A running tool that delivers an object selectively to one of a plurality of landing nipples and then releases from the object is disclosed. The tool is actuated by raising it after it has passed the desired landing nipple to release a locating dog. The locating dog places locking dogs on the object even with a groove on the landing nipple. Movement of the tool downhole secures the locking relationship and releases the running tool from the object. A shear pin allows testing at the surface that the object is locked in place, prior to removal of the running tool. The object comprises a fishing neck to allow it to be subsequently retrieved.
SELECTIVE RUNNING TOOL WITH SEPARATION FEATURE

FIELD OF THE INVENTION

[0001] The field of this invention related to running tools that can deliver an object to a selected location downhole and more particularly to running tools that can be used with standardized landing nipples and release from the object after securing it in the selected nipple.

BACKGROUND OF THE INVENTION

[0002] Landing nipples have special profiles that allow tools or plugs to be located at desired locations in a well. The landing nipples are part of a tubing string and their placement is determined when the tubing is run into the borehole. In the past, seal bore size has decreased as the well depth increased. Accordingly, the landing nipples had to have different sizes, depending on their location. More recently, with the increased use of expansion technology, wells are being completed as a monobore, where the tubing size is the same for the depth of the well. In a monobore application, the landing nipples at various depths had to be unique as did the lock assembly that became supported at a selected landing nipple. An example of such a design is U.S. Pat. No. 4,043,392. The problem with such a system is that an array of landing nipples had to be available to be run in at specific depths and the matching configuration for the lock had to be used to get the lock to land at the proper depth. In systems with decreasing tubing size upon greater depth, selectivity was obtained by keeping on hand an assortment of lock sizes and running in the lock that would catch at the desired depth.

[0003] In the past, a tool from Baker Hughes known as the Sure-Set® model AM-40 was available to attach to a lock for delivery to a predetermined depth. Thus in a monobore application, this system could be positioned adjacent a desired landing nipple among many that were identical to each other and then locked in place. The problem with this assembly was that the selective feature was integrated with the lock and had to stay in the hole as long as the lock remained in place. Leaving the selective feature in the hole was a large item of expense for the well operators that essentially had to purchase the selective feature as an item left in the hole.

[0004] Accordingly, the present invention is designed to allow separation of the selective feature after setting the lock, leaving only the essential components of the lock in the hole and removing the running tool and the selective feature. Since the running tool and the selective feature are removed from the hole, the cost to the well owner is decreased in that purchase of the running tool is avoided and instead the operator pays for a service using the running tool, which is a considerably lower charge. This advantage of the present invention, and others, will become more readily apparent to those skilled in the art from a review of the description of the preferred embodiment and the claims, which appear below.

SUMMARY OF THE INVENTION

[0005] A running tool that delivers an object selectively to one of a plurality of landing nipples and then releases from the object is disclosed. The tool is actuated by raising it after it has passed the desired landing nipple to release a locating dog. The locating dog places locking dogs on the object even with a groove on the landing nipple. Movement of the tool downhole secures the locking relationship and releases the running tool from the object. A shear pin allows testing at the surface that the object is locked in place, prior to removal of the running tool. The object comprises a fishing neck to allow it to be subsequently retrieved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIGS. 1a-1d are a section view of the running tool and the lock at the start of the sequence to actuate the lock at a pre-selected landing nipple;

[0007] FIGS. 2a-2d are the view of FIGS. 1a-1d shown with the lock engaged and the running tool released from the lock except for a shear pin connection to allow testing of the locked connection from the surface;

[0008] FIG. 3 is a detailed view of the selective lock used to allow escape of the jarring dog for locating the running tool in the selected nipple profile for actuating the locking sequence; and

[0009] FIG. 4 is a detailed view of the jarring dogs engaged in the landing nipple groove for actuation of the locking and release sequence.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0010] Referring to FIGS. 1a-1d, a mandrel 32 is made of multiple components. From the upper end is a fishing neck 1 that is connected to inter-linkage sleeve 23 at thread 34. Sleeve 23 has a longitudinal groove 36 through which inter-linkage dog 22 extends. Lower dog prong 29 is connected to inter-linkage sleeve 23 at thread 38. For run in, lower dog prong 29 supports lower dog 30 in a locking relation to groove 40, see FIG. 1d. A groove 42 on lower dog prong 29 is initially offset from lower dog 30. Fishing neck dog retainer 25 is connected to sleeve 23 at thread 44. Fishing neck dog 27 extends through an opening 119 in fishing neck dog retainer 25. Dog 27 extends into groove 48 at the upper end of lock assembly 50. Inter-linkage probe 28 extends between inter-linkage sleeve 23 and lower dog prong 29. It has a groove 52 that is initially offset from dog 27. At its lower end, inter-linkage probe 28 has an opening 54 in which resides dog 30. Dog 30 supports lock assembly 50 in a locked relation to probe 28 for run in. The lock assembly 50 has an outer sleeve 56 with an opening 58 in which anchoring dog 60 resides in a recessed relationship for run in. The lock assembly has an inner sleeve 62 that has groove 48 near its upper end. A recessed surface 164 on inner sleeve 62 is juxtaposed against dog 60 for run in to allow dog 60 to locate within opening 58. Inner sleeve 62 has a ramp 64 that will ultimately push dog 60 into anchoring groove 66 in nipple profile 68. A snap ring 70 is mounted to sleeve 62 and will ultimately snap into groove 72 on outer sleeve 56. A seal assembly 74 is mounted to a housing 76 that is secured to outer sleeve 56 at thread 78. Seal assembly 74 will ultimately seal inside the nipple profile 68. A lower sub 80 is connected to housing 76 at thread 82 to seal off the passage inside the nipple profile 68 when the lock assembly is secured. Finally, a shear pin 84 extends through outer sleeve 56 and into probe 28 to allow surface personnel to confirm that the lock assembly 50 is secured to groove 66. Breaking this shear pin 84 will allow the lock assembly 50 to remain in place while everything else is removed from the wellbore.
Referring again to FIG. 1a, a retaining sleeve sub 5 is secured with shear screw 6 to fishing neck 1. A retaining ring cap 2 holds a retrieving ring 4. Ultimately, ring 4 will snap into groove 86 on fishing neck 1. Sub 5 is connected to locator sub 16 at thread 88. Jarring dog retainer 19 is connected to locator sub 16 at thread 90. Retainer 19 defines a recess 92 in which is disposed jarring dog 17 and leaf spring 18 to bias it out. Initially dog 17 is misaligned with opening 94 in lower cover sleeve 12. Cover sleeve 12 is biased upright by power spring 14 acting on stop ring 13 and supported off of locator sub 16. Upper cover sleeve 8 is attached to cover sleeve 12 at thread 96. Upper cover sleeve 8 has a longitudinal opening 98 through which select dog 11 extends. Spring 9 biases sleeve 8 against snap ring 7 in an uphole direction and pushes down on retainer ring 10 and select dog 11 in a downhole direction. Retaining sleeve sub 5 has upper groove 100 and lower groove 102. Groove 102 has a reverse shoulder 104 that eventually traps mating shoulder 106, as shown in FIG. 2a. When running in the hole select dog 11 is pushed against the bias of spring 9 into groove 100 to allow the tool to advance unhindered. Once the select dog 11 enters groove 102, the bias of spring 14 and the interaction of shoulders 104 and 106 retains the select dog 11 in groove 102. Finally, cross-link dog retainer 20 is secured to jarring dog retainer 19 at thread 108. Dog retainer 20 has a recess 110 in which sits inter-linkage dog 22. Dog 22 supports inter-linkage probe 28 from dog retainer 20. While dog retainer 20 abuts fishing neck dog retainer 25, they are not connected and they come apart from each other, as shown in FIG. 2b.

The significant components of the apparatus now having been described, the operation will be reviewed in more detail. FIGS. 1a-1d illustrate the run in position. Dogs 18 are offset from window 94 and are held inwardly retracted. Shear screw 6 holds retaining sleeve sub 5 to fishing neck 1. Dog 60 in lock assembly 50 is in a retracted position. The inner sleeve 62 is supported from dog 27. The outer sleeve 56 is supported from dog 30 and shear pin 84. When the tool is lowered through a given nipple profile 68 the select dog 11 encounters obstructions and is pushed back against the bias of spring 9 into groove 100 where it is sufficiently retracted to allow the assembly to continue to travel lower. Once a selected nipple profile 68 is reached and passed, the assembly is raised to the position shown in FIGS. 1a-1d. Select dog 11 hangs on surface 112 in nipple profile 68. When the tool is moved up more, the select dog 11 is forced into groove 102 and is trapped there. Select dog 11 pushed on the bottom of opening 98 to force down lower cover sleeve 12. This allows spring 18 to push out jarring dog 17 into the now aligned opening 94. Indexing dog 17 is raised above indexing grooves 114 and 116 and then the entire assembly is lowered until dog 17 can be pushed into grooves 114 and 116 as shown in FIGS. 2b and 4. With dog 17 in grooves 114 and 116, dog 60 is aligned with groove 66. Pushing down on fishing neck 1 breaks shear screw 6. The connected pieces from cross-link dog retainer 20 at the lower end and up to retaining ring cap 2 remain stationary as the fishing neck 1 advances. Dog 22 and inter-linkage probe 28 do not move as they are supported by retainer 20 which now can't move. Since dog 22 is in opening 36 lower dog prong 29 and inter-linkage sleeve 23 can move down with respect to dog 22 that is held stationary. Dog 22 winds up at the uphole end of opening 36 as a result of such movement of prong 29 and sleeve 23. Dog 27 engages inner sleeve 62 in groove 48 and pushes it down so that ramp 64 pushes out dog 60 into groove 66 and locks it in there with surface 118. Snap ring 70 jumps into groove 72 to hold the locked position of dog 60. As this happens, dog 27 falls into groove 52 to release the lock assembly 50 from fishing neck dog retainer 25. At the same time, downward movement of lower dog prong 29 puts groove 42 opposite dog 30 to release housing 56 from inter-linkage probe 28 leaving just the shear pin 84 holding them together. Also at the same time retrieving ring 4 registers in groove 86. At this time, the dog 60 is locked in groove 66 of the landing nipple 68 with snap ring 70 holding the locked position by expansion into groove 72. There is no longer any connection by the lock assembly 50 to any other part of the tool except for shear pin 84. Surface personnel can now apply a pulling force to break shear pin 84 as their signal that the lock assembly is properly secured to groove 66. When a subsequent upward force is applied, dog 17 simply is cammed out of grooves 114 and 116 and the fishing neck 1 and all parts supported by it can come out of the hole leaving only the lock assembly 50. At a later time groove 48 can be engaged by a fishing tool and inner sleeve 62 can be picked up, taking snap ring 70 out of groove 72 and moving surface 118 out from behind anchoring dog 60 so that the lock assembly 50 and whatever tool is attached to it can be removed from the well.

Those skilled in the art will appreciate that although the lock assembly is illustrated to be a plug in the preferred embodiment, other types of tools may be selectively positioned in one of a plurality of landing nipples. Where items are referred to in the singular, multiple quantities are also contemplated, such as, for instance, the various dogs in the apparatus. While a specific preferred structure to release a running tool that has capability to be actuated at a selected location from any tool that it carries has been disclosed, those skilled in the art will appreciate that the present invention contemplates any type of system of release of the downhole tool from the running tool when the running tool is configured for selective actuation at a predetermined location. While the present invention is particularly useful in a monobore application, other applications can also be within the scope of the invention. The present invention allows the running tool to be removed after it is used to place the downhole tool selectively at one of a plurality of anchoring points. In a monobore application identical landing nipples 68 can be used with one selective running tool that can come out of the hole after the downhole tool is anchored. The shear pin 84 allows a surface signal to be sensed that the anchoring dog 60 is secured to its anchoring groove 66.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made without departing from the spirit of the invention.

1. A tool assembly for delivering a downhole tool into a wellbore, comprising:

   a body;

   an indexing mechanism on said body selectively actuated to support said body in one of a plurality of wellbore locations;
an actuating assembly on said body selectively movable when said indexing mechanism supports said body in the wellbore for actuating an anchor on the downhole tool to support the downhole tool in the wellbore;

2. The assembly of claim 1, further comprising:

a release device on said body for disconnecting said body from the downhole tool when the downhole tool is supported by its anchor;

a plurality of downhole downhole landing nipples mounted in the wellbore and serving as said plurality of locations for support of said body, said landing nipples comprising at least one locating groove and at least one locking groove.

3. The assembly of claim 2, wherein:

said indexing mechanism comprises at least one indexing dog held in a retracted position to said body; and

a release assembly capable of passing through said landing nipples in a first direction while maintaining said indexing dog retained to said body, said release assembly allowing said indexing dog to extend when said body is moved into one of said landing nipples in a second direction opposite said first direction.

4. The assembly of claim 3, further comprising:

da downhole tool releasably connected to said body and further comprising an anchoring dog, said anchoring dog aligned with said locking groove when said body is supported by said indexing dog in said locating groove.

5. The assembly of claim 4, further comprising:

an inner and outer sleeve on said downhole tool, said actuating assembly selectively retained to said inner and outer sleeves to cause relative movement between them, said relative movement forcing said anchoring dog into a locked relation with said locking groove.

6. The assembly of claim 5, further comprising:

said relative movement releases connection of said inner and outer sleeves to said body.

7. The assembly of claim 6, further comprising:

at least one shear pin;

said shear pin maintaining contact with at least one of said inner and outer sleeves after said relative movement releases connection of said inner and outer sleeves to said body.

8. The assembly of claim 5, further comprising:

said body further comprises a first dog to engage said outer sleeve and a second dog to engage said inner sleeve, whereupon movement of at least one of said first and second dogs with respect to the other said dogs release from their respective sleeves.

9. The assembly of claim 8, further comprising:

said sleeves lock to each other subsequent to relative movement between them that results in locking said anchoring dog in said locking groove.

10. The assembly of claim 8, wherein:

said release of said first and second dogs occurs when grooves on a part of said body come into alignment with said first and second dogs.

11. A method of placing a downhole tool in a well, comprising:

providing a plurality of anchoring points for the downhole tool in the well;

connecting the downhole tool to a running tool and running the assembly into the well;

providing a selectivity feature to the running tool so that the running tool can obtain support selectively near said plurality of the anchoring points;

supporting the running tool from near one of the anchoring points;

anchoring the downhole tool to an anchoring point; and

releasing the running tool from the downhole tool.

12. The method of claim 11, comprising:

providing an indexing point adjacent each anchoring point;

retaining an indexing dog to the running tool when the running tool is moved in a first direction and releasing said indexing dog for support of the running tool at an indexing point when the running tool is moved in a second direction opposite said first direction.

13. The method of claim 12, comprising:

shifting a sleeve to align an opening opposite said indexing dog to allow it to be biased out from the body of the running tool; and

locking said sleeve to the running tool body when its opening is aligned with said indexing dog.

14. The method of claim 12, comprising:

positioning an anchoring dog on the downhole tool adjacent an anchoring point when said indexing dog suspends the running tool from an indexing point; and

locating said anchoring dog into said anchoring point with movement of a portion of said running tool relative to another portion suspended from said indexing point.

15. The method of claim 14, comprising:

providing an inner and outer sleeve on the downhole tool;

creating relative movement between said sleeves from said movement of a portion of the running tool; and

using a ramp on one of said sleeves for said locating said anchoring dog through an opening in the other of said sleeves.

16. The method of claim 15, comprising:

connecting a first dog on said running tool to said inner sleeve and a second dog on said running tool to said outer sleeve;

releasing said first and second dogs as a result of said relative movement.

17. The method of claim 16, comprising:

providing a breakable connection to one of said inner and outer sleeves;

applying a force to said running tool with said anchoring dog located into said anchoring point and said first and second dogs released;
using resistance to said force to the running tool as a signal said anchoring dog is in place in said anchoring point; and
breaking said breakable connection.
18. The method of claim 16, comprising:
moving one of said first and second dogs, when said dogs are still connected to said sleeves, with respect to the other of said first and second dogs;
presenting grooves opposite said first and second dogs after said anchoring dog is located into said anchoring point; and
locking said inner and outer sleeves to each other after said anchoring dog is located into said anchoring point.
19. The method of claim 15, comprising:
providing said opening in said outer sleeve and said ramp on said inner sleeve;
holding said outer sleeve while moving said inner sleeve;
locking said sleeves to each other after said ramp has pushed said anchoring dog into the anchoring point through said window.
20. The method of claim 19, comprising:
connecting a first dog on said running tool to said inner sleeve and a second dog on said running tool to said outer sleeve;
releasing said first and second dogs as a result of said relative movement.
21. The method of claim 11, comprising:
using one of coiled tubing and a workstring to run the assembly into the well; and
setting hydraulically at least one of the running tool and the downhole tool.

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