Aug. 2, 1932. C. B. KENNEDYE 1,869,969

ROTARY DRILLING TOOL

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Fig. 1.

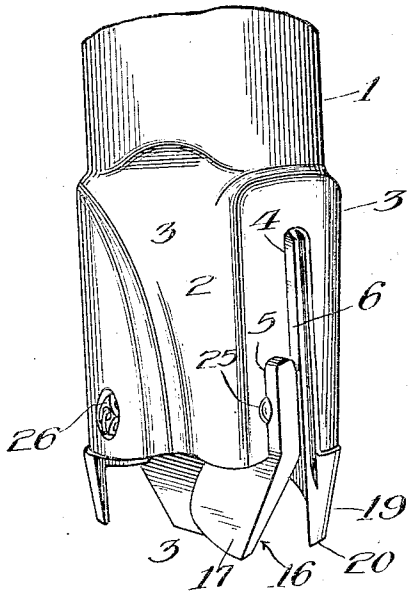


Fig. 2.

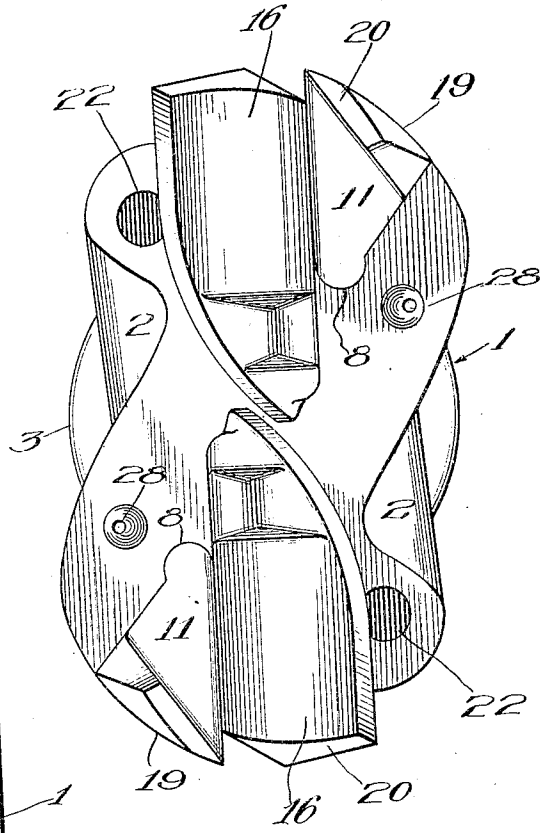
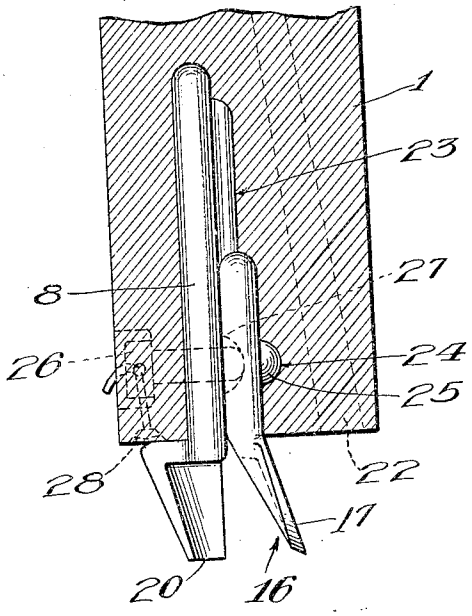


Fig. 3.



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Fig. 4.

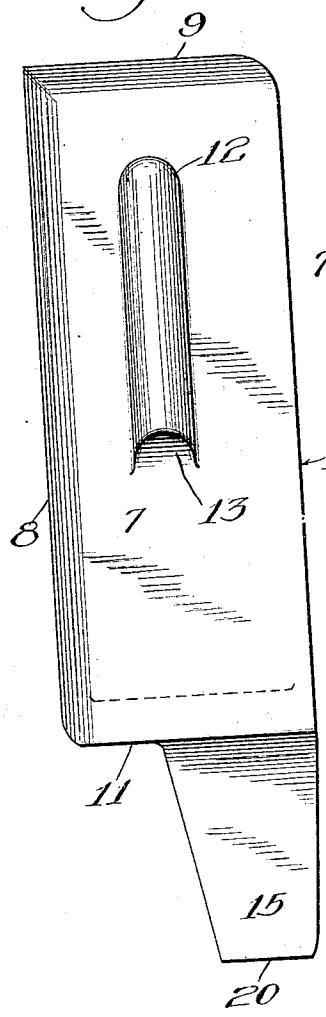


Fig. 5.

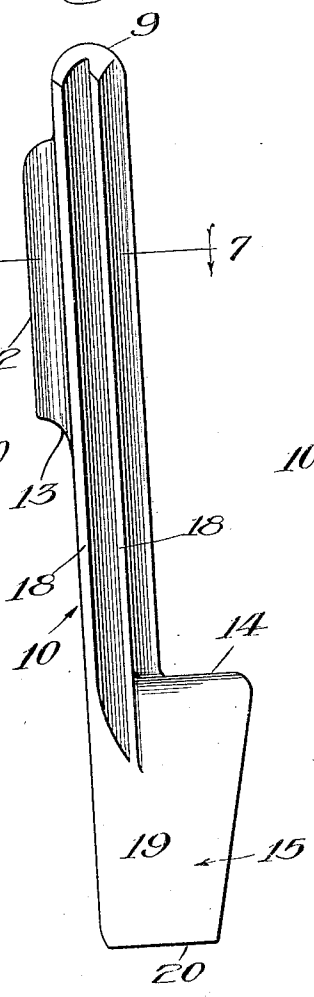


Fig. 6.

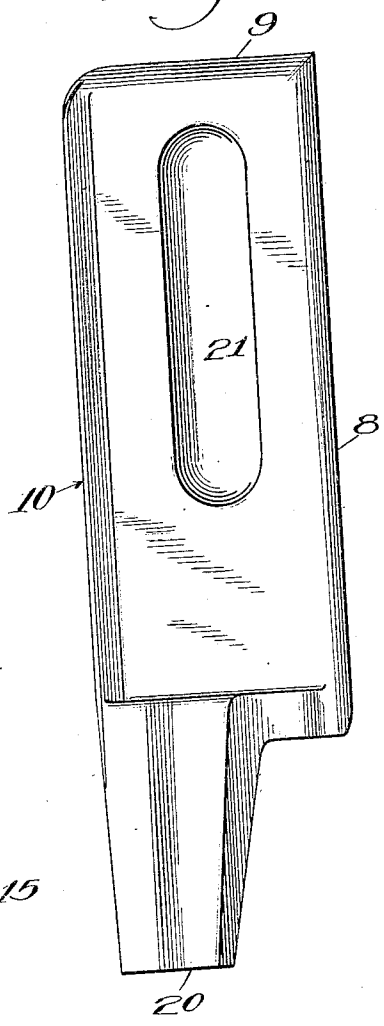
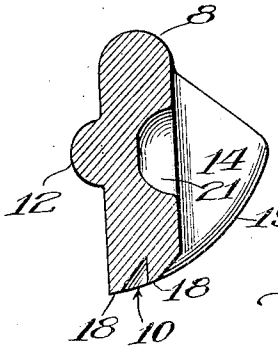


Fig. 7.



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UNITED STATES PATENT OFFICE

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ROTARY DRILLING TOOL

Application filed November 23, 1929. Serial No. 409,206.

This invention relates to improvements in a rotary drilling tool particularly designed for the efficient and economical drilling of oil wells, although in its broader aspects it is, of course, adapted for use in the drilling of a hole of any kind.

The present invention is primarily directed to improving that type of rotary drilling tool which simultaneously drills and reams the hole to gauge and in which drilling blades and separate reaming blades are removably mounted in a head.

In the drilling of oil wells, it has become increasingly evident in recent years that rotary drilling tools must be designed to drill a straight hole, that is, one substantially vertical. The importance of this requirement arises because of the constantly increasing depth to which oil wells are now drilled and because of the fact that by far the greater number of wells must be pumped after the diminution of natural flow. In the pumping of oil wells, particularly the deeper wells, it is a constant problem to secure a good production of oil.

The drilling industry in the past four or five years has become increasingly conscious of the importance and almost necessity for drilling a straight hole, and rotary well drilling tools are now being designed with that thought primarily in mind.

To drill a straight hole it is almost essential to design a tool which will simultaneously drill and ream the side walls of the hole being drilled. For this purpose I have heretofore designed a tool comprising a head provided with longitudial and base slots opening, respectively, to the sides and to the base of said head, in which slots are adapted to be removably mounted reaming blades and drilling blades, the reaming blades bearing in and supported by the head and having a portion extending slightly beyond the side wall of the head while the drilling blade also bears in and is supported by the head and has a drilling portion projecting from the base of the head. The lower edge of the reamer blade projects below the base of the head, terminating in substantially the same horizontal plane as the lower cutting edge of the drilling blade, whereby the lower edge of the reamer functions as an auxiliary or secondary drilling blade.

In use and operation, the lower edges of the drilling and reaming blades are gradually worm away until their lower edges, instead of projecting for a substantial distance below the base of the head, are substantially flush with the base of the head, at which time the large area comprising the base of the head is presented to the formation being drilled, and since there is no sharp cutting surface, the speed of rotation will be materially checked and the driller will be notified that the lower edges of the drilling and reaming blades have become worn to the point where they must be replaced.

Following the introduction of electric power driven pumps of 150 to 250 H. P., which will carry a considerable overload before blowing a fuse, it has been found that the driller was not notified that the drilling edges of the drilling and reaming blades had worn out as quickly as it was indicated to him in the usual type of steam driven pump, and, as a result, in certain sharp sand deformations, the outer edge of the head was worn. This was objectionable for the reason that the head performs merely the function of a support or holder for the drilling and reaming blades and is designed to last indefinitely.

I have designed a new type of reamers which presents a considerable amount of flat surface which will not drill and which, therefore, protects the head from such wear.

Another important feature of the tool of the present invention is that it permits more weight to be placed on the drilling bit proper without pounding out the slots in the drilling head. This is effected by an offset portion of the reamer which sets flat on the bottom of the head and acts as a bearing surface as well as does the topmost part of the reaming blade which is inserted in the slots of the head.

In addition, by twisting or offsetting the lower drilling portion of the reamer which acts as a secondary cutter on the bottom of the hole being drilled, the reamer tracks approximately one-half to three-quarters of an

inch on the outer periphery of the hole, which makes for much faster drilling and at the same time it keeps up the corner of the bit and causes it to wear off straight, preventing the bit from drilling off at an angle, which it might do more readily if the bit was permitted to wear diamond point.

Another feature resides in the fact that with the twist in the lower portion of the reamer, I am able to secure much greater strength than if the reamer were parallel to the drilling blade. That is, the formation is encountered while the cutting portion of the reamer is travelling in a thin circular plane, rather than presenting a large amount of horizontal cutting surface to the formation.

Another feature resides in providing the lower portion of the reaming blade with a rounded portion approximately 2½" to 3", which is disposed close to the outer diameter of the hole which has been drilled. At 40 R. P. M. it can be readily seen that with this type of construction the bit would not tend to drill off at an angle. In other words, the rounded portion of the offset guides the travel and holds the reamer, and, of course, the entire drilling tool, more truly to travel in a circular plane. If the elongated side edges of the reamer should suddenly meet a fault or softer formation, which usually occurs at a distinct angle, the reamer would be prevented from drilling too far into the bank by the guide.

Another feature resides in the fact that the lower twist or offset in the reaming blade prevents material from clogging between the back portion of the primary drilling blade and the secondary reaming blade.

The utility of the invention as well as other objects and advantages will be more apparent from the following description.

Fig. 1 is a side elevational view of the drilling tool of the present invention.

Fig. 2 is a bottom plan view thereof on an enlarged scale.

Fig. 3 is a cross sectional view taken on line 3—3 of Fig. 1.

Figs. 4, 5 and 6 are, respectively, side, edge and side elevational views of the reamer.

Fig. 7 is a cross sectional view taken on line 7—7 of Fig. 5.

Referring more in detail to the drawings, 1 designates as a whole a head of suitable metal, suitably heat treated. This head is preferably provided at its upper end with the usual tapered screw threaded pin adapted for registering engagement with the screw threaded portion of a drill collar. The head 1 is preferably designed so that its lower portion simulates to some extent the tail of a fish. For instance, it is cut away at 2 at both sides and enlarged at 3. The cut-away portion 2 defines a groove for directing the cuttings upwardly and outwardly to effectively dispose of same, while the enlarged portion 3 is provided with longitudinal slots 4 and communicating cross slots 5. It is understood that the head 1 may be provided with any number of slots 4 and 5. Slot 4 opens to the side 3 of the head, is closed at its upper end and open at the base of the head. Cross slot 5 likewise opens to the side 3 of the head, and also opens to the base of the head. The slots 4 and 5 are preferably in free communication, and the upper end of slot 5 terminates a substantial distance below the upper end of slot 4.

A reamer designated as a whole at 6 is is adapted to be removably mounted in the slot 4, the upper end thereof bearing against the upper wall defining slot 4, while the lower end thereof projects a substantial distance below the head for a purpose to be described. Each reamer 6 comprises essentially a body portion 7 having rounded sides 8 and 9, cutting side 10 and lower edge 11. Intermediate its length and parallel with sides 8 and 10 each reamer is preferably provided with an integral rib 12 cut away on its lower end to provide a rounded cut away portion or shoulder 13 for a purpose to be described. Integrally connected with the lower edge 11 of the body portion 7 is an offset portion 14 terminating in a downwardly extending blade 15. When the reamer 6 is properly placed in head 1 for operation, the rounded edge 9 bears against the complemental rounded wall closing the upper end of slot 4, while rounded edge 8 similarly contacts and bears against the inner complemental rounded wall of slot 4. Edge 11 terminates substantially flush with the base of the head 1. By far, the greater amount of body portion 7 is enclosed in and supported by the head 1, the arrangement being such that a relatively small portion of the reamer projects beyond the side wall 3 to present the cutting edge 10 to the formation being drilled.

A drilling blade 16 is likewise removably mounted in each slot 5, the upper rounded edge thereof bearing against and contacting the upper rounded wall closing slot 5, the arrangement being such that each drilling bit is adequately supported in the head 1 and has a portion projecting below the base of the head forming a drilling blade 17. Preferably, the drilling blade 17 is offset forwardly, as shown, for the purpose of facilitating drilling operation. The arrangement is such that when a drilling bit 16 and reamer 6 are inserted into the slots 5 and 4, respectively, and properly placed in the head for operation, the shoulder 13 bears against the upper rounded edge of drilling bit 16.

Referring now to Figs. 4 to 7, each drilling edge 10 comprises a plurality of relatively thin parallel elongated longitudinal knife-like cutting edges 18. While I have illustrated the edge 10 as being divided into two cutting edges 18 in Fig. 5, it is to be under-

stood that this is simply illustrative. I have found it desirable to provide knife-like cutting edges 18 to secure efficient reaming. As a feature of the invention, the outer surface of the extension 15 of each reamer is rounded, as shown at 19, for a purpose to be described. The lower edge of each extension 15 terminates in a cutting edge 20. The face of each reamer opposite the face which carries rib 12 may be recessed, as at 21, during manufacture.

I will now describe the steps of assembling and disassembling the different parts described. Before doing so it may be well to point out that the head is provided with the usual water channel, which in the present instance preferably divides into two branches 22, Fig. 2. Assume, to start with, that the head is empty, that is, that no drilling or reaming bits are positioned therein. After the slots 4 and 5 are thoroughly cleaned with an air or steam hose, and suitably greased, they are ready to receive reaming blades 6 and drilling blades 16. Preferably, one wall of the longitudinal slot 4 is provided with a parallel recess 23 (Fig. 3) to register with the rib 12 of the reamer. A wall of the recess 5 is likewise provided with a transverse recess 24 to accommodate the rib 25 of drilling bit 16. A reaming blade 6 is inserted upwardly in the longitudinal slot 4 until the rounded edge 9 bears against the upper round wall closing slot 4, the rib 12 at that time registering with recess 23 and the upper surface of the offset shoulder 14 abutting against and contacting the opposite face or base of head 1, the reaming edge 10 projecting beyond the side wall of the head a slight distance. A drilling blade is then transversely slid into the cross slot 5 in such a manner that the rib 25 thereof registers with the slot 24, the upper rounded edge of the blade 16 at that time abutting against and contacting the rounded wall closing the upper end of slot 5. A locking screw 26 is then screwed into the head until its inner end abuts in a recess 27 provided in the face of the drilling blade 16 opposite the rib 25. After the safety bolt 26 is tightened, a small pin or nail is inserted in the small hole 28 at the base of the head and through a hole in the head of the safety bolt 26. The head of bolt 26 is preferably countersunk and the end of the nail is preferably bent into the countersunk portion.

While I have described the insertion of only one reamer and one blade, it is understood that this description is applicable to more than one, since the parts are identical. The bit is now ready for drilling.

During the drilling operation, the lower edge of the drilling blade 17 drills on the bottom of the hole being drilled, while the side edges 18 of reamers 6 ream the side walls of the hole being drilled. In addition, the lower edge 20 of each reamer rotates in substantially the same horizontal cutting plane as the lower edge of cutting blade 17 so that it functions as an auxiliary or secondary drilling bit. The water used for drilling is fed through branches 22 directly to the point where drilling is being carried on, thus insuring the efficient removal of cuttings which are directed upwardly and outwardly by the groove 2. During the drilling operation, it will be seen that the strain of the tremendous weight on the drilling tool is well distributed. For instance, each reamer bears against the upper and inner walls closing slot 4, and in addition, the broad face of shoulder 14 forms an auxiliary bearing surface with the base of the head.

Likewise, the cut-away shoulder 13 at the base of the rib 12 bears against the upper edge of drilling bit 16. In addition, the upper and inner edges of drilling bit 16 bear against the upper and inner rounded walls closing slot 5. The drilling blade 17 is offset forwardly into the path of the formation being drilled to facilitate drilling. Because of the great amount of space between the rear face of drilling bit 17 and front face of extension 15, there is little likelihood for material to ball up and clog in this space.

When the drilling has proceeded to the point where the drilling blade 17 and extension 15 of reamer 6 have become worn to the point of inefficiency, a broad blunt surface will be then presented to the formation being drilled. If for any reason the driller is not immediately notified of this fact, the broad face of shoulder 14 will prevent the base of the head 1 from being worn away. Eventually, the tool is withdrawn from the hole, and the reamers and drilling bits are removed. After being cleaned as before described, new reamers and drilling bits may be inserted in the head and the head is returned to the hole for further drilling.

From the foregoing it will be seen that the base of the head will always be protected from unintentional wear because the larger flat face of the shoulder 14 presents a considerable amount of flat surface which will not drill and which, therefore, protects the head from wear. In addition, this offset portion decreases the tendency to pound out the slots in the drilling head because of excessive weight on the drilling bit proper. In addition, by offsetting the extension 15, a device is provided which amounts substantially to a circular knife. Further, the rounded face 19 of the offset portion guides the travel of the entire assembly and holds it more truly to a circular travel.

I claim as my invention:

1. A rotary drilling tool comprising in combination, a head provided with longitudinal slots and communicating transverse slots opening, respectively, to the sides and

to the base of said head, reamers removably mounted in the longitudinal slots and so disposed as to present an elongated reaming edge to the formation being drilled, and also a portion projecting below the base of said head, drilling blades removably mounted in said transverse slots provided with lower drilling edges projecting below the base of said head the faces of said drilling blades being disposed in a plane substantially radial with respect to said head, the lower projecting portion of each reamer being offset to provide a flat shoulder abutting against the base of the head and a lower side and bottom cutting edge travelling in spaced relation with respect to the lower cutting edge of the drilling bit and having the plane of its face disposed substantially tangent to the line traced by the outer edges of the drilling blades.

2. A reamer comprising a body portion substantially rectangular in shape, one side of which comprises a cutting edge, an offset shoulder integrally associated with the lower edge of said rectangular body portion, and an extension projecting below said shoulder provided with a lower side and bottom cutting edge, the plane of the face of said extension being at an angle to the plane of the face of the rectangular member.

3. A reamer comprising a body portion substantially rectangular in shape, one side of which comprises a cutting edge, an offset shoulder integrally associated with the lower edge of said rectangular body portion, and an extension projecting below said shoulder provided with a lower side and bottom cutting edge, the outer surface of said offset shoulder being rounded and the plane of the face of said extension being at an angle to the plane of the face of the rectangular member.

In testimony whereof I affix my signature.

CHARLES B. KENNEDYE.