March 8, 1949. J. A. ZUBLIN 2,463,932

DRILLING BIT

Filed May 23, 1944 2 Sheets-Sheet 1

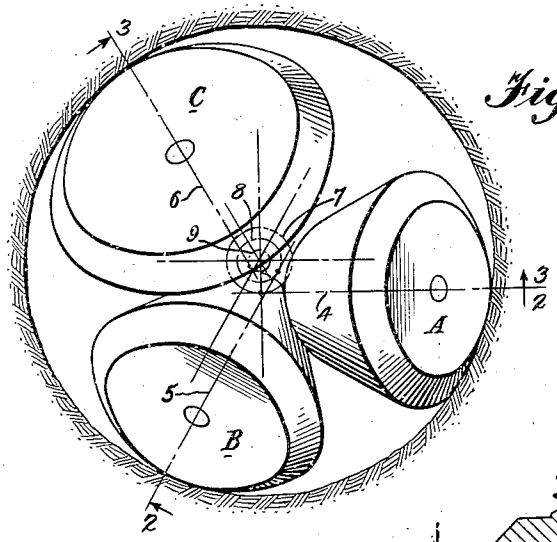

Fig. 1.

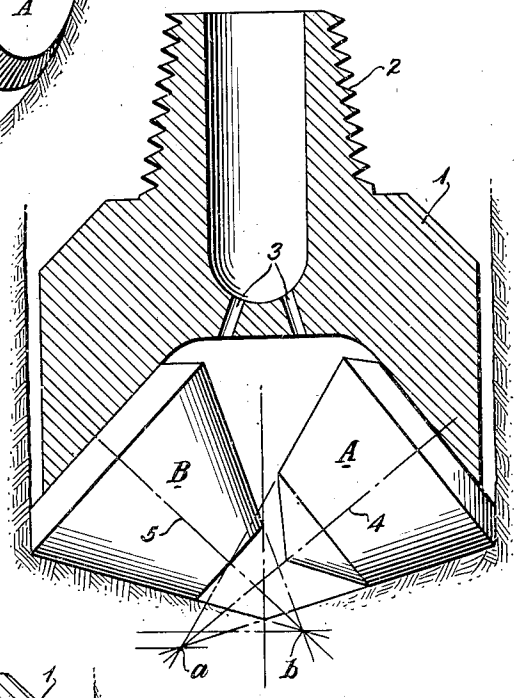

Fig. 2.

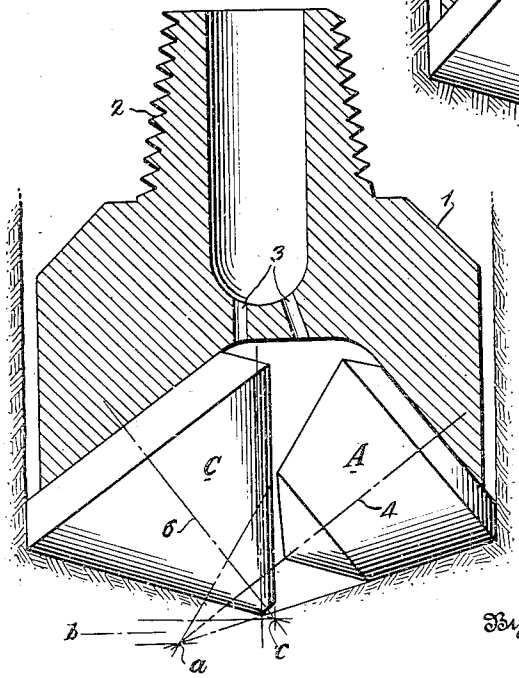

Fig. 3.

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DRILLING BIT

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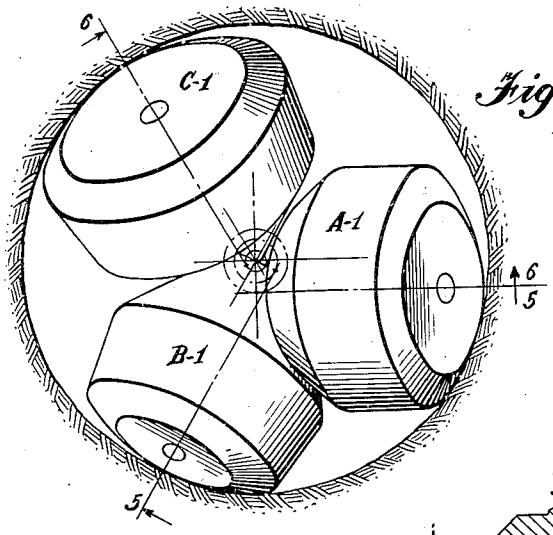

Fig. 4.

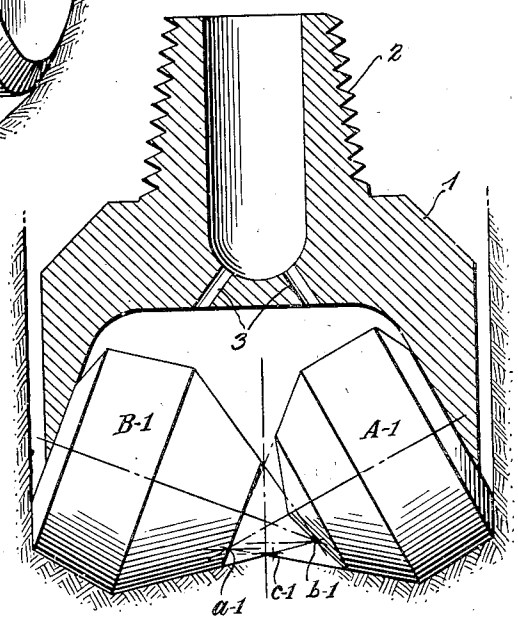

Fig. 5.

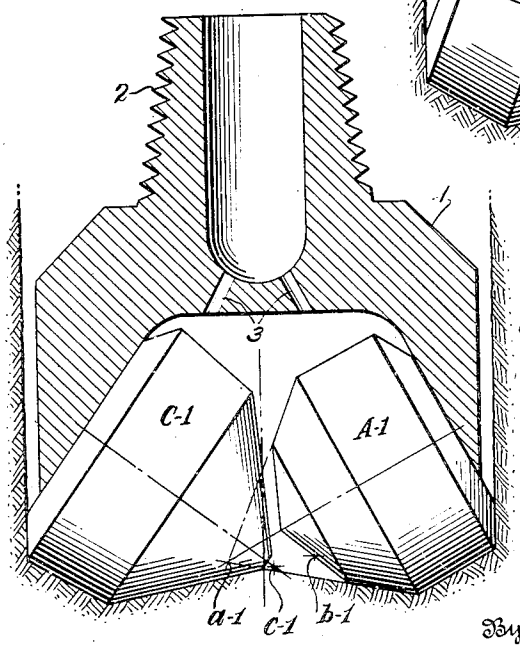

Fig. 6.

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2,463,932

DRILLING BIT

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Application May 23, 1944, Serial No. 536,945

1 Claim. (Cl. 255—71)

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This invention relates to improvements in drilling bits and more particularly to drilling bits of the type embracing a bit body rotatable about the axis of the hole carrying a plurality of rollers, each provided with a cutting surface.

More specifically, the invention contemplates the provision of drilling bits of high efficiency which materially aid in the drilling of a straight hole.

In the design of rollers having cutting surfaces for use on drilling bits of this type, it is possible to vary the cutting effect of an individual cutting surface by so shaping the same and so disposing the axis of the roller provided with such cutting surface that it has either true rolling motion on the hole bottom or a rolling motion accompanied by some slippage on the formation. In the case of conical cutting surfaces or frusto-conical cutting surfaces, the degree of scraping effected by slippage which accompanies the rolling action of the bit roller is governed by the extent to which the shape of the cutting surface departs from a cone having its apex lying in the axis of rotation of the bit. The only shape of cutting surface which will have a true rolling motion on the hole bottom is a conical or frusto-conical surface, the apex of which lies in the bit axis. Conical or frusto-conical rollers having other shapes of surface or deviations of the apex of the cone have a rolling motion accompanied by a slipping or scraping action.

It is a known fact that bits embracing rollers with cutting surfaces have a tendency to leave a pattern on the hole bottom. In non-brittle formations having great crushing strength, this pattern is almost a true picture of the cutting surface and there is a tendency for the roller teeth to gear with this pattern to such an extent that in some instances the drilling progress almost comes to a standstill. If all of the rollers having frusto-conical cutting surfaces assembled on a single bit have the same apex relative to the bit axis, all of the rollers will partake of the same gearing effect, with the pattern on the bottom of the hole, and very materially retard drilling progress.

Various attempts have been made to overcome the above-noted objection. These attempts have in large part resided in the variation in the shape or position of the teeth on the rollers so that the cutting surface of one roller makes a different pattern than the cutting surface of another roller carried by the bit. This frequently results merely in the production of a finer pattern, particularly since the various patterns do not obliterate each other and consequently the tracking of the teeth in the pattern is not obviated.

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The present application constitutes a continuation-in-part of my copending application, Serial No. 406,688, filed August 13, 1941, now Patent 2,367,637, granted January 16, 1945, and additionally constitutes an improvement on the type of drilling bit disclosed in that application, primarily due to the provision in accordance with the invention of the present application of an improved pattern produced by frusto-conical rollers having differentially spaced apices with respect to the hole axis. I have now found that bits having frusto-conical rollers with their apices lying in only one horizontal plane are not as advantageous for some purposes as bits in which the apices of the rollers are vertically spaced and lie in two or even three vertically spaced horizontal planes, since in the latter arrangement the cutting effect of the teeth of the individual frusto-conical rollers is improved because of the deviation of one roller axis from another roller axis. Additionally, by deviating the axes of the frusto-conical rollers in such a manner that they respectively lie in lines tangent to circles coaxial with the axis of the hole or bit, with, however, each of said circles having a different diameter, the cone or roller axes will not only diverge in a horizontal plane, but will also lie in vertical planes standing at an angle to each other, thus placing the apices of the cones of a three-roller bit in a three dimentional pattern, the apex of each roller lying in a plane perpendicular to the bit or hole axis and vertically spaced from the plane in which the apex of any other roller may lie.

It is accordingly an object of the present invention to provide an improved roller bit structure such that the pattern formed at the bottom of the hole is broken up into two or three different dimensions. It is a further object of the invention to provide a bit embodying a plurality of frusto-conical rollers so arranged as to drill a hole having a convex bottom as well as to provide an alternative arrangement for drilling a hole having a concave bottom in order to more or less stabilize the direction of the well bore and increase the straightness thereof.

It is highly advantageous in some formations to employ a drilling bit that drills a hole having either a concave or a convex bottom configuration. Such a configuration tends to center the bit and mitigates against deviation thereof from the predetermined desired path, thus avoiding the production of a crooked hole. This is

particularly true in those instances where the formation stands at any substantial angle to the desired direction of the well. The bits of the present invention are highly effective in improving the cutting action of the drill and in the attainment of a straight hole.

The invention will be described in connection with the accompanying drawings forming a part thereof and in which:

Figure 1 is a view showing the relative true location of the three frusto-conical rollers of the bit of the present invention when disposed in a well;

Figure 2 is a longitudinal sectional view on the line 2—2 of Figure 1, with the section taken, for purposes of illustration, to show the two rollers A and B as having their axes parallel to the plane of the paper rather than in true angular relation, as illustrated in Figure 1;

Figure 3 is a longitudinal sectional view on the line 3—3 of Figure 1, similar to Figure 2, with the section taken to show rollers A and C as having their axes parallel to the plane of the paper rather than as shown in Figure 1;

Figure 4 is a view similar to Figure 1, showing a second embodiment of the invention;

Figure 5 is a view on the line 5—5 of Figure 4, similar to Figure 2, illustrating the embodiment of Figure 4; and

Figure 6 is a view on the line 6—6 of Figure 4, similar to Figure 3, illustrating the embodiment of Figure 4.

Referring to the drawings, the roller bit body 1 is provided with the usual threaded shank 2 and circulating fluid apertures 3. In the embodiment of Figures 1 to 3, the frusto-conical rollers carried by the bit body 1 are so designed and arranged as to insure the drilling of a hole having a concave bottom surface. In this embodiment, the bit body 1 carries three frusto-conical rollers designated A, B and C, each mounted for rotation on the bit body 1. The line representing the axis of roller A is marked 4; the line representing the axis of roller B is marked 5; and the line representing the axis of roller C is marked 6. Referring to Figure 1, it will be observed that the line 4, representing the axis of roller A, lies tangentially to the circle 7; the line 5, representing the axis of roller B, lies tangentially to the circle 8; and the line 6, representing the axis of the roller C, lies tangentially to the circle 9. It will be additionally observed that the circles 7, 8 and 9 are concentric and have the axis of the bit body 1 as their center.

Referring to Figure 2, it will be observed that the apex *a* of the cutting surface of the frusto-conical roller A lies substantially to one side of the axis of the bit body 1 and in a plane perpendicular to the axis of the bit body 1. It will likewise be observed that the apex *b* of the frusto-conical surface of the roller B lies on the opposite side of the axis of rotation of the bit body 1 and in a plane perpendicular to the axis of the bit body 1, but vertically spaced from the plane in which the apex *a* of roller A lies.

By reference to Figure 3, it will be observed that the apex *c* of the frusto-conical surface of the roller C lies in this instance somewhat closer to the axis of the bit body 1 than do the apices *a* and *b* of rollers A and B respectively. It will likewise be noted that the apex *c* of roller C lies in a third plane perpendicular to the axis of the bit body 1, but vertically spaced both with reference to the plane in which the apex *a* of roller A lies and from the plane in which the apex *b* of roller B lies. For purposes of illustration, the plane of apex *b* has been superimposed on Figure 3 and is designated *b* so that the relative vertical spacing of the horizontal planes in which the apices *a*, *b* and *c* respectively lie may be appreciated and understood.

It will be observed that the apex *a* of roller A lies in a line tangent to a circle 7 having the axis of the bit and, therefore, the axis of the hole as its center, and that it likewise lies in a plane perpendicular to the axis of the bit and hole. Likewise, it will be observed that the apex *b* of roller B lies in a line that is tangent to a second circle 8 having the axis of the bit body 1 as its center and it will also be noted that the apex *c* of roller C lies in a line tangent to a third circle 9, also having the axis of the bit body as its center. Thus, the apices of the three rollers lie in lines tangent to concentric circles of different diameters having the axis of the bit body 1 as their center. It will additionally be observed that the apices *a*, *b* and *c* of rollers A, B and C respectively lie in vertically spaced planes perpendicular to the axis of the bit body 1. The frusto-conical rollers A, B and C in the embodiment of Figures 1 to 3 are so designed and arranged that the bit will drill a hole having a concave bottom configuration.

Referring to the embodiment of Figures 4 to 6, frusto-conical rollers are designated A—1, B—1 and C—1. They differ from the rollers A, B and C of the embodiment of Figures 1 to 3 primarily in that they are each provided with a double cutting face. In this instance, the apices *a*—1, *b*—1 and *c*—1 of the primary frusto-conical surface of rollers A—1, B—1 and C—1 likewise lie in lines tangent to concentric circles of different diameters having the axis of the bit body 1 as their center, as is apparent by reference to Figure 4. The apices *a*—1, *b*—1 and *c*—1 of rollers A—1, B—1 and C—1 also lie in vertically spaced planes perpendicular to the axis of rotation of the bit body 1, as will be apparent by reference to Figures 5 and 6. In Figure 5, the relative location of the plane in which the apex *c*—1 of roller C—1 has been superimposed and is designated *c*—1, whereas in Figure 6, the relative location of the plane in which the apex *b*—1 lies has been superimposed on the figure, the plane being designated *b*—1. The principles involved and the mode of operation is the same for the embodiment of Figures 4 to 6 as for the embodiment of Figures 1 to 3, with the difference that the bit, when provided with rollers conforming to the design shown in Figures 4 to 6 is effective to drill a hole having a bottom of substantially convex configuration.

In each instance, due to the relative location of the rollers, there is no tracking of the cutting surface of one roller in the pattern formed by another. Furthermore, the bit effects the most efficient drilling action since it combines both the rolling and slippage effects upon the formation. It will additionally be observed that in both embodiments the bit is effective to drill a hole having other than a flat bottom, i. e., a hole having either a concave or a convex bottom configuration. In this way, the bit is substantially self-centering in its action and greatly facilitates the drilling of straight holes. It is to be understood that the foregoing specification and the accompanying drawings are set out by way of exemplification of the invention and are not to be construed as a limitation thereof, the scope

of the invention being that defined by the subjoined claim.

I claim:

In a rotary drilling bit three frusto-conical rollers adapted to roll in simultaneous contact but with different degrees of scraping motion over the hole bottom, the apex of the first roller lying in a first horizontal plane at a 90° angle to the bit axis, the apex of the second roller lying in a second horizontal plane at a 90° angle to the bit axis and the apex of the third roller lying in a third horizontal plane at a 90° angle to the bit axis, all three parallel planes having a substantial vertical distance between each other.

JOHN A. ZUBLIN.

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