Aug. 13, 1963 L. W. SHORT 3,100,543

DRILL BIT FOR CUTTING CORES

Original Filed March 8, 1957

Fig. 1

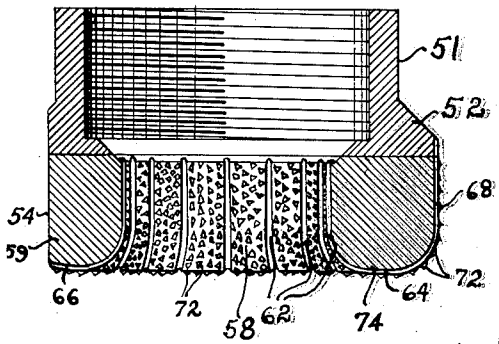


Fig. 2

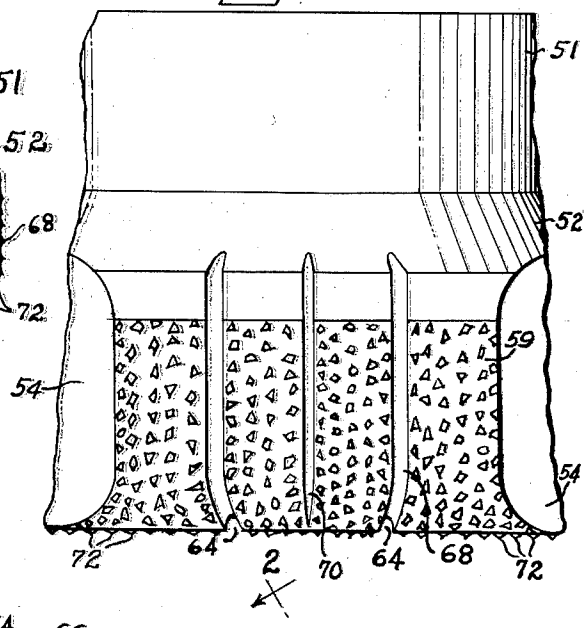
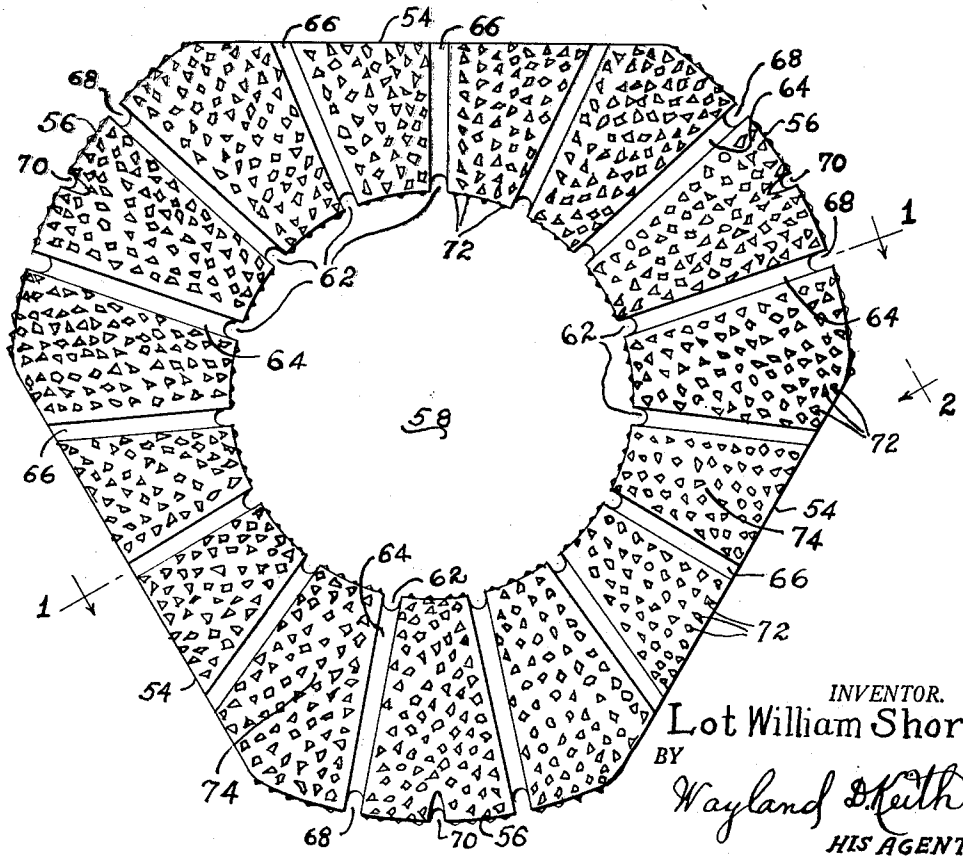


Fig. 3



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DRILL BIT FOR CUTTING CORES

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3 Claims. (Cl. 175—330)

This invention relates to rotary drill bits for drilling bore holes in earth formations, and more particularly to a drill bit for cutting cores, which drill bit utilizes hard abrading elements, such as diamonds or the like, for performing the cutting or abrading action on the earth formations.

This application is a divisional part of application Ser. No. 644,893, filed March 8, 1957, for Drill Bit.

With more particularity, this invention is directed to a drill bit which makes the greatest use of the abrading elements, such as diamonds, so as to obtain the maximum cutting efficiency with the minimum of wear and decomposition of the abrading elements, and the material bonding the abrading elements to the bit body.

Various drill bits embodying diamond insets, or other hard abrading elements, have been proposed heretofore, but these, for the most part, were not designed to give the correct circulation of a coolant to the face of the bit so that each and every abrading element, such as a diamond, was properly cooled during the abrading action, and which was, at the same time continuously cleansed, as was the area surrounding the abrading elements. These are washed free of particles resulting from the abrading action on the formation. These particles are in the form of fine powder or minute formation particles. The constant cleansing of the abrading elements and the area surrounding them, enables the abrading elements, such as diamonds, to directly contact the formation on the bottom and the adjacent sides of the bore hole, which makes possible rapid cutting action by the abrading elements.

Furthermore, the abrading type bits which have been in use heretofore, were generally of a character which were substantially of the same diameter as the diameter of the bore hole, and, as the abrading elements dislodged the formation from the bottom of the bore hole, the drill bit, being of such construction, further abraded the loose material into finely comminuted powder, which would retard considerably the drilling action, in that the comminuted material is not readily dispelled, because the drilling fluid is not readily forced through the interstices around the abrading elements between the lateral passages on the lower end of the bit body, thereby preventing full contact of the abrading elements with the uncut formation, thereby reducing the effective cutting action of the abrading elements.

In the present invention, the drill bit comprises a body portion having a threaded cylindrical shank, which threaded shank portion usually has a tapered tool joint thread, which threads may be either male or female, in accordance with the particular string of the drill stem on which the bit is to be used. The body portion of the present bit is enlarged and preferably has three flattened facets spaced symmetrically around the periphery thereof, so as to present vertically arranged channels between each flatened side portion or facet and the wall of the bore hole, when the bit is in the bore of a well. The bit, in general, presents a design of triangular shape, with modified rounded corners, when viewed from the bottom, with each of the adjacent facets being connected to an arcuate face of substantially the same curvature as the circumference of the hole it will cut. The bottom of the bit is of a shape to present a center core receiving hole, and an annular rounded bottom face portion which blends into

tangential continuity with the cylindrical side portions and with the center core receiving hole. A bit of this construction enables the abraded particles to be readily washed from the lower portion of the bore hole, which particles are disposed of by the circulation of the drilling fluid in the bore hole in the conventional manner.

The body of the bit has the cylindrical segment portions thereof positioned to lie transversely opposite the respective flattened portions, which cylindrical segment portions have a common axis. The diameter described by the cylindrical segment portions about said common axis is greater than any transverse distance taken on a plane through the bit body, which plane is perpendicular to the axis of the cylindrical segments. The lower end of the drill bit has a substantially annular, convexly contoured face covering the greater portion thereof, which face has lateral passages formed therein for supplying coolant, such as water, drilling mud, or the like, to the drilling face of the bit, which passages are constricted in such manner as to permit the fluid to be discharged along the face of the bit in sufficient volume to thoroughly cool the abrading elements, such as diamonds, which fluid is discharged at a pressure and velocity sufficient to erode or cut the formation by the action thereof, which greatly expedites the removal of the loosened formation, thereby expediting the progress of the bit. This eroding or cutting action by the fluid presents an advantage over other bits which use similar abrading elements.

An object of this invention is to provide a bit of the character which utilizes diamonds or other hard abrading elements, which diamonds are set along the contact face and sides of the bit, so as to obtain the maximum cutting or abrading functions with a minimum of wear on the abrading elements and on the bonding elements therefor.

Another object of the invention is to provide a conduit system for fluid circulation through a bore hole and around a drill bit, which will maintain a high pressure on the coolant fluid which is directed at high velocity, to every abrading portion of the bit body.

Still another object of the invention resides in the provision of a drill bit wherein any transverse distance through the bit, which lies in a plane perpendicular to the axis of the bit, is less than the size of the bore hole which it will cut.

A still further object of the invention is to provide a rotary drill bit of the abrading type, which has lateral fluid discharge passages formed in the face thereof, wherein the lateral passages are so designed as to discharge the fluid under pressure in such manner that the fluid discharged will be at a velocity and pressure which erodes or cuts the formation and washes the abraded formation free therefrom, so as to keep the interstices between the abrading elements free of formation particles.

Yet another object of the invention is to provide an abrading drilling bit, the pressure on and the lineal speed of the cutting portions of which, can be controlled to give maximum efficiency.

A yet further object of the invention is to provide, in a drill bit, a course for the drilling fluid, which course is so designed as to provide free flow of coolant to the portions of the bit which are operating under great pressure, thereby dissipating the heat created thereby.

Still another object of the invention is to provide a bit construction whereby the cut and eroded formation will pass directly into the up-stream of drilling fluid, without having to be reground over the cutting surface, and which will allow the material in the bottom of the hole to be washed up without wearing the cutting elements by regrinding such material.

Yet another object of the invention is to provide a drill bit construction whereby the maximum amount of

cooling fluid is directed under pressure to the abrading surfaces which contact the formation.

Another object of the invention is to provide a polygonal bit body, preferably triangular in shape, with rounded or modified corners, thereby eliminating hydrostatic pressure differential when going into or coming out of the hole, the non-circular shape of which bit also eliminates the sticking thereof in certain formations.

A general object of this invention is to provide a drill bit, the construction of which provides a maximum use period for the abrading elements, by providing coolant in the greatest amounts where the greatest abrading action takes place, and by protecting the abrading elements and the matrix thereof from regrinding cut formation before it can be washed from the bore hole by the drilling fluid.

Another object of the invention is to provide an abrading type drill bit, wherein the wall reaming contact portions are relatively narrow compared to the intermediate, non-contact portions.

A final object of the invention is to provide a drill bit of substantially triangular shape with modified rounded corners, which bit may be run into a non-circular hole as drilled by a three-cone milling type rock bit without the bit hanging or becoming stuck in the well.

With the foregoing objects in minds, and others which will become manifest as the description proceeds, reference is to be had to the accompanying drawings, in which like reference characters designate like parts in the several views thereof; in which:

FIG. 1 is a longitudinal sectional view of a core drill bit, taken substantially on the line 1—1 of FIG. 3, looking in the direction indicated by the arrows;

FIG. 2 is a fragmentary elevational view of the bit, taken on the line 2—2 of FIG. 3, looking in the direction indicated by the arrows, and showing a portion of the bit body and one of the upright cutting sides thereof; and

FIG. 3 is a bottom plan view of the core drill bit embodying the invention.

The drill bit, as shown and described herein, is of the character used on the lower end of rotary drill stem in the drilling of deep wells and the like, and particularly in the drilling of hard formation to obtain a formation core, by the rotary drilling method, wherein the drill stem (not shown) is rotated by a rotary table (not shown), and wherein the drill stem is usually raised from or lowered into the bore hole by the draw works (not shown) of the drilling rig, and wherein drilling fluid, prepared from bentonite clays and the like, is circulated down through the drill stem and is discharged through the lower end of the drill bit, so as to cool the abrading elements on the bit, and to cleanse the bottom portion of the bore hole to free it of abraded particles of formation, as is well understood in the art of rotary well drilling.

Core bits as have been used heretofore have, for the most part, utilized a cylindrical body with a convex face on an annular type bit, which necessitated the grinding of the formation into a relatively fine powder before the abraded particles where discharged into the circulation fluid, which circulated the abraded particles up the bore hole to be discharged with the drilling fluid at the upper end of the bore hole.

The present bit, as disclosed herein, is of general triangular shape with rounded or modified corners, which modified or rounded corners are inset with abrading elements on the rounded corners and with facets between the cylindrical segment portions each providing an open space between the bit body and the wall of the well when the core bit is within the well.

The bit, as disclosed herein, comprises a shank portion 51, which is threaded for suitable connection with a core barrel or other threaded arrangement on the lower end of a drill stem, which threaded shank is preferably integrally connected with an enlarged bit body portion 52. The body portion 52 is of general triangular shape with modified rounded corners, and is of the general configuration as shown in FIG. 3, and has three flattened sides or facets 54, which sides or facets are connected by arcuate segments 56, which arcuate segments are coaxial with the axis extending longitudinally through the bit body, and which arcuate segments 56 are of less width on the perimeter of the bit body than the width of the respective facets 54, which facets provide large openings between the bit body and the wall of the well for passage of large pieces of formation therethrough without the formation having to be ground or pulverized into powder. An axial opening 58 extends through the bit body and interconnects, in fluid communication through threaded shank 51, with a drill stem used for conducting drilling fluid downward therethrough.

A matrix 59, of sintered metal, is securely bonded to the lower end of the bit body 52, which matrix 59 is of the same triangular shape with modified rounded corners as the bit body 52. The matrix has passages 62 formed therein, which passages are parallel to the rotational axis of the bit body. These passages lead from the threaded portion of shank 51 so as to direct drilling fluid downward on the outside of the core being cut, hence radially outward through passage 64 and passages 66, with the passage 64 being connected with peripheral passage 68, with the terminal ends of passages 66 leading into the opening formed between facets or flattened portions 54 and the wall of the well being drilled. It is preferable to have a passage 70 spaced intermediate the peripheral passages 68, so as to afford passages to direct the circulation fluid and the abraded particles into the drilling fluid stream and to the top of the well.

The bit body 52 is preferably constructed of high quality steel, which body 52 is fitted into a mold cavity wherein the abrading elements, such as diamonds, have been prepared. The abrading elements 72, which are to be bonded to the bit body 52, are pre-set in a mold cavity, in a manner well understood in the art of molding abrading or diamond set bits of this character, and with the abrading elements 72, such as diamonds, thus set or arranged in the mold cavity, a sintered metal or matrix 59, which is to be the bonding element between the abrading elements and the bit body, is formed in the mold cavity in such manner as to receive the enlarged body portion 52 of the bit. Then high pressure and relatively high heat are applied to cause the bonding or fusion of the sintered metal with the bit body, which sintered metal has the abrading elements protruding therefrom, but firmly anchored therein in such manner that the abrading elements form abrading lands between the various lateral fluid passages 62, 64, 66, 68 and 70 on the bit body, so that the entire abrading portion of the bit, including the walls of the core receiving bore or axial opening 58 and the annular convex portion 74 thereof, as well as the cylindrical segments 56, are set with the abrading elements 72.

The abrading elements 72, such as diamonds, are inset within the sintered metal of the matrix 59 in a manner well understood in the art of setting abrading elements. The abrading elements, such as diamonds, are set within the inner bore of the matrix 59, which abrading elements extend around the convex lower face 74 of the matrix 59, and over the cylindrical segments 56, substantially as shown in FIGS. 1 and 2. The cross-sectional area of the passages 62, 64, 66 and 68 is such as to enable a high velocity of fluid to be maintained therethrough at all times, so as to present a cooling action on the matrix and the abrading elements, and at the same time exert an eroding effect on the formation being abraded.

By having the bit body and the matrix of a general triangular form, and with the cylindrical cutting surfaces 56 being of relatively small area compared with the circumference of the bit, it is possible for the cutting action of the abrading elements to be proportionately distributed,

as the reaming action of the abrading elements on the peripheral faces **56** is sufficient to keep the hole to size, while the greatest cutting action is on the convex face **74** inwardly, to remove the formation from the bottom of the hole to enable the cutting of the core, which projects upward into opening **58** of the bit body.

It is to be pointed out that the formation abraded from the bottom of the hole is discharged into channels formed between the flattened facets **54** and the wall of the well, with little or no re-grinding. The abraded particles cut from the wall of the well are washed into the fluid stream and up to the top of the well with little or no re-grinding of such particles, which improves the performance of the abrading elements and prolongs the useful life thereof.

The bit, as described herein, may be run into a non-circular well, such as may be drilled by a three-cone milling type rock bit, without the bit hanging or becoming stuck in the well.

The reaming faces **56** of the bit, as described herein, are relatively narrow as compared to the circumference of the bit, and it is possible, therefore, for the bit to be passed down through a crooked hole in which "key-hole slots" may have been formed by the action of a drill stem wearing against the wall of a well.

The bit as shown and described herein may be used with any type core barrel, but is particularly adaptable for use with a core barrel as disclosed in Patent No. 2,490,512, dated December 5, 1949, for Core Barrel.

Having thus clearly shown and described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A core bit adapted to be attached to a drill stem for the cutting of cores in earth formations, said core bit comprising

a hollow shank,

an annular body carried by said shank and having in bottom plan view a generally triangular outer configuration defined by three coaxial segmental substantially cylindrical lateral reaming faces and by three non-reaming facets,

each of said facets being of greater circumferential extent than any of said faces with one such facet between and joining successive ones of said reaming faces and lying wholly within the cylindrical surface generated by said reaming faces,

said body having a coaxial core-receiving opening in communication with the hollow of said shank, and

abrading elements set in said reaming faces and in the inner, lower and outer surfaces of said annular body.

2. A core bit as defined by claim 1, wherein

said shank is cylindrical,

said body is of larger transverse dimension than said shank, and

any transverse external dimension of said body perpendicular to its axis is less than the diameter of the cylindrical surface generated by said lateral reaming faces in drilling.

3. A core bit as defined by claim 1, wherein,

said body has an inner cylindrical surface and a lower convex surface smoothly merging into said inner surface and also into said lateral reaming faces, and

said abrading elements are set in said inner cylindrical surface, said lower convex surface and said lateral reaming faces, with said non-reaming facets free of abrading elements.

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