A drill string tubing anchor defines a quarter turn means for driving at least one upper cone below a slip by quarter turn rotation of a J-pin within a shaped J-slot, extending the slip from within the anchor housing against the tubing surface. The anchor also includes a shear pin within a lower cone as a secondary means to engage the slip upon shearing of the pin engaging in an emergency situation and recovery of the tubing, which would require an upward movement to disengage the lower cone and this relieve the pressure on the slip to elevate the anchor from within the tubing.
QUARTER TURN TUBING ANCHOR
CROSS REFERENCE TO RELATED APPLICATIONS

[0001] Applicant claims the benefit of U.S. Provisional Patent Application No. 61/996,438, filed on May 7, 2014, by the same inventors.

I. BACKGROUND OF THE INVENTION

[0002] 1. Field of Invention

[0003] A production string tubing anchor defines a quarter turn means for driving at least one upper cone below a slip by quarter turn rotation of a J-pin within a shaped J-slot, extending the slip from within the anchor housing against the casing surface. The anchor also includes a shear pin within a lower cone as a secondary means to engage the slip upon shearing of the pin engaging in an emergency situation and recovery of the tubing, which would require an upward movement to disengage the lower cone and this relieve the pressure on the slip to elevate the anchor from within the tubing.

[0004] 2. Description of Prior Art

[0005] A preliminary review of prior art patents was conducted by the applicant which reveal prior art patents in a similar field or having similar use. However, the prior art inventions do not disclose the same or similar elements as the present well bore anchor, nor do they present the material components in a manner contemplated or anticipated in the prior art.

[0006] Greenlee is disclosed as an anchor having a quarter turn engagement, Figs. 7A-D, Column 2, and as contained in Claims 1-3.

[0007] In U.S. Pat. No. 4,496,000, to Weeks a slotted engagement anchor is disclosed in Column 3. It discloses a pin which is disengaged from a slot which causes the deployment of a plurality of slips against the casing to suspend attached drill stem. The slot requires the location of the pin, which is completely disengaged from the slot, requiring the operator to find the pin, guide it into the upper angular surface of the slot, rotate the upper drill stem attached to the anchor, retracting the slips and then catching the pin in a lower portion of the slot to withdraw the anchor and attached stem from the encasement. The slips are pushed outward by a single upper wedge-shaped cone as the cage assembly, connected to the slips, is force upward along the mandrel.

[0008] The Garay patent, U.S. Pat. No. 5,771,969, discloses upper slips having two surfaces with gripping teeth separated by a spring which is compressed when the slips are deployed outward to secure the anchor within the well casing. A lower drag means has an inner spring which urges the drag means outward providing friction to hold the anchor while more than one pin is turned within a helical groove to forcing the bearing element upward against a lower and upper conical surface forcing the slips outward. Reloosening the slips is caused by counter rotation to spread the cones or conical surfaces and allow the slips to withdraw into the slip retainer.

[0009] In U.S. Pat. No. 6,318,459 to Wright a plurality of radial slips are shown, but the slips are not deployed by cones and retracted by springs. Instead, they are elongated, generally rectangular structures rotateably mounted on a longitudinal axle, each slip having an outer surface comprising longitudinal blades. These slips are deployed into an engagement position through rotation of the anchor mandrel in a clockwise direction, turning the slips along the longitudinal axis, forcing the blades against the casing. Drag blocks are also included which maintain a constant friction against the casing to allow for rotation of the anchor mandrel without rotation to the outer radial plate.

[0010] In U.S. Patent Application No. 2013/0299160 to Lott, opposing surface aligned wickers, or gripping teeth are placed on a common slip. However, beyond that similarity, Lott is a hydraulic anchor that forces its slips outward through the hydraulic pressure applied to the cones to extend the upper and lower slips, the slips being located at different levels along the anchor body above and below one another as opposed to being set on the same level and requiring rotational movement to activate the manually deployed slips on the current anchor using a pin and J-slot and also using an upper and lower cone for uniform extension of the slip against the casing.

II. SUMMARY OF THE INVENTION

[0011] Tubing anchors are commonly used in the oil and gas well industry as a means to provide temporary hang off point in the well bore of a tubing string. The tools are configured for a number of applications, including an anchor point and as a device to catch materials being inserted into the drill casement. The tubing anchors support a variety of weights and are generally raised and lowered in the hold, with a twisting motion used to engage and disengage the anchors within the well bore.

[0012] The present tubing anchor employs a plurality of slips having opposing wickers with the slips being extended and retracted by the rotation of the tubing and by utilizing a J-pin which is directed by a J-shaped slot defining a long slot portion, and transverse slot portion and a short slot portion.

III. DESCRIPTION OF THE DRAWINGS

[0013] The following drawings are informal drawings submitted with this provisional patent application.

[0014] FIG. 1 is an exterior and cutaway view of the tubing anchor.

[0015] FIG. 2 is a sectional view of the tubing anchor in a run-in position.

[0016] FIG. 3 is a sectional view of the tubing anchor in a run-out position.

[0017] FIG. 4 is a view of the tubing anchor in the set position within a well casing.

[0018] FIG. 5 is a cross-sectional view of FIG. 4 along section lines A-A.

[0019] FIG. 6 is a view of the J-pin setting during retrieval or run-out from a well.

[0020] FIG. 7 is a view of the J-pin setting during insertion or run-in from a well bore.

[0021] FIG. 8 is a view of the J-pin setting when the tubing anchor is in a set position, with the actual location of the pin in the long portion of the slot determined by the casing weight pulled into the tool.

IV. DESCRIPTION OF THE PREFERRED EMBODIMENT

[0022] A quarter turn tubing anchor provides a secure anchor mechanism for a tubing string within a well casing A and a catcher function in the event the tubing parts from a direction above the anchor 10. The tubing anchor 10, in a preferred embodiment, is as indicated in the attached drawing Figs. 1-8. The present quarter turn tubing anchor 10 com-
prises a top cap 22 attached to a housing 20 by at least one cap screw 26 at an upper coupling 24 and a bottom crossover sub 72 attached to a body 70 which is installed within the housing 20 and attaches to a lower tubing string C within the well bore casing A. The anchor 10 is supported by the top cap 22 attached from above by an upper tubing string B.

[0023] The body 70 further defines a hollow cavity 74 which provides passage of fluid between the tubing strings B, C. The housing 20 is attached to the body 70 through a plurality of housing holes 30 in the housing 20 which allow for the insertion and securing of a plurality of housing screws 32 securing the body 70 and the housing 20 together but allowing for limited movement between the housing 20 and the body 70 for movement and activation of the anchor 10 as indicated below through interaction between a J-slot 50 and J-pin 75.

[0024] The quarter turn tubing anchor 10 further comprises the J-slot 50 which is formed in the housing with the J-pin 75 extending from the housing 20 through the J-slot 50. The J-pin 75 may be inserted within a threaded J-pin bore, not shown, in the body 70, or it may be integrated within the body 70 as a machined extension. This J-slot 50 and J-pin 75 relate in the positioning of the housing 20 relative to the body 70, which in turn, controls the position of at least three lower cones 62 independently attached to the housing 20 by a lower cone screw 63 which serves as a shear pin, each lower cone 63 moveable up or down, and at least three upper cones 60, also independently attached to the housing 20 by an upper cone screw 61, by are held in a fixed position. At least three slips 80 define an outer surface 82 having a plurality of bidirectional carbide cleats, with an upper set of cleats 83 projecting at a downward angle and a lower set of cleats 84 projecting at an upward angle, which are forced against the casing A to maintain the position of the tubing anchor 10 within the casing A when extended. Each slip 80 is fitted with rear extension springs 86, FIGS. 1 and 5, which urge each slip 80 back into a retracted position and forcibly extend outward when forced to so by outward angular pressure from a paring of upper and lower cones 60, 62, when the cones are moved vertically towards one another.

[0025] The J-slot 50 and J-pin 75 positioning, shown in FIGS. 6-8, are movable in relation to one another and controlled by the turning of the body 70 within the housing 20 while the anchor 10 remains stationary within the casing A and to the external forces applied by a plurality of drag springs 40 which are positioned against the casing A and attached to the housing 20, FIG. 1, but not in a location which would interfere with the activation of the J-slot 50 or J-pin 75. Each of the plurality of drag springs 40 are attached to the housing 20 by independent spring screws 42, which would allow for replacement over time of the drag spring 40 when they become worn from friction.

[0026] The present tubing anchor 10 is shown in three positions—inertion or “run-in”, FIGS. 2 and 7, extraction or “run-out”, FIGS. 3 and 6, and set, FIGS. 5 and 8. As seen from the drawing figures, the J-slot 50 is defined as a short vertical groove 52 and a long vertical groove 56, the vertical grooves commonly connected by a short horizontal groove 58. The J-pin 75 extends from the body 70 through the J-slot 50. The short vertical groove 52 further defines an upper end 53 and a lower end 54.

[0027] In the insertion position, the J-pin 75 is located in the lower end 54 of the short vertical groove 52. This coincides with the positioning of each relative set of the upper cone 60, lower cone 62 and the involved slip 80, shown in FIG. 3, wherein each upper and lower cone 60, 62, is located within close proximity to the respective slip 80, but have not applied any outward force to the slip 80 to compel it outward beyond the housing 20. The anchor runs in and out of the casing A with only the tension of the drag springs 40 applying a friction force against the casing A. In the extraction position, the J-pin 75 is located in the upper end 53 of the short vertical groove 52 and the positioning of the upper cone 60, lower cone 62 and the slips 80 are as indicated in FIG. 2. The upper cone 60 is above and in proximity to each respective slip 80 while the lower cone 62 is at a distance away from each slip 80. In the extended position, shown in FIGS. 4, 5 and 8, the upper cones 60, being fixed, and the upward driven lower wedge-shaped cones 62 are moved towards one another, pushing the slips 80 contemporarily outward beyond the housing. FIGS. 4-5, with a force applied to the casing A to lock the position of the anchor 10 at the location chosen by the operator. This extension position is applied during either insertion of extraction by the repositioning of the J-pin 75 by a quarter turn rotation of the body 70 with the housing 20 remaining static, shifting the J-pin 75 from the short vertical groove 52 to the long vertical groove 56 through the short horizontal groove 58 connecting the two vertical grooves 52, 56. Once the anchor 10 is in the extended position, it may be pulled upward, but will not allow any downward movement or drop. While in the extended position, the J-pin 75 will actually be allowed to float freely within the long vertical groove 56, moving downward when lifted and moving upward when being set in position, with each upper cone 60 being the overwhelming force that keeps the anchor 10 in place while holding a large mass and/or weight of tubing string C below the anchor 10.

In FIG. 5, the three slips 80 are in the forced extended position against the casing A from a down hole view or a sectional view along sectional lines A/A of FIG. 4, the slips 80 being set in tension. Release of the anchor 10 from an extended position to an insertion or retraction position requires a slight release of tension by downward movement and rotation of the body 70 a quarter turn counter clockwise, moving the J-pin 75 back into the short vertical groove 52.

[0028] The anchor 10 may also be used as a catcher when the tubing B separates from above the anchor 10. This default prevention occurs due to the slips 80 having a bite into the casing A greater than the applied downward forces of the tubing C held below the anchor 10. The anchor 10 will lock within the casing and remain there until retrieval. An emergency release is also available, which occurs by function of at least one shear pin, referenced herein as the lower cone screw 63, which hold the lower cones 62 to the body 61. When the screws are sheared, the lower cone 62 drops away from the slip 80, allowing the slip 80 to retract releasing the anchor 10 from the casing A. The top cap 22 and the drag springs 40 centralize the body 70 within the housing 20 and limits the down travel of the housing 20 to the middle of the casing A, preventing a reactivation of the slips 80.

[0029] The primary advantages of the present quarter turn tubing anchor 10 introduce several novel and improved features to the field of tubing anchors 20. First, there are no complicated or multiple threads required to activate the slips and alter the anchor from an insertion/extraction position to an extended position. A simple quarter turn within a J-slot 50 is all the movement required. The operator simply pulls up slightly on the upper attached tubing B as the anchor 10 is situation within the casing A when a desired level is attained.
and rotates clockwise, moving the J-pin 75 in the J-slot 50 to the long vertical groove 56. Second, the upper cone 60 is in a fixed or static position, held in place throughout the entire use of the anchor 10. During an emergency release, wherein the shear pin, identified as the lower cone screw 63 holding the lower cone 62 is broken and dropped away from the slip 80. The only moving cones are the three lower cones 62 being raised and lowered contemporaneously. Third, the limited rotation required to activate and deactivate the anchor 10 provide the tubing anchor 10 for practical use on horizontal wells, with activation requiring only a quarter turn clockwise and deactivation requiring only a quarter turn counter clockwise. Fourth, the slips 80, when in an extended position, are in position to anchor 10 and act as a catcher at the same time. Fifth, the purpose of the tubing anchor 10 is to eliminate impact loading of the slips 80 during tubing parture. 

Although the embodiments of the quarter turn tubing anchor 10 have been described and shown above, it will be appreciated by those skilled in the art that numerous modifications may be made therein without departing from the scope of the invention as herein described, including positioning of the slips 80, number of slips 80 and cones, 60, 62, slight reconfiguration and relative positioning of the short vertical groove 52, long vertical groove 56 and short horizontal groove 58 of the J-slot 50, length or shape of the J-pin 75, choice of materials, relationship and/or sizing of the components, and design features of each component deemed immaterial to the function, operation or intent of the tubing anchor 10 as presented herein.

What is claimed is:
1. A quarter turn tubing anchor providing a secure stationary anchor mechanism for a tubing string within a well casing and a catcher function in the event the tubing string disengages from above, said tubing anchor comprising:
   a top cap attached to a housing by at least one cap screw at an upper coupling, said housing further defining a hollow cavity;
   a bottom crossover sub attached to a body installed within said housing attaching a lower tubing string within said well bore casing, said anchor supported from said top cap from above by an upper tubing string, said housing attached to said body through a plurality of housing holes in said housing through which a plurality of housing screws secure said body and said housing together in a slidable connection, yet allowing for limited movement between said housing and said body for activation of said anchor through interaction between a J-slot within said housing and a J-pin extending from said body through said J-slot controlling said housing relative to the positioning of said housing, said body further defines a hollow cavity through which fluid passage is provided between said upper and lower tubing strings;
   a plurality of drag springs attached to said housing by independent spring screws, said drag springs positioned against said casing; and
   at least three lower cones independently attached to said body by a lower cone screw, said lower cones activated by movement of said J-pin within said J-slot controlling movement and positioning of each said lower cone in an upward or downward direction;
   at least three upper cones independently attached to said housing by an upper cone screw, said at least three upper cones held in a fixed position; and

2. The tubing anchor as disclosed in claim 1, said J-slot further comprising a short vertical groove, a long vertical groove, and a short horizontal groove, with said J-pin extending from the said body through said J-slot, said short vertical groove further defining an upper end and a lower end; and said J-pin relative to said J-slot indicating the rotational and positional relationship between said body and said housing defining an insertion position, an extraction position and a set position, wherein said insertion position places said J-pin within said lower end of said short vertical groove coinciding with said at least three upper cones and said at least three lower cones exert no projections force against each respective said at least three slips, said extraction position places said J-pin within said upper end of said short vertical groove, said at least three upper cones and said at least three lower cones moved together, yet applying no outward force upon each respective said at least three slips, and said extended position places said J-pin within said long vertical groove, forcing said at least three lower cones upward, causing each said at least three slips to be forced outward beyond said housing and against said casing by said respective at least three upper cones and said at least three lower cones, locking said tubing anchor within said casing to prevent lower movement of said tubing anchor within said casing.

3. The tubing anchor as disclosed in claim 1, said J-slot further comprising a short vertical groove, a long vertical groove, and a short horizontal groove, with said J-pin extending from the said body through said J-slot, said short vertical groove further defining an upper end and a lower end; and said J-pin relative to said J-slot indicating the rotational and positional relationship between said body and said housing defining an insertion position, an extraction position and a set position, wherein said insertion position places said J-pin within said lower end of said short vertical groove coinciding with said at least three upper cones and said at least three lower cones exert no projections force against each respective said at least three slips, said extraction position places said J-pin within said upper end of said short vertical groove, said at least three upper cones and said at least three lower cones moved together, yet applying no outward force upon each respective said at least three slips, and said extended position places said J-pin from said short vertical groove through said short horizontal groove into said long vertical groove one quarter turn clockwise, forcing said at least three lower cones upward, causing each said at least three slips to be forced outward beyond said housing and against said casing by said respective at least three upper cones and said at least three lower cones, locking said tubing anchor within said casing to prevent lower movement of said tubing anchor within said casing, said J-pin allowed to float freely within said long vertical groove downwards when lifted and upward a when being set into position, each said at least three upper cones
providing sufficient force to keep the tubing anchor in place while holding a large mass weight of tubing string below said tubing, and release of said tubing anchor from said extended position to said insertion or retraction position requiring only a slight release of tension by a downward movement and rotation of said body one quarter turn counter clockwise, moving said J-pin back into said short vertical groove.

4. The tubing anchor as disclosed in claim 1, said tubing anchor further comprising:
   each said lower cones screw designed to shear during an emergency release situation causing said respective lower cone to drop away from said slip, allowing said slip to retract within said housing releasing said tubing anchor from said casing, with said top cap and said drag springs centralizing said body within said housing to prevent reactivation of said respective slip.

5. The tubing anchor as disclosed in claim 1, said tubing anchor further comprising any other feature as disclosed within the specification.

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