

Nov. 8, 1932.

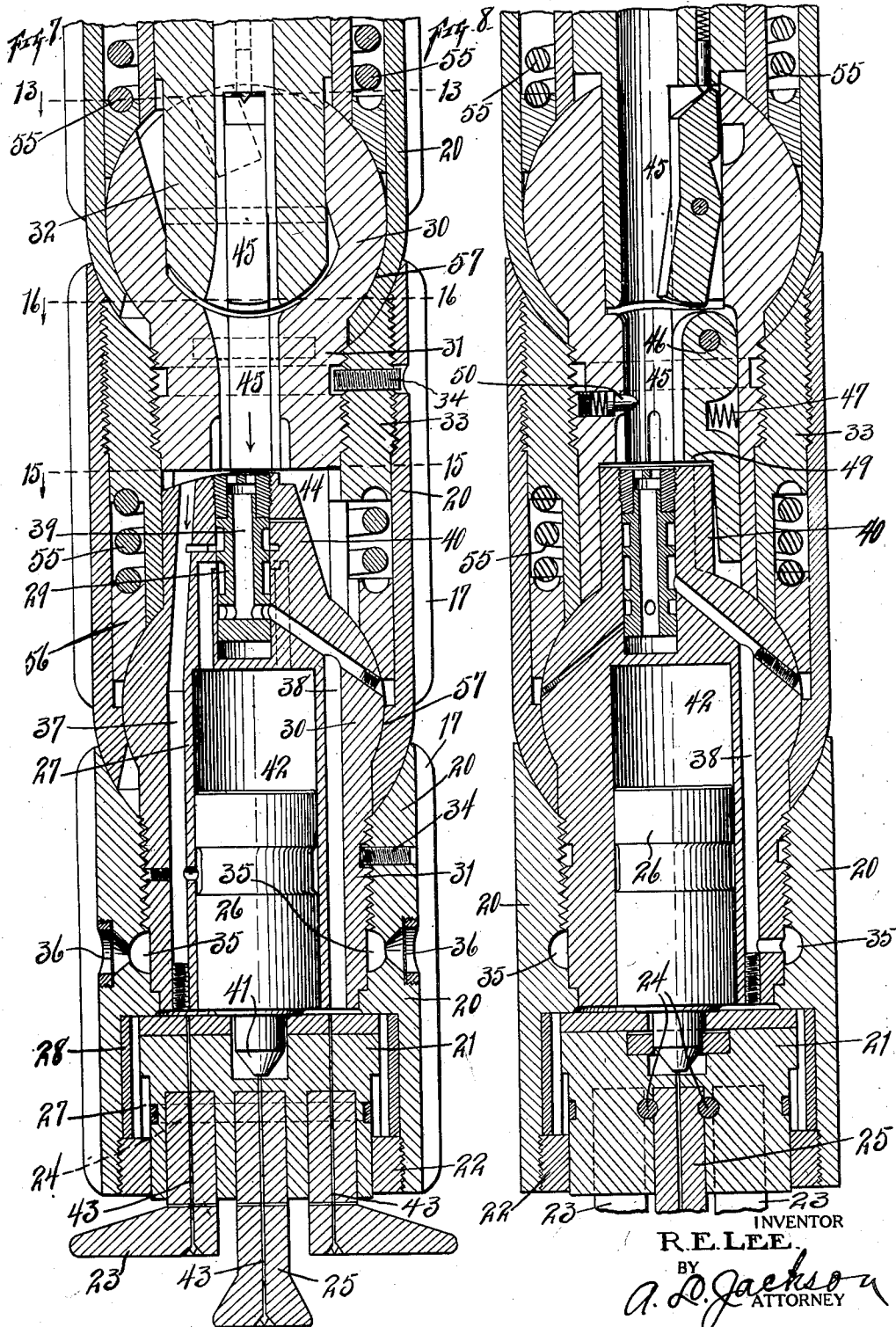
R. E. LEE

1,886,820

DRILLING TOOL FOR LATERAL AND ANGULAR DRILLING

Filed April 5, 1930

7 Sheets-Sheet 2



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DRILLING TOOL FOR LATERAL AND ANGULAR DRILLING

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7 Sheets-Sheet 3

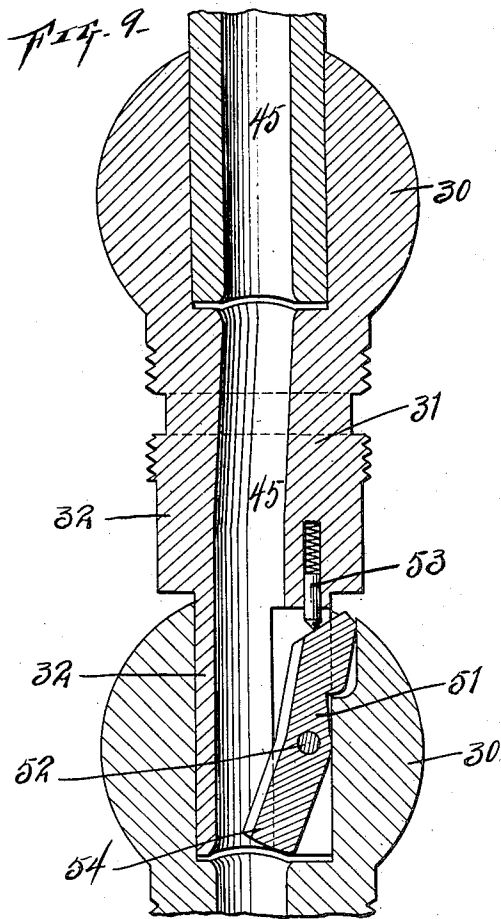


Fig. 10.

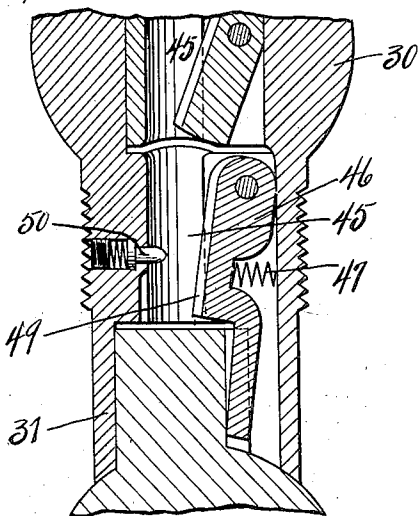


Fig. 11.

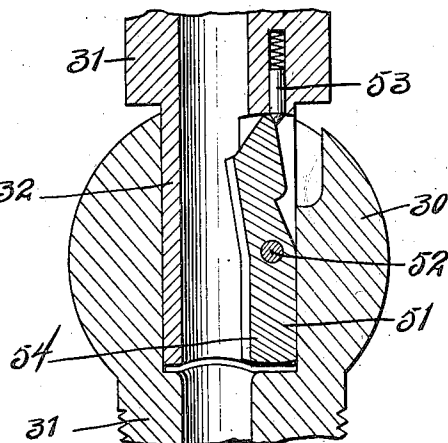
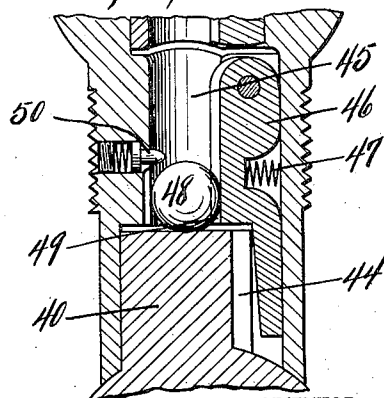


Fig. 12.



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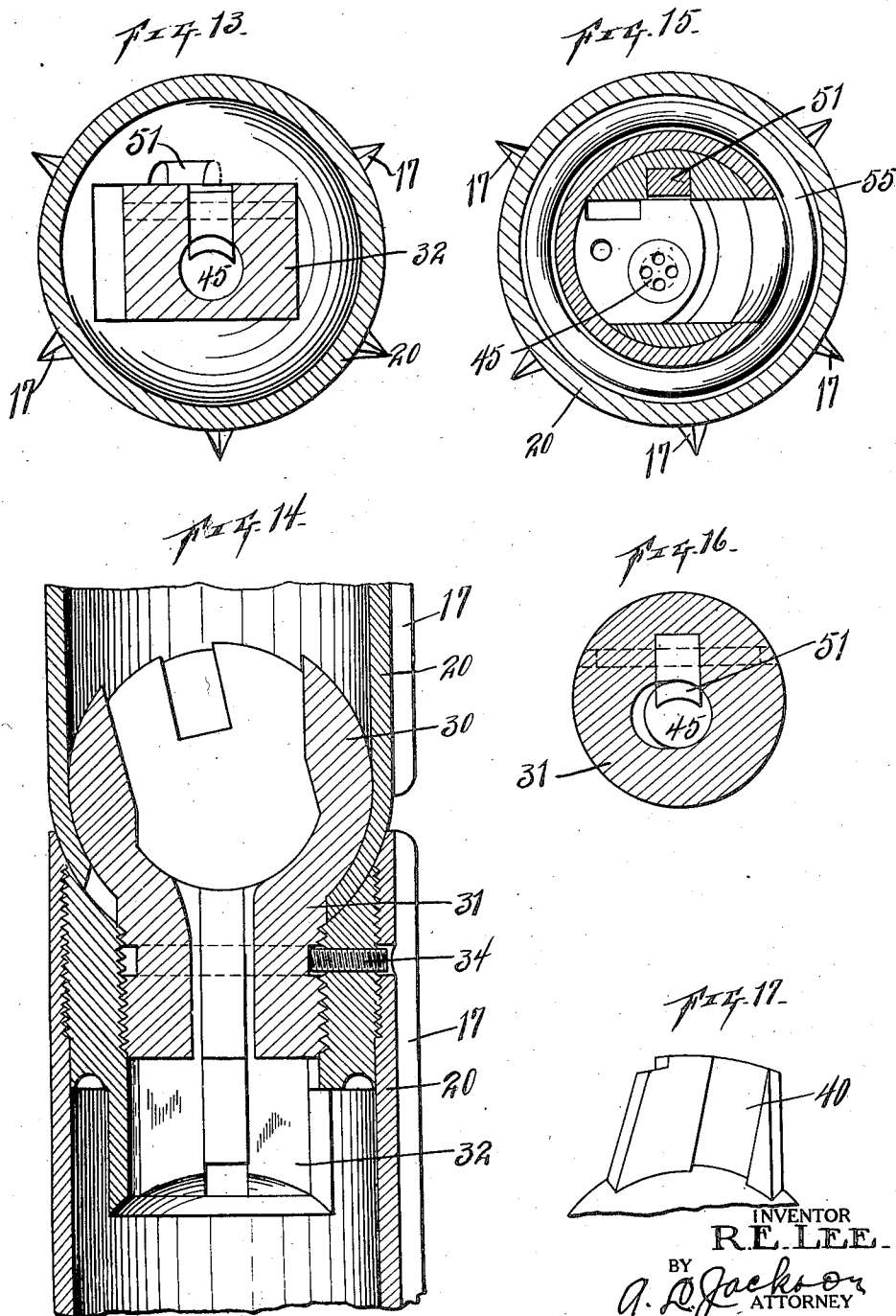
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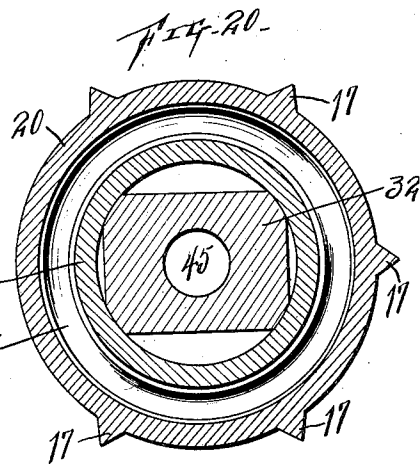
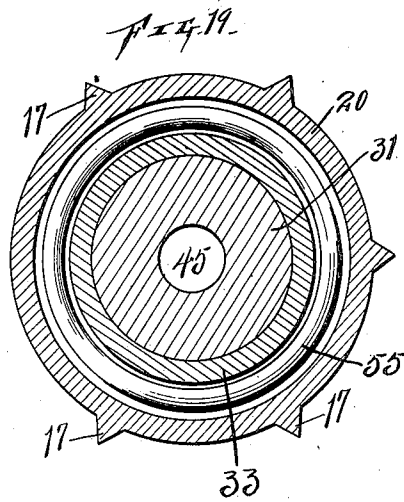
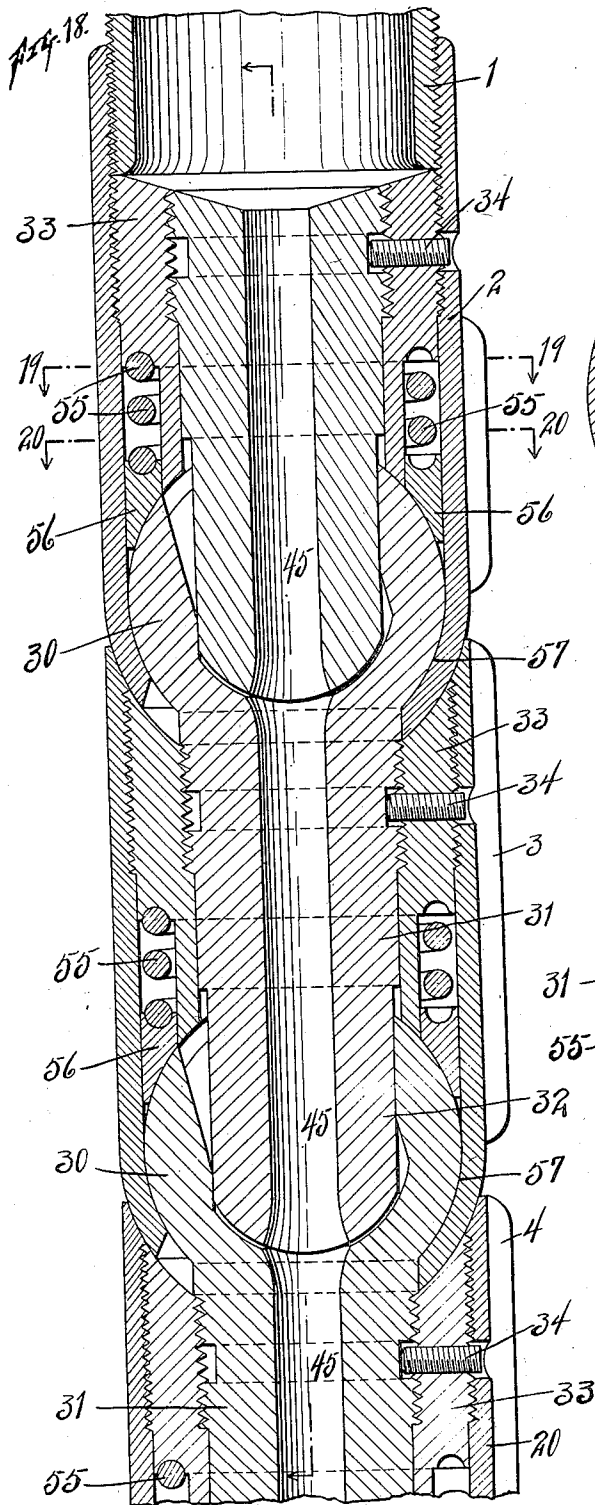
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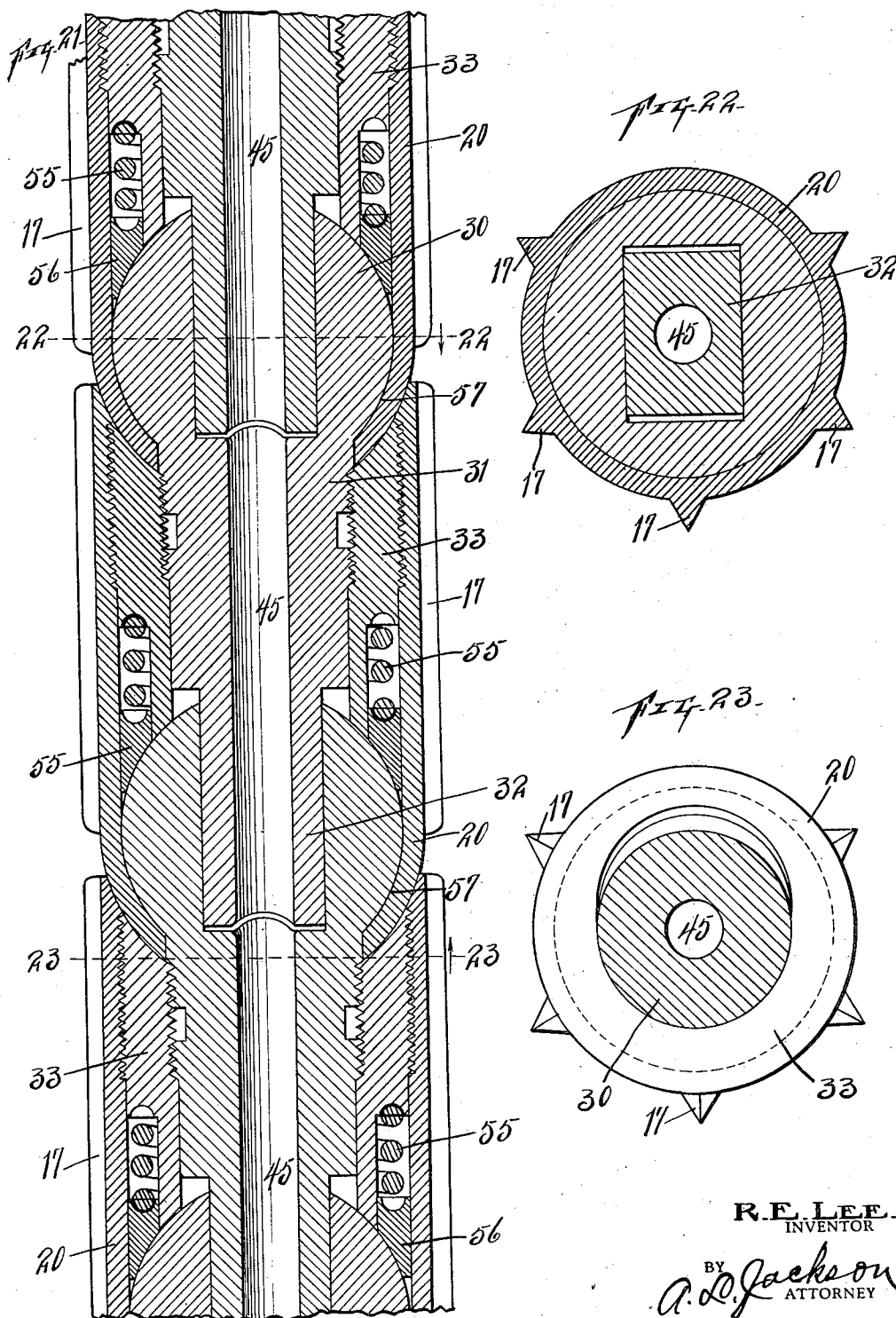
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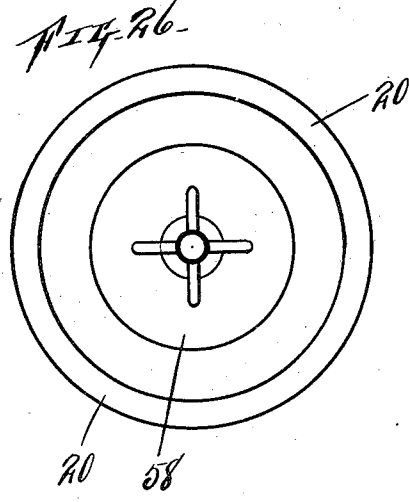
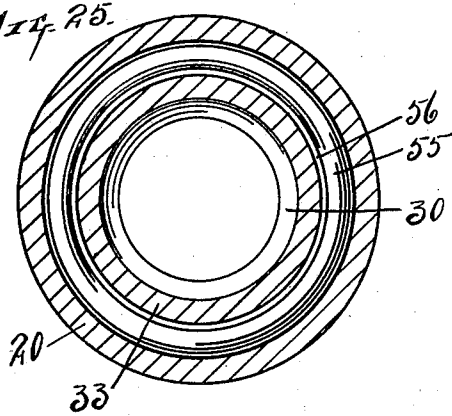
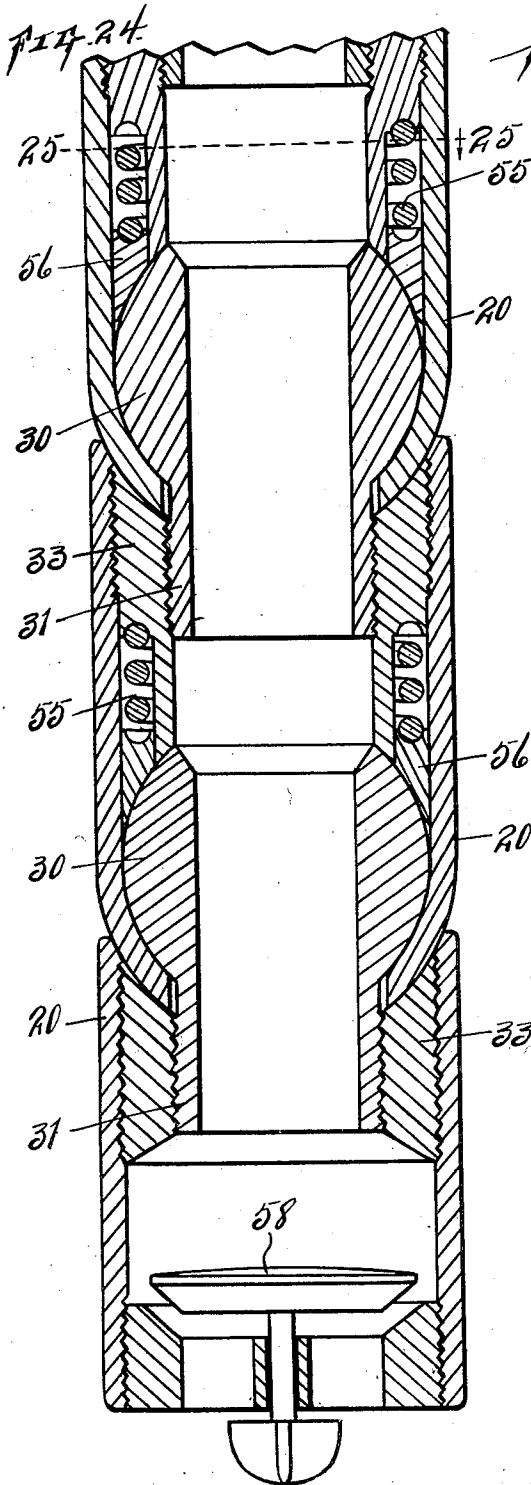
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DRILLING TOOL FOR LATERAL AND ANGULAR DRILLING

Application filed April 5, 1930. Serial No. 441,917.

My invention relates to drilling tools and more particularly to tools for lateral or angular drilling; and the object is to provide apparatus for drilling angular or lateral channels from the vertical opening in the earth known as the well. The object is to make channels extending through the surrounding area and generally called for producing reservoirs of a well. For carrying out such drilling it is necessary to use flexible drilling apparatus composed of a plurality of units connected by knuckle joints and to use directing means for the drilling tools and to provide means for operating the drilling tools,—preferably by air, but other means may be used. Other objects and advantages will be fully explained in the following description and the invention will be more particularly pointed out in the claims.

Reference is had to the accompanying drawings which form a part of this application.

Fig. 1 is a vertical section of a well casing, showing the drilling shaft therein and extending out of the well casing.

Fig. 1a is a vertical section of pipe 13 showing a plurality of deflectors.

Fig. 2 is a broken portion of the well casing, showing the opening for the drilling shaft to leave the well casing.

Fig. 3 is a horizontal section, taken on the line 3—3 of Fig. 1.

Fig. 4 is a similar view, taken on the line 4—4 of Fig. 1.

Fig. 5 is a similar view, taken on the line 5—5 of Fig. 1.

Fig. 6 is a similar view, taken on the line 6—6 of Fig. 1.

Fig. 7 is a longitudinal section of the first units of the drilling shaft, being two full units and a part of a third unit.

Fig. 8 is a longitudinal section of the same approximately at right angles to the view of Fig. 7.

Fig. 9 is a longitudinal section of a portion of the drilling shaft, showing the locking means and the flexing means.

Fig. 10 is a similar view, being a section of the first unit which holds the drilling tools.

Fig. 11 is a section showing the lower por-

tion of Fig. 9 and showing the unlocked position of the locking devices.

Fig. 12 is a section showing the parts of Fig. 10 in unlocked position.

Fig. 13 is a cross-section of one of the locking units.

Fig. 14 is a longitudinal section of the same.

Fig. 15 is a horizontal section, taken on the line 15—15 of Fig. 7.

Fig. 16 is a cross-section, taken on the line 16—16 of Fig. 7.

Fig. 17 is a perspective view of a part of the locking devices.

Fig. 18 is a vertical section of a portion of the knuckle non-locking joints, showing the pipe to which the knuckle joint sections are connected.

Fig. 19 is a horizontal section, taken on the line 19—19 of Fig. 18.

Fig. 20 is a horizontal section, taken on the line 20—20 of Fig. 18.

Fig. 21 is a longitudinal section of the parts shown in Fig. 18, but at right angles to the view of Fig. 18.

Fig. 22 is a horizontal section, taken on the line 22—22 of Fig. 21.

Fig. 23 is a horizontal section, taken on the line 23—23 of Fig. 21.

Fig. 24 is a vertical section of the baler units.

Fig. 25 is a horizontal section, taken on the line 25—25 of Fig. 24.

Fig. 26 is an inverted plan view of the lowest section or unit.

Similar characters of reference are used to indicate the same parts throughout the several views.

My invention relates to the operative end of a drilling shaft and the power element is supplied through a pipe 1, a section of which is shown in Fig. 18. The power element, whether air or some other element, is supplied through pipe 1.

A non-rotating shaft is made of a plurality of flexing units and there are flexing non-locking units 2, 3, 4, and 5, and flexing locking units 6, 7, 8, 9, 10, and 11. There may be more or less of each kind of units. The non-rotating shaft is included in a pipe 13

which may be of variable lengths. It may extend from the top of the ground or the surface to the bottom of the well, or it may extend from the bottom of the well far enough upwardly to have sufficient weight so that it will hold positively the deflector plate 14 contained therein in a set or determined position. The deflector plate 14 is rigidly mounted in the lower part of the pipe 13.

The pipe 13 is mounted so that it projects upwardly inside of the well casing 12. The pipe 13 has a cut-out 15 in the side thereof for the passage of the drilling shaft of flexible units for lateral or angular drilling.

The deflector plate has a double curvature,—one relatively long curve or incline for directing the flexible units out of the pipe 13 and it also has a curvature as shown in Figs. 3 to 6 inclusive. A V-shaped groove 16 is formed in the deflector plate 14 to serve as a guide for the flexible units as they are passing over the deflector plate out of pipe 13. The flexible units have ribs 17 extending longitudinally on the exterior surface. One of these ribs 17 serves as a guide cooperating with the groove 16 for directing the flexible units out of the pipe 13. The ribs 17 generally hold the flexible units out of contact with the walls of the channels in the reservoir area so that there will be clearance for the passage of drill cuttings and exhausts from the operating medium or element of the drill which cuttings and exhaust pass along about the units into the pipe 13 and also on the outside of pipe 13 in the well hole. The pipe 13 may be set at any desirable position,—higher or lower in the well by using a longer or shorter nipple or pipe 18 between the end of pipe 13 and the anchor points 19, the deflector plate 14 being rigidly secured to the pipe 13. The deflector plate 14 must be properly positioned relative to the opening 15 so that flexible units will be directed by the plate out through the opening 15. The anchor points 19 prevent the turning of pipe 13 or being twisted in the well. The weight of the pipe 13 on the points 19 securely anchors the pipe 13 in place.

The unit 11 of the flexible units carries a drill head 21 in a housing 20 and the head is secured in the housing 20 by a cylindrical ring 22 which is screwed into housing 20. A plurality of drills 23 have shanks projected into the drill head 20 and are secured therein by pins 24, which project through the shanks of the drills and through the head 21. A pilot drill 25 is secured in the head 21 in the same manner. The drill head 21 is actuated by a piston 26 of standard make. The weight of the shaft composed of the flexible units keeps the drills 23 and 25 pressed against the earth to be bored or drilled. The drill head 21 has an annular cut-out 27 which forms a working joint for the drill head to permit the drill head to move back and forth sufficiently

to take the strain off of the housing 20 and also compensates any difference of excess movement of the drill shaft with drill speed forward. The drill head 21 forms the bottom part of the cylinder 27 in which the piston 26 works. The cylindrical ring 22 has a sleeve 28 which seals the drill head 21 therein. This sleeve 28 is machined and ground so that the drill head 21 when ground will form a reciprocating working seal. The drills 23 and 25 are operated through the drill head 21 by the piston 26 which is reciprocated by the power element (preferably compressed air). The sleeve 29 and cooperating ports are of standard design and constitute no part of my invention, but are used to actuate the piston 26 which in turn actuates the drill head 21. The piston 26 has an annular recess in its periphery to prevent the piston from being air-locked when in operation.

The units 10 and 11 are connected by a sealed ball joint.

A ball joint 30 has a sleeve 31 which sleeve is screwed into the coupling 33 and coupling 33 is screwed into housing 20. In unit 11, the sleeve 31 of ball joint member 30 is screwed into the housing 20 and is locked in the proper position by a screw 34 after the flexing units have been lined up to turn all together. The members 30 and 31 have the usual ports 37 and 38 which are fed to the exhaust ports and these ports communicate with the passage 39 through the sleeve 29. The sleeve 29 reciprocates vertically in the extension 40 of ball joint 30. The piston 26 has an extension nose 41 for the purpose of compressing air which remains in the cavity in the head 21 and the object is to provide a force for aiding in the rebound of the piston 26. The housing 20 is provided with an annular port 35 for exhausting air so that the exhaust air will pass out around the units 11, 10, etc. A screen 36 is placed around the port 35 to keep out sand and sediments from entering the piston cylinder 42. Other exhaust ports 43 are provided in head 21, drills 23 and 25. The extension 40 is reduced in unit 11 to provide space 44 for flexing the drill pipe approximately 15 degrees. The drill shaft can be flexed only in one direction. The object is to insure lateral or angular drilling control. The air for drilling purposes is fed down through a central opening 45 for operating the drills 23 and 25 by means of the piston 26. The air reaches the piston 26 through the central opening 45 and central opening 39 by the action of sleeve 29. The spent air escapes through the ports 35, and passages 43 and serves to keep liquids in the channels and well hole agitated and assists in keep the drill cuttings in suspension while the drill is in operation. This action materially assists in subsequent baling out the drill cuttings from the channels.

The locking devices cannot be seen in Fig. 1

7, but they are shown in Fig. 8 of the drawings. The object of the locking devices is to hold the different units at the same angle to which they are brought or placed on leaving the deflector 14. When the drilling units are directed for lateral operations or angular operations, they will continue at the angle effected by the deflector 14 until they are unlocked and then they will drill in straight lines from the points at which they are unlocked. All the units are locked and automatically locked from the time they engage the deflector 14 until the pilot unit reaches the point from which the channels are to be drilled straight. The units are unlocked by dropping and forcing a ball down through the passage 45. The forcing of the ball is done by the action of the pressure element. The locking devices are used only on the units which are used to determine the direction of the channels. For instance, the six units determine a right angular direction from the vertical opening of the well, as shown in Fig. 1. More or less lock units may be used to vary the angle up or down instead of a right angular position. Only enough locked units are employed to determine the direction of the channels to be drilled. The remaining units to be employed are non-locking units, but will flex only in one direction, as below explained. The locking unit 11 shown in Fig. 8, and Figs. 10 and 12, has a lock 46 which is pivotally mounted at the juncture of ball member 30 and sleeve 31 and projects downwardly and slightly into the passage 45 and the lower parts of the lock engages the extension 40. The spring 47 normally holds the lock locked after the unit has passed the deflector plate 14. The lock is released or disengaged by a ball 48 which is dropped, as shown in Fig. 12, down the passage 45. The ball will strike the shoulder 49 and force the lock out of engagement with the extension 40. The ball 48 will be held against movement by a spring-pressed dog 50. See Fig. 10 for the locked position of unit 11 and Fig. 12 for the unlocked position. The unit 11 is the only unit which is locked as above described.

Fig. 9 illustrates the manner of locking unit 9. The device is shown locked and the ball member 30 cannot turn or move. This member 30 contains a lock 51 which is connected to member 32 by a pivot bolt 52 and after the lock 51 is swung into locked position by passing over deflector plate 14, it is held in locked position by a spring-pressed dog 53. The lock may be released by a ball 48. The ball is passed down through the space 45 and strikes the projecting end 54 and forces the same open against the tension of the dog 53, the lock coming against the member 30 and the dog 53 slipping over the beveled end of the lock to the position shown in Fig. 11.

In the locking unit 9, the passage 45 must be slightly off-set as shown in Fig. 9 on ac-

count of the construction of units 10 and 11, since the two locks come close together as shown in Fig. 8. Fig. 9 shows the locked position of a flexing unit and Fig. 11 shows the unlocked position.

Fig. 1 shows six locking units, commencing with unit 6 and including unit 11. There may be more or less of such units according to the angle of the channels to be drilled. These units 6-11 are both flexible and locking units. After these units are positioned, they are flexible in one direction.

Figs. 18 to 23 inclusive show the non-locking and flexible units.

These are above the locking units shown in Fig. 1 and below the regular drill pipe sections ending with section 1, in Fig. 18. All units, both flexible and locking, flex only in one direction after they are lined up and locked in position by locking screws 34.

The members 30 have ground joints to fit the pipe members 20 for sealing purposes and additional sealing means are provided in packing rings 56 which are curved to conform to the curvature of the ball members 30. Each packing ring 56 is held in place by its own spring 55.

A plurality of deflector plates 14 are shown in Fig. 1a for drilling angular or lateral channels in different directions at approximately the same level. The bottom plate or deflector 14 is made rigid with the pipe 13, as above described. The other deflector plates 14 are removable, beginning at the top plate 14, and are held in position by external ribs 17a and grooves 16, as above described, so that the deflectors will be held in position to cause the flexing units to pass out of the openings 15 in pipe 13. Several openings 15 are made in the pipe 13 at the required positions to direct the drilling flexing units in the different directions as determined. A rib 17a and a groove 16 therefor will guide the deflectors 14 to the required openings 15, preventing the turning of the deflectors relative to the openings 15.

The deflector plates 14, except the lowest plate 14, are keyed to each other by means of ribs 17a on the exterior of the plates 14 which are similar to the ribs 17 on the flexing units. The ribs 17a are adapted to fit into the same grooves 16 as ribs 17 on the flexing units. There is a series of deflector plates 14 and also openings 15, the openings 15 being on opposite sides of the housing 13 at different elevations or at irregular parts of the housing 13 and the removable plates 14 are to be selectively used until the lowest plate 14 is reached. The removable plates 14 are fitted together before they are let down in the well or housing 13. After each removable deflector plate 14 has been used to direct a drilling tool out through an opening 15 for drilling a lateral channel, the drilling tool is removed and the used plate 14 is removed from the well (being

detachably connected to the next plate 14 below) by a suitable instrument. This opens the way down to the next opening 15 which is for directing a drilling element in a different direction. The drilling tool is again let down into the well or housing 13 to the next opening 15 and then out through this next opening as above described. These operations are repeated until all the deflector plates have been used down to the fixed deflector plate 14 which is rigid with the housing 13.

Figs. 24 and 26 illustrate baler units to be used in the process of drilling. These baler units are similar to the non-locking flexing units in construction. The lowest unit has a check valve 58 to prevent the escape of matter to be baled out.

What I claim is,—

1. A drilling shaft having a plurality of flexible units including locking units at the lower part and non-locking units at the upper part, a housing for guiding said units down in the well and provided with lateral openings in the lower part thereof, a plate for deflecting said locking units out of said housing and positioning the same for lateral or angular drilling, said units having longitudinal ribs on the periphery thereof and said deflecting plate having a longitudinal groove to receive one of said ribs of each unit, and the other ribs serving to space the units from the walls of the channels made by the drilling shaft.

2. A drilling shaft having a plurality of flexible units, each unit having a housing curved at one end, a ball member fitted in said housing by a ground joint and having a depending sleeve, a coupling member screwed on said sleeve and into the housing of the connecting unit below, a metallic packing ring engaging said ball member, a spring bearing against said packing ring and against the coupling member of the adjacent unit above, and means for locking the last mentioned coupling and housing to the sleeve of the adjacent ball member.

3. A drilling shaft having a plurality of flexible units, each unit having a housing curved at one end, a ball member fitted in said housing, and having a depending sleeve, a coupling member screwed on said sleeve and into the housing member of the connecting unit below, a metallic packing ring engaging said ball member and bearing against the coupling member of the adjacent unit above, means for locking the last mentioned coupling and housing to the sleeve of the adjacent ball member above, and means for limiting the flexing of said units to one direction.

In testimony whereof, I set my hand, this 1st day of April, 1930.

ROBERT EDWARD LEE.