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CLEANING DEVICE FOR ROTARY DRILLING TOOLS

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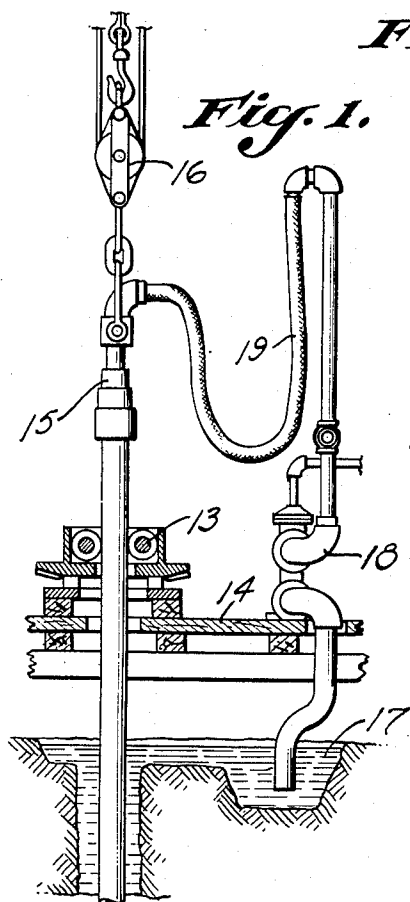


Fig. 2.

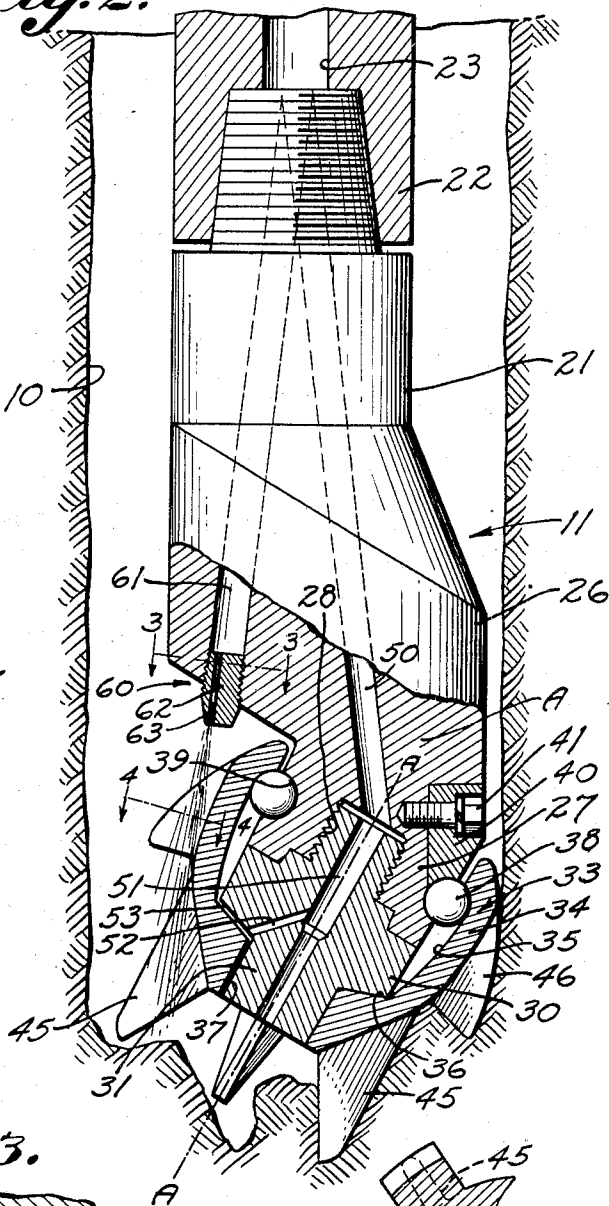


Fig. 3.

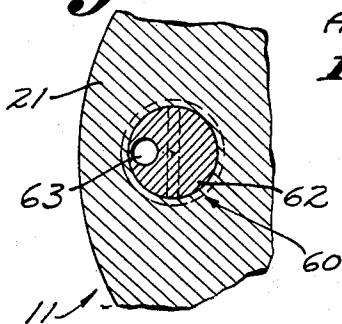
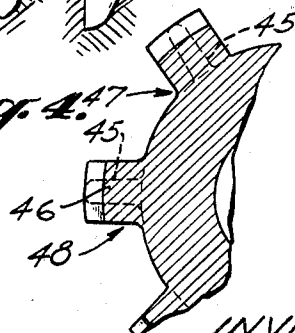


Fig. 4.



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CLEANING DEVICE FOR ROTARY DRILLING TOOLS

Application filed January 5, 1929. Serial No. 330,526.

Our invention relates to rotary bits used in drilling wells, and consists of a rotary bit having a rotatable cutter and a novel means for cleaning the cutter while it is operating in the well.

In the well-drilling art, the bit is secured to the lower end of the drill pipe which rotates it and carries rotary fluid to it. The rotary fluid issues from the bit and carries the cuttings upward around the drill pipe.

Teeth on different types of bits have different cutting actions, but where the cutters have a more or less rolling motion relative to the strata, the spaces between the teeth become filled with cuttings which pack in place and seriously impair the cutting qualities of the bit. This is especially true when drilling in sticky formations.

It is an object of this invention to provide a device for cleaning the space between the teeth on a bit having a rotatable cutter, this device operating to direct a flow of fluid therebetween.

The direction of this flow is important, and we have found it desirable to provide a nozzle which is adjustable relative to the shank of the bit so that the jet of fluid passing therethrough may be directed tangentially against the cutter, this jet passing between the cutter teeth.

It is a further object of this invention to provide an adjustable nozzle means for directing a jet of fluid tangentially against a cutter and between the teeth thereof.

A further object of our invention is to provide a bit of this nature in which the nozzle directs a washing stream onto the body and between those teeth which are momentarily not working.

Further objects and advantages of this invention will be made evident hereinafter.

In a co-pending application entitled "Rotary bit for reciprocating motion", invented by John A. Zublin, filed September 8, 1925, Serial No. 54,874, there is disclosed a par-

ticular type of rotary bit on which the nozzle means of our invention has proved particularly satisfactory. We will thus describe our invention as applicable to this type of bit without limiting ourselves thereto.

Referring particularly to the drawing,—
Fig. 1 is a utility view diagrammatically illustrating the drilling apparatus.

Fig. 2 is a view, partially in section, of the rotary bit shown in Fig. 1.

Figs. 3 and 4 are sectional views taken on their respective lines indicated in Fig. 2.

Referring particularly to Fig. 1, we have illustrated a bore hole 10 being formed by a rotary bit 11 incorporating the features of this invention. The rotary bit 11 is rotated by a drill pipe 12 which extends upward to the surface of the ground and is turned by a rotary machine 13 positioned above a floor 14 of a derrick structure. A swivel 15 is connected to the top of the drill pipe and is supported by a travelling block 16 in a manner to control the pressure of the bit 11 on the bottom of the hole. Rotary mud is adapted to be pumped from a sump 17 by a pump 18 and delivered through a flexible hose 19 to the swivel 15, whence this fluid passes downward through the drill pipe and through the rotary bit 11 in a manner to be described.

Referring particularly to Fig. 2, the bit 11 comprises a shank 21 which is suitably connected to the lower end of the drill pipe 12 by a collar 22 which has an opening 23 communicating with the interior of the drill pipe 12 and through which the fluid passing downward therethrough passes.

The shank 21 has an offset portion 26. A pin 27 is formed on the lower end of the offset portion 26 with its axis lying along the line A—A, this axis being oblique relative to the axis of rotation of the shank 21.

Threaded into an opening 28 of the pin 27 is the head of a thrust member 30, this member having a concentric bearing projection 31 extending downward therefrom.

Adapted to fit over the thrust member 30 and the pin 27, and to be rotatable relative thereto is a cutter 33 which comprises a body 34 having an opening 35 therein which is larger in diameter than the outer diameter of the pin 27 or thrust member 30. A bearing face 36 is formed on the body 34 and extends between the opening 35 and an opening 37, this latter opening being only slightly larger than the outer diameter of the projection 31 which serves as a radial bearing. The face 36 is adapted to bear against the thrust member 30 when the bit is in operation.

The cutter 33 is held on the pin 27 by means of a series of balls 38 which are positioned in a race 39 formed in the periphery of the pin 27. These balls are inserted after the cutter 33 is in its position shown in Fig. 2, this insertion taking place through a suitable opening which is subsequently closed by a lock member 40 clamped in place by a lock screw 41 which passes therethrough and is threaded into the pin 27.

Extending downward from the cutter 33 is a series of lower or drill teeth 45 each of which is shaped substantially as shown in Fig. 2, and a series of upper or reaming teeth 46 also shown in Fig. 2. Fig. 4 clearly illustrates these series of teeth, and the offset relationship therebetween. It will be noticed that a space 47 exists between each of the teeth 46, while a similar space 48 exists between each of the teeth 45.

During the time that such a bit is being rotated, rotary mud is supplied to the drill pipe 12 and passes downward therethrough and through the opening 23 of the collar 22. This mud subsequently passes through a fluid passage 50 formed through the shank 21 and pin 27, and through a passage 51 formed axially through the thrust member 30. A major portion of the fluid entering the passage 51 passes therefrom between the teeth 45, and acts to move any cuttings upward to the surface of the ground in the space between the drill pipe and the bore hole. However, a small portion of this fluid passes through a passage 52 communicating with the passage 51 and with a channel 53 formed in the surface of the thrust member 30 which contacts the shelf 36. This fluid rises in the opening 35 and lubricates the balls 38, as well as the engaging surfaces of the cutter and thrust member 30.

The most important feature of the present invention lies in the providing of a suitable nozzle means 60 which is placed in a side passage 61 which communicates with the opening 23 of the collar 22. This nozzle means 60 comprises a nozzle body 62 which is threaded into the side passage 61 in the embodiment shown in Fig. 2. However, we are not limited to this threaded engagement of the nozzle body 62 relative to the side passage 61. Formed through the nozzle body 62 is an ori-

fice 63 so positioned that by turning the nozzle body 62, the direction of flow of the stream of fluid passing through this orifice may be readily changed. We have shown the orifice 63 as being eccentrically placed in the nozzle body 62, this orifice being parallel to the axis of the nozzle body.

We have found it desirable that the jet of fluid leaving the nozzle means 60 should be directed substantially tangentially along the exterior of the body 34 of the cutter 33. This jet is thus successively directed through the spaces 47 between the teeth 46, all of these spaces being cleaned when the cutter 33 has made one revolution relative to the shank 21. The jet issuing from the orifice 63 also tends to clean the spaces 48 between the lower or drilling teeth 45 although this action is not as pronounced as that cleaning action which takes place in the spaces 47. However, it has been found that the drilling teeth 45, due to their peculiar swing and scraping cutting motions, are not as susceptible to being "balled-up" by cuttings when penetrating sticky formations as are the spaces 47 between the teeth 46, these latter teeth having more of a rolling motion with a lesser degree of scraping action, and it is on cutters having such roller motions that our invention is most applicable, inasmuch as these cutters become quickly clogged when penetrating certain types of formations. The jet issuing from the nozzle is directed between the teeth which are momentarily not working.

A jet of very material force is formed by the orifice 63. This is adequately demonstrated by the polish on the teeth 46 after a bit of this type has been in operation, these teeth being polished by the foreign particles ordinarily carried by the rotary mud which is used as a fluid for carrying the cuttings upward.

The teeth 45 and the lower portion of the thrust member 30 are invariably embedded in a dense structure, formed usually of cuttings which have been saturated with the mud supplied through the passage 51. A material back-pressure is thus built upon this passage, and the difference in pressure between this passage and that portion of the well into which the orifice 63 discharges, is ordinarily very great.

The position of the nozzle body 62 relative to the shank 21 is ordinarily adjusted at the factory, the determining factor in this adjustment being the determination of the most efficient position of the jet formed by the orifice 63 relative to the cutter 33. As previously mentioned, the position of this jet may be readily changed by rotating the nozzle body 62 relative to the shank 21. The nozzle body 62 ordinarily fits rather tightly in the side passage 61 so as to prevent any turning thereof during the operation of the bit.

It should be understood that our inven-

tion is not limited to the particular type of bit shown in the drawings, but is useful on various other types of rotary bits wherein it is desirable to direct a jet of fluid tangentially against a cutter for the purpose of preventing the accumulation of foreign matter between the teeth thereof.

Our invention in its broad concept consists of a bit having a cutter which rotates on the body, and the body has means for directing washing fluid against the cutter (preferably tangentially) and between the teeth as they rotate beneath the means which forms the washing stream.

We claim as our invention:

1. In a rotary bit, the combination of: a shank; a cutter rotatable on said shank and adapted to rotate as said shank rotates; and nozzle means for directing a flow of fluid tangentially against said cutter, said nozzle means comprising a nozzle body rotatably mounted in said shank and providing an eccentric orifice.

2. In a rotary bit, the combination of: a shank; a cutter rotatable on said shank and adapted to rotate as said shank rotates; nozzle means for directing a flow of fluid tangentially against said cutter; and means for adjustably connecting said nozzle means to said shank to change the path of said flow of fluid.

3. In a rotary bit, the combination of: a shank providing a fluid passage; a pin on said shank, the axis of said pin being oblique to the axis of rotation of said shank; a cutter rotatable on said pin; teeth extending outward from said cutter; nozzle means communicating with said fluid passage; and means for supplying fluid under pressure to said fluid passage while said bit is being used, said nozzle means directing a flow of said fluid tangentially against said cutter in a manner to clean the spaces between said teeth, and said nozzle means including a nozzle body rotatably mounted in said shank and providing an eccentric orifice.

4. In a rotary bit, the combination of: a shank providing a fluid passage; a pin on said shank, the axis of said pin being oblique to the axis of rotation of said shank; a cutter rotatable on said pin; teeth extending outward from said cutter; nozzle means communicating with said fluid passage; and means supplying fluid under pressure to said fluid passage while said bit is being used, said nozzle means directing a flow of said fluid tangentially against said cutter in a manner to clean the spaces between said teeth, and said nozzle means includes a nozzle body rotatably mounted in said shank and providing an eccentric orifice formed therein and extending parallel to the axis of rotation of said nozzle body.

5. In a rotary bit, the combination of: a shank; and a cutter rotatably mounted on

said shank, said cutter having digging teeth on the lower part thereof and reaming teeth on the upper part thereof, there being means in said shank for delivering rotary fluid to said digging teeth for mixing with the cuttings, and for directing a separate stream of rotary fluid against said reaming teeth.

6. In a rotary bit, the combination of: a shank; and a cutter rotatably mounted on said shank, said cutter having digging teeth on the lower part thereof and reaming teeth on the upper part thereof, there being means in said shank for delivering rotary fluid to said digging teeth for mixing with the cuttings, and for directing a separate stream of rotary fluid against said reaming teeth and said digging teeth.

7. In a rotary bit, the combination of: a shank; and a cutter rotatably mounted on said shank, said cutter having digging teeth on the lower part thereof and reaming teeth on the upper part thereof, there being means in said shank for delivering rotary fluid to said digging teeth for mixing with the cuttings, and for directing a separate stream of rotary fluid along one side of said cutter to wash the cuttings from said reaming and digging teeth.

8. In a rotary bit, the combination of: a shank; and a cutter rotatably mounted on said shank, said cutter having digging teeth on the lower part thereof forming a pocket and reaming teeth on the upper part thereof, there being means in said shank for delivering rotary fluid to said pocket formed by said digging teeth for mixing with the cuttings, and for directing a separate stream of rotary fluid against said reaming teeth.

9. In a rotary bit, the combination of: a shank; and a cutter rotatably mounted on said shank, said cutter having digging teeth on the lower part thereof forming a pocket and reaming teeth on the upper part thereof, there being means in said shank for delivering rotary fluid to said pocket formed by said digging teeth for mixing with the cuttings, and for directing a separate stream of rotary fluid along one side of said cutter to wash the cuttings from said reaming and digging teeth.

10. In a rotary bit, the combination of: a shank; and a cutter rotatably mounted on said shank, said cutter having digging teeth on the lower part thereof and reaming teeth on the upper part thereof, there being means in said shank for delivering rotary fluid to said digging teeth for mixing with the cuttings, and for directing a separate stream of rotary fluid to one side of said cutter to assist in carrying the cuttings upward in the well.

11. In a rotary bit, the combination of: a shank; and a cutter rotatably mounted on said shank, said cutter having digging teeth on the lower part thereof forming a pocket

and reaming teeth on the upper part thereof,
there being means in said shank for deliver-
ing rotary fluid to said pocket formed by
said digging teeth for mixing with the cut-
tings, and for directing a separate stream of
rotary fluid to one side of said cutter to as-
sist in carrying the cuttings upward in the
well.

In testimony whereof, the said JOHN A.
ZUBLIN has hereunto set his hand at Los
Angeles, California, this 26th day of De-
cember, 1928, and the said ELMER T. SCOTT
has hereunto set his hand at Los Angeles,
California, this 26th day of December, 1928.

JOHN A. ZUBLIN.
ELMER T. SCOTT.

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