July 13, 1943. L. C. MILLER ET AL 2,324,102

MEANS FOR DIRECTIONAL DRILLING

Filed Feb. 9, 1940 2 Sheets-Sheet 1

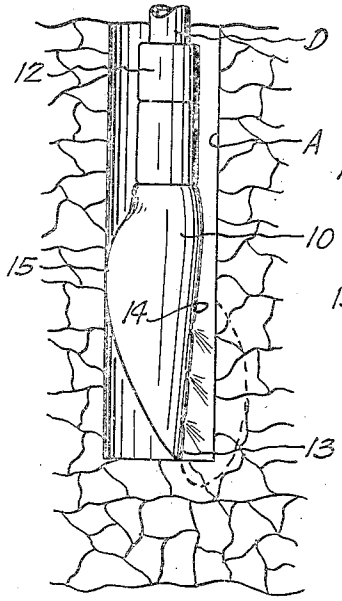

Fig. 1.

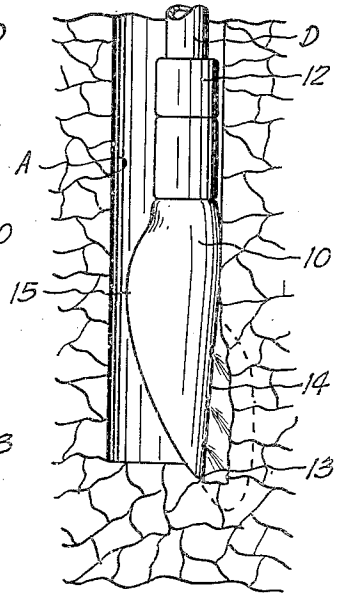

Fig. 2.

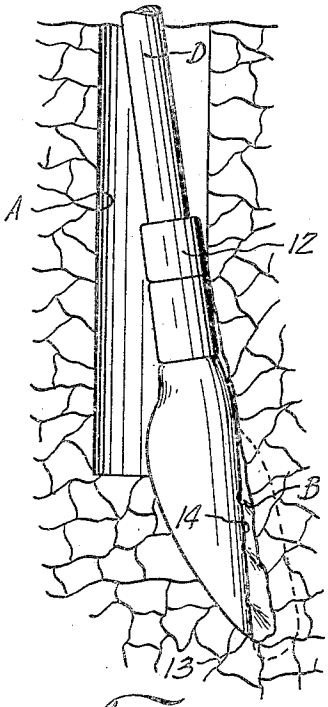

Fig. 3.

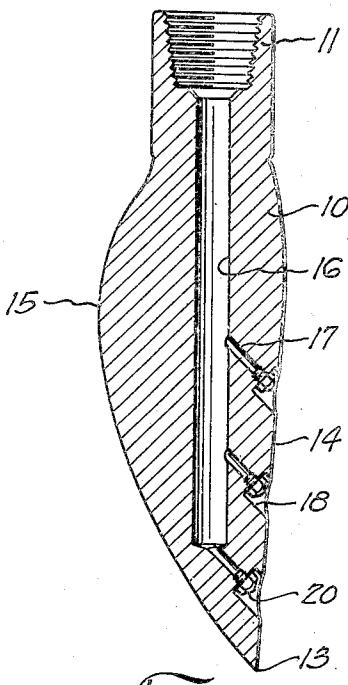

Fig. 4.

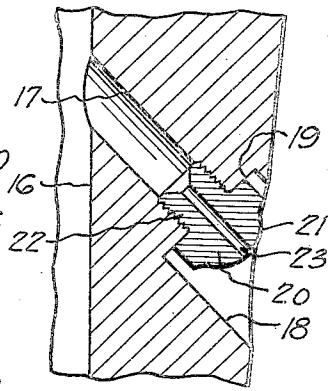

Fig. 6.

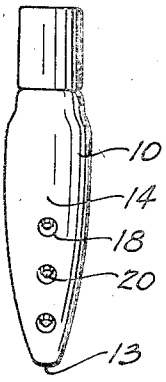

Fig. 5.

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MEANS FOR DIRECTIONAL DRILLING

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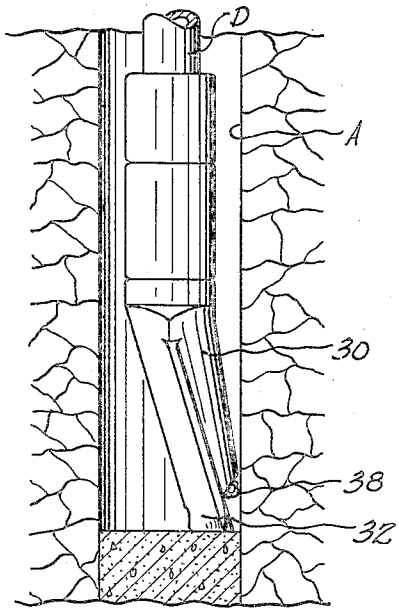

Fig. 7.

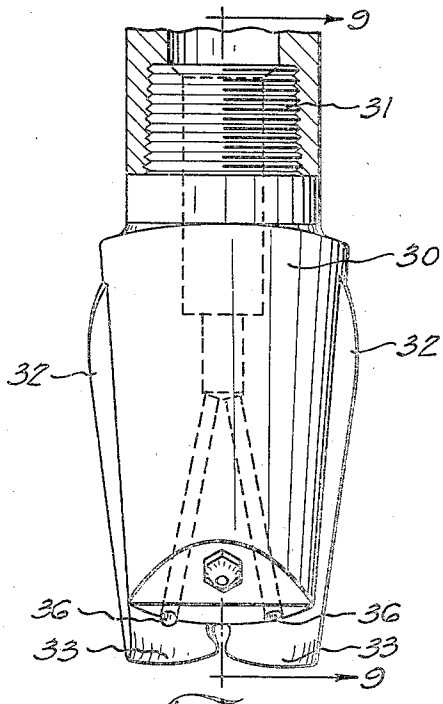

Fig. 8.

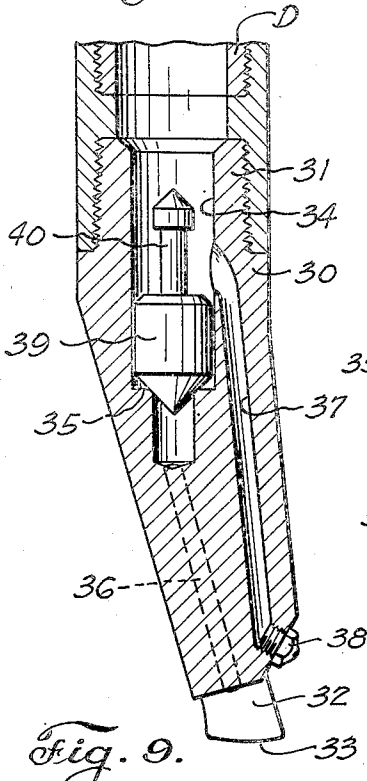

Fig. 9.

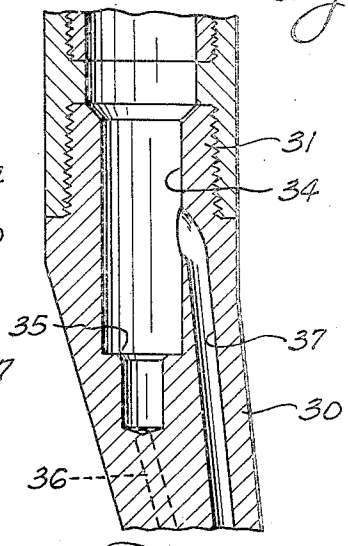

Fig. 10.

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UNITED STATES PATENT OFFICE

2,324,102

MEANS FOR DIRECTIONAL DRILLING

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Application February 9, 1940, Serial No. 318,034

2 Claims. (Cl. 255—1.6)

This invention relates to new and useful improvements in means for directional drilling.

In performing directional or controlled drilling, it has been the practice to employ "spudding" bits for starting the new bore which, of course, angles off from the drilled bore. These spudding bits are first oriented in the old bore by any suitable orienting means and are operated by imparting a reciprocating or hammering action thereto to drive the bit into the formation and thereby begin the new bore at the desired angle. This practice has been found satisfactory in the softer formations because there is little or no resistance to the entrance of the bit, but in hard formations it is most difficult, and practically impossible, to drive the bit into the formation. Further, cement plugs have come into general use for plugging the old bore and in order to start the new bore, the spudding bit must be driven through a portion of the plug and the resistance of the cement to the passage of the bit is so great as to make the usual type of spudder bit unsatisfactory in cases where such plug is employed.

It is, therefore, one object of this invention to provide an improved method whereby accurate directional drilling through hard formations may be accomplished.

An important object of the invention is to provide an improved method of directional drilling, wherein a suitable chemical or acid is directed into the formation in advance of the bit, whereby the formation, contacted by the chemical, is attacked and weakened by the chemical reaction so as to facilitate the entry of the bit into said formation.

Another object of the invention is to provide an improved method of directional drilling which includes, orienting a tool within the well bore, then ejecting a formation-weakening chemical through the tool into the formation at the desired angle, and then forcing a drill bit through the portion of the formation which has been weakened by the action of the chemical, whereby a new bore, disposed at the desired angle from the well bore, is started.

A particular object of the invention is to provide an improved bit for directional drilling which is provided with means for forcibly ejecting a chemical into the formation in advance of the bit, whereby said chemical attacks, weakens and even disintegrates said formation to facilitate the entry of the bit into the formation.

Still another object of the invention is to provide an improved bit, of the character described, having one or more jets disposed at one side thereof, whereby a suitable chemical, capable of attacking and loosening the formation, may be forcibly ejected into the formation in advance of the bit.

Still another object of the invention is to provide an improved directional bit having blades, said bit being so constructed that it may be utilized as a spudder bit and driven downwardly into the formation and may also be employed as a rotary bit by rotating the same to cause the blades to perform a cutting action; the bit having means for circulating the usual drilling fluid therethrough when rotation is imparted to the bit and also having a passage for conducting and ejecting a formation-weakening chemical into the formation in advance of the bit, said passage being so arranged that it does not interfere with the drilling fluid circulation during the normal drilling operation.

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, in which an example of the invention is shown, and wherein:

Figure 1 is a side elevation of a directional drill bit constructed in accordance with the invention for practicing the improved method, the bit being shown lowered within the well bore,

Figure 2 is a similar view, illustrating the action of the chemical on the formation,

Figure 3 is a similar view, showing the bit lowered and penetrating the weakened portion of the formation,

Figure 4 is an enlarged, transverse, vertical, sectional view of the bit,

Figure 5 is an elevation of the drill bit, taken at a right angle to Figure 1,

Figure 6 is an enlarged transverse, vertical, sectional view of one of the jets,

Figure 7 is a view, similar to Figure 1, showing a modified form of drill bit,

Figure 8 is an elevation of the same, taken at a right angle from the position shown in Figure 7,

Figure 9 is an enlarged, transverse, vertical, sectional view, taken on the line 9—9 of Figure 8, and illustrating the drilling fluid passage closed, and

Figure 10 is a partial view, similar to Figure 9, with the closure for the drilling fluid passage removed.

In the drawings, the numeral 10 designates a bit body having an internally screw-threaded box 11 preferably made integral with its upper end. A suitable coupling 12 has its lower end connected in the box, while its upper end receives the drill stem or pipe D, whereby the bit is secured to the lower end of said pipe. The drill bit is illustrated in Figures 1 to 6 as the type generally referred to as a spudder bit and is substantially elliptical in cross-section. The bit is gradually tapered or reduced toward its lower end, said lower end terminating in a cutting edge 13. A flat vertical side or surface 14 is formed on the bit body and extends substantially vertically from the cutting edge, while the remaining surface of the bit body is rounded or curved, the curvature extending from the lower end of the box 11 to the cutting edge 13, as is clearly shown in Figure 4. The curvature of the outer surface of the bit is such that the cross-sectional area of the bit is greatest intermediate the extremities of the bit and preferably nearer the upper end, as indicated at the point 15.

A vertical bore or passage 16 extends from the box 11 downwardly through the body of the bit and terminates at a point spaced from the lower end of said body. Manifestly, this passage is in direct communication with the interior of the drill stem or pipe D and fluid introduced into said stem will flow downwardly into the bore. A plurality of inclined passages 17 are formed in the body and have their inner ends communicating with the bore. The passages are spaced, one above the other, and have their outer ends inclined downwardly and terminating in the flat vertical surface 14 of the bit body. The extreme outer end of each passage is enlarged, as shown at 18, whereby an internal, annular shoulder is formed at the outer end of each passage. Obviously, the passages establish communication between the vertical bore 16 of the bit and the exterior of the body and any fluid forced downwardly into the bore from the drill stem is ejected through said passages.

For jetting the fluid flowing through each passage outwardly in a relatively thin stream and at a relatively high velocity, a jet or nozzle 20 is disposed in the outer end of each passage. Each jet or nozzle comprises an enlarged head 21 having an axial nipple or collar 22 made integral therewith and said nipple is externally screw-threaded, whereby it may be screwed into the outer end of the passage. When the nipple is threaded into the passage, the head 21 abuts the internal shoulder 19, as is clearly shown in Figure 6. The head and nipple are provided with a reduced orifice 23 which extends axially therethrough and the size of said orifice controls the volume and velocity of the fluid which is ejected from the passage. By removing the nozzle and substituting one having a larger or smaller orifice, the velocity of the ejected fluid may be varied. Since the passages are inclined with their discharge ends directed downwardly, it is obvious that the ejected fluid is directed outwardly and downwardly of the bit body. The lowermost nozzle is immediately above the cutting edge 13 of the bit, whereby a portion of the ejected fluid is directed below the cutting edge of said bit. It is noted that the inclination of the passages 17 is subject to variation, in accordance with the direction in which it is desired to eject the fluid.

In carrying out the improved method, the drill bit 10 is connected to the lower end of the drill stem D and is lowered therewith to the bottom of the well bore A (Figure 1). In some instances, the well bore may be closed at a desired point by a cement plug, as is the usual practice, and in such case, the bit is lowered until it strikes said plug. After being lowered into proper position, further downward movement of the bit is halted and then, by means of a suitable orienting means (not shown), the flat vertical surface 14 of the bit is faced in the proper direction, that is, the direction in which drilling is to continue. Any orienting method may be employed in positioning the bit, as for example, the method disclosed in the patent to Stokenbury No. 2,088,539 could be used. The particular orienting method which is used forms no part of the inventive thought herein and so long as the flat surface 14 of the bit is properly oriented, the purposes of the method are accomplished.

The orientation of the surface 14 disposes the outlet nozzles 20, which are located in said face in the desired direction, or the direction in which drilling is to continue. A suitable chemical, such as hydrochloric or hydrofluoric acid, which is capable of attacking, loosening, weakening, or even disintegrating the subsurface formation upon contact therewith, is pumped downwardly through the drill stem under a relatively high pressure. This chamical enters the vertical bore 16 of the bit body and then flows into the inclined passages 17. The chemical is forcibly discharged from the passages in a plurality of thin streams under a relatively high velocity through the nozzles 20 and is thus directed into intimate contact with the formation in advance of the drill bit. Due to the properties of the chemical, the portion of the formation contacted by said chemical is loosened and weakened, as indicated by the dotted lines in Figure 2. Since this portion of the formation is in the path of the drill bit, it will be obvious that the loosening or disintegration of said formation by the action of the chemical facilitates the entry of said bit thereinto.

After sufficient chemical has been discharged through the nozzles to effect the loosening of the formation, the flow of chemical through the bit is stopped by halting the pumping equipment at the surface. The bit is then spudded or forced into the loosened formation, as shown in Figure 3, by imparting a reciprocating or hammering action to said bit. After the bit has completely penetrated the loosened portion of the formation, the chemical may again be discharged to loosen an additional portion of the formation, after which spudding of the bit is continued. Thus, the chemical is ejected and the bit spudded downwardly, these steps being alternately performed until the new bore B is of sufficient depth to permit the use of a rotating bit. The use of the chemical provides an efficient and simple means for loosening the formation in advance of the bit to facilitate penetration of said formation by the bit. The nozzles or jets assure that the chemical is discharged at a sufficient velocity to effect intimate contact of said chemical with the formation. As explained, the number and size of said nozzles may be varied, in accordance with the conditions encountered.

The drill bit which is shown in Figures 1 to 6 is generally referred to as a spudder bit and, as explained, is arranged to be driven downwardly into the formation. The bit is not adapted for

rotation. In some instances, it might be desirable to perform the improved method with a spudding bit which is capable of rotation and, in such case, a bit, as illustrated in Figures 7 to 10 may be employed. This bit is similar in construction to the bit disclosed in the application of Ray F. Bolton, one of the co-inventors herein, Serial No. 303,074, filed November 6, 1939. This bit includes a body **30** which is provided with an upstanding cylindrical pin **31** at its upper end. That portion of the body immediately below the pin **31** is also cylindrical but the remainder of said body has a general elliptical shape in cross-section. The elliptical portion of the bit body is tapered or gradually reduced toward its lower end, as is clearly shown in Figure 9, and this tapered portion is inclined with relation to the vertical axis of the pin **31**, whereby it might be said that the lower portion of the body is in the form of an inclined shank.

A pair of elongate cutting blades **32** are secured to the exterior of the shank and extend longitudinally thereof, as is clearly shown in Figure 8. The blades are disposed on opposite sides of the shank and have their lower cutting edges **33** projecting in a plane below the lower end thereof. By constructing the blades **32** in the manner shown, it is possible to utilize the bit as a spudder bit and drive the same into the formation through a reciprocating or hammering action. Also, if desired, the bit may be rotated whereby the blades **32** perform a cutting or drilling action.

When the bit is rotated to perform a drilling operation, it is preferable that a drilling fluid, such as mud, be circulated downwardly through the drill stem and through the bit body and around the cutting edges **33** of the blades. For this purpose, the bit body **30** is formed with an axial, vertically extending bore **34** which extends from the upper end of the body to a point about mid-height thereof. The extreme lower end of the bore is reduced so as to form an internal, annular shoulder or seat **35** within the bit body. A pair of inclined passages **36** extend from the lower end of the bore **34** and have their outer ends terminating adjacent the faces of the blades **32** above the cutting edges (Figure 8). With such arrangement, it is obvious that when a drilling fluid is circulated downwardly through the drill stem D, such fluid will flow downwardly through the bore **34** and then through the passages **36**, escaping from said passages and contacting the cutting edges of the blades **32**. This drilling fluid serves to wash the cutting edges of said blades and also circulates the cuttings which are removed by the drilling operation to the surface.

A vertical, inclined passage **37** is formed at one side of the bit body **30** and extends from the upper portion of the bore **34** to the lower end of the shank of the bit. As is clearly shown in Figure 9, the passage **37** terminates just above the lower ends of the cutting blades **32**. This extreme lower end is internally screw-threaded to receive an outlet nozzle **38**, which nozzle may be constructed in the same manner as the nozzles **20**, which are employed in the first form hereinbefore described. When it is desired to eject a chemical into the formation, in order to loosen or weaken such formation, a plug **39** is dropped downwardly through the drill stem and falls therethrough into the bore **34** of the bit body **30**. This plug is arranged to seat on the annular shoulder **35** formed within said bore and, when so seated, closes the bore.

After the plug **39** has been positioned, as shown in Figure 9, the chemical is pumped downwardly through the drill stem and flows through the passage **37**, the upper end of which passage is above the plug **39**. This chemical is ejected outwardly through the nozzle **38** in a relatively thin stream and at a high velocity, whereby it is directed into intimate contact with the formation. As above explained, the contact of the chemical with the formation will loosen or weaken said formation and, in some cases, might even disintegrate the same.

After sufficient chemical has been ejected to loosen the formation to the desired extent, an overshot of standard design (not shown) is run downwardly through the drill stem on a cable or wire line and is engaged with a fishing neck **40** formed on the upper end of the plug **39**. The plug is then pulled upwardly through the drill stem and is removed therefrom so as to open the bore **34** and passages **36**. The drill bit is then driven downwardly into the loosened formation and after being driven as far as possible, a rotation is imparted to the drill stem to cause the cutting blades **32** to perform a drilling operation.

During such rotation, a suitable drilling fluid is circulated downwardly through the drill stem and will flow through the bore **34** and then through the passages **36** into the lower end of said bore. This drilling fluid will maintain the cutting edges **33** of the blades in a clean condition and will also wash the cuttings to the surface. It is noted that since the size of the outlet orifice in the nozzle **38** is very small as compared with the diameter of the bore **34** and the passages **36**, only a very small amount of drilling fluid will be circulated outwardly through the nozzle. This small volume of drilling fluid which might escape through the nozzle **38** does not materially interfere with the normal circulation of the drilling fluid.

After the drilling operation has continued as far as possible, it might be desirable to again circulate or eject the chemical into the formation in advance of the bit. In such case, the plug **39** is again dropped downwardly to close the bore **34**, after which the chemical may again be pumped downwardly through the stem so as to be directed into contact with the formation. Of course, in this form of the invention, the drill bit **30** and the drill stem D are first oriented in any suitable manner, as has been explained.

In both forms of the invention, provision is made for ejecting or directing a chemical, having properties capable of weakening or disintegrating the formation in advance of the bit, into such formation so as to facilitate the entry of the bit thereinto.

The foregoing description of the invention is explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made, within the scope of the appended claims, without departing from the spirit of the invention.

What we claim and desire to secure by Letters Patent is:

1. A deflecting tool including, a bit body having its lower portion inclined from the vertical axis of said body, a pair of elongate diametrically opposed cutting blades on the outer surface of the inclined portion of the body arranged to drill a bore when the bit body is rotated, said blades extending parallel to the axis of said in-

clined portion of the body and having their lower ends projecting in a plane below the body, said lower ends being sharpened to permit the bit to be spudded into the formation, the body having an axial bore in its upper portion with reduced inclined passageways extending from said bore to the lower end thereof, whereby a drilling fluid may be circulated through the body and around the cutting blades, the body also having a reduced passage leading from the upper end of the bore downwardly through the body to the lower end thereof, said passage having its discharge end disposed between and forwardly of the lower ends of the cutting blades, and a closure for closing the bore of the body above the drilling fluid passageways and below the upper end of the reduced passage, whereby a chemical pumped downwardly through the bore will be ejected through the reduced passage and into contact with the formation in advance of the bit body.

2. A deflecting tool as set forth in claim 1, with a nozzle removably mounted in the discharge end of the bit, whereby the chemical is discharged from the passage at a relatively high velocity.

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