

Aug. 24, 1954

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2,687,282

REAMING BIT STRUCTURE FOR EARTH BORES

Filed Jan. 21, 1952

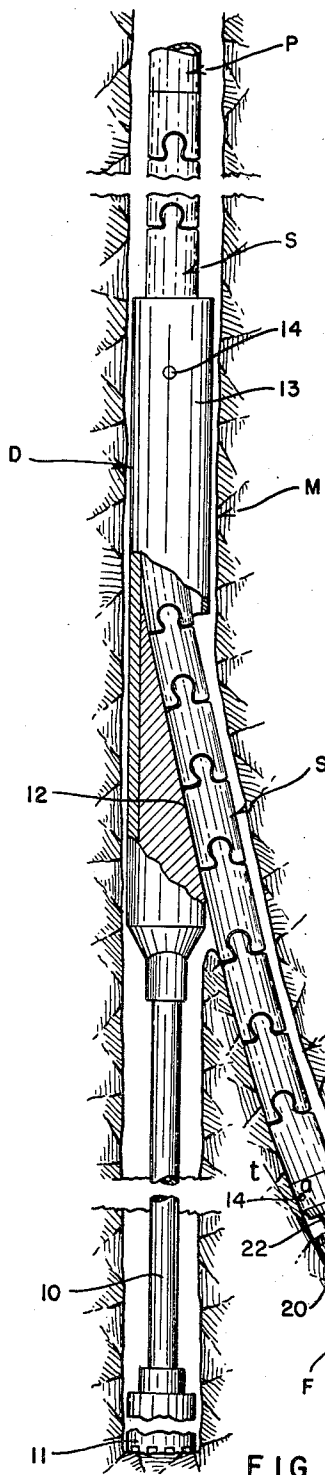


FIG. - 1

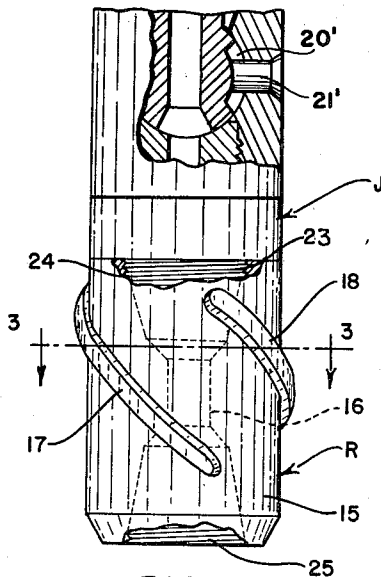


FIG. - 2

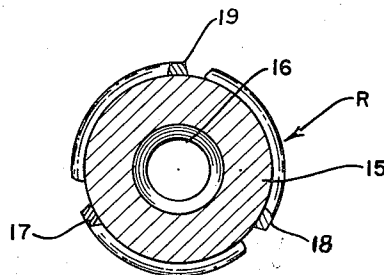


FIG. - 3

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2,687,282

REAMING BIT STRUCTURE FOR EARTH BORES

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Application January 21, 1952, Serial No. 267,377

4 Claims. (Cl. 255—1.6)

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This invention relates to reaming bits useful in the drilling of bores in the earth's formation and particularly to reaming bits for use in drilling lateral bores generally at high angles to a main bore for oil producing purposes in order to obtain greater drainage from the oil reservoir and wherein said reamer bit is designed to be embodied in an improved drilling combination including a flexible drilling pipe, a drill bit and a universal joint.

One of the objects of my invention is to produce a new and improved reamer bit for positioning between a drilling bit and a flexible shafting employable in drilling lateral bores from a main well bore.

A further object is to produce a new reaming bit and associate it in a new manner in lateral bore drilling apparatus employable with a deflecting tool in a main earth bore so as to aid in the drilling of a curved lateral hole after the hole is begun at an angle to the main bore as a result of being deflected at a predetermined angle by the deflecting tool.

Still a further object of my invention is to produce a reaming bit for association with a drill bit, a universal joint and a flexible drill pipe in such a manner that it can fulcrum on the bore between the joint and drill bit to give predetermined direction to the drill bit, besides functioning as a reamer for the drill bit.

Yet another object is to provide stabilizer means between a drill bit and a flexible drill shaft employable in drilling lateral bore holes from main earth bores.

Other objects of my invention will become apparent from the following description taken in connection with the accompanying drawings showing a reamer bit embodying my invention and the novel manner in which it is to be employed in lateral bore drilling apparatus.

In the drawings:

Figure 1 is a side view of a part of a main earth bore showing drilling apparatus embodying my invention being employed to drill a lateral bore;

Figure 2 is an enlarged side view of the reamer bit and also a sectional view of a part of the joint of the drilling apparatus; and

Figure 3 is a cross sectional view of said reamer bit, said view being on the line 3—3 of Figure 2.

Referring to the drawings in detail and first to Figure 1, the drilling apparatus shown by way of example for producing lateral bores comprises a suitable deflecting tool D, commonly known as a whipstock, a drill pipe P which is to

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extend down into the main bore M from the drilling rig at the surface of the earth, a flexible drill pipe or shafting S attached to the lower end of the drill pipe, a universal joint structure J, an improved reamer bit R and the drilling bit B at the extreme lower end. The flexible shafting may be of any suitable construction having sufficient flexibility that it can move into the desired curved bore which is going to be drilled.

The joint J may also be of any suitable construction, but should have a universal action and yet be capable of transmitting drilling torque from the flexible pipe to the drill bit. This drill bit B, which is shown in Figure 1, is of the rock type having rotary cutters, but may be of any other desired type as, for example, a diamond bit. The deflecting tool D is arranged to be set on the bottom of the main bore M by means of a tail pipe 10 having an anchor 11 at its lower end which is capable of digging into the bottom of the bore to hold the deflecting tool from rotation. The deflecting tool has a deflecting surface 12 at an angle to the axis of the deflecting tool and it is by means of this angle that the drill bit will be deflected to one side of the main bore and begin drilling the lateral bore which will be a drain hole indicated at L and extending into the oil reservoir formation at a fairly high angle. The upper end of the deflecting tool is tubular, as indicated at 13, and surrounds the flexible shafting. When the deflecting tool is first placed in the main bore, it will be suitably attached to the drilling apparatus by means of a frangible pin which extends through the tubular part 13 of the deflecting tool into the joint J to thereby hold the deflecting tool and drilling apparatus together for lowering into the main bore and orienting the deflecting tool with its deflecting surface in the proper direction for drilling the lateral bore. When the deflecting tool and drilling apparatus are connected by the frangible pin, the bit will be in the tubular part 13. The frangible pin, to perform the holding, is indicated at 14 in its sheared condition. Shearing can be easily accomplished by merely allowing weight of the drilling apparatus to make the shear.

The reamer bit which comprises part of the structure embodying my invention is of a special construction. Further, it is associated with the drilling apparatus in a particular manner in order to accomplish the new results desired, which include a fulcruming action and a stabilizing action for the bit B. As shown in Figure 2, this reaming bit has a body 15 of cylindrical shape in which a bore 16 is provided so that fluid can

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circulate down through the drill pipe, the flexible shafting and to the drill bit B during drilling operations. The outer cylindrical surface of the body 15 is provided with spiral cutting ribs shown as three in number and indicated by the numerals 17, 18 and 19. Preferably, none of the spiral ribs are of a length to extend completely around a body, but each is of such length that the upper end of each rib will overlap in a longitudinal direction the lower end of an adjacent rib. Thus, there will always be some portion of a cutting rib acting upon the side wall of the bore being drilled to perform stabilizing action along with reaming action and to also fulcrum on the wall of the bore being drilled, all in a manner which will become apparent. The reamer bit is preferably made of an outside diameter the same as the outside diameter of the face of the drill bit B at the lower end of the string. By outside diameter of the reamer is meant the overall diameter from the outer surface of one cutting rib to the outer surface of another cutting rib in a diametrical direction. Of course, the reaming bit may have a slightly different diameter than the drill bit, if desired.

The reaming bit R must also have a certain diameter relationship to the joint J which is positioned rearwardly of the reamer and between it and the lower end of the flexible shafting S. As shown in Figure 1, the joint J is constructed with one part having a ball 20 setting in a socket structure 21, thus giving the joint universal movement. In order to transmit torque, the socket structure carries pins 21' fitting in longitudinal slots 22' in the ball surface. The ball 20 is attached to a stem member 22 and this is connected to the lower end of the shaft. The socket structure 21 has a suitably threaded extension 23 whereby it can be connected into the threaded upper end 24 of the reamer bit. The lower end of the reamer bit also has a threaded portion 25 whereby the rock bit B is connected thereto. The diameter of the joint J is constructed to be less than the diameter of the reamer bit and the pivotal point of the joint also must have a particular distance from the drilling face of the drill bit and also from the reamer bit in order that during drilling of the lateral bore it will be drilled with the desired curvature, that is, have the desired radius of curvature.

In the particular structure shown, in order to drill a lateral drain bore having a radius of curvature of approximately 30 feet and by using a $4\frac{3}{4}$ inch drilling bit and reamer bit, the outer diameter of the joint should be approximately $4\frac{1}{4}$ inches above the drilling face of the bit B. The diameter of the shaft should also be about the same diameter as the joint. A suitable angle for the deflecting surface of the deflecting tool in drilling this lateral bore having a 30 foot radius of curvature would be approximately 9 degrees.

With the joint J having a diameter less than the greatest overall diameter of the reamer bit, it will be seen, as illustrated in Figure 1, that the axis of the drilling bit and the reamer bit can be caused to assume an angle with respect to a line which is tangent to the curve of the bore at the face of the drill bit. In Figure 1 the axis of the drill bit B and the axis of the reamer bit are indicated by the line $a-a$ and the tangent line is indicated by $t-t$. The result will be that the drill bit and reamer bit will be "cocked" somewhat so that the drill bit will be directed toward the high side of the lateral bore being drilled. Consequently, this will tend to cause the drill bit

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to "build" angle as it is rotated by the flexible shafting through the joint. By "building" angle is meant that the hole being bored will not be straight, but on a curve, and the curve will always be in the direction of the high side of the lateral bore being drilled. If the bit did not "build" angle, there would not be a curved bore but the lateral bore would go straight off from the deflecting surface of the tool and consequently a considerable more amount of hole would be required to reach into the oil bearing formation to a given distance laterally spaced from the main bore. It will be noted that during drilling the external part of the joint will always be forced against the low side of the lateral bore being drilled, such condition taking place due to the forces acting downwardly on the drilling apparatus during drilling operations. Consequently, the cutting ribs of the reaming tool will function as a fulcrum at the point where the rib engages the lower side of the bore, which in Figure 1 is marked with the letter F. It is because of this fulcruming action that the rock bit is "cocked" upwardly towards the high side of the bore being cut and consequently the action of "building" angle will take place.

Another feature of the reaming bit is not only to produce a fulcruming action at the point between the center of the joint J and the face of the drill bit B, but to clean out and ream the hole so that proper cocking can take place. Since the reamer bit R is being forced downwardly towards the low side of the bore during drilling, the spiral ribs will tend to cut in and slightly enlarge the bore on the low side. Consequently the overall size of the bore will be slightly greater than that being drilled at the face of the drill bit B. The reaming bit, because of its length and position behind the drill bit B, stabilizes the drilling action of the drill bit. If only stabilizing were desired and no reaming action, then of course the cutting ridges could be eliminated and replaced by other non-cutting structure.

The use of a universal joint independently of a reamer bit to connect the flexible pipe to a drilling bit does not embody invention as such is the invention of William G. James and is disclosed and claimed in co-pending application Ser. No. 267,401 filed January 21, 1952, for "Joint Structure Between Flexible Shafting and Drill Bit Structure for Drilling Lateral Bores."

Being aware of the possibility of modification in the drilling structure shown, all without departing from the fundamental principles of my invention, it is to be understood that the scope of the invention is not to be limited except in accordance with the appended claims.

What is claimed is:

1. In drilling structure for drilling a lateral curved bore from a main bore and off from a deflecting tool positioned in the main bore, said drilling structure comprising a flexible drill shafting, a drill bit, a reamer bit connected directly above and relatively close to the drill bit, and joint means connecting the lower end of the flexible shafting to the reamer bit and being close to the reamer bit, said joint means embodying universal joint structure permitting limited universal movement of the reamer and drill bits as a unit with respect to the lower end of the shafting and also embodying means so that drilling torque can be transmitted to said bits, said reamer bit comprising a body having spiral cutting ribs thereon with the overall diameter of the reamer bit being greater than that of the joint but not greater

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than the drilling bit so that when the joint is forced to one side of the bore being reamed the reaming bit will fulcrum on the bore wall and "cock" the drilling bit toward the high side of the bore.

2. In drilling structure for drilling a lateral curved bore from a main bore and off from a deflecting tool positioned in the main bore, said drilling structure comprising a drilling bit, a reamer bit above and relatively closely adjacent the drilling bit, a flexible drill shafting, and universal joint means capable of transmitting torque and connecting the reamer bit to the lower end of the flexible drill shafting and being close to the reamer bit, said universal joint means having a body structure of overall smaller diameter than the hole drilled by the drilling bit and said reamer bit having such diameter greater than the joint but not greater than the drilling bit and being so constructed and positioned between the joint and drilling bit that under drilling forces acting downwardly through the flexible shafting onto the joint the reamer bit will fulcrum on the low side of the bore being drilled and the drill bit will be "cocked" in a manner to be directed toward the high side of said bore.

3. In drilling structure for drilling a lateral curved bore from a main bore and off from a deflecting tool positioned in the main bore, said drilling structure comprising a drilling bit, a reamer bit above and adjacent the drilling bit, a flexible drill pipe made of relatively short sections flexibly connected together, and universal joint means connecting the reamer bit at a point closely above the reamer bit to the lower end of the flexible drill pipe, with said joint means embodying means permitting torque to be transmitted therethrough, said universal joint means having a body structure of smaller diameter than the hole drilled by the drilling bit and said reamer bit having such diameter greater than the joint but not greater than the drilling bit and being so constructed and positioned between the joint and drilling bit that under drilling forces acting downwardly through the flexible pipe onto the

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joint the reamer bit will fulcrum on the low side of the bore being drilled and the drill bit will be directed toward the high side of said bore, said drill pipe, joint means, reamer bit and drill bit being provided with such conduit means that drilling fluid will be conducted to the drilling face of the drill bit.

4. A drilling structure for drilling a lateral curved bore from a main earth bore and off from a deflecting tool positioned in the main bore, said drilling structure comprising a drilling bit, a reamer bit above and closely adjacent the drilling bit, a flexible drill pipe, and means connecting the flexible drill stem to the reamer bit including a joint structure positioned closely adjacent said reamer bit and constructed to permit the bit to have universal movement with respect to the lower end of flexible stem and embodying means for transmitting torque from the stem to the bit, said joint structure having a diameter less than the diameters of both the reamer bit and the drilling bit and said joint and reamer bit so functioning that under drilling forces the joint structure will be forced to the lower side of the bore being drilled and the drill bit will be forced toward the high side with the reamer bit fulcruming on the low side of the hole, said reamer bit having a cylindrical body provided on its surfaces with spiral cutting ridges with the upper end of each overlapping in a vertical direction the lower end of an adjacent one.

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