

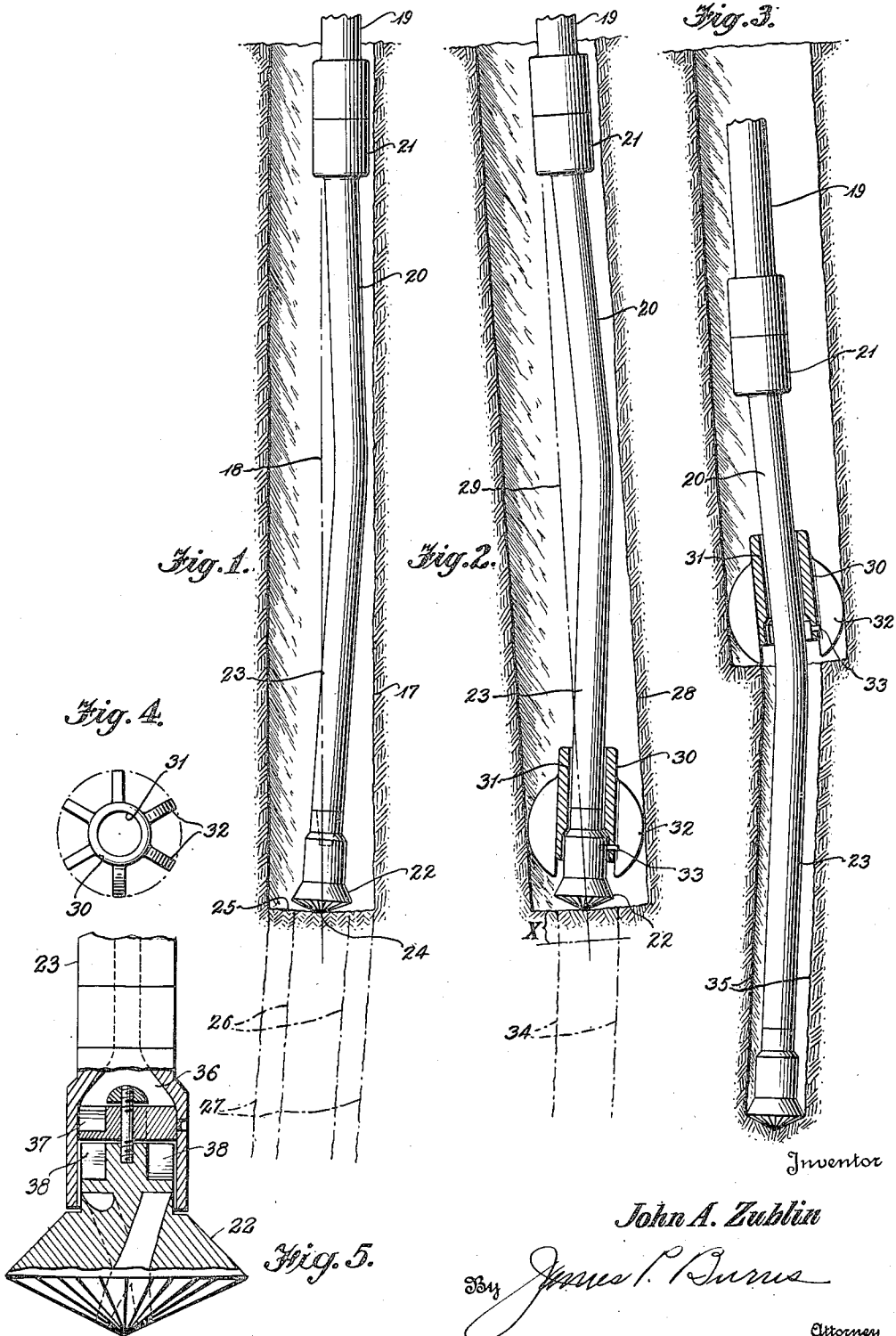
March 14, 1950

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2,500,267

APPARATUS FOR DRILLING DEFLECTING WELL BORES

Filed March 26, 1945



UNITED STATES PATENT OFFICE

2,500,267

APPARATUS FOR DRILLING DEFLECTING WELL BORES

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Application March 26, 1945, Serial No. 584,840

3 Claims. (Cl. 255—1.6)

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This invention relates to an improved apparatus for drilling an oriented deflecting bore from an existing well bore, and which is accurate in its desired azimuth and its angle of deflection.

It is often desired to drill from the bottom of an existing well bore an extension thereof deflecting from the direction of the existing bore in a predetermined oriented direction. This has been done through the use of whipstocks, knuckle joints, and other types of auxiliary tools, designed to guide the drill bit at the correct angle of deflection. However, these devices have been used with rotating drill pipe and have presented problems for the reason that the rotating pipe will not maintain the desired azimuth.

In my prior Patent No. 2,336,336, there is disclosed a rotary turbine bit of the type which makes the rotation of a drill pipe unnecessary.

It is the purpose of the present invention to provide apparatus for accurately drilling a deflecting bore from the bottom of an existing bore through the medium of a non-rotating drill stem and a rotating turbine bit.

In some instances, it is desirable to initiate a deflecting bore from an existing well at an intermediate level thereof. This may be conveniently done by filling the existing well bore to the desired intermediate level with a suitable filler such as liquid cement which, when hardened, forms a new or artificial well bottom sufficiently firm to serve as a starting point for the deflecting drilling operation. In this application therefore the term "bottom of an existing well" refers to either the natural bottom or to any artificial bottom formed by filling the well bore to a desired intermediate level.

The prior art practices in drilling deflecting bores from an existing well bore have entailed the initial drilling of a smaller bore than the existing well bore for the reason that all deflecting devices need space for operation. The smaller bore thus drilled is subsequently reamed to produce a bore of larger size.

These practices have also been characterized by the circumstance that the drilling of the small deflecting bore is initiated at one side of the existing well bore, leaving a substantial shoulder which makes casing of the deflecting bore difficult if not impossible. It is a further object and advantage of the present invention to overcome this difficulty.

It is a specific object of the invention to permit of the initiation of the drilling of a deflecting bore from a point at the approximate center of the existing bore whether the existing bore be verti-

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cal or already disposed at an angle to the vertical. The invention will be further described in connection with the accompanying drawings, in which:

Fig. 1 illustrates the present invention applied to a vertical existing well bore;

Fig. 2 illustrates a modified form of the invention adapted for application to an existing well bore extending at an angle to the vertical;

Fig. 3 illustrates the progression of the drilling of the deflecting bore initiated as indicated in Fig. 2; and

Fig. 4 is a top plan view of the centering guide illustrated in Figs. 2 and 3.

Referring to Fig. 1, the existing vertical well bore is indicated at 17, and has the center line indicated at 18. There is introduced into the well the drill string 19 carrying the lower permanently bent section 20 coupled to the drill string 19 at 21. The permanently bent drill stem section 20 carries at its lower end a turbine driven drill bit 22 such, for example, as illustrated in my Patent No. 2,336,336.

The drill stem section 20 is bent to a predetermined degree to provide the requisite angle of deflection. The direction in which the deflecting bore is to be drilled is controlled by orienting the permanently bent drill stem section 20 and the bit 22 from the surface of the well. The drill string is connected at its upper end with a square or hexagonal drill stem, which fits into a bushing of a rotary table. Since this structure is conventional, it is not shown. After the drill string has been properly oriented in the existing well bore, it assumes a definite orientation within the rotary table. The table is then locked in this position, and from that point on the square drill stem can be raised and lowered freely without disturbing the orientation of the bent drill stem section 20 and the turbine bit 22 within the well.

When the lower inclined portion 23 of the bent drill section 20 is oriented so that it extends in the desired direction of deflection, the drill string 19 is therefore locked at the surface of the well against rotation. It will be observed that the arrangement is such as to permit initiation of the drilling of the deflecting bore at a point approximating the center 24 of the bottom 25 of the existing well bore 17. When the drill string 19 is held against rotation with the permanently bent drill stem 20 oriented as indicated in Fig. 1, drilling of the deflecting bore through rotation of the turbine bit 22 and the advancing of the same results in the production of a deflecting bore taking the direction indicated by the dotted

lines 26. When this small diameter deflecting bore is subsequently reamed, a bore is produced as indicated by dotted lines 27 which joins the existing vertical bore 17 with no abrupt shoulder or obstructions, and therefore the deflecting extension of the existing bore can be readily cased.

It will be appreciated that the turbine bit 22 will take a direction conforming to that of the inclined portion 23 of the permanently bent drill stem 20. The degree of deflection will, therefore, be determined by the extent to which the drill stem section 20 is bent. Different degrees of deflection may be obtained by using different drill stem sections immediately back of the turbine driven bit 22. It will be appreciated that the present invention is concerned primarily with the drilling of deflecting bores with a relatively small angle of deflection and is not intended for the drilling of abruptly deviating bores extending laterally from the existing well.

In Fig. 2, the invention is illustrated as being applied to a well in which the bore 28 having a center line 29 already extends at a substantial angle to the vertical. This situation is not infrequently encountered in the drilling of oil wells because of deflection of the drill bit by changes in the formation. When this occurs, it is highly desirable to restore the bore to its original direction, and this can be accomplished in accordance with the present invention by providing a centering guide 30 having a sleeve 31 adapted to fit reasonably loosely about the permanently bent drill stem section 20. The centering guide 30 embraces a series of spaced ribs 32 as more particularly shown in Fig. 4. The diameter of the centering guide 30, including the ribs 32, corresponds fairly closely to the diameter of the existing well bore 28.

Fig. 5 is a view partly in section and partly in side elevation of a turbine driven bit suitable for use in practicing the invention.

The centering guide 30 is adapted to be interlocked to the shank of the turbine bit 22 by means of a frangible pin 33. In this way, permanently bent drill stem section 20, carrying the turbine bit 22, can be lowered into the existing bore 28 and the drill bit 22 oriented in close juxtaposition to the center of the bottom of the well bore 28 and with the inclined portion 23 of the bent drill stem section 20 extending in the desired direction. When so oriented, the drill string 19 is locked against further rotation, the turbine driven bit 22 is rotated and advanced into the formation. The result will be the drilling of a short section of new hole, indicated generally at X, during which time the centering guide 30 moves to the bottom of the hole.

When the centering guide 30 reaches the bottom of the existing well bore, the frangible pin 33 is sheared, and the bent drill stem section 20 permitted to progress through the sleeve 31. As the bit 22 progresses, it will be guided by the angular portion 23 of the permanently bent drill stem section 20 to produce a deflecting bore as indicated by the dotted lines 24, Fig. 2, and as shown in full lines 35, Fig. 3.

While the centering guide 32 may be employed in an undeflecting vertical bore such as 17 of Fig. 1, it is not required in such a vertical bore, but it is essential in the drilling of an oriented deflecting bore from an existing bore that already extends at an angle to the vertical, since otherwise the bit 22 would hug one side of the existing bore and the deflecting bore would be initiated in an objectionable manner.

The turbine drive for the bit 22 may be of any

conventional type. The illustrative type shown in Fig. 5 includes a passage 36 for the mud laden fluid. Stationary vanes 37 impart a whirling action to this fluid which then impinges on the vanes 38 which are formed in the shank of the bit 22. The bit 22 is thus caused to rotate relative to the drill pipe as will be apparent from an inspection of Fig. 5.

From the foregoing, it will be apparent that the present method embraces the provision of a permanently bent drill stem section bent at the desired angle of deflection for the deflecting bore to be drilled, the orientation of the bit and permanently bent drill stem section so as to initiate the drilling of a deflecting bore from a point juxtaposed to the center of the bottom of the existing bore, the holding of the permanently bent drill stem section against rotation while rotating and advancing the turbine bit to thus effect the desired drilling action. This method is very effective. It is far more advantageous than methods involving the use of whipstocks and other expedients employed in connection with rotating drill stems.

It will be appreciated that the linear extent of the permanently bent drill stem section may be varied so as to provide variations in the degree of angularity of the deflecting bore to be produced.

Having thus described my invention, what I claim is:

1. Apparatus for drilling a deflecting extension from the bottom of an existing well bore starting at a point substantially co-axial with the existing bore, comprising a drill stem rotatably carrying a rotary bit at its lower end, said drill stem embracing a section in juxtaposition to said bit permanently bent intermediate its ends to provide a lower section extending at an angle to the axis of the existing bore such that when the bit is seated at substantially the center of the bottom of the existing bore said lower section of the drill stem extends upwardly from the bit at the angle of deflection desired for the extension to be drilled and guide means carried by said drill stem adapted to insure seating of said bit at the approximate center of the bottom of the existing bore.

2. Apparatus for drilling a deflecting extension from an existing well bore starting from a point substantially at the center of the bottom of the existing bore comprising a drill string rotatably carrying a driven rotary bit at its lower end, said drill string including a permanently bent section in juxtaposition to the bit, the extent and location of the bend being such as to provide a drill stem section immediately behind the bit extending therefrom at the predetermined angle of the desired deflecting bore when said bit is seated at approximately the center of the bottom of the existing well bore, and guide means carried by said drill stem adapted to insure seating of said bit at the approximate center of the bottom of the existing bore.

3. Apparatus for drilling a deflecting extension from an existing well bore starting from a point substantially at the center of the bottom of the existing bore, comprising a drill string with its lowest section permanently bent intermediate its ends, a power driven rotary bit rotatably connected to the free end of said permanently bent section, guide means carried by said bit and permanently bent section adapted to ensure setting of said bit substantially in the center of the bottom of the existing well bore before starting the drilling of the deflecting bore, and also adapted

to permit movement of said bent section there-
through to hold said bit and bent section in the
desired deflected position during the drilling of
said deflecting extension.

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