A signal conductor installation tool includes a chassis; a tracking system in operable communication with the chassis; a spool rotationally supported on the chassis; and a through hole in the chassis sized to pass a conductor from the spool to a target tubular member and method thereof.
SIGNAL CONDUCTOR INSTALLATION TOOL AND METHOD

BACKGROUND

[0001] Signal conductors, and particularly optic fibers are often placed in grooves in equipment designed for the downhole environment to protect the signal conductor from mechanical impact. While conductors can be and are placed in all configurations of grooves, it is notable that grooves that extend around a tubular member present a particularly time consuming installation of signal conductor, especially when it is inconvenient or impossible to rotate the tubular due to diameter, length, etc., or due to the location at which the conductors are to be joined with other downhole tools. For example, while it may be possible to rotate a tool at a large manufacturing facility, it may not be possible to rotate the same tool at a rig site. This results in many installations of conductors being affected by hand. As will be clear to the reader, hand installations are not particularly speedy. In view of the length of signal conductor needed and used in the downhole environment, operations directed to installing conductors are remarkably inefficient with respect to the overall completion of the well. Without a competent method and apparatus to install conductors in such circumstances however, the art is left to maintain its status quo.

SUMMARY

[0002] A signal conductor installation tool includes a chassis; a tracking system in operable communication with the chassis; a spool rotatably supported on the chassis; and a through hole in the chassis sized to pass a conductor from the spool to a target tubular member.

[0003] A method for installing a conductor at a target tubular member includes setting the tracking system of the tool described in the foregoing paragraph, rotating at least one of the tool and the target tubular member relative to the other of the tool and the target tubular member; automatically dispensing a conductor from the spool through the chassis to the target tubular member.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Referring now to the drawings wherein like elements are numbered alike in the several figures:

[0005] FIG. 1 is a three-quarter section view of one embodiment of the Signal Conductor Installation Tool as disclosed herein;

[0006] FIG. 2 is a side view of an alternate embodiment of the Signal Conductor Installation Tool as disclosed herein;

[0007] FIG. 3 is a view of the embodiment of FIG. 2 rotated about 90 degrees;

[0008] FIG. 4 is a cross sectional view of the embodiment of FIG. 2; and

[0009] FIG. 5 is a perspective view of an alternate tracking system.

DETAILED DESCRIPTION

[0010] Referring to FIG. 1, a first embodiment of a Signal Conductor Installation Tool 10 is illustrated in three-quarter section view disposed about a tubular member 12 around which a conductor 14 (which may be an optic fiber, electrical conductor or any other type of conductor) is to be deposited. As can be ascertained from the figure, the conductor 14 is disposed within a conductor groove 16 in the surface of the tubular member 12. In this embodiment, the groove is helical with an angle of about 20 degrees to about 60 degrees relative to an axis 18 of the tubular member 12. FIG. 1 is depicted with the tool 10 having partially already traversed the tubular member 12 installing conductor 14 as it moves. The tool 10 itself comprises a chassis 20, which is tubular in nature and dimensioned to relatively closely fit over the tubular 12 so that a clearance fit is achieved but excess slop is avoided. The chassis 20 further includes a tracking system 22 that enables the chassis to index itself to the groove pitch in the tubular member 12 and advance along the tubular member 12 in operation. As illustrated, the tracking system 22 is a pin having a length sufficient to extend radially into the groove 16. In this position, the chassis when rotating relative to the tubular member 12, will advance along the tubular member 12. The chassis and pin length are collectively to be sized to ensure that the pin remains in the groove 16 by not allowing for sufficient room within the chassis for the pin to disengage from the groove 16. The chassis 20 further includes a through hole 24 sized to allow clearance passage for the conductor 14 intended to be passed therethrough. The hole 24 is initiated in a direction substantially tangential to an outside surface of the chassis 20 and at an angle closely approximating the groove 16 angle of the tubular member 12 with which the tool 10 is intended to be used, and then exits the chassis at an angle substantially tangential to an inside surface of the chassis. The angles of the hole 24 as described ensure that conductor 14 can pass through the chassis 20 as it is being transported from a spool 30 to the groove 16.

[0011] The spool 30 is mounted rotatably on the chassis 20, and axially restrained thereon by such as upset 32. It is noted that the upsets 32 may be continuous about chassis 20 as shown or may be discontinuous or may simply comprise one short member on each axial end of the spool 30 with similar results. Because the spool 30 is not subject to any significant axial load, very little restraint is needed. Indeed, it is possible in some particular applications that no axial restraint is needed at all. The spool may utilize bushings, bearings, nothing at all (as illustrated), etc to enable the spool 30 to rotate freely relative to the chassis 20. It is important that the chassis 20 and spool 30 are rotatable relative to each other and to the tubular member 12 independently as the length of conductor 14 representing one 360 degree rotation about the tubular member 20 is not likely to require the same rate of rotational movement in the spool that it does in the chassis.

[0012] Finally, in iterations of this embodiment, an additional feeder tube 34 is positioned within one end of the hole 24 and extending therefrom toward the spool 30 to assist the conductor 14 to make its way without damage to the hole 24. The feeder tube 34 in one embodiment is rigid while in an alternate embodiment is semi-rigid.

[0013] In order to deposit the conductor 14 in the groove 16, tool 10 is fitted over one end of a target tubular 12 such that the pin 22 engages the groove 16. The tool 10 is then rotated relative to the tubular member 12. The rotation may be of the tool 10 or of the member 12 or both as circumstances dictate and may be manual or mechanized depending upon implementations at the disposal of the operator. As the tool 10 and tubular member 12 rotate relative to one another, the pin 22 moves the tool 10 along the tubular member 12 in an indexed manner so that deposition of the conductor 14 into the groove 16 is assured and is automatic. Tension is kept to a minimum while being simultaneously sufficient to play out conductor. Because the tool 10 ensures that the conductor 14 is deposited
properly even at relatively rapid speeds, the tool significantly improves time to completion. The relative rotation of the tool 10 may be continued for as long as the tubular member 12 has axial length, until the spool 30 runs out of conductor 14 or until a segment of the tubular member 12 that is intended to contain conductor has been completed.

In another embodiment, referring to FIGS. 2-4 greater adjustability and ease of use provided. While some of the components are quite similar to those disclosed in the foregoing embodiment, nuances thereof dictate the use of distinct reference numerals for the best description of the invention. For this reason, one hundred series numbers are used and are not intended to find equivalence with the foregoing numerals.

Referring to FIG. 2, tool 110 is illustrated with an uphole end 112 at the left side of the drawings as is conventional for this art and its downhole end 114 at the right side of the drawing figure. A chassis 116 in this embodiment is of two-piece construction. One of the pieces is identified as 118 and the other as 120. In the illustration the pieces 118 and 120 are roughly hemi cylindrical for ease of connection around the target tubular. The pieces 118 and 120 are hingedly connected to one another at hinge 122 (see FIG. 3). Connection duties are performed by latch system 124. The chassis 116 further includes a torque ring 126 and a bearing 128 that work together to support a drum 130 and a spool 132. It is to be appreciated that the spool 132 is illustrated without a conductor thereon but that a conductor such as an electrical wire or an optic fiber would be wound around the spool 132 when the tool is in use. A feeder tube 134 leads from the spool 132 in a helical manner to an opening 136 in the chassis 116 in order to allow through passage of the conductor to the target tubular. The angle of the through passage is similar to that of the previously described embodiment. Finally in FIG. 2, a pin 138 is visible, which acts as the tracking system for this embodiment similarly to the way in which it functions in the previously described embodiment.

Referring to FIG. 4, the cross sectional view of the embodiment will provide an understanding of the cooperation among the component parts just identified. Piece 120, it will be appreciated extends axially into an inside dimension of torque ring 126 and is fixedly maintained in this position. Affixation may be by threads or other suitable methods. It will be noted that the other piece 118 of the chassis 116 does not extend axially into torque ring 126 but rather merely ends adjacent the same. This allows the part 118 to swing open on the hinge 122 to allow for easy installment onto the target tubular. The torque ring supports a spool drum 130 and a bearing 128 to prevent wear of the torque ring by the drum when rotating thereon. Further, torque ring includes a brake member 140 disposed in a recess of the torque ring 126. The brake member is to be in contact with an inside dimension 144 of the drum 130 to ensure that the drum and therefore the spool 132 do not “bird nest”. In order to ensure that an appropriate amount of friction is obtained for various embodiments of the tool, it is desirable to render the friction adjustable. Referring to FIG. 3, it is apparent that the drum 130 is a split member based upon the visibility of the split 142. The degree to which the split 142 is closed can be controlled by a cap screw disposed in cap screw recess 144. The drum, therefore, is a manner of shaft coupling and can be tightened or loosened by adjustment of the cap screw (not shown). Also visible in FIG. 4 is a pair of wear guides 150 and 152 disposed within the chassis 116 to prevent wear from the target tubular.

In use, this embodiment is placed upon a target tubular by sliding all of the components illustrated in FIG. 4 as one assembly onto the target tubular. The conductor (not shown this embodiment) is routed from the spool 132 through the feeder tube 134 and out of an end 154 (see FIG. 2) of the feeder tube 134. The free end of the conductor is then available for an operator to manually begin the insertion process into a groove of the target tubular. In some embodiments, the insertion process of the conductor into the groove is accompanied by epoxy to ensure that the conductor is permanently affixed therein. Once a short portion of the conductor is affixed in the groove, the pieces 118 and 120 of chassis 116 are closed around the target tubular and the pin 138 is aligned at the same time with the groove. The latch 124 is then secured and the brake 140 force is adjusted with the cap screw (not shown) in the drum 130. The tool 110 can then be rotated relative to the target tubular or held stationary relative to the rotating tubular. This can be accomplished manually through use of a leverage connector 160 (see FIG. 2) or by mechanized means (not shown).

It is to be appreciated that each of the embodiments of the tool 10 or 110 can be configured to rotate either clockwise or counter clockwise as is appreciate for the groove helix direction on the target tubular. Further, it is to be noted that reliability of the system can be enhanced by ensuring that the direction of rotation of the chassis 116 will be opposite that of the spool assembly because if they rotate in the same direction, the chassis tends to drive the spool to unwind, an undesirable condition. An alternate embodiment of the tracking system useful for all embodiments is illustrated in FIG. 5. This embodiment uses a track segment 200 as the operable component of the tracking system. The segment 200 replaces the function of the pin illustrated for the above-described embodiments. As illustrated in FIG. 5, the segment 200 is a part of or mounted to a base 202 to maintain structural integrity thereof. The base may be placed upon an inside surface of the chassis or the chassis may be configured with a recess into which the base 202 is received. In either event, the base will be secured to the chassis by a fastening configuration such as a threaded fastener, welding, adhesive, etc.

While preferred embodiments have been shown and described, modifications and substitutions may be made thereto without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of illustrations and not limitation.

1. A signal conductor installation tool comprising:
   a. a chassis;
   b. a tracking system in operable communication with the chassis;
   c. a spool rotarly supported on the chassis; and
   d. a through hole in the chassis sized to pass a conductor from the spool to a target tubular member.
2. The tool as claimed in claim 1 further comprising a feeder tube disposed between the spool and the chassis.
3. The tool as claimed in claim 1 wherein the tracking system is a pin.
4. The tool as claimed in claim 1 wherein the tracking system is a track segment.
5. The tool as claimed in claim 1 wherein the spool is axially restrained.
6. The tool as claimed in claim 1 wherein the spool further comprises a bearing between the spool and the chassis.
7. The tool as claimed in claim 1 wherein the spool contains an optic fiber.
8. The tool as claimed in claim 1 wherein the through hole extends in a direction substantially tangential to an outside surface of the chassis.
9. The tool as claimed in claim 1 wherein the through hole exits the chassis at an angle substantially tangential to an inside surface of the chassis.
10. The tool as claimed in claim 1 wherein the through hole extends at an angle closely approximating a groove angle of a conductor groove in the tubular member.
11. The tool as claimed in claim 1 wherein the conductor is an optic fiber.
12. The tool as claimed in claim 1 wherein the chassis is a two-piece structure.
13. The tool as claimed in claim 1 wherein the chassis includes a braking system to provide drag on the spool.
14. The tool as claimed in claim 13 wherein the braking system is adjustable.
15. The tool as claimed in claim 13 wherein the braking system includes a braking material and a split drum having a tightening mechanism.
16. The tool as claimed in claim 1 wherein the chassis includes a tension adjustable latch.
17. A method for installing a conductor at a target tubular member comprising:
   setting the tracking system of the tool as claimed in claim 1;
   rotating at least one of the tool and the target tubular member relative to the other of the tool and the target tubular member; and
   automatically dispensing a conductor from the spool through the chassis to the target tubular member.
18. The method as claimed in claim 17 wherein setting includes engaging a pin with a groove in the target tubular member.
19. The method as claimed in claim 17 wherein the rotating is by hand.
20. The method as claimed in claim 17 wherein the rotating is mechanized.
21. The method as claimed in claim 17 wherein the automatic dispensing of the conductor is passive.
22. The method as claimed in claim 17 wherein the rotating comprises rotating the chassis in one direction and the spool in the opposite direction.