June 1, 1954 L. W. STORM 2,680,005

DEFLECTING TOOL

Filed Feb. 24, 1948 2 Sheets-Sheet 1

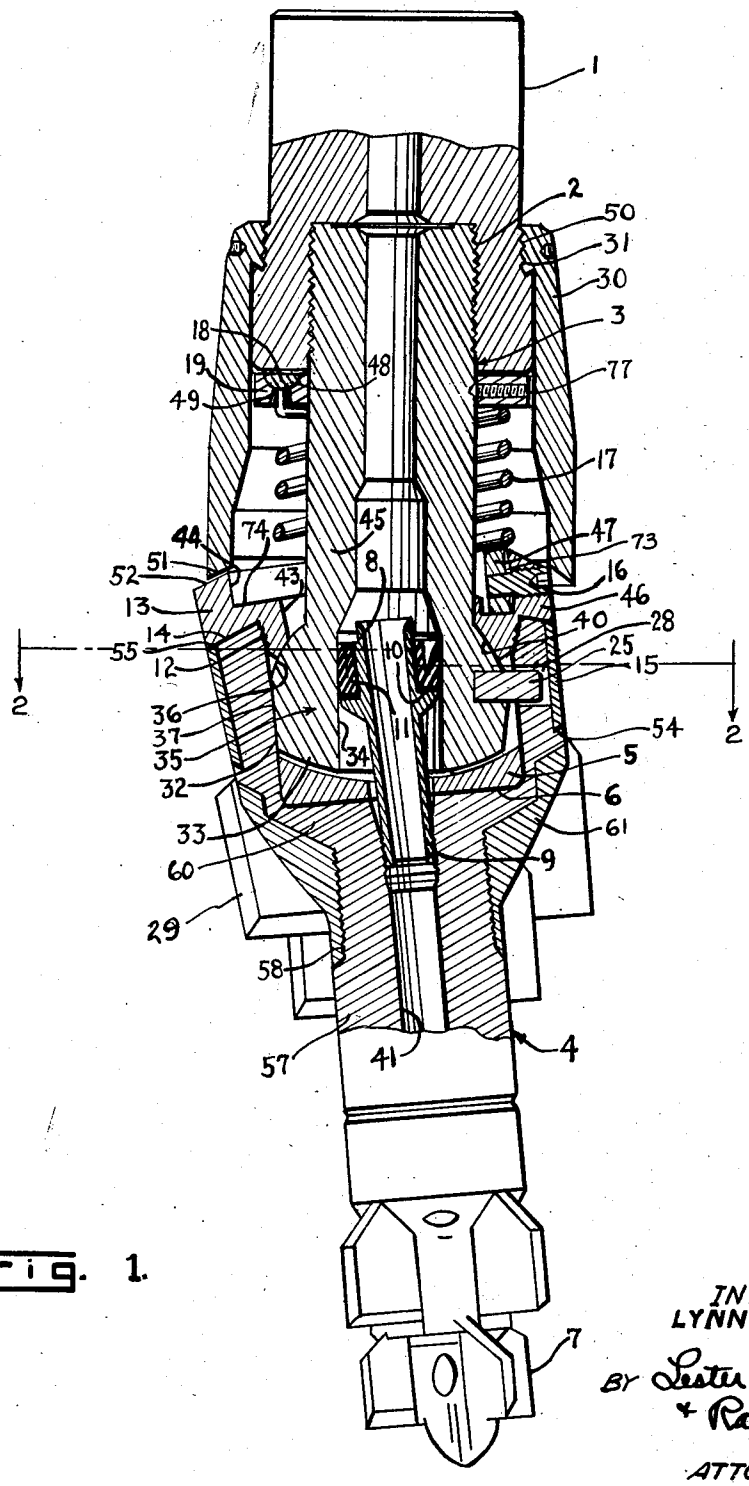

Fig. 1.

INVENTOR
LYNN W. STORM

BY Lester B. Clark
& Ray Lesmith

ATTORNEYS

June 1, 1954 L. W. STORM 2,680,005

DEFLECTING TOOL

Filed Feb. 24, 1948 2 Sheets-Sheet 2

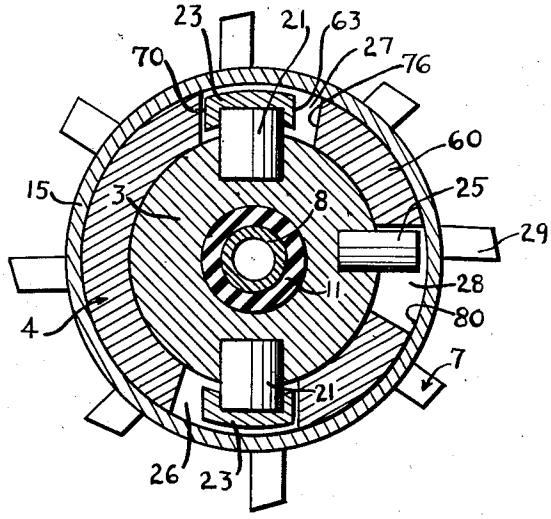

Fig. 2

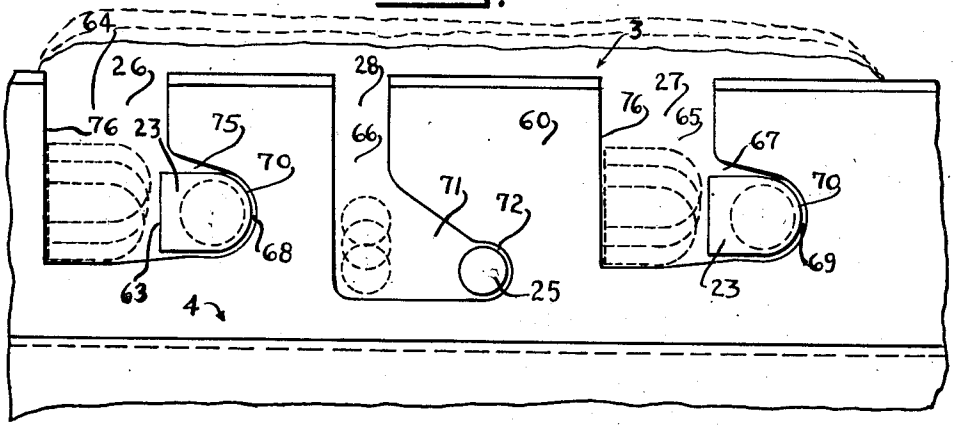

Fig. 3

Inventor
LYNN W. STORM

By Lester B. Clark & Ray L. Smith.

ATTORNEYS

Patented June 1, 1954

2,680,005

UNITED STATES PATENT OFFICE

2,680,005

DEFLECTING TOOL

Lynn W. Storm, Houston, Tex., assignor to Houston Oil Field Material Company, Inc., Houston, Tex., a corporation of Delaware

Application February 24, 1948, Serial No. 10,211

7 Claims. (Cl. 255—1.6)

1

This invention relates to a deflecting tool used in directional drilling operations wherein the course of a well may be directed in a predetermined desired manner.

It is an object of this invention to provide a tool of this class which comprises a knuckle joint having mechanism therein to deflect the body of the knuckle joint on which the drilling bit is mounted at an angle to the axis of the stem of the joint so that the tool with the bit axis thus deflected may be lowered into the well on the end of a drill string.

It is a further object of this invention to provide a tool of this class provided with positive locking means for locking the joint body in a position with the axis thereof extending at an angle to the stem axis while the tool is being lowered into the well.

It is also an object of this invention to provide a tool of this class which can be locked in the desired deflecting position while being lowered into the well and prior to the beginning of the drilling operation but which is yieldable while the tool is running in the well.

It is yet a further object of this invention to provide a wear-free deflecting mechanism which receives no load while the tool is drilling.

It is another object of this invention to provide a knuckle joint adapted to have full gauge reaming blades mounted thereon above the smaller blades of the bit so that a full gauge diameter hole may be drilled in the desired direction of deflection.

It is another object of this invention to provide a tool of this class which has no moving parts of the orienting mechanism exposed to the debris and formation usually encountered in a well.

It is still another object of this invention to provide a rugged and simple tool which is constructed to be maintained with a minimum of effort and expense.

Other and further objects of this invention will be readily apparent when the following description is considered in connection with the accompanying drawings wherein:

Fig. 1 is a sectional elevation of the tool.

Fig. 2 is a sectional plan of the tool taken along line 2—2 of Fig. 1.

Fig. 3 is a developed elevation which shows the relationship between the slotted portion of the tool body and the pin and keys on the stem. For purposes of clearest illustration this development has been taken with the body positioned with axis extending vertically and with the stem

2

tilted so that its axis intersects the body axis at the angle of deflection. It is pointed out, however, that ordinarily the axis of the stem is substantially vertical and the axis of the body is tilted in the well, as Fig. 1 represents, so that the angle of deflection of the body and bit is the desired deviation from the well bore.

In this tool a top sub 1 is adapted to be fitted onto the end of a drill string, not shown. This top sub has a threaded counterbored section 2 which is adapted to receive the upper end of a hollow stem 3. The lower end of this hollow stem 3 has a flanged lower end portion 35 which in contour comprises a convex surface 36, a tapered surface 32 and at the lower extremity another convex surface 33. This flanged end 35 also has an axial counterbore 34 therethrough. The tool has a hollow body 4 which is adapted to receive a deflecting bit 7 at the end thereof.

The upper end of the body is enlarged and the enlargement has an internally taper threaded section 12 at the mouth thereof, and a tapered section 37 of a taper to correspond with the tapered section 32 of the flange 35, and a seat 6 at the lower end of the enlargement.

A ball and socket connection is formed between the stem 3 and the body 4 by means of the thrust plate 5 which rests in the seat 6 and which is adapted for contact with the convex surface 33 of the flange 35 and by the retainer nut 13 which has an internally dished portion 40 adapted for contact with the convex surface 36 of the flange 35, the retainer nut being externally taper threaded to be threaded into the threaded portion 12 of the body 4.

A wash pipe 8 is threaded into the threaded upper portion 9 of the bore 41 of the body 4 and this wash pipe has a flanged seat 10 thereon to receive a pack-off cup 11 which forms a flexible seal between the wash pipe 8 and the counterbored surface 34 of the stem 3. The retainer nut 13 is shown having a bore 43 and a counterbore 44 therethrough, the bore 43 being of slightly larger diameter than the shank 45 of the stem 3 to permit tiltability therebetween.

Prior to assembling the top sub 1 and the stem 3 a torsion spring 17 is installed over the stem shank 45 and is connected to the retainer nut 13 by means of the pin 16 which is threaded through the walls 46 of the nut so that the end of the pin may be pressed into the spring anchor 47 which is rigidly connected, as by welding, to the lower end of the torsion spring 17.

The upper end of the torsion spring 17 is rig-

idly connected to a hemispherical button 18 which fits into a concave surface 48 of a take-up ring 19, the take-up ring being countersunk from the lower side so as to provide a bore 49 adapted to permit limited lateral motion to the torsion spring 17. The pitch of the torsion spring 17 may thus be regulated by the degree of interthreading between the top sub 1 and the stem 3. A set screw 77 fixes the ring 19.

A shroud sleeve 30 having internally threaded section 31 is adapted to be threaded over an externally threaded portion 50 of the top sub 1, and this shroud extends downwardly to protect the torsion spring 17. This sleeve 30 terminates downwardly in a dished portion 51 of a concavity similar to the convex surface 52 of the retainer nut 13 and this construction permits the shroud sleeve 30 not only to protect the torsion spring 17 but the ball and socket connection hereinbefore described between the stem 3 and body 4.

A protective sleeve 15 is also provided to encase the softer metallic material of the upper portion of the body 4. This protective sleeve 15 forms a dovetail connection 54 with the body 4 at the lower end thereof and the upper end has the same taper 55 thereon as has the shoulder 14 which forms the upper end of the body 4.

The shank 57 of the body 4 has a turned-down externally threaded section 58 thereon centrally of the body 4 where the shank merges into the enlarged body head 60. A mounting sleeve 61 which is connected in halves by any well-known manner, not shown, is internally threaded over the externally threaded section 58 of the body 4 and this sleeve forms the support on which are mounted full gauge blades 29.

The flanged end 35 of the stem 3 has cylindrical driving keys 21 (best shown in Fig. 2) loosely fitted thereinto on diametrically opposite sides thereof. An orienting pin 25 is also pressed into the flanged end 35 at 90 degrees from the driving keys and the axes of the keys and pin are in a transverse plane through the stem which is perpendicular to the stem axis. The keys 21 have wear lugs 23 pressed over the outwardly extending ends of the keys and these lugs have finished driving faces 63 on one side thereof. The orienting pin 25 is also of a length to extend outwardly from the flanged end 35 of the stem 3. The body head 60 has slots 26 and 27 therein to receive the wear lugs 23 of the keys 21. These slots 26 and 27 have legs 64 and 65 respectively which open upwardly into the shoulder 14 and which extend downwardly to substantially near the lower end of the protective sleeve 15. The body head 60 also has a slot 28 therein with a leg 66 which opens upwardly into the shoulder 14 and which extends downwardly to substantially near the lower end of the sleeve 15.

The slots 26 and 27 also have generally horizontally extending legs 75 and 67 therein which terminate in recesses 68 and 69 designed to receive the semi-circular faces 70 of the wear lugs 23. The slot 28 also has a horizontally extending leg 71 which terminates in a semi-circular shaped recess 72 designed to receive the orienting pin 25. It should be noticed that neither wear lugs 23 nor the outer end of the pin 25 extend to the inner wall 80 (see Fig. 2) of the protective sleeve 15 and that the slots 26, 27 and 28 are formed only in the body head 60 and not in the sleeve 15 which protects the interior elements of the body and stem assembly from debris entering from the bore of the well.

As shown in Fig. 3, the axes of the recesses 68 and 69 are located vertically above the axis of the recess 72.

The torsion spring 17 is formed to exert a counter-clockwise torque, as viewed from above, which acts through a spring anchor 47 against the walls of the recess 73 in the shoulder 74 of the retainer nut 13. This force acts through the retainer nut 13 to pivot the whole stem 3, and the elements assembled thereon, in a counter-clockwise direction, around the modified ball and socket or knuckle joint connection between the stem 3 and body 4. This torsional movement is arrested when the orienting pin 25 is in abutment with the recess 72 of the slot 28, and the faces 70 of the wear lugs 23 rest in the recesses 68 and 69. With the orienting pin 25 thus positioned the tool is yieldably locked by the force of the torsional spring 17 at the degree of tilt corresponding to the difference in elevation on the body 4 of the axes of the recesses 68 and 69, and of the axis of the recess 72, this angle of tilt being about six degrees in the disclosure shown but the structure may be varied from this degree of deflection.

When the drill string is first rotated to commence drilling, the orienting pin 25 is moved clockwise out of the recess 72 to unlock the tool. Further rotation moves the driving faces 63 of the wear lugs 23 into driving abutment with the walls 76 of the slot legs 64 and 65, and still further rotation commences rotating together both stem 3 and body 4 so that the bit 7 commences drilling in the direction of deflection.

During a revolution, the body 4, as shown in the development of Fig. 3, moves successively upwardly and downwardly with relation to the orienting pin 25 and the wear lugs 23, the vertical slot leg 66 of the slot 28 moving up and down about the pin 25 without the pin abutting the slot walls. The knuckle joint connection between stem 3 and body 4, and the configuration of the slots 26, 27 and 28 make such movement possible, the body 4 occupying the relative positions indicated by the dotted lines of Fig. 3 in the course of one revolution.

Broadly, the invention contemplates a means and method of deflecting well bores in which the direction of deflection is predetermined, and the means and method of this invention provide for yieldably locking the tool in this position against the force of a torsion spring to be released therefrom only upon the application of drilling rotation to the tube. This invention also contemplates a means and method of deflecting well bores and of reaming out such deflected bores to full gauge diameter.

What is claimed is:

1. In a drilling tool the combination of a stem adapted for connection to a drill string, a body adapted for connection to a bit, a knuckle joint for tiltably connecting said stem and body, driving keys and an orienting pin disposed about the lower portion of said stem in the same transverse plane, an upper end of said body being provided with cooperating substantially L-shaped slots to receive such keys and pin, such slots including substantially horizontal and vertical legs, the horizontal leg of such pin receiving slot being at a different elevation than the horizontal legs of such key receiving slots, and torsional means connected to such stem and body to yieldingly lock such keys and pin in such horizontal legs whereby such tool is yieldingly locked in a deflecting position.

2. In a drilling tool the combination of a stem

adapted for connection to a drill string, a body adapted for connection to a bit, a knuckle joint for tiltably connecting said stem and body, driving keys and an orienting pin disposed about the lower portion of said stem in the same transverse plane, an upper end of said body being provided with cooperating substantially L-shaped slots to receive such keys and pins, such slots including substantially horizontal and vertical legs, the horizontal leg of such pin receiving slots being at a different elevation than the horizontal legs of such key receiving slots, and torsional means about such stem above such body and torsionally connecting such stem and body whereby such keys and pin are yieldingly retained in such horizontal legs thereby yieldingly locking such tool in a deflecting position.

3. The drilling tool of claim 1 including flexible sealing means disposed between and exteriorly of said body and interiorly of said stem, and shield means on said stem and body to protect said joint and slots from debris from a well bore.

4. In a drilling tool the combination of a stem adapted for connection to a drill string, a body adapted for connection to a bit, a knuckle joint for tiltably connecting said stem and body, driving keys and an orienting pin disposed about the lower portion of said stem in the same transverse plane, said body having in its upper end cooperating substantially L-shaped slots to receive such keys and pin, such slots including substantially horizontal and vertical legs, the horizontal leg of such pin receiving slot being at a different elevation than the horizontal legs of such key receiving slots, and torsional means externally of said stem and connected to such stem and such body for rotatably bearing against said joint to position said pin in the horizontal leg of such pin receiving slot whereby such tool is yieldably locked in tilted position and whereby on rotation of the tool for drilling such pin will rotate out of such horizontal leg of such pin receiving slot and the driving keys will contact the vertical legs of such key receiving slots thereby serving to transfer drilling rotation from the stem to the bit without transmitting load to the wearing mechanism of said tool.

5. A driving and orienting lock for a tiltable joint comprising, interfitting first and second members, driving keys and an orienting pin disposed in a lateral plane about an end of the first member proximate said joint, the second member having cooperating substantially L-shaped slots proximate said joint adapted to receive such keys and pin, said slots including substantially lateral legs, the lateral leg receiving said pin being in a plane different from the lateral legs receiving said keys, and torsional means proximate

said joint and connected to said members adapted to yieldingly lock said keys and pin in said lateral legs thereby yieldingly locking such first and second members in tilted position.

6. A knuckle joint for drill stems including a ball and socket connection, driving keys and an orienting pin disposed about said ball in a transverse plane, said socket being provided with slots and such slots having substantially longitudinal and transverse legs receiving said keys and pin, the transverse leg receiving said pin being disposed in a plane different from that of the other transverse legs, and torsional means connected to said ball and socket connection to yieldingly lock said keys and pin in said lateral legs thereby yieldingly locking such knuckle joint in deflected position.

7. A driving and orienting lock for deflecting tools comprising, a body having a socket at one end and adapted for connection to a bit, said socket having interconnecting lateral and longitudinal slots, a stem adapted for connection to a drill string, a ball element at the end of the stem and insertable within said socket thereby providing a ball and socket connection between the body and stem, lugs about said ball element, said slots receiving said lugs, one of said lugs being at an elevation different from that of the other of said lugs when the lugs are in the lateral slots thereby maintaining said ball and socket in tiltable position, and torsional means connected to said ball element and socket adapted to yieldably lock said lugs in said lateral slots and thereby yieldingly locking such driving and orienting lock in deflecting position.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
771,457	Bullard	Oct. 4, 1904
926,929	Dusseau	July 6, 1909
1,006,661	Knapp	Oct. 24, 1911
1,546,630	Deavers	July 21, 1925
1,796,106	Johnson	Mar. 10, 1931
1,798,530	Haigh	Mar. 31, 1931
1,805,678	Smith	May 19, 1931
2,016,042	Lewis	Oct. 1, 1935
2,147,491	Le Bus	Feb. 14, 1939
2,173,309	Monroe	Sept. 19, 1939
2,194,267	Brock et al.	Mar. 19, 1940
2,197,991	Wright	Apr. 23, 1940
2,266,383	Quintrell	Dec. 16, 1941
2,275,832	Zublin	Mar. 10, 1942
2,291,100	Oswald	July 28, 1942
2,304,119	Potts	Dec. 8, 1942
2,402,238	Carpenter	June 18, 1946