April 7, 1953 H. GRUNER 2,634,105

DRILLING BIT

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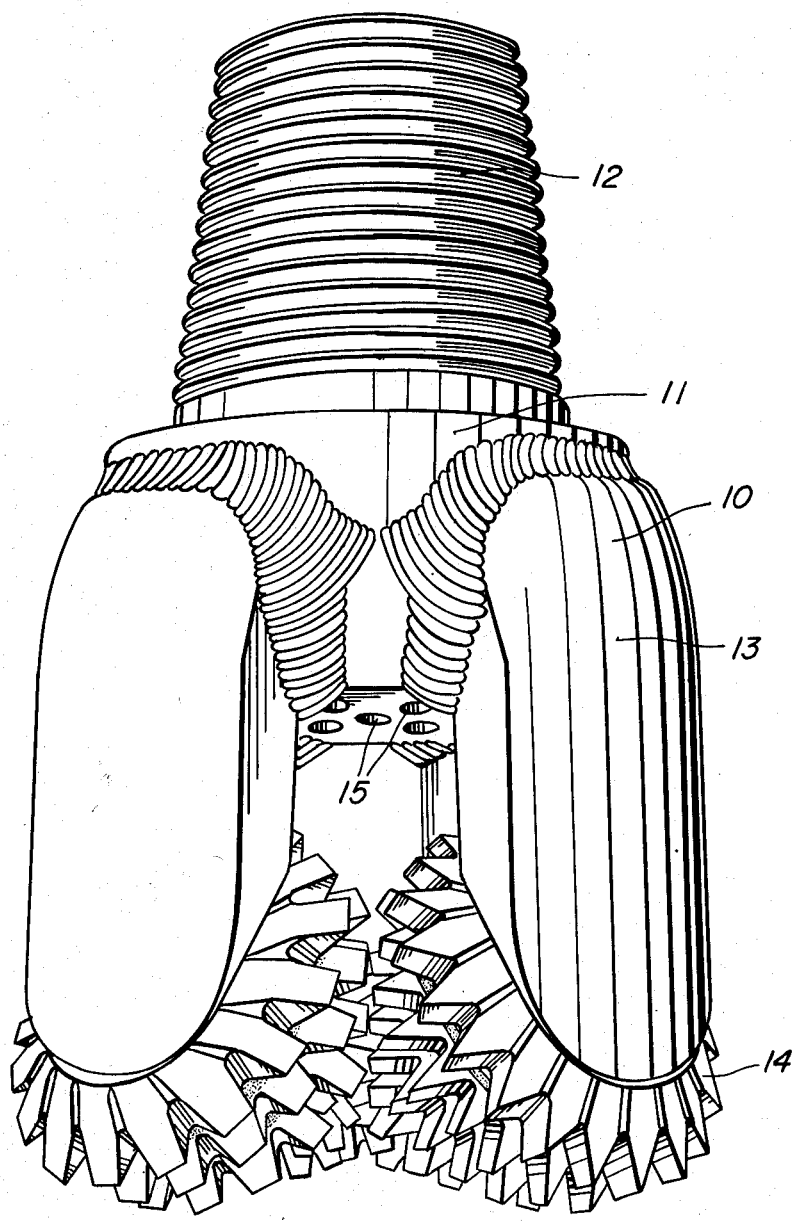

Fig. 1

Hans Gruner
INVENTOR

Ashley & Ashley
Attorneys

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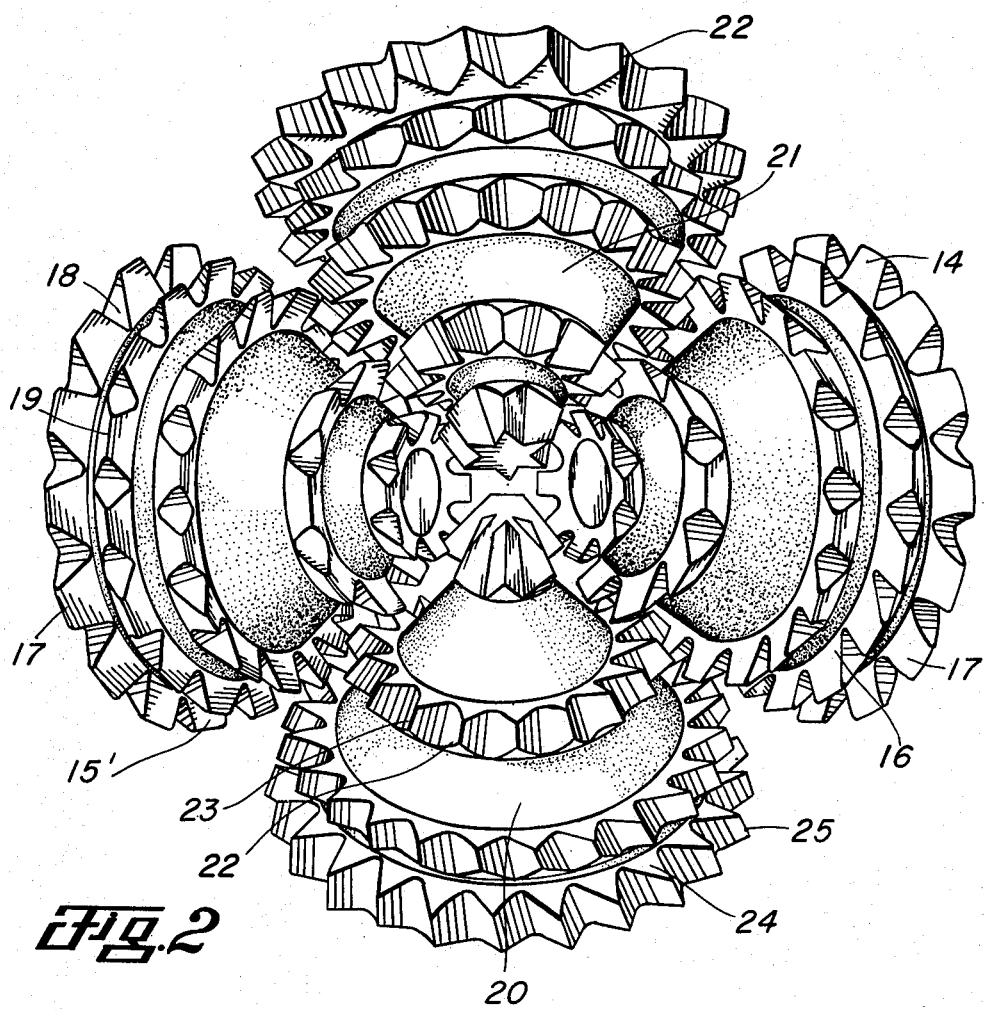

Fig. 2

Hans Gruner
INVENTOR.

BY Ashley & Ashley
Attorneys

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DRILLING BIT

Hans Gruner, Tonkawa, Okla.

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4 Claims. (Cl. 255—71)

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This invention relates to new and useful improvements in drilling bits.

One object of the invention is to provide a new and improved bit having an enhanced drilling action.

A particular object of the invention is to provide an improved drilling bit having a plurality of cutter cones, the teeth of which engage the formation being drilled in different angular dispositions whereby tracking of the teeth is eliminated and an improved cutting action is obtained.

An important object of the invention is to provide an improved drilling bit having thereon a plurality of cutter cones carrying wedge-shaped cutting teeth with cutting edges, the cutting edges of the teeth upon at least one of the cutters engaging the formation being drilled at an angle, preferably approximately 90°, with respect to the lines of engagement between the formation and the cutting edges of the teeth of other of the cutters whereby the formation being drilled is alternately or intermittently subjected to a cutting action by cutting teeth disposed at varying angles.

A further object of the invention is to provide an improved drilling bit having a plurality of cutter cones with cutting teeth thereon, said teeth having cutting edges, the cutting edges of the teeth of some of the cutter cones extending substantially circumferentially of the path of rotation of the bit, while the cutting edges of the teeth of other cones extend substantially radially with respect to said path of rotation.

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, wherein an example of the invention is shown, and wherein:

Fig. 1 is a perspective view taken from the side of a drilling bit constructed in accordance with this invention, and

Fig. 2 is a view taken from the bottom or underside of said bit illustrating the cutting face exposed to the formation being drilled.

In the drawings, the numeral 10 designates a drilling bit having a substantially cylindrical body 11 with a tapered, screw-threaded pin 12 extending upwardly therefrom. A plurality of cutter supporting shanks 13 depend from the body 11 and carry spindles (not shown) upon which a plurality of cutter cones 14 are rotatably mounted. The pin 12 and body 11 are provided with the usual water courses 15 for permitting the flow of drilling fluid downwardly onto the cutter structure. Up to this point, the construction of the bit is entirely conventional, the cutter cones preferably being mounted upon the

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spindles by means of ball bearings in any of the various arrangements customary to this art. The invention resides in the arrangement and relationship of the cutting teeth of the bit, and since the remainder of the bit may be of any suitable or desirable structure, a detailed description thereof is not necessary. Many types of structures or cone bits are well known in this particular field and to those skilled in this art, and may be used in connection with the present invention.

Although the invention may be applied to any bit having two or more cutters of the conical type, it is preferably applied to a four-cone bit, and as a specific embodiment of the invention, such a bit has been illustrated. The cutter cones 14 are divided into two diametrically-opposed pairs, the cones 15 and 16 of one pair carrying a plurality of cutting teeth 17 arranged in a plurality of rows 18 extending circumferentially of said cones. The teeth 17 are of the wedge-shaped variety, common in this art, and carry cutting edges 19 extending circumferentially of the rows 18 and of the cones 15 and 16. The cutting edges 19 are thus disposed substantially at right angles with respect to the axes of the cones 15 and 16 and circumferentially with respect to the path of rotation of the bit 10.

The opposite pair of diametrically-opposed cutter cones 20 and 21 are interposed between and arranged at right angles with respect to the cones 15 and 16. The cones 20 and 21 also carry cutting teeth 22 having cutting edges 23 and being arranged in circumferential rows about the bodies of the cones 20 and 21. As shown in the drawings, the cutting edges 23 of the teeth 22 extend transversely of the rows in which the teeth are arranged and are substantially alined with the axes of the cones 20 and 21. The cutting edges 23 are thus disposed substantially radially with respect to the path of rotation of the bit 10.

It is to be noted that the teeth 24 in the outer two rows upon the cutter cone 20 have their cutting edges 25 disposed at a slight angle with respect to the axis of the cone 20, and thus are not disposed exactly radially with respect to the path of rotation of the bit. They are substantially so, however, and in the course of rotation of the bit, they engage the formation substantially at right angles with respect to the track left by the cutting edges 19 of the teeth 17. The essence of this invention is to be found in a bit and cone structure having cutting teeth which intermittently subject the formation to the action of cutting teeth with cutting edges disposed substantially at right angles. Thus, the formation is drilled by cutting edges, some of which are disposed radially of the bottom of the well bore and some of which are disposed circumferen-

tially thereof. In the usual type of bit, all of the cutting teeth are similarly arranged, and all of the cutting is normally effected by cutting edges disposed radially of the bottom of the hole. In the present invention, the drilling is accomplished by intermittently or alternately bringing into engagement with the formation teeth disposed both radially and circumferentially of the bottom of the well bore or hole, and a much faster drilling action is obtained.

While it is preferable to alternate the two types of cutting edges as illustrated in the drawings, it is obvious that any suitable or desirable arrangement of the cutting edges may be employed whereby, in the course of one complete revolution of the bit 10, a given portion of the well bore bottom is subjected to cutting action both circumferentially and radially. Nor, as pointed out hereinbefore, must the invention be limited to the use of four cutter cones. So long as two or more cutters are employed, the bottom of the well bore may be intermittently or alternately subjected to the two types of cutting action in the course of rotation of the bit.

It is further to be noted that the inner rows of teeth on the various cutters do not pass over the same portion of the well bore, that is, they do not follow in the tracks of teeth upon the preceding cutters. Of course, less material must be drilled near the center of the well bore and a smaller number of teeth may be employed for this purpose. It has been found that this staggering of the rows of teeth with respect to one another and the intermittent or alternate subjection of the formation in the center of the bore to radial and circumferential cutting results in a fast and very desirable drilling action.

Since the action of the novel tooth arrangement embodied in this invention is dependent upon intermittent or alternate subjection of the formation to the action of the teeth disposed substantially at right angles, it is obvious that various tooth arrangements may be made. The teeth of one group of cutters may have their cutting edges disposed at an angle to the axes of the cones carrying such teeth, while the cutting edges upon the other group of cutters are arranged in the opposite direction, being disposed to strike the tracks of the first set of teeth at an appreciable angle. Thus, the aim of the invention is carried out in subjecting a section of the formation to the cutting action of one group of teeth and subsequently subjecting that, or an adjacent, section of the formation to cutting by teeth arranged at a substantially different angle. In this manner, cutting of the formation by a number of teeth, all arranged at a similar angle, is avoided. Instead, cuts are made at different angles and the drilling speed is naturally increased.

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 I claim and desire to secure by Letters Patent is:

1. A drilling bit including, a body, four spindles carried by the body, conical cutters on the spindles extending substantially to the vertical axis of the bit and adapted to revolve on said spindles, and wedge-shaped teeth on each cutter having cutting edges, the teeth on alternate ones of the cutters having their cutting edges disposed to engage the formation being drilled substantially at right angles to the line of formation-engagement of the cutting edges of the other two cutters.

2. A drilling bit including, a body adapted to be rotated in a well bore, a plurality of spindles on the body, conical cutters on the spindles extending substantially to the vertical axis of the bit, each cutter carrying concentric rows of wedge-shaped cutter teeth having chisel-like cutting edges, the cutters being adapted to roll over the formation being drilled as the body is rotated and to bring the cutting edges of the teeth into engagement with said formation, the teeth on alternate ones of the cutters being disposed to engage the cutting edges of the teeth with the formation substantially at right angles with respect to the lines of engagement between the formation and cutting edges of the teeth on the other cutters, and the concentric rows of teeth upon the inner portions of the cutters being staggered between adjacent cutters whereby the inner rows of teeth of adjacent cutters track in different paths as the bit is rotated over the formation being drilled.

3. A drilling bit including, a body adapted to be rotated in a well bore, four spindles carried by the body, conical cutters on the spindles extending substantially to the vertical axis of the bit and adapted to revolve on said spindles, each cutter carrying concentric rows of wedge-shaped cutter teeth having chisel-like cutting edges, the cutters being adapted to roll over the formation being drilled as the body is rotated and to bring the cutting edges of the teeth into engagement with said formation, the teeth on one diametrically-opposed pair of the cutters being disposed to engage the cutting edges of the teeth with the formation at a predetermined angle, the teeth on the opposite diametrically-opposed pair of cutters being disposed to engage the cutting edges of the teeth with the formation substantially at right angles with respect to the line of engagement between the formation and the cutting edges of the teeth of the first named pair of cutters, and the concentric rows of teeth upon the inner portions of the cutters being staggered between adjacent cutters whereby the inner rows of teeth of adjacent cutters track in different paths as the cutters pass over the formation.

4. A drilling bit as set forth in claim 3, wherein the cutting edges of the teeth of one diametrically-opposed pair of cutters engage the formation substantially radially of the bit, and the cutting edges of the teeth of the opposite diametrically-opposed pair of cutters engage the formation substantially circumferentially of the bit.

HANS GRUNER.

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