary to the sub member, said sleeve member having a threaded extension of reduced diameter cooperating with the threads of the sub member to provide a telescoping connection therebetween, cooperating shoulders on the sub and sleeve members transmitting rotation of the drilling string to the sleeve member in one direction and limiting the engagement of the cooperating threads, a lower sleeve secured to the first mentioned sleeve and adapted to connect with an adjacent portion of the drilling string for transmitting the rotation of the first mentioned connecting sleeve member, a mandrel provided in the sub member and extending through the first mentioned sleeve member and into the last mentioned sleeve member, a piston head on the mandrel slidably disposed in the last mentioned sleeve, a plurality of lugs on one side of the mandrel head, a plurality of lugs on the lower portion of the first mentioned sleeve and adapted to cooperate with the lugs on the mandrel head in a telescoped expanded position of the slip joint, whereby torque of the rotating drilling string may be maintained.

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