United States Patent

Cortes

[15] **3,693,735**

[45] **Sept. 26, 1972**

[54] **DRILLING TOOL WITH ELEMENTS HAVING DIAMOND-STUDDED ATTACK SURFACE**

[72] Inventor: **Abel C. Cortes,** Neuilly-sur-Seine, France

[73] Assignee: **Compagnie Francaise Des Petroles,** Paris, France

[22] Filed: **Sept. 29, 1970**

[21] Appl. No.: **76,512**

[30] **Foreign Application Priority Data**

Sept. 29, 1969 France.....6933081

[52] **U.S. Cl.**.....**175/329**
[51] **Int. Cl.**.....**E21b 9/36**
[58] **Field of Search**.....175/329

[56] **References Cited**

UNITED STATES PATENTS

2,371,490	3/1945	Williams	175/329
2,817,885	12/1957	Long	175/329 X
2,966,949	1/1961	Wepsala	175/329
3,135,341	6/1964	Ritter	175/329
3,027,952	4/1962	Brooks	175/329

FOREIGN PATENTS OR APPLICATIONS

1,261,950	4/1961	France	175/329
1,508,961	12/1967	France	175/329

Primary Examiner—David H. Brown
Attorney—Sughrue, Rothwell, Mion, Zinn & Macpeak

[57] **ABSTRACT**

A drilling tool for drilling in either hard or soft ground at high speeds and incorporating a plurality of diamond-studded protuberances formed on the end cutting surface of the tool, with a plurality of radially outwardly extending grooves formed in the end of the tool and having additional circular grooves formed between rows of protuberances to assist in removal of the debris. The protuberances are formed so that the diamond projections thereon are each aligned with each other in a given row in the direction of rotation to assist in cutting.

7 Claims, 3 Drawing Figures

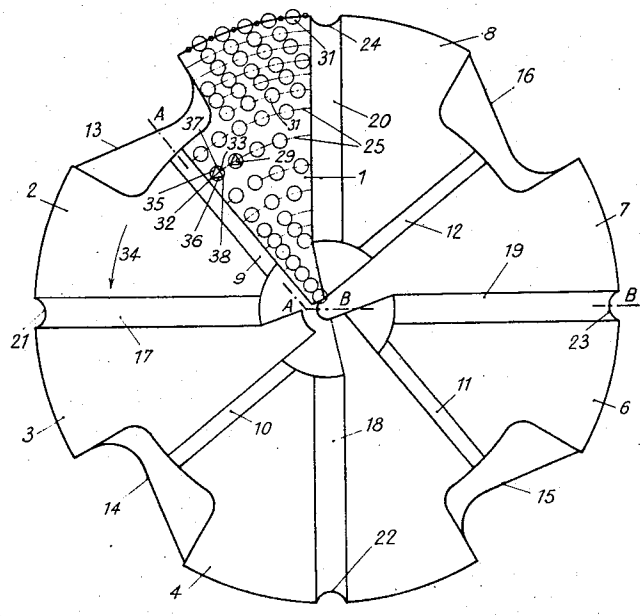


FIG. 2

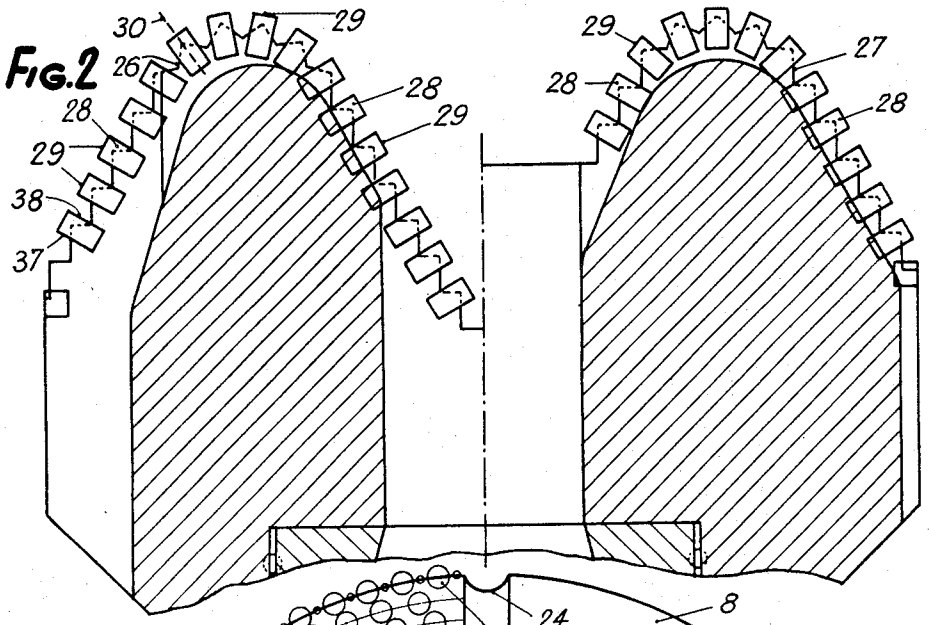


FIG. 1

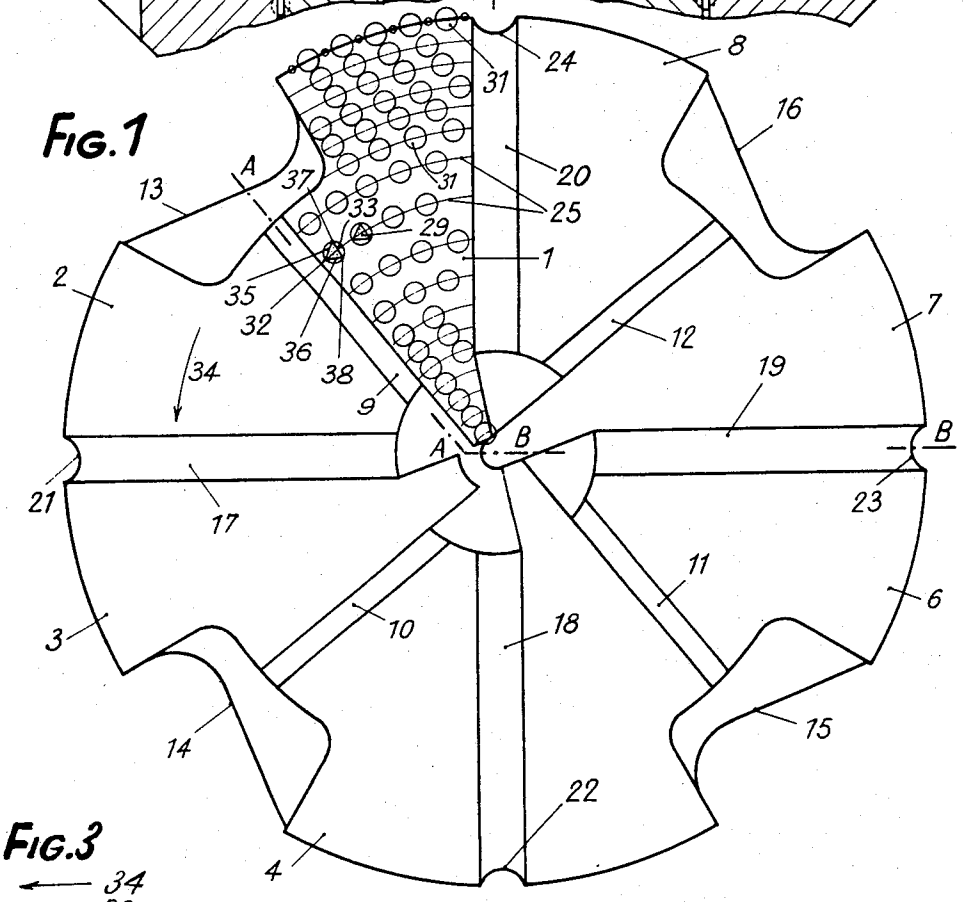
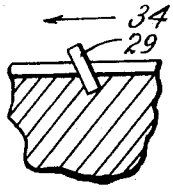


FIG. 3



DRILLING TOOL WITH ELEMENTS HAVING DIAMOND-STUDDED ATTACK SURFACE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a drilling tool which advances rapidly, regardless of whether the drilling is done in hard or soft ground. The tool incorporates diamond-studded attack elements consisting of prismatic blocks or truncated pyramid blocks.

2. Description of the Prior Art

The tools used for drilling in the earth encompass a wide variety of structure. Some of the tools have a compact body on which is inserted diamonds arranged either in a circular or in a spiral pattern, while others, on the other hand, have thin plates on which are placed either diamonds or diamond-studded plates. The first-mentioned tools are particularly suitable for drilling in very hard ground while the latter are better suited for soft ground and sticky ground.

In order to evacuate the debris of the earth which has been ground up or broken up by the tools of the first type, more or less wide grooves or recesses which separate the plates carrying the diamonds are put on the body of the tool. Slush is injected into these grooves or recesses, making it possible to move the earth debris, broken up by the diamonds, and at the same time to cool the tool.

In spite of the grooves and recesses in the body of the tool, the debris has a tendency to pile up at certain points and as a result rapid advancing speed cannot be maintained. This inconvenience is partly remedied by increasing the dimension of the diamonds used but this solution is rapidly limited by the prohibitive cost of the tool.

It has thus been recommended that diamonds be inserted on portions of the crowns bordered at the ends by the grooves and recesses used for the normal evacuation of debris, and bordered in a circular fashion, on either side, by grooves separating two adjacent crowns. Although, to a certain extent this construction improves the evacuation of the crushed earth, it does not prevent the clogging of portions of crowns covered with diamonds.

Another has been to use wedges or teeth, forming cutting crests, and arranged especially in steps, but these tools entail the disadvantage of cutting the bottom of the drill hole in accordance with the steps. This construction makes the flow of the slush around the points of attack, as well as the cooling of the tool, insufficient. The clogging of the tool is thus not eliminated and heating prevents any increase in the drilling speed.

SUMMARY OF THE INVENTION

The purpose of this invention is to provide a drilling tool capable of working in either hard or soft ground at high speeds. Said tool has a general revolution surface with a base interrupted by grooves and recesses for the evacuation of the slush and is characterized by the fact that said surface is also interrupted by protuberances, which are diamond-studded on at least the entire region of their terminal section, the assembly of these sections constituting a discontinuous soil attack surface. The surface envelope of the said attack surface defined by the rotation around the axis of the tool, is a line tangent to the intersections of said attack surfaces with a plane passing through the axis of the tool, and is essentially above and parallel to the revolution surface defined by the rotation of a line enveloping the section of said base surface around said axis, and assumed to be bare of said protuberances, and a plane passing through the axis of the tool. Each protuberance is so arranged as to present, in the direction of rotation of the tool, the crest of a dihedron or the generatrix of a tronconic surface delimiting two small regions practically similar to flat areas whose plane or bisection, with the direction of the rotation movement, forms an angle between plus and minus 10°.

The advantage of such a tool is that it increases the flow of the slush for the same density of diamonds or attack elements working on the earth and that it prevents the clogging between neighboring protuberances which may consist of inserted blocks, by virtue of the stem shape given to these blocks, thus promoting the break up and movement of the slush.

Another advantage is that, due to the levelling brought about by each protuberance whose attack section is diamond-studded, the effect is as intense as the effect derived from large-size diamonds while the attack surface is considerably increased when compared to the surfaces offered by the diamonds in known tools.

Furthermore, the lateral surfaces of diamond-studded blocks offer a large cooling surface which makes it possible to work the tool under all conditions.

Another purpose of the invention is to provide a tool of the type described above where said diamond-studded blocks are lined up in the direction of the rotation movement, with two consecutive blocks in the same line up being separated from each other by an interval more than 0.5 times the length of a block and having, at the opposite side of its attack crest, a surface perpendicular to the bi-section plane of the dihedron of the attack crest.

This arrangement promotes the flow of slush, on the one hand, because a first block, by means of its attack crest and its rear surface, drives the slush toward the outside of its trajectory and, on the other hand, because, in the absence of earth broken up by the preceding block, the space separating two consecutive blocks is sufficient so as not to be packed by the mere action of the following block.

Another purpose of the invention is to provide a tool of the type mentioned above, involving a general surface having the shape of circular steps and an attack surface made up of the surfaces of the terminal sections of the diamond-studded blocks, these attack surfaces being perpendicular to a line that is perpendicular to an imaginary plane line enveloping the outside summit of the broken-up line serving as the generatrix of the tool, the attack strip of the surfaces of the diamond-studded blocks being on a middle level whose distance above the line enveloping the summits of the generatrix is at least equal to one quarter of one of the smallest sides of the broken line of the generatrix, the median axis of the rear face of each block passing through an outside summit of the generatrix situated in its plane, while the crests of said rear face cuts said generatrix at points situated between said outside summit and the consecutive inside summit of the generatrix.

In this way a tool is obtained where the attack on the earth is no longer made in the form of steps, but rather,

along a surface parallel to the envelope, with the steps no longer constituting cutting lines but only the walls of a way from which flow the slush and the debris of the earth toward the evacuation grooves or recesses interrupting the step-like revolution surface. Thus, the attack upon the earth no longer involves the formation of a step-like surface at the bottom of the drill hole from which it is difficult to expel the debris. Instead, a surface constituting the envelope of the attack surfaces situated above the steps is obtained, the latter used only for channelling the debris toward the evacuation grooves.

The free circulation of the slush drains the debris and makes it possible to increase the advancing speed of the tool, whose performance remains excellent in either hard or soft ground.

Other advantages and features will emerge from the following description, made with reference to the attached drawing which, by way of non-restrictive example, presents one manner of implementing this invention.

IN THE DRAWING

FIG. 1 shows a plan view of a tool according to the invention, where the prismatic blocks have been placed only on one portion of a sector to make the drawing clearer.

FIG. 2 shows, on one and the same elevation, the axial cross-section of the tool in FIG. 1, made along sections A—A for the left-hand portion and B—B for the right-hand portion of the cut after removal of the lower portion of the tool.

FIG. 3 is a sectional view along line III—III of FIG. 2 showing the inclination of the prismatic blocks in the direction of rotation of the drilling tool.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the version chosen by way of example here, the tool is made in eight sectors, **1–8**, delineated by four small-diameter grooves **9–12**, running respectively into four recesses **13–16** and by four larger-diameter grooves **17–20**, leading into four lateral grooves **21–24**.

The crests of the step-like surface of the tool have been shown schematically by circle arcs **25** on sector **1**. These circle arcs are in fact continued upon the seven other sectors **2–8**.

The step profile, shown in FIG. **2** along the broken line **26** for sector **1** and on line **27** for sector **7**, corresponds to a nonregular broken line whose envelope is essentially parallel to the discontinuous attack surface adopted here.

In FIG. **2** the arrangement of the insertion of the prismatic blocks **28** on the surface of sectors **1** and **6** is shown.

The terminal section of the blocks chosen in this example is an equilateral triangel **29** seen in FIG. **1**, which also constitutes the attack surface of the block, as shown in FIG. **2**. The symmetry, or median plane **30** of each prism contains the line perpendicular to the surface enveloping the steps of the tool and the tangent to the crest of the step after the point where the normal or perpendicular line intersects this crest.

Referring now to FIG. **1**, it can be seen that, for greater ease, the insertion of the prisms has been represented by circles **31**. The orientation of the terminal sections **29** is such that each of the prismatic blocks has a crest **32** aligned with the circle arc **25**, the crest **32** being forward of the face **33** with respect to the direction of rotation, represented by arrow **34**.

Thus, when the tool is lowered into the drill hole and rotated in the direction of the arrow, the assembly of the attack surfaces **29** rests in the drill hole with each crest dihedron **32**, made up of faces **35** and **36**, driving the debris of earth and the slush to either side of the median plane **30**. The blocks **29** thus distribute the slush and the debris over the walls of the steps until they reach the grooves **9–12** and **17–20**, terminating at the recesses **13–16** and **21–24**. The action involving the break up and channelling of the debris by the dihedrons **32** of the prismatic blocks permits an increase in the debris circulation speed and makes it possible to move the attack blocks closer. Furthermore, the attack surfaces **29** prevent any cutting of the bottom of the drill hole into steps and, on the contrary, create sufficient space between portions of earth not yet attacked and the portions of the steps surrounding the attack blocks. In order to facilitate the flow between two series of neighboring blocks, situated on one and the same generatrix, crests **37** and **38**, delimiting the rear face **33** are preferably spaced apart so as to cut only the faces of one and the same steps.

Although in this drawing only one way of implementing this particular invention has been shown, the scope of the invention is not limited thereto, but numerous modification can be made in the various elements involved without going beyond the framework of the invention. By way of example, the blocks could be truncated pyramids or truncated cones whose forward generatrix would delimit surface portions more or less similar to the faces of the dihedron of a prismatic block. Likewise, the attack surfaces could present a slight inclination with respect to the line perpendicular to the tool and the symmetry plane of the prismatic or tronconic block could make up an angle between $-10°$ and $+10°$ with respect to the direction of movement.

What is claimed is:

1. A drilling tool having a basic general surface of revolution interrupted by a plurality of grooves and recesses for the evacuation of slush, said drilling tool comprising a plurality of concentric stepped projections formed on said revolution surface around the axis of rotation of said drilling tool interrupting said surface, each of said projections having a crest forming a circle arc symmetrically arranged around the axis of rotation of said drilling tool, a plurality of diamond-studded prismatic blocks positioned in said stepped projections at the crests of each of said stepped projections over the general surface of revolution of said tool, the longitudinal axis of each diamond-studded block passing through the circle arc of the stepped projection in which it is positioned and being perpendicular to a first line which is tangential to a second line intersecting the crests of consecutive stepped projections, said diamond-studded blocks being arranged in a plurality of sectors formed on the surface of revolution of said drilling tool by said grooves, the blocks of the consecutive circle arcs of each sector lying in a plurality of planes parallel to a first plane containing the first blocks of each sector and passing through the axis of

rotation of said tool, each diamond-studded block having a flat end surface formed at right angles to the longitudinal axis of said block, a crest of each prismatic block lying on the corresponding circle arc of the stepped projection in which said block is positioned and facing the direction of rotation of said drilling tool, the planar surfaces on each side of said crest forming an angle of between plus and minus 10° with a longitudinal plane in the direction of rotational movement of said tool.

2. A drilling tool as claimed in claim 1, wherein the distance between consecutive blocks on the same circle arc is equal to at least one-half the length of a block.

3. A drilling tool as claimed in claim 1, wherein each block has a plane surface opposite the crest facing the direction of rotation, said plane surface being perpendicular to a plane bi-secting the angle of said crest.

4. A drilling tool as claimed in claim 1, wherein the level of the discontinuous attack surface of said tool, constituted by said plane terminal sections of said diamond-studded blocks is an average distance from an envelope formed by said second line joining the crests of said step-like protuberances on said revolution surface when stripped of said protuberances, said average distance being equal to at least one-quarter of the length of one of the sides forming said stepped surface of said base revolution surface.

5. A drilling tool as claimed in claim 1, wherein each diamond-studded block overlaps the two sides of the stepped surface in which it is positioned, to the exclusion of the sides of adjacent steps.

6. A drilling tool as claimed in claim 5, wherein said diamond-studded blocks have a straight-line section in the form of an equilateral triangle.

7. A drilling tool as claimed in claim 5, wherein said diamond-studded blocks are inclined in the direction of rotation of said drilling tool.

* * * * *