

[54] **KICK-OVER TOOL**

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[51] Int. Cl. **E21b 7/06**

[58] Field of Search..... 166/117.5, 117.6, 241

[56] **References Cited**

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[57] **ABSTRACT**

For use with a setting tool or a retrieval tool in installing or removing gas lift valves in side pockets of a gas lift well, a kick-over tool which incorporates a knuckle capable of rotating the tool and a sleeve which slides over the knuckle to lock the knuckle in a straight position. The sleeve locks a set of bow springs against deflection. Means are included to enable the tool to function on upward movement whereby the sleeve is moved downwardly. When it is moved downwardly, the knuckle is freed to rotate and four bow springs expand. The bow springs contact the inner wall and find the side pocket causing the lower portions of the kick-over tool to extend into the side pocket, thereby positioning the attached apparatus for installation or retrieval of the gas lift valve.

9 Claims, 4 Drawing Figures

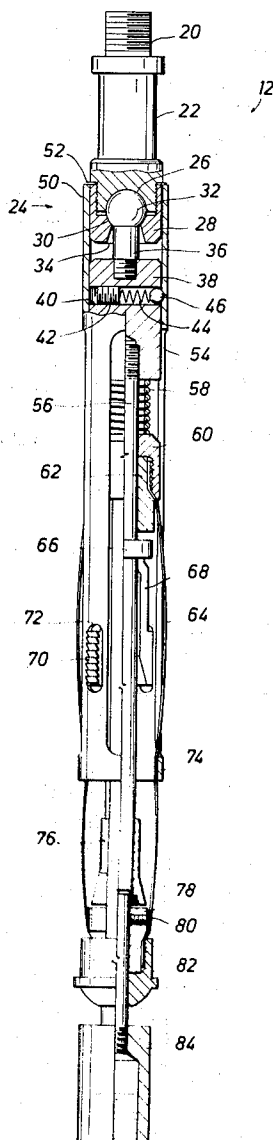


FIG. 1

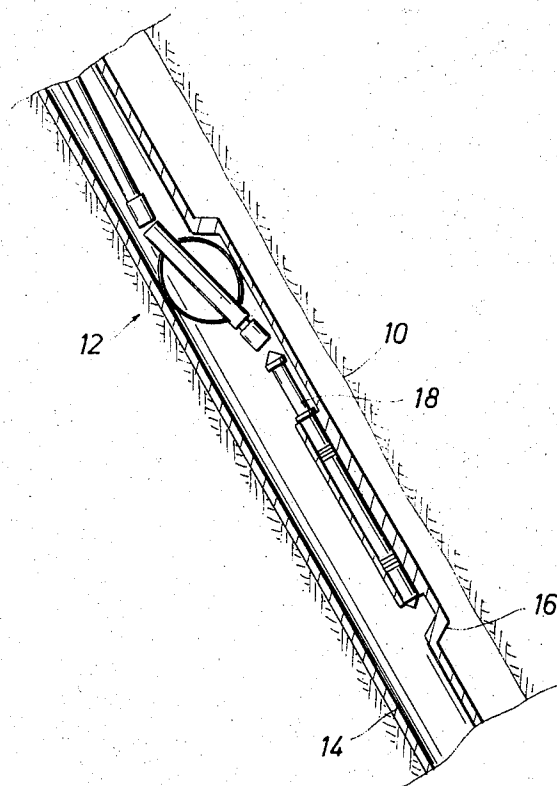
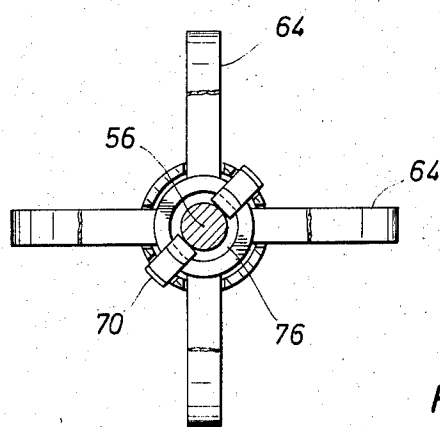


FIG. 4

FIG. 2

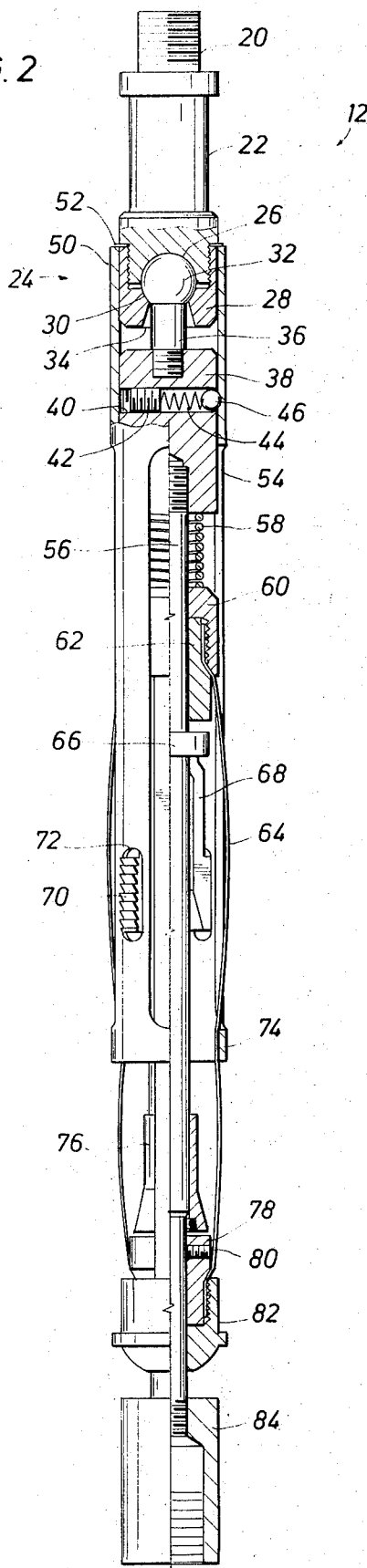
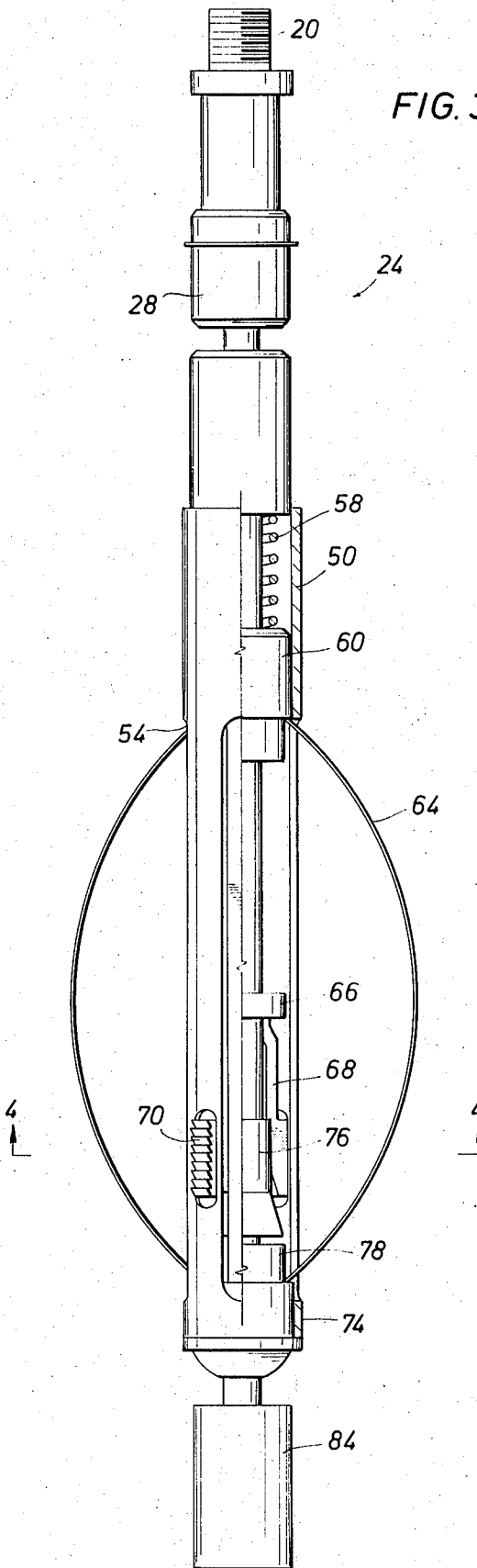


FIG. 3



KICK-OVER TOOL

BACKGROUND OF THE INVENTION

Many oil and gas wells are produced with the gas lift method. Gas lift valves are installed in side pocket mandrels at various elevations in a well. There has been some difficulty heretofore in locating side pocket mandrels because operators on the surface do not have precise information on the location of the side pockets insofar as the angular position is concerned. Using the axis and north as references, it is unusual to have information establishing the angular direction of the side pocket with respect to the axis of the tubing string.

When this problem is compounded by other problems, the difficulty in locating a side pocket mandrel can sometimes become insurmountable. A typical compounding factor arises when the well is a deviated well. Deviated wells will vary from the vertical by as much as 60° or so. A portion of the well may be laying nearly on its side. In this event, the side pocket may be positioned at any angle with respect to the axis of the deviated well so that it is located on the bottom, side, or even top of the pipe. It is more accurate to speak of the side pocket being on the side or top rather than at an angle with respect to an axis. Kick-over devices previously known have met with limited success in installation or retrieval of gas lift valves in deviated wells. They often have to be manipulated several times over a period of a few days to complete the process.

SUMMARY OF THE INVENTION

The apparatus includes a threaded pin at the top end adapted to be connected with a rope socket enabling the tool to be run on a wire line in a deviated gas lift well while a universal joint or knuckle is connected below the pin end and permits deflection in multiple directions. The knuckle supports a mandrel. A sleeve surrounds the mandrel. When the sleeve is in the up position, it passes over the knuckle and freezes it in a straight arrangement preventing deflection. The mandrel supports an encircling anchor mechanism for the upper end of a number of bow springs, preferably four. A spring forces the encircling anchor mechanism downwardly. The anchor mechanism does not move downwardly in the running-in position. A lock collar is positioned just below the encircling anchor. The lock collar has a number of serrated dogs on collet fingers which extend through openings in the outer sleeve. When the device is being run in, the springs are depressed. When the device is pulled upwardly, the dogs drag on the tubing string, forced outwardly by the collet fingers, and move downwardly, thereby enabling the compressed coil spring to force the encircling anchor mechanism downwardly. When this occurs, the tubular sleeve is also forced downwardly. The tubular sleeve has matching elongate ports and a lower clamp ring which keeps the bow springs in a compressed position for running in. When the encircling clamp ring moves downwardly, the bow springs spring outwardly. This causes the tool to kick over and find the side pocket, pivoting about the knuckle.

DESCRIPTION OF THE DRAWINGS

FIG. 1 shows the kick-over tool of the present invention in a deviated gas lift tubing string seeking a side pocket mandrel for installation or retrieval of a gas lift valve;

FIG. 2 is a sectional view along the length of the kick-over tool arranged for running-in where the bow springs are clamped to the tool and rotation about the knuckle is prevented by an external sleeve;

FIG. 3 is a view similar to FIG. 2 showing the tool in the kick-over position where the bow springs have expanded; and,

FIG. 4 is a sectional view taken along the line 4 — 4 of FIG. 3 disclosing internal details of construction.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Attention is first directed to FIG. 1 which shows a well 10 which has been drilled at a deviated angle to best illustrate the operation of the kick-over tool 12 shown in the tubing string 14. The tubing string 14 includes a side pocket 16 where a gas lift valve or dummy 18 is to be installed or retrieved. The kick-over tool 12 is adapted to be run on a wire line in the customary manner with similar equipment to that currently used in the industry. It can be run with installation or retrieval tools from numerous manufacturers, such as Camco.

In FIGS. 2 and 3 together, details of construction are identified. The upper pin end 20 is connected to a solid member 22 which then extends to a knuckle joint assembly 24. The knuckle joint assembly 24 includes a semi-spherical opening 26 formed in the solid member 22. A cap 28 threads on the solid member 22 and is axially drilled and a shoulder 30 is formed which faces the semi-spherical opening above. The shoulder 30 is curved rather than tapered to cooperate with the semi-spherical opening 26 to define a receptacle or chamber for a sphere 32. The sphere 32 is locked between the solid member 22 and the cap 28. The axial passage tapers outwardly at 34 to enable the sphere 32 and a connected shaft 36 to pivot or deflect in any direction. The rotation of the sphere 32 and the connected shaft 36 is in any direction with respect to the axis of the tool. The range of deflection is limited by the taper in the passage 34.

The member 36 is threaded at its lower end and is threaded into and joined with a tubular body 38. The tubular body 38 has a lateral passage 40 which receives a plug 42 at one end and a coil spring 44 adjacent to the plug. The coil spring forces a ball 46 partially out through the end opening of the lateral passage 40 to serve as a lock for a sleeve 50 which telescopes about the body 38. In the illustrated position of FIG. 2, the sleeve 50 covers over the opening adjacent to the ball 46 and holds it within the lateral passage 40. When the sleeve is down, the ball is permitted to protrude and is held from escaping only by an internal shoulder which defines an opening smaller than the ball 46. The ball extends beyond the surface of the body 38 and locks the upper edge of the sleeve 50 to prevent it from passing over the ball. In the position of FIG. 2, a small indentation is formed on the inside of the sleeve 50 to receive the ball 46 so it serves as a lock mechanism in this position also. It prevents the sleeve from accidentally

sliding downwardly from the position of FIG. 2 until the intended time.

The sleeve 50 is limited in upward movement by a washer 52 which is captured at the threaded joint between the solid member 22 and the cap 28. The sleeve 50 incorporates a number of lengthwise slots 54 for reasons to be discussed hereinafter.

The body 38 is threaded at its bottom portions and a mandrel 56 extends the full length of the tool. The mandrel 56 is within the sleeve 50. The mandrel 56 is surrounded at its upper end by the coil spring 58. The spring bears against the body 38 at its upper end. An encircling anchor device 60 is slidably mounted on the mandrel 56. The anchor device is loose and is able to move upwardly and downwardly on the mandrel 56. The anchor piece 60 cooperates with a tapered lock sleeve 62. The members 60 and 62 encircle the mandrel 56 and slide upwardly and downwardly on it as a unit. They thread together, but also include slots adjacent to the threaded interconnection where a number of centering or bow springs 54 can be inserted to lock their upper ends. The springs 64 are inserted into the slots left between the members 60 and 62 at the threaded connection and are locked in position. The centering springs 64 flex outwardly through the lengthwise slots 54 in the sleeve 50.

A ring-like member 66 is just below the spring anchor assembly on the mandrel 56. The ring 66 slides upwardly and downwardly also. It carries a number of cantilevered fingers 68, preferably two, which serve as collet fingers on which serrated dogs 70 are mounted. The dogs 70 protrude through openings 72 formed in the sleeve 50 which are of suitable size. The dogs 70 have a number of serrations which point upwardly. They tend to drag slightly on downward movement of the tool through the tubing string. However, on upward movement, the drag is measurably increased. The serrated dogs are forced outwardly by the collet fingers 68. The dogs are positioned in the openings 72 so that relative movement of the dogs 70 on the collet fingers 68 will be imparted to the sleeve 50. More will be noted concerning this hereinafter.

A lock ring 74 is at the bottom of the sleeve 50. The lengthwise slots 54 terminate just above the ring 70. As illustrated, the centering springs 64 bow outwardly but are constrained in position by the ring 74. The ring 74 defines the lower end of the sleeve 50.

The mandrel 56 passes through a tapered bushing 76 which is fixed to the mandrel. The bushing 76 is just above a hub 78 which is fixed to the mandrel by means of a set screw 80. The hub 78 has an outer surface which readily engages a lock nut 82. The mating thread surfaces are complete except that slots of appropriate width and depth are left for the centering springs 64. The slots which are left between the two threaded surfaces receive the lower ends of the centering springs and lock them in position as illustrated. The lock nut cooperates with the hub 78 to anchor the lower end of the centering spring. The mandrel extends therethrough and terminates in a box end 84 enabling connection of the kickover tool 12 with a setting or retrieval tool.

A comparison of FIGS. 2 and 3 is helpful in understanding operation of the tool. The tool is installed with a retrieval or installation tool connected to its lower end. All this equipment is run into the well on a wire line. The tool is then lowered to a point in the well just

below a known depth or elevation of a side pocket where a gas lift valve or dummy is to be installed or retrieved. As the kick-over tool is run in, the drag of the tubing string on the dogs 70 tends to force the dogs upwardly as viewed in FIG. 2, and the kickover tool maintains the operative position shown in FIG. 2. When the elevation of the side pockets is passed, and some additional difference can be added for safety's sake, the wire line is manipulated to pull the tool upwardly. As it moves upwardly, the dogs 70 drag on the tubing string. The dogs are forced outwardly by the collet fingers 68. As they drag, they tend to move downwardly on the mandrel 56. As they move downwardly, they move the sleeve 50 downwardly also. As the sleeve moves downwardly, it rides over the check ball 46 which tends to hold it in position. Further movement downwardly of the sleeve then enables the centering springs 64 to bow outwardly somewhat. Downward movement of the sleeve enables the bow springs to bow outwardly as the ring 74 moves down as shown in FIG. 2. As it moves downwardly, the bow springs move outwardly pulling the upper anchor ring 60 downwardly on the mandrel where sliding movement is permitted. Sliding movement is further permitted because the ring 66 moves down with the dogs 70. At some point where movement is sufficient to free the upper anchor 60, the spring 58 extends forcing the anchor down and enabling the bow springs to take their final set. When the bow springs take their final set or position, they have pulled the anchor with them to a specified location although the bow springs themselves resist additional downward movement of the anchor 60.

Attention is next directed to FIG. 3 where the sleeve 50 is in the down position and the bow springs are extended. The springs 54 extend through the elongate slot 54 formed in the sleeve. The sleeve 50 is then below the knuckle joint 24. The knuckle joint is then free to rotate the lower portion of the tool in any direction.

In FIG. 1, the tool is shown in operation. The centering springs 64 expand outwardly but are constrained by the tubing string until the side pocket is encountered. One of the four springs will fall into the side pocket. The upper spring anchor device 60 slides upwardly and downwardly as the springs are flexed inwardly and outwardly. When the side pocket is encountered, one of the springs will fall into the pocket, tending to pull the spring anchor device 60 downwardly on the mandrel 56. This tends to bow the springs further outwardly, creating a lateral force which is common to all springs except the one in the side pocket. This causes the lower portions of the tool to deflect into the side pocket, the deflection being accommodated at the knuckle 24. This positions the installation or retrieval tool in the side pocket for easy connection or disconnection of the gas lift valve or dummy.

Retrieval of the kick-over tool is relatively easy to achieve by pulling up on the wire line. When the tool is pulled from the side pocket into the smaller tubing string, the springs 64 are radially compressed. The compression is accommodated by upward movement of the anchor 60.

The tapered or wedge-shaped bushing 76 slides under the collets 68 and dogs 70 and tends to hold the dogs and the sleeve 50 in the down position as better illustrated in FIG. 3.

The foregoing is directed to the preferred embodiment. Many alternations and variations can be incorpo-

rated without departing from the scope of the present invention, which is determined by the claims which are appended hereto.

I claim:

1. A kick-over tool for installing or removing apparatus in side pockets in gas lift wells, comprising:
 - an elongate body;
 - swivel means at the top of said elongate body,
 - lock means immobilizing said swivel means, said lock means incorporating a telescoping sleeve about said body which has one position locking said swivel means;
 - centering springs on said body at multiple locations about the circumference thereof;
 - said sleeve means having openings through which said springs extend, said openings altering said springs between withdrawn and extended positions, said openings and said sleeve means being arranged to releasably maintain said springs in the withdrawn or extended positions;
 - means at the lower end of said elongate body adapted to be connected to an installation or retrieval tool; and,
 - means for controlling operation of said lock means and said sleeve to extend said springs to the extended position and enabling said body to move at said swivel means.
2. The apparatus of claim 1 wherein said swivel means includes a captured sphere having an extending connected shaft which is connected to said elongate body.
3. The apparatus of claim 1 wherein said springs connect to a circular anchor which is slidably mounted with respect to said elongate body at the upper end and which are anchored at their respective lower ends, said

sleeve incorporating a ring which moves between two positions with said sleeve, one position clamping said springs close to said elongate body and the other position permitting said springs to move away from said elongate body.

4. The apparatus of claim 1 wherein said swivel means includes a captured sphere within a cap having an axial passage, said passage having a taper opening along its length to define a range of deflection.

5. The apparatus of claim 1 wherein said controlling means includes a

means extending outwardly to drag on the surrounding tubing string on upward movement;

means imparting a relative downward movement to said sleeve on upward movement of said tool in the tubing string; and,

means carried by said body and connected to said springs and operated by said drag means to move relative to said springs in a direction causing said springs to shorten in length and bow outwardly.

6. The apparatus of claim 5 wherein said drag means includes a set of dogs mounted on collet fingers urged outwardly toward the tubing string.

7. The apparatus of claim 6 including openings in said sleeve where said dogs extend outwardly to engage the tubing string and said dogs pull said sleeve at said openings.

8. The apparatus of claim 5 wherein said springs are leaf springs fixed to said body at their lower ends and movably fixed at their upper ends and which bow outwardly through said openings in said sleeve.

9. The apparatus of claim 8 wherein said openings terminate at a ring at the lower end of said sleeve, and said springs are constrained thereby.

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