United States Patent [19]

Feenstra et al.

[11] **3,747,699**

[45] **July 24, 1973**

[54] **DIAMOND BIT**

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[73] Assignee: **Shell Oil Company**, New York, N.Y.

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[21] Appl. No.: **239,037**

[30] **Foreign Application Priority Data**

Apr. 23, 1971 Great Britain 11,031/71

[52] **U.S. Cl.** **175/329**
[51] **Int. Cl.** **E21b 9/36**
[58] **Field of Search** 175/329, 330

[56] **References Cited**

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Primary Examiner—David H. Brown
Attorney—Harold L. Denkler et al.

[57] **ABSTRACT**

In a diamond bit having mud channels formed in the face thereof, a single row of diamonds is arranged along each mud channel. The diamonds are positioned so that the scraping edge of each diamond is between two perpendicularly arranged planes of the diamond and so that one of these planes lies in the wall of the mud channel.

9 Claims, 15 Drawing Figures

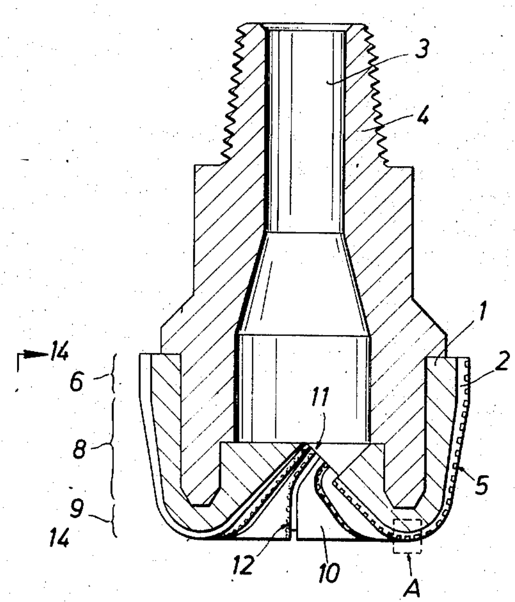


FIG. 2

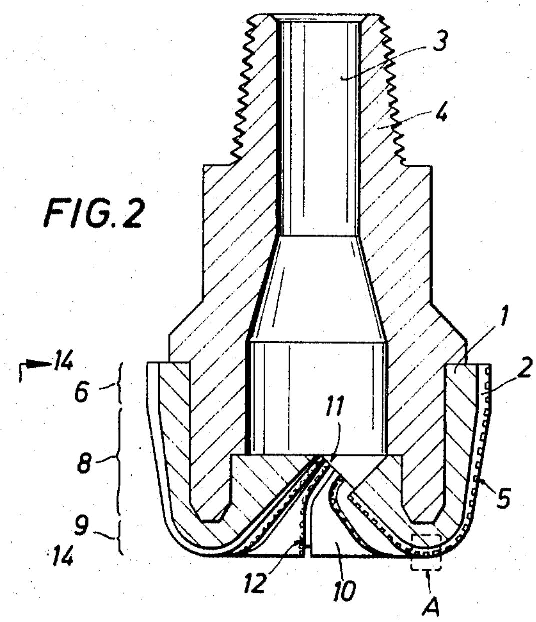


FIG. 1

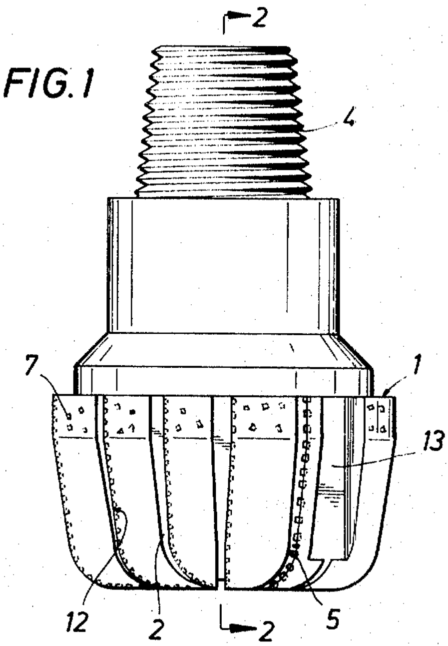


FIG. 3

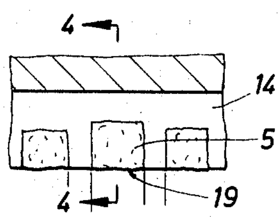


FIG. 4

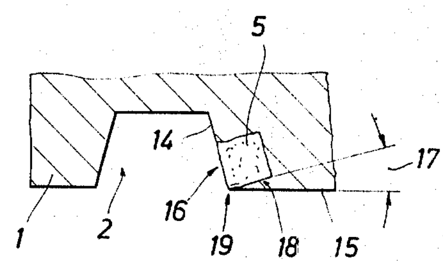


FIG. 5

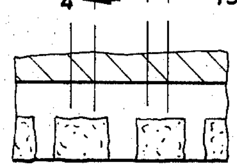


FIG. 6

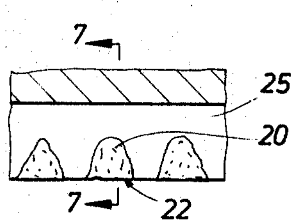


FIG. 7

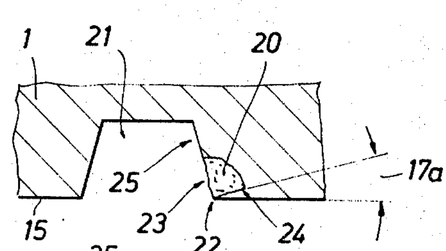


FIG. 8

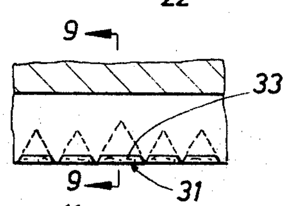


FIG. 9

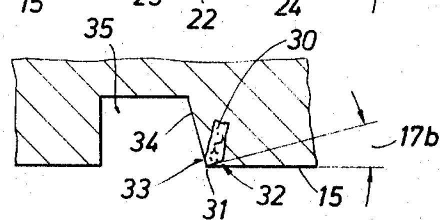


FIG. 10

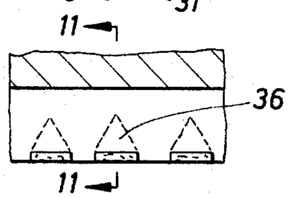
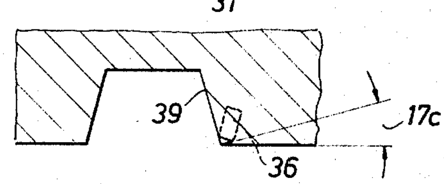


FIG. 11



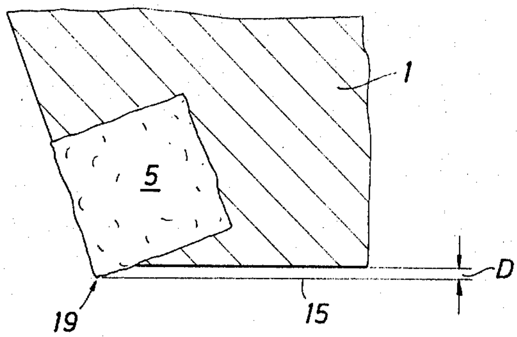
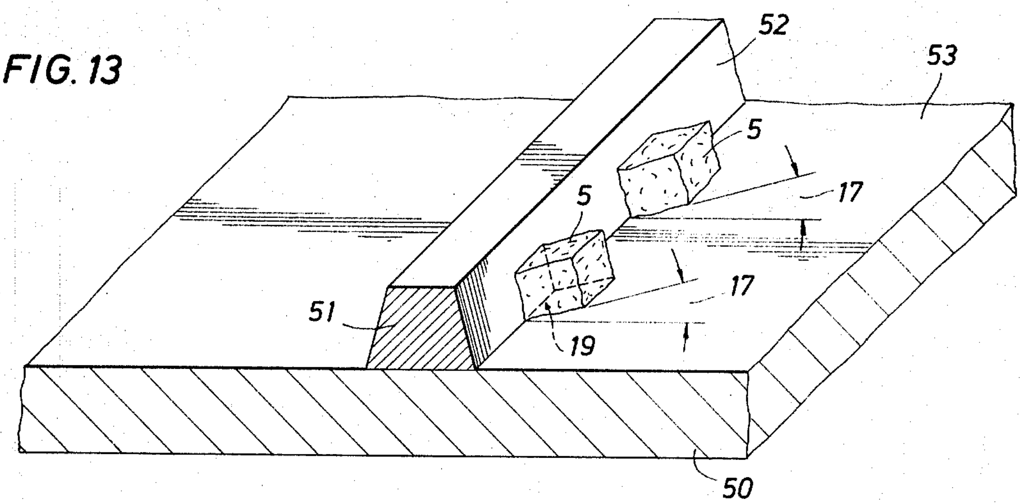


FIG. 12

FIG. 13



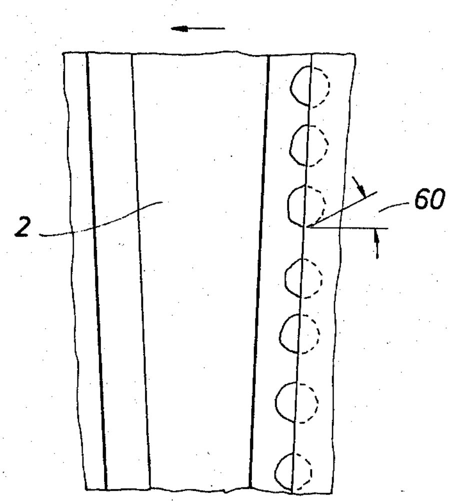


FIG. 14

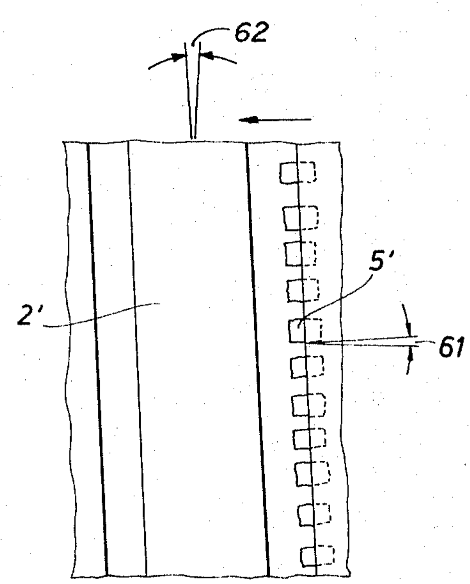


FIG. 15

DIAMOND BIT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to diamond bits of the type used in well drilling.

2. Description of the Prior Art

Diamond bits are used for drilling holes through rock material of poor drillability, for example in drilling subsurface formations for the purpose of prospecting for and/or recovering oil or other valuable products.

These bits are of the rotary type. The diamonds thereof exert a scraping action or a scratching action on the rock through which a hole is being drilled, the bit being loaded in an axial direction and being rotated around its central axis.

Bits of this type are especially useful for drilling through deep, abrasive, hard formations, since under these operating conditions they have a longer life than any other type of rotary rock bit, such as a roller bit. Consequently, a diamond bit has to be replaced less frequently than a bit of another type. The higher material and manufacturing costs of a diamond bit as compared with other types of bits are easily compensated by the advantages obtained as a result of the reduction in time required to replace the work bits during drilling operations.

The diamonds used in diamond bits have various shapes. Theyare mounted in a bit body comprising a wear-resistant material, such as tungsten carbide, which may be formed by sintering a suitable powder at an elevated temperature by means of a suitable binder, such as a copper alloy. In manufacturing the bit, the diamonds can be glued on their appropriate locations in a graphite mold of the bit body, which is thereafter filled with the wear-resistant material powder and subjected to a sintering operation.

Mud channels are usually arranged in the surface of the bit body. Mud can pass through these channels during drilling operations to promote cooling of the bit and removal of the drilling flour and scrapings. The diamonds may be grouped between these mud channels according to various patterns. In one pattern the diamonds are evenly distributed over the areas located between the mud channels. In another pattern the diamonds are preferably located near one side of each mud channel. In still another pattern the diamonds are arranged in a single row along one side of each mud channel.

The present invention relates to diamond bits having the diamonds arranged according to this last pattern. The bits described and shown in U.S. Pat. Nos. 2,818,233 (E. B. Williams, Jr.; published 31st Dec., 1957) and 3,058,535 (E. B. Williams, Jr.; published 16th Oct., 1962) may be considered representative of bits having this diamond pattern.

SUMMARY OF THE INVENTION

An object of the present invention is a diamond bit of the type having a single row of diamonds along one side of each mud channel, which diamond bit has the diamonds placed in a manner which will allow a very high rate of drilling progress.

A further object of the present invention is a diamond bit having a single row of diamonds along one side of each mud channel, which bit will be extremely cheap since a relatively low amount of diamonds is re-

quired which can be set in the mold in a very simple, but effective manner.

Still a further object of the present invention is a diamond bit of a design allowing an extremely accurate setting of the scraping edge of each diamond, thereby preventing an unfavorable non-uniform load distribution over the diamonds during operation and lengthening the operational life of the bit.

These objects are achieved by the diamond bit according to the invention, wherein each of the diamonds arranged in the face of the bit in a single row along one of the sides of each mud channel has a straight scraping edge formed by two flat planes of the outer surface of the diamond. Each of the diamonds is positioned so that the scraping edge is in a scraping position with respect to the bottom of the hole to be drilled and so that one of the flat planes lies in the wall of a mud channel.

The diamonds may be cube-shaped, triangle-shaped or have the form of a quarter sphere.

It will be appreciated that the scraping edge of a diamond when in a scraping position during the operation of the bit, will not carve the formation at the bottom of the hole which is being drilled, but scrape an annular track of substantial width in the bottom of the hole. It will further be appreciated that the various diamonds are placed such that more than one diamond may have a scraping edge running in a track scraped by another diamond, and that adjoining tracks will preferably slightly overlap.

As will be explained in more detail hereinafter, this particular manner of arranging the diamonds in the face of the bit along the mud channels allows the use of a graphite mold of extremely accurate dimensions. The scraping edges of the diamonds will rest on the bottom of this mold during manufacturing when setting the diamonds along the mud channels. Consequently, the scraping edges of diamonds operating on the same track during operation of the bit are all arranged at exactly the same level, which means that the diamonds will be equally loaded during operation without the risk of their being burnt or broken out one after the other as a result of overloading.

Moreover, the arrangement of the diamonds along the mud channels such that a flat plane of each diamond lies in the wall of a mud channel allows excellent cooling of the diamonds and intensive cleaning of the scraping action. Further, by selecting the correct angle for the wall of the molds of the mud channels in the graphite mold of the bit body, the diamonds, when glued with one plane thereof to one of the walls of the mud channel molds, will automatically be positioned at the correct relief angle with respect to the surface which is being scraped.

The invention will now be explained in more detail with reference to the drawing wherein by way of example some embodiments of the invention are shown.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a side view of a diamond bit according to the invention.

FIG. 2 shows a cross-section of the diamond bit according to FIG. 1 taken along the central axis of the bit in the direction of arrows 2—2.

FIG. 3 shows a portion A of a mud channel in FIG. 2 on a larger scale.

FIG. 4 is a section along the line 4—4 of FIG. 2.

FIG. 5 is a longitudinal section over part of a mud channel adjoining the mud channel of FIG. 3.

FIG. 6 shows an alternative of the arrangement according to FIG. 3.

FIG. 7 is a section along the line 7—7 of FIG. 6.

FIG. 8 shows another alternative of the arrangement according to FIG. 3.

FIG. 9 is a section along the line 9—9 of FIG. 8.

FIG. 10 shows an alternative of the arrangement according to FIG. 8.

FIG. 11 is a section along the line 11—11 of the FIG. 10.

FIG. 12 shows the bit portion illustrated in FIG. 4 (but on a larger scale) after a certain amount of drilling has been carried out.

FIG. 13 shows a perspective view, partly in cross-section, of part of a mold for sintering a diamond bit according to the invention.

FIG. 14 shows on an enlarged scale a side view of a part of the bit of FIG. 2 taken in the direction of the arrow 14.

FIG. 15 shows an alternative of the arrangement shown in FIG. 14.

DESCRIPTION OF PREFERRED EMBODIMENT

The diamond bit shown by way of example in FIGS. 1 and 2 of the drawing comprises a bit body 1 consisting of a wear-resistant material. Mud channels 2 run in the outer surface of the bit body. During operation of the bit, mud is supplied to these channels 2 via the bore 3 of steel shank 4. The mud flows through the channels to cool the bit body 1 and the diamonds 5 located along the channels 2, and prevent the channels 2 from being clogged by the scrapings and flour resulting from the operation of the diamonds on the formation.

In the side view of the bit according to FIG. 1, three areas can be distinguished on the bit body 1. The upper area 6 is cylindrical and the diamonds 7 placed in this area are set in a blunt position, which means that they cannot exert a cutting action in a direction lateral to the wall of the hole which is being drilled. If desired, these diamonds may exert a cutting action in a direction parallel to the central axis of the bit, which means that they will maintain the hole which is being drilled at a constant diameter, independent of both the loads exerted on the bit in a direction lateral to the central axis thereof, and the breaking out or burning of one or more of the uppermost diamonds arranged in the area 8 located below the area 6.

This area 8 has the shape of a frusto-conical surface with an apex angle of 20°, and merges at the lower part thereof into the area 9, which has a curved shape as shown in the drawing and merges in its turn into the central introversion of the bit face which introversion is formed by the conically shaped area 10 (vide FIG. 2).

The diamonds arranged in the areas 9 and 10 (which together are indicated as the face of the bit) act on the bottom of the hole which is being drilled when the bit is rotated in a subterranean hole.

The mud channels 2 starting in area 10 where they communicate via passage 11 with the bore 3 of the shank 4, pass through areas 10, 9, 8 and 6 successively and communicate at their other ends with a annular space within the hole around the shank 4. Where passing through the areas 8, 9 and 10, the channels are provided with a single row of diamonds 5 along one of their side walls. The locations of the diamonds of the rows along the side walls of channels, which diamonds are not visible in FIGS. 1 and 2, are indicated by dotted lines 12 for the sake of clarity. It will be appreciated that various diamonds may operate in a common annular track in the wall or on the bottom of the hole during drilling. Further, the diamonds are set in such a manner that adjoining annular tracks will slightly overlap, thus preventing ridges from being built up on the wall and bottom of the hole being drilled. This will be explained in more detail hereinafter with reference to FIGS. 3 and 5.

Junk slots 13 (one of which is shown in FIG. 1) are arranged in the outer surface of the bit body 1. These slots 13 have a cross-section greater than the cross-section of the channels 2 used for are usedfor the removal of particles of a size larger than the normal scrapings.

It will be appreciated that the diamonds 7 in area 6 are not placed along the parts of the mud channels 2 where these channels pass through area 6, since under normal operation the diamonds 7 are not performing any scraping action and hence need no cooling. The main function of these diamonds 7 is to guide the bit through the hole which is being drilled. Since the diamonds 7 are each set in a blunt position in a direction radial to the central axis of the bit, they cannot enlarge the hole under the influence of lateral loads exerted on the bit body, and consequently will suppress the creation of lateral vibrations resulting from oversized holes. This is very desirable as such vibrations would allow the diamonds to cut non-concentric tracks, which would result in breakage of diamonds due to a non-uniform load distribution over the diamonds when the latter are passing locations where these tracks intersect.

The position of the diamonds 5, which are arranged in single rows along each mud channel 2 where they pass through the areas 8, 9 and 10, will now be explained in more detail with reference to FIGS. 3 and 4. The arrangement shown in FIG. 3 is an enlargement of detail A of FIG. 2, and FIG. 4 is a cross-section along the line 4—4 of the arrangement shown in FIG. 3.

The diamonds 5 are cube-shaped and are so placed that one plane of the outer surface thereof coincides with the wall of the mud channel 2. In the cross-section, the wall 14 of the channel slopes with respect to the outer surface 15 of the bit body 1, so that the flat plane 16 of the diamond 5 will be arranged at an angle different from zero with respect to a line perpendicular to a plane tangential to the bit surface (in the case of the diamond illustrated which is on the bottom of the bit, the central axis of the bit is such a line). Thus, there is a relief angle 17 between the lower plane 18 of the cube and the outer surface 15 of the bit body 1, which enables the scraping edge 19 between the planes 16 and 18 to operate under optimal conditions. The value of the angle 17 is between 5° and 25°. Extremely good results will be obtained with a relief angle of 10°–15°. The scraping edge 19 preferably lies in or tangentially intersects the plane of the outer surface 15.

The depth of the cross-section of channel 2 may be about 4 millimeters, and the width thereof may be about 5 millimeters. The width of the scraping edge 19 may be about 2 millimeters. It will, however, be appreciated that the invention is not restricted to bits having channels and diamonds of the size mentioned, but that equally good results can be obtained by applying channels and diamonds having other dimensions.

FIG. 5 shows a section over a mud channel adjoining the mud channel of FIG. 3. As can be seen, any ridges which will be left in the bottom of the hole being drilled when the diamonds located along the mud channel shown in FIG. 3 have passed, will be removed by the action of the diamonds placed along the mud channel shown in FIG. 5. The tracks scraped in the bottom of the hole by the diamonds of FIG. 5 overlap the tracks scraped by the diamonds of FIG. 3. Preferably the mud channels shown in FIGS. 3 and 5 are arranged alternately over the outer surface of the bit body 1.

In the alternative arrangement shown in FIGS. 6 and 7 diamonds are applied of a shape other than the cube-shape shown in FIGS. 3 and 4. The diamonds 20 in FIGS. 6 and 7 are obtained by sawing substantially spherical diamonds along two perpendicularly arranged planes. The diamonds thus obtained have the shape of a quarter sphere and are placed with one of the flat planes thereof in the side wall of the mud channel 21 (which has a cross-section slightly differing from the cross-section of the channel 2 shown in FIG. 5) and with the scraping edge 22 in the outer surface 15 of the bit body 1. The scraping edge is formed at the intersection of the two flat planes 23 and 24. Since these planes 23 and 24 are perpendicularly arranged with respect to each other, and the side wall 25 of channel 21 is arranged at an angle different from 90° with respect to the outer surface 15 of the bit body 1, a relief angle 17*a* exists between the plane 24 and the outer surface 15 of the bit body 1. This relief angle will, in the same manner as in the case of the cube-shaped diamond in FIG. 5, favorably influence the scraping action of the diamond 20.

Triangle-shaped diamonds 30 are applied in the arrangement shown in FIGS. 8 and 9. The diamonds are set closely together as shown in FIG. 8 to form an almost uninterrupted scraping edge composed of the scraping edges 31 of the diamonds. In the same manner as described with reference to FIGS. 5 and 7, there exists a relief angle 17*b* between the outer surface 15 of the bit body 1 and the plane 32 adjoining the scraping edge 31. The other plane 33 adjoining the scraping edge 31 lies in the wall 34 of the mud channel 35 (which has a cross-section different from the cross-sections of the channels 2 and 21 shown in FIGS. 4 and 7, respectively). The scraping edges 31 of the triangle-shaped diamonds 30 may be specially cut.

The triangle-shaped diamonds, however, need not be positioned in the manner shown in FIG. 8. If desired, they may also be arranged at some distance from each other as shown in FIG. 10. FIG. 11 showsa cross-section over the line 11—11 of FIG. 10. It will be appreciated that the arrangement of the diamonds 36 shown in FIG. 10 (as well as the arrangement of the diamonds 20 shown in FIG. 6) requires setting of diamonds along other mud channels that is capable of removing the ridges left between the annular tracks, in the manner described with reference to FIGS. 3 and 5.

The scraping edges of the diamonds set according to the present invention are all in the outer surface of the bit body. During operation of the bit in a hole, the outer surface of the bit body will wear over a depth D at the locations between diamonds scraping adjoining annular tracks in the bottom of the hole. FIG. 12 shows a cross-section over a location between two adjoining cube-shaped diamonds 5 belonging to a row of diamonds set along a mud-channel of a bit which has been in operation for some time.

Consequently the outer surface of the bit will always exactly match the wall and bottom of the hole which is being drilled by this bit, and the flow of mud supplied via the bore 3 of the shank 4 will be restricted to the mud channels arranged in the outer surface of the bit body. Since there is substantially no leakage of mud along those parts of the outer surface of the bit body lying between the mud channels, a very intensive mud flow action can be reached in these channels which results in an intensive cooling of the diamonds adjoining these channels and an excellent cleaning of these channels and the scraping edges of the diamonds from the scrapings and flour resulting from the action of the diamonds on the formation

FIG. 13 of the drawing shows a perspective view, partly in cross-section, of a graphite mold during mounting of the diamonds therein. By way of example, cube-shaped diamonds are shown, but it will be appreciated that any other type of diamonds having a scraping edge formed by the intersection of two flat planes, can be set in the same manner.

Only a part of the graphite mold 50 has been shown in FIG. 13. The mold has a cup-shape and is cut on a lathe, from a solid block of graphite thus forming a negative replica of the outer surface of the bit body 1 as shown in FIG. 1, but without the mud channels arranged therein. Since the mold is cut on a lathe, it can be made very accurately and to extremely close tolerances.

Thereafter, negative replicas of the mud channels 2 are placed and glued onto the interior of the cup-shaped mold, only one of thesechannel molds 51 being shown. Junk slot molds (not shown) are further placed at the locations where desired.

At one side along each channel mold 51, the diamonds 5 are placed by glueing them with one plane thereof to the side wall 52 of the channel mold 51, so that the scraping edge 19 thereof is exactly on the line of intersection between the side wall 52 of the channel mold 51 and the surface 53 of the mold 50. As a result there exists a free angle 17 betweeneach diamond 5 and the surface 53. Filling of the mold with powdered wear-resisting material and sintering the powder at an elevated temperature in a manner as is normal for this type of operations, results in a drill bit which after removal of the graphite mold elements has diamonds in the face thereof positioned as shown in FIGS. 3–5.

This way of setting the diamonds allows the use of mud channel molds which can be placed in a cup-shaped mold which has been cut very accurately on a lathe. Since the scraping edges 19 of the diamonds rest on the inner surface of this cup-shaped graphite mold, all the diamonds operating on a common annular track have their scraping edges within extremely close tolerances on the same level, which means that the diamonds will be uniformly loaded during operation, resulting in an excellent performance of the diamonds and an extremely long operational life of the bit.

As has already been noted above the face of the bit is that part thereof carrying the diamonds responsible for scraping the bottom part of the hole during the drilling operation. Thus, the face of the bit, as shown by way of example in FIGS. 1 and 2, is formed by the areas 9 and 10 thereof. The area 8 is used for scraping the side wall and contains diamonds which are also placed along the mud channels **2**. The lower ends of the scraping edges of these diamonds are rather heavily loaded during operation of the bit, and to improve the scraping action thereof it is desirable to have a free angle at this end of the scraping edge of each diamond.

When applying diamonds having the shape of a quarter sphere (these diamonds being of the same type as shown in FIGS. **6** and **7**), the desired free angle is the angle **60** in FIG. **14** which shows a side view (when looking in the direction **14** as indicated in FIG. **2**) of a mud channel **2** where it passes through the area **8**.

When using the cube-shaped diamonds shown in FIG. **15**, the desired result is obtained by placing the mud channel **2'** at a small slope with respect to the central axis (not shown) of the bit. This slope maybe in the order of from 1° to 5°. The lower plane of each cube-shaped diamond **5'** is then arranged at an angle **61** with respect to a plane located perpendicularly to the central axis of the bit. It will be appreciated that the mud channels may be situated as shown in FIG. **15** over the area **8** (vide FIG. **2**) only and be combined with the mud channel parts as present in the areas **6**, **9** and **10** shown in FIGS. **1** and **2**. Preferably, however, all parts of a mud channel are situated in a common flat plane to prevent excessive erosion of the side walls thereof. To this end, the central axis of each mud channel may be in a plane which is slightly slanted with respect to the central axis of the bit, e.g., at an angle **62** between 1° and 5°. The slope of the side walls (such as the walls **14**, **25**, and **34** and **39** in FIGS. **4**, **7**, **9** and **11** respectively) of the mud channels may be adapted such that the desired angles **17**, **17***a–c* are obtained in this situation.

As shown in FIGS. **1** and **2**, the cross-sectional area of the mud channels **2** gradually increases over the area **8** in the flow direction of the mud passing through these channels. This creates a diffusor action in the mud flow passing through the channels **2**, resulting in a conversion of dynamic energy of the mud flow into static energy and consequently in a smaller pressure drop along the mud channels. Thus, the inlet pressure of the mud entering bore **3** of shank **4** can be reduced, which results in a reduction of the pressure of the mud flowing through the channels. Consequently, the upward force exerted on the bit will be reduced thus allowing the application of a smaller load on bit. Further, the reduction in the velocity of the mud flowing through the channel parts in the area **8**, decreases the erosive effect of the mud flow deteriorating the setting of the diamonds in this area. Since the diamonds located in this area **8** will be subjected to heavy loads when the bit is drilling through an undersized hole over a trajectory cut by a worn, previous bit, it will be appreciated that any measures taken to decrease erosion on the walls of the mud channels will be most effective.

It will further be appreciated that the application of the invention is not limited to the use of the types of diamonds shown in the drawing. It will also be understood that although the diamonds used may be cut in such a manner that they have a mathematically straight scraping edge and mathematically flat planes forming this scraping edge, the use of non-cut diamonds having a substantially straight scraping edge between substantially flat planes is not excluded. Thus, a selection can be made from a collection of non-cut diamonds as diamonds which are suitable for use in the bit body without requiring any corrective cutting action.

Further, the invention is not limited to the particular shape of the face of the bit, which in the examples shown in FIGS. **1** and **2** is formed by the areas **9** and **10**. Thus, the invention can be applied to the face of any type of diamond bit, be it a full-hole bit or a core bit.

The shapes of the areas **6** and **8** may differ from the shapes shown in FIGS. **1** and **2**. If desired, the area **8** may be curved in the cross-section shown in FIG. **2**. The diamonds **7** in the area **6** may be grouped along the mud channels in one or more rows. Since they are set in a blunt position in a direction radial to the central axis of the bit, the cooling requirements thereof are relatively low.

If desired, the diamonds **7** may be set in a blunt position in a radial direction as well as in a direction parallel to the central axis of the bit. This means that the diamonds do not exert any cutting action at all.

In another embodiment of the present invention the area **6** together with the diamonds **7** may be omitted.

The width of the channels **2** is relatively small, and in the order of 2–8 millimeters. The depth of these channels is in the order of 2–6 millimeters.

Further, the invention is not limited to the number and shape of the mud channels, nor to the location on or the distribution of these channels over the surface of the bit body.

If desired, the diamond bit according to the invention may be used in combination with stabilizers and/or reamers of known design. These known stabilizers may, for example, be of rubber or hard-faced steel and are carried by the drill string at some distance above the diamond bit according to the invention. They will dampen the oscillating movements of the drill string. The known reamers, if applied, are also located above the diamond bit according to the invention. Since these known reamers have the characteristic feature of being able to cut in directions radial to the central axis of the reamer, the hole is cut to a diameter greater than the outer diameter of the reamer, which has the advantage that the diamond bit (and the reamer) can be very easily lifted from the hole, or run in.

Since the flat plane of each diamond adjoining the scraping edge thereof lies in the plane of the wall of a mud channel, the diamonds will be effectively cooled and the scrapings and flour removed from the locations where they are collected on the scraping edge, the plane of the diamond and the wall of the mud channel independent of the depth to which the diamonds are scraping into the formation. This means that the bit according to the invention can be used with equally good results in soft as well as in hard formations, since the cleaning and cooling of the diamonds will be sufficient in both cases.

We claim as our invention:

1. In a diamond bit for drilling a hole in a subsurface earth formation of the type wherein a single row of diamonds is arranged along one substantially flat side wall of each of a plurality of mud channels which extend through the outer surface of a diamond-carrying bit body having a face portion for cutting the bottom of the hole, the improvement which comprises:

diamonds having at least two substantially flat outer surfaces which intersect to form a scraping edge;

said diamonds being positioned in said diamond-carrying bit body in single rows along the substantially flat mud channel side walls so that said scraping edge is in a scraping position with respect to the hole to be drilled and so that one of said intersecting substantially flat outer surfaces of said diamonds lies in the substantially flat mud channel side wall.

2. The diamond bit of claim 1 wherein the scraping edge of diamonds positioned in the face portion of the bit lies in the outer surface of the bit body.

3. The diamond bit of claim 1 wherein at least a portion of the second of said intersecting substantially flat outer surfaces of said diamonds is positioned within said bit body adjacent said bit body outer surface; said second of said intersecting flat outer surfaces intersecting said bit body outer surface at a relief angle different from zero of the bit body along the line of intersection of said scraping edge and sand outer surface of said bit body.

4. The diamond bit of claim 1 wherein at least some of said diamonds having at least two substantially flat outer surfaces have at least one triangular outer surface.

5. The diamond bit of claim 1 wherein at least some of said diamonds have at least two substantially flat outer surfaces which perpendicularly intersect to form a scraping edge.

6. The diamond bit of claim 5 wherein at least some of said diamonds having outer surfaces which perpendicularly intersect are diamonds having the shape of a quarter sphere.

7. The diamond bit of claim 5 wherein at least some of said diamonds having outer surfaces which perpendicularly intersect are cube shaped.

8. The diamond bit of claim 7 wherein said bit body and each of said mud channels has a central axis and wherein at least a portion ofthe central axis of at least some of said mud channels is arranged in a flat plane which is slanted at an angle different from zero with respect to the central axis of the bit body.

9. The diamond bit of claim 8 wherein the angle different from zero is an angle between 1° and 5°.

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