Claims

1. An apparatus for performing remote operations in a well, comprising:

a running tool having a stem for connecting to a string of conduit, the stem having a passage extending therethrough along an axis of the stem, a body, and a plurality of functional positions selected in response to rotation of the stem relative to the body; and

a feedback mechanism assembly connected to the running tool and operational with rotation of the stem relative to the body, the feedback mechanism assembly being capable of increasing the torque required to rotate the stem relative to the body at the plurality of functional positions, thereby providing a positive indication that the running tool is in the proper functional position of the plurality of functional positions.

2. The feedback mechanism assembly according to claim 1, wherein the feedback mechanism assembly further comprises:

a mechanism body connected to the body of the running tool, the mechanism body having a plurality of engagement elements, the plurality of engagement elements corresponding to the plurality of functional positions of the running tool; and

a feedback cam connected to the stem and the mechanism body such that the feedback cam rotates simultaneously with the stem and is capable of movement axially relative to the stem and the mechanism body, the feedback cam having an engagement element, the engagement element of the feedback cam adapted to engage the plurality of engagement elements of the mechanism body corresponding to the plurality of functional positions of the running tool, thereby increasing the torque required to rotate the stem relative to the body at the plurality of functional positions, thereby providing a positive

indication that the running tool is in the proper functional position of the plurality of functional positions.

3. The feedback mechanism assembly according to claim 2, wherein the plurality of engagement elements of the mechanism body further comprise:

a plurality of detents extending radially inward from an inner diameter of the mechanism body; and

wherein the engagement element of the feedback cam further comprises:

a detent extending radially outward from an outer diameter of the feedback cam, the detent adapted to engage the plurality of detents of the mechanism body corresponding to the plurality of functional positions of the running tool.

4. The feedback mechanism assembly according to claim 2, wherein the running tool further comprises:

an inner cam positioned between the stem and the body and connected to the stem and the body such that rotation of the stem causes the inner cam to translate axially relative to the body to the functional positions and simultaneously causes the inner cam and the feedback cam to move axially in the same direction relative to the body.

5. The feedback mechanism assembly according to claim 1, wherein the feedback mechanism assembly further comprises:

a plurality of engagement elements positioned on the outer diameter of the stem, the plurality of engagement elements corresponding to the plurality of functional positions of the running tool; and

an engagement element positioned on the inner diameter of the body, the engagement element of the body adapted to engage the plurality of engagement elements

of the stem corresponding to the plurality of functional positions of the running tool, thereby increasing the torque required to rotate the stem relative to the body at the plurality of functional positions, thereby providing a positive indication that the running tool is in the proper functional position of the plurality of functional positions.

6. The feedback mechanism assembly according to claim 5, wherein the plurality of engagement elements of the stem further comprise:

a plurality of detents extending radially outward from an outer diameter of the stem; and

wherein the engagement element of the body further comprises:

a detent extending radially inward from an inner diameter of the body, the detent adapted to engage the plurality of detents of the stem corresponding to the plurality of functional positions of the running tool.

7. The apparatus for performing remote operations in a well according to claim 1, the apparatus further comprising:

an inner cam positioned between the stem and the body and connected to the stem and the body such that rotation of the stem causes the inner cam to translate axially relative to the body to the functional positions;

an engagement element, carried by the body and adapted to be engaged with a well pipe hanger, the axial movement of the inner cam relative to the body causing the engagement element to move radially outward and into engagement with the hanger to releasably secure the running tool to the hanger; and

a piston, substantially surrounding portions of the stem, the inner cam, and the body and downwardly moveable relative to the stem in response to fluid pressure applied to the axial passage to thereby set a packoff seal.

8. The feedback mechanism assembly according to claim 7, wherein the feedback mechanism assembly further comprises:

a plurality of engagement elements positioned on the outer diameter of the stem, the plurality of engagement elements corresponding to the plurality of functional positions of the running tool; and

an engagement element positioned on the inner diameter of the inner cam, the engagement element of the inner cam adapted to engage the plurality of engagement elements of the stem corresponding to the plurality of functional positions of the running tool, thereby increasing the torque required to rotate the stem relative to the body at the plurality of functional positions, thereby providing a positive indication that the running tool is in the proper functional position of the plurality of functional positions.

9. The feedback mechanism assembly according to claim 8, wherein the plurality of engagement elements of the stem further comprise:

a plurality of detents extending radially outward from an outer diameter of the stem; and

wherein the engagement element of the inner cam further comprises:

a detent extending radially inward from an inner diameter of the inner cam, the detent adapted to engage the plurality of detents of the stem corresponding to the plurality of functional positions of the running tool.

10. An apparatus for performing remote operations in a well, comprising:

a running tool having a stem for connecting to a string of conduit, the stem having a passage extending therethrough along an axis of the stem, a body, and a plurality of functional positions selected in response to rotation of the stem relative to the body;

a mechanism body connected to the body of the running tool, the mechanism body having a plurality of engagement elements, the plurality of engagement elements corresponding to the plurality of functional positions of the running tool; and

a feedback cam connected to the stem and the mechanism body such that the feedback cam rotates simultaneously with the stem and is capable of movement axially relative to the stem and the mechanism body, the feedback cam having an engagement element, the engagement element of the feedback cam adapted to engage the plurality of engagement elements of the mechanism body corresponding to the plurality of functional positions of the running tool, thereby increasing the torque required to rotate the stem relative to the body at the plurality of functional positions, thereby providing a positive indication that the running tool is in the proper functional position of the plurality of functional positions.

11. The apparatus for performing remote operations in a well according to claim 10, the apparatus further comprising:

an inner cam positioned between the stem and the body and connected to the stem and the body such that rotation of the stem causes the inner cam to translate axially relative to the body to the functional positions;

an engagement element, carried by the body and adapted to be engaged with a well pipe hanger, the axial movement of the inner cam relative to the body causing the

engagement element to move radially outward and into engagement with the hanger to releasably secure the running tool to the hanger; and

a piston, substantially surrounding portions of the stem, the inner cam, and the body and downwardly moveable relative to the stem in response to fluid pressure applied to the axial passage to thereby set a packoff seal.

12. The feedback mechanism assembly according to claim 11, wherein the plurality of engagement elements of the mechanism body further comprise:

a plurality of detents extending radially inward from an inner diameter of the mechanism body; and

wherein the engagement element of the feedback cam further comprises:

a detent extending radially outward from an outer diameter of the feedback cam, the detent adapted to engage the plurality of detents of the mechanism body corresponding to the plurality of functional positions of the running tool.

13. The feedback mechanism assembly according to claim 12, wherein rotation of the stem causes the inner cam to translate axially relative to the body to the functional positions and simultaneously causes the inner cam and feedback cam to move axially in the same direction relative to the body.

14. A method of performing a remote operation in a well, the method comprising:

(a) providing a running tool with an elongated stem, a body, and a feedback mechanism assembly, the running tool having a plurality of functional positions selected in response to rotation of the stem relative to the body;

(b) connecting the stem to a string of conduit and running the tool into a subsea wellhead; then

(c) rotating the conduit and the stem relative to the body to one of the plurality of functional positions, the feedback mechanism increasing the torque required to rotate the conduit and the stem relative to the body when the running tool reaches the one of the plurality of functional positions, thereby providing a positive indication and feedback that the running tool is in the one of the plurality of functional positions.

15. The method of claim 14, wherein the feedback mechanism assembly comprises:

a mechanism body connected to the body of the running tool, the mechanism body having a plurality of engagement elements, the plurality of engagement elements corresponding to the plurality of functional positions of the running tool; and

a feedback cam connected to the stem and the mechanism body, the feedback cam having an engagement element; and wherein step (c) further comprises:

moving the feedback cam axially relative to the body and the mechanism body in response to the rotation of the stem relative to the body, thereby engaging the engagement element of the feedback cam with one of the plurality of engagement elements of the mechanism body when the running tool reaches the one of the plurality of functional positions, thereby increasing the torque required to rotate the conduit and the stem relative to the body and providing a positive indication and feedback that the running tool is in the one of the plurality of functional positions.

16. The method according to claim 15, wherein the plurality of engagement elements of the mechanism body further comprise:

a plurality of detents extending radially inward from an inner diameter of the mechanism body; and

wherein the engagement element of the feedback cam further comprises:

a detent extending radially outward from an outer diameter of the feedback cam.

17. The method of claim 14, wherein:

step (a) further comprises providing the running tool with a piston substantially surrounding portions of the stem and the body and downwardly moveable relative to the stem, and an inner cam positioned between the stem and the body and connected to the stem and the body such that rotation of the stem causes the inner cam to translate axially relative to the body to the plurality of functional positions;

prior to step (b), rotating the stem relative to the body, thereby securely engaging the running tool with a well pipe hanger; and

step (c) further comprises moving the piston downward relative to the stem to set a packoff.

18. The method of claim 14, wherein

step (a) further comprises providing the running tool with an inner cam positioned between the stem and the body and connected to the stem and the body such that rotation of the stem causes the inner cam to translate axially relative to the body to the plurality of functional positions; and wherein the feedback mechanism assembly further comprises:

a plurality of engagement elements positioned on the outer diameter of the stem, the plurality of engagement elements corresponding to the plurality of functional positions of the running tool; and

an engagement element positioned on the inner diameter of the inner cam; and

wherein step (c) further comprises:

moving the inner cam axially relative to the body and the stem in response to the rotation of the stem relative to the body, thereby engaging the engagement element of the

inner cam with one of the plurality of engagement elements of the stem when the running tool reaches the one of the plurality of functional positions, thereby increasing the torque required to rotate the conduit and the stem relative to the body and providing a positive indication and feedback that the running tool is in the one of the plurality of functional positions.

19. The method according to claim 18, wherein the plurality of engagement elements of the stem further comprise:

a plurality of detents extending radially outward from an outer diameter of the stem; and

wherein the engagement element of the inner cam further comprises:

a detent extending radially inward from an inner diameter of the inner cam.

Claims

1. An apparatus for performing remote operations in a well, Comprising:

a running tool having a stem selectively connected to a string of conduit, the stem having a passage extending therethrough along an axis of the stem, a body, and a plurality of functional positions selected in response to rotation of the stem relative to the body; and

a feedback mechanism assembly connected to the running tool and operational with rotation of the stem relative to the body, the feedback mechanism assembly selectively increasing the torque required to rotate the stem relative to the body at the plurality of functional positions, thereby providing a positive indication that the running tool is in the proper functional position of the plurality of functional positions;

an inner cam positioned between the stem and the body and connected to the stem and the body such that rotation of the stem causes the inner cam to translate axially relative to the body to the functional positions;

an engagement element, carried by the body and adapted to be engaged with a well pipe hanger, the axial movement of the inner cam relative to the body causing the engagement element to move radially outward and into engagement with the hanger to releasably secure the running tool to the hanger; and

a piston, substantially surrounding portions of the stem, the inner cam, and the body and downwardly moveable relative to the stem in response to fluid pressure applied to the axial passage to thereby set a packoff seal.

2. The feedback mechanism assembly according to claim 1, wherein the feedback mechanism assembly further comprises:

a mechanism body connected to the body of the running tool, the mechanism body having a plurality of engagement elements, the plurality of engagement elements corresponding to the plurality of functional positions of the running tool; and

a feedback can connected to the stem and the mechanism body such that the feedback cam rotates simultaneously with the stem and is capable of movement axially relative to the stem and the mechanism body, the feedback cam having an engagement element, the engagement element of the feedback cam adapted to engage the plurality of engagement elements of the mechanism body corresponding to the plurality of functional positions of the running tool,

thereby increasing the torque required to rotate the stem relative to the body at the plurality of functional positions, thereby providing a positive indication that the running tool is in the proper functional position of the plurality of functional positions.

3. The feedback mechanism assembly according to claim 2, wherein the plurality of engagement elements of the mechanism body further comprise:

a plurality of detents extending radially, inward from an inner diameter of the mechanism body; and

wherein the engagement element of the feedback cam further comprises:

a detent extending radially outward from an outer diameter of the feedback cam, the detent adapted to engage the plurality of detents of the mechanism body corresponding to the plurality of functional positions of the running tool.

4. The feedback mechanism assembly according to claim 2, wherein the running tool further comprises:

an inner cam positioned between the stem and the body and connected to the stem and the body such that rotation of the stem causes the inner cam to translate axially relative to the body to the functional positions and simultaneously causes the inner cam and the feedback cam to move axially in the same direction relative to the body.

5. The feedback mechanism assembly according to claim 1 , wherein the feedback mechanism assembly further comprises:

a plurality of engagement elements positioned on the outer diameter of the stem, the plurality of engagement elements corresponding to the plurality of functional positions of the running tool; and

an engagement element positioned on the inner diameter of the body, the engagement element of the body adapted to engage the plurality of engagement elements of the stem corresponding to the plurality of functional positions of the running tool, thereby increasing the torque required to rotate the stem relative to the body at the plurality of functional positions, thereby providing a positive indication that the running tool is in the proper functional position of the plurality of functional positions.

6. The feedback mechanism assembly according to claim 5, wherein the plurality of engagement elements of the stem further comprise:

a plurality of detents extending radially outward from an outer diameter of the stem; and

wherein the engagement element of the body further comprises:

a detent extending radially inward from an inner diameter of the body, the detent adapted to engage the plurality of detents of the stem corresponding to the plurality of functional positions of the running tool.

7. The feedback mechanism assembly according to claim 1, wherein the feedback mechanism assembly further comprises:

a plurality of engagement elements positioned on the outer diameter of the stem, the plurality of engagement elements corresponding to the plurality of functional positions of the running tool; and

an engagement element positioned on the inner diameter of the inner cam, the engagement element of the inner cam adapted to engage the plurality of engagement elements of the stem corresponding to the plurality of functional positions of the running tool, thereby increasing the torque required to rotate the stem relative to the body at the plurality of functional positions, thereby providing a positive indication that the running tool is in the proper functional position of the plurality of functional positions.

8. The feedback mechanism assembly according to claim 7, wherein the plurality of engagement elements of the stem further comprise:

a plurality of detents extending radially outward from an outer diameter of the stem; and

wherein the engagement element of the inner cam further comprises:

a detent extending radially inward from an inner diameter of the inner cam, the detent adapted to engage the plurality of detents of the stem corresponding to the plurality of functional positions of the running tool.

9. An apparatus for performing remote operations in a well, comprising:

a running tool having a stem for connecting to a string of conduit, the stem having a passage extending therethrough along an axis of the stem, a body, and a plurality of functional positions selected in response to rotation of the stem relative to the body;

a mechanism body connected to the body of the running tool, the mechanism body having a plurality of engagement elements, the plurality of engagement elements corresponding to the plurality of functional positions of the running tool; and

a feedback cam connected to the stem and the mechanism body such that the feedback cam rotates simultaneously with the stem and is capable of movement axially relative to the stem and the mechanism body, the feedback cam having an engagement element, the engagement element of the feedback cam adapted to engage the plurality of engagement elements of the mechanism body corresponding to the plurality of functional positions of the running tool, thereby increasing the torque required to rotate the stem relative to the body at the plurality of functional positions, thereby providing a positive indication that the running tool is in the proper functional position of the plurality of functional positions.

10. The apparatus for performing remote operations in a well according to claim 9, the apparatus further comprising:

an inner cam positioned between the stem and the body and connected to the stem and the body such that rotation of the stem causes the inner cam to translate axially relative to the body to the functional positions;

an engagement element, carried by the body and adapted to be engaged with a well pipe hanger, the axial movement of the inner cam relative to the body causing the engagement element to move radially outward and into engagement with the hanger to releasably secure the running tool to the hanger; and

a piston, substantially surrounding portions of the stem, the inner cam, and the body and downwardly moveable relative to the stem in response to fluid pressure applied to the axial passage to thereby set a packoff seal.

11. The apparatus for performing remote operations in a well according to claim 10, wherein the plurality of engagement elements of the mechanism body further comprise:

a plurality of detents extending radially inward from an inner diameter of the mechanism body; and

wherein the engagement element of the feedback cam further comprises:

a detent extending radially outward from an outer diameter of the feedback cam, the detent adapted to engage the plurality of detents of the mechanism body corresponding to the plurality of functional positions of the running tool.

12. The apparatus for performing remote operations in a well according to claim 11, wherein rotation of the stem causes the inner cam to translate axially relative to the body to the functional positions and simultaneously causes the inner cam and feedback cam to move axially in the same direction relative to the body.

13. A method of performing a remote operation in a well, the method comprising:
(a) providing a running tool with an elongated stem, a body, and a feedback mechanism assembly, the running tool having a plurality of functional positions selected in response to rotation of the stem relative to the body;

(b) connecting the stem to a string of conduit and running the tool into a subsea wellhead; then

(c) rotating the conduit and the stem relative to the body to one of the plurality of functional positions, the feedback mechanism increasing the torque required to rotate the conduit and the stem relative to the body when the running tool reaches the one of the plurality of functional positions, thereby providing a positive indication and feedback that the running tool is in the one of the plurality of functional positions.

14. The method of claim 13, wherein the feedback mechanism assembly comprises:
a mechanism body connected to the body of the running tool, the mechanism body having a plurality of engagement elements, the plurality of engagement elements corresponding to the plurality of functional positions of the running tool; and

a feedback cam connected to the stem and the mechanism body, the feedback cam having an engagement element; and wherein step (c) further comprises:

moving the feedback cam axially relative to the body and the mechanism body in response to the rotation of the stem relative to the body, thereby engaging the engagement element of the feedback cam with one of the plurality of engagement elements of the mechanism body when the running tool reaches the one of the plurality of functional positions, thereby increasing the torque required to rotate the conduit and the stem relative to the body and providing a

positive indication and feedback that the running tool is in the one of the plurality of functional positions.

15. The method according to claim 14, wherein the plurality of engagement elements of the mechanism body further comprise:
a plurality of detents extending radially inward from an inner diameter of the mechanism body; and

wherein the engagement element of the feedback cam further comprises:

a detent extending radially outward from an outer diameter of the feedback cam.

16. The method of claim 13, wherein:
step (a) further comprises providing the running tool with a piston substantially surrounding portions of the stem and the body and downwardly moveable relative to the stem, and an inner cam positioned between the stem and the body and connected to the stem and the body such that rotation of the stem causes the inner can to translate axially relative to the body to the plurality of functional positions;

prior to step (b), rotating the stem relative to the body, thereby securely engaging the running tool with a well pipe hanger; and

step (c) further comprises moving the piston downward relative to the stem to set a packoff.

17. The method of claim 13, wherein
step (a) further comprises providing the running tool with an inner cam positioned between the stem and the body and connected to the stem and the body such that rotation of the stem causes the inner cam to translate axially relative to the body to the plurality of functional positions; and wherein the feedback mechanism assembly further comprises:

a plurality of engagement elements positioned on the outer diameter of the stem, the plurality of engagement elements corresponding to the plurality of functional positions of the running tool; and

an engagement element positioned on the inner diameter of the inner cam; and

wherein step (c) further comprises:

moving the inner cam axially relative to the body and the stem in response to the rotation of the stem relative to the body, thereby engaging the engagement element of the inner cam with one of the plurality of engagement elements of the stem when the running tool reaches the one of the plurality of functional positions, thereby increasing the torque required to rotate the conduit and the stem relative to the body and providing a positive indication and feedback that the running tool is in the one of the plurality of functional positions.

18. The method according to claim 17, wherein the plurality of engagement elements of the stem further comprise:

a plurality of detents extending radially outward from an outer diameter of the stem; and

wherein the engagement element of the inner cam further comprises:

a detent extending radially inward from an inner diameter of the inner cam.