

May 21, 1946.

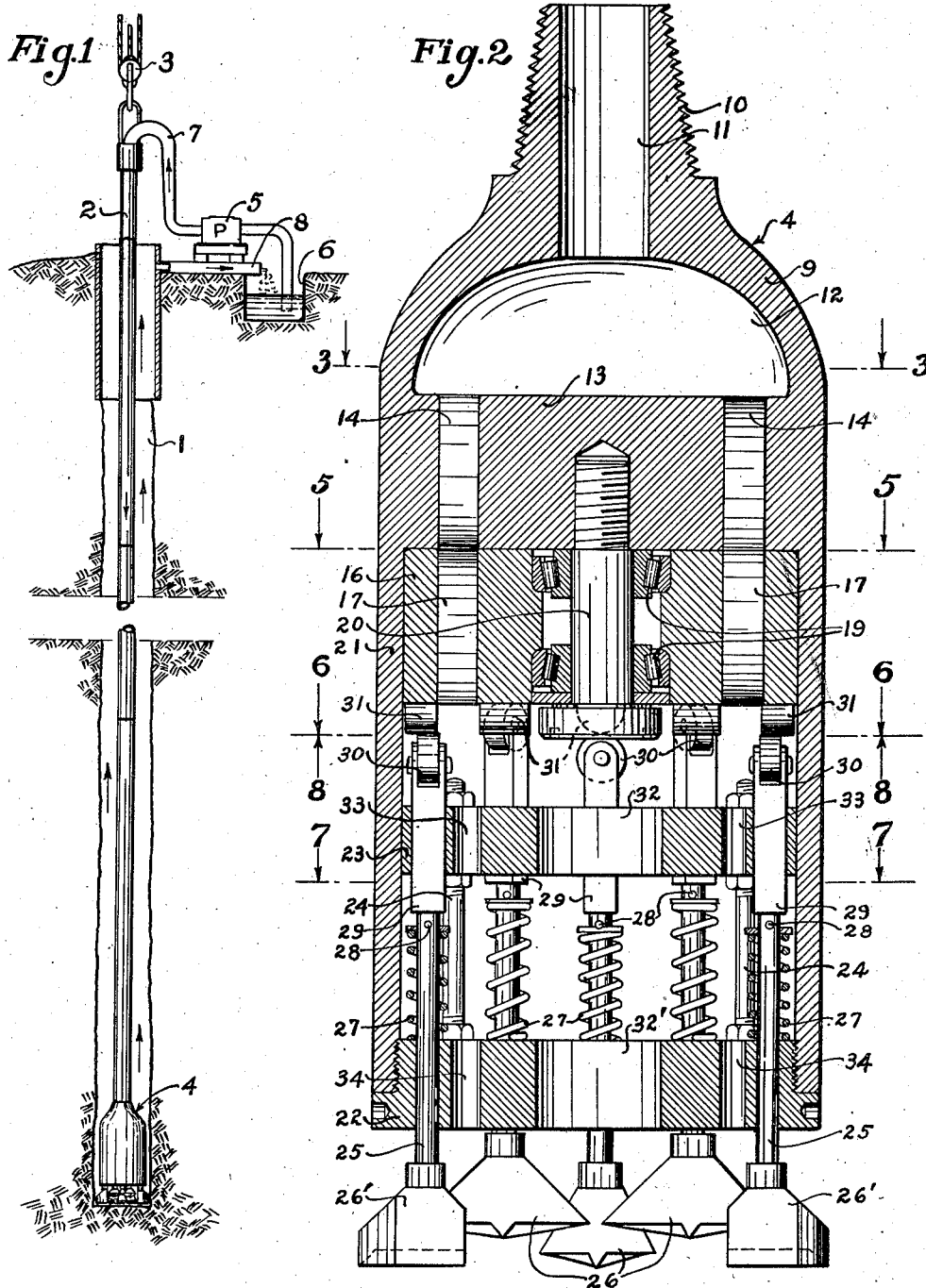
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2,400,853

WELL DRILLING APPARATUS

Filed July 8, 1941

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

Fig. 3

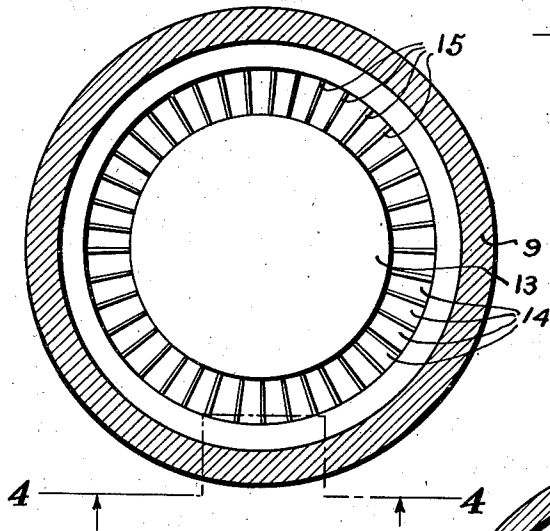


Fig. 4

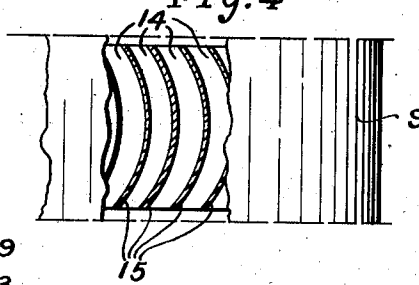


Fig. 5

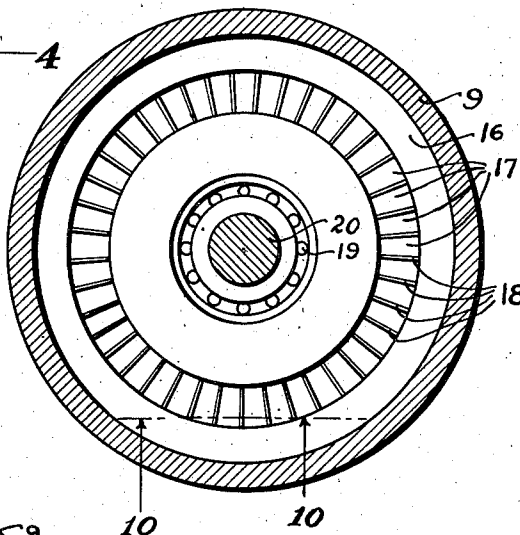
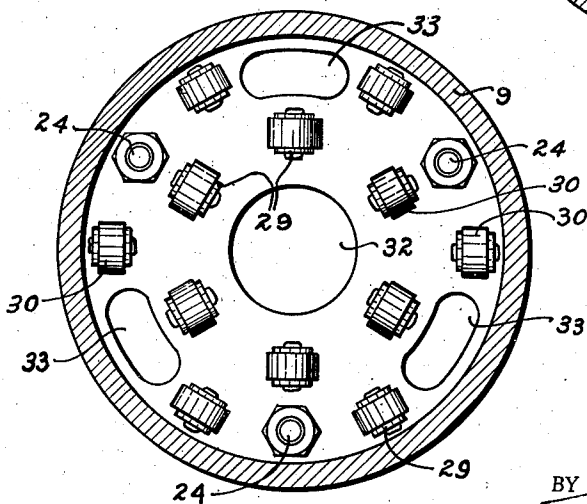


Fig. 6



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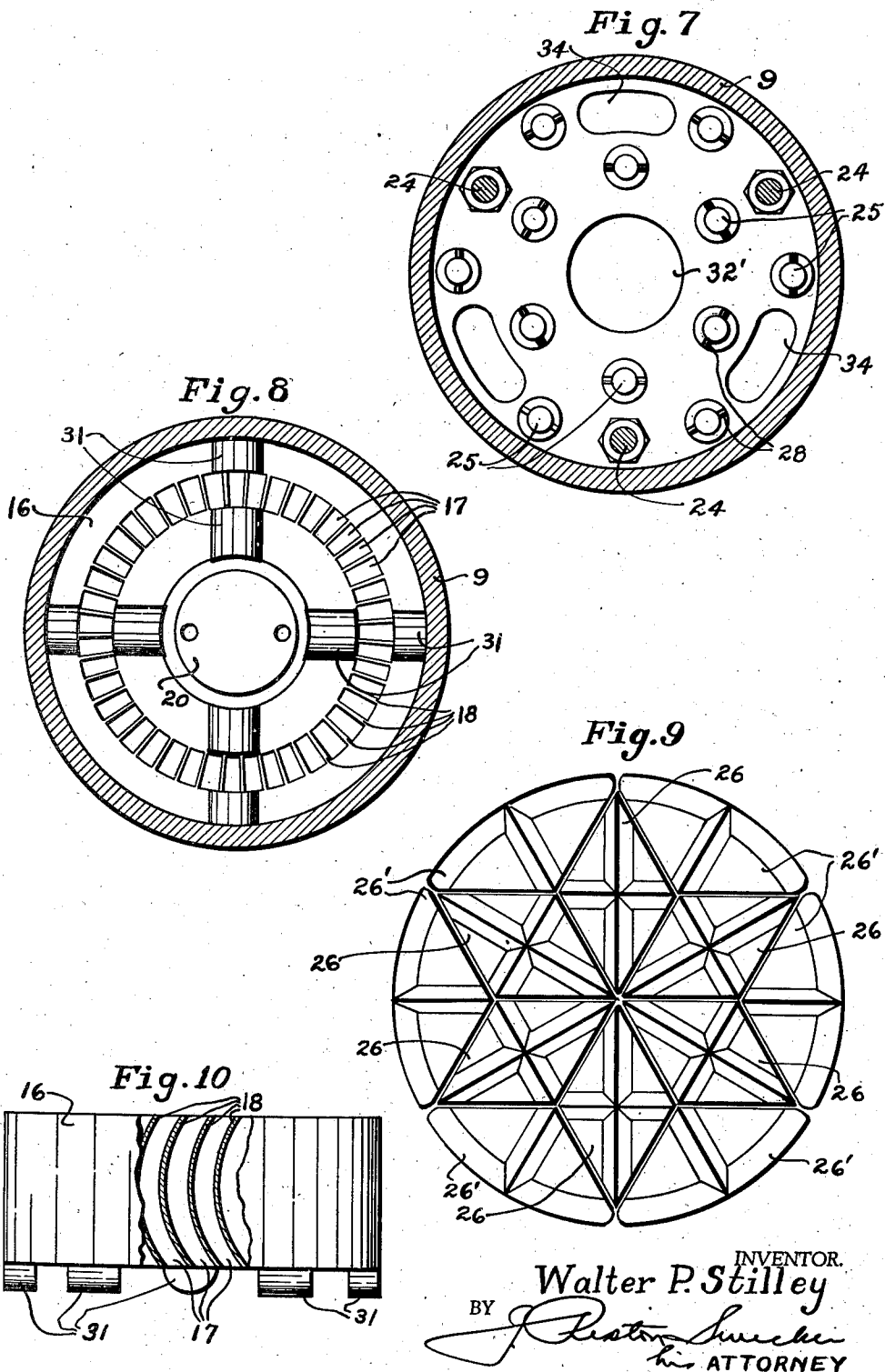
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4 Sheets-Sheet 3



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4 Sheets-Sheet 4

Fig. 11

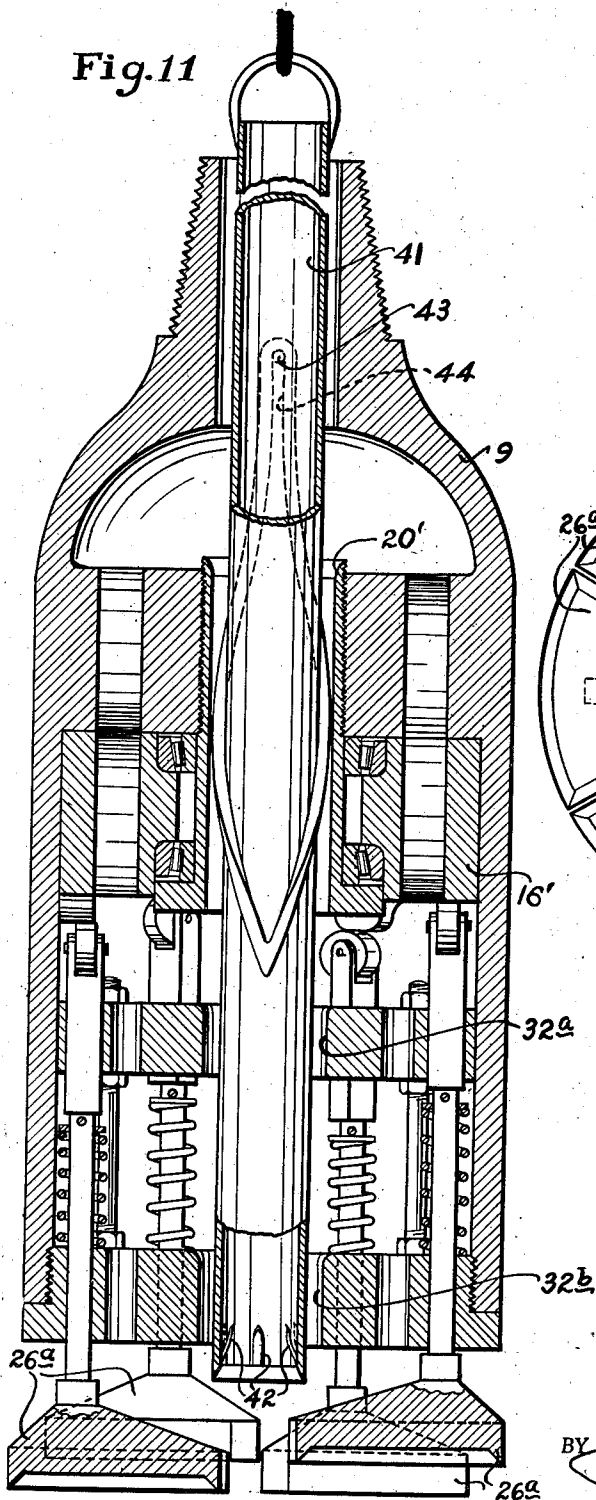
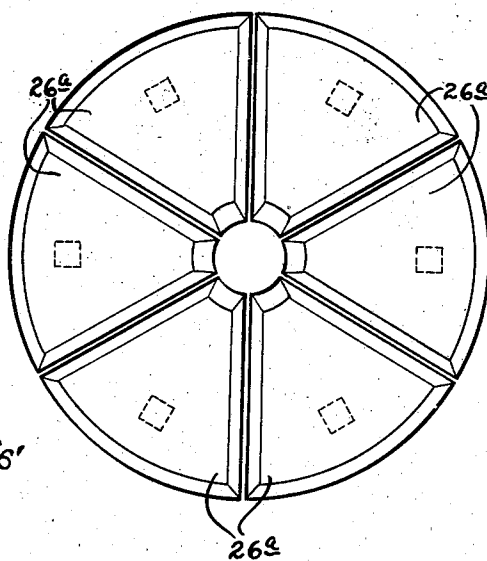


Fig. 12



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UNITED STATES PATENT OFFICE

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WELL DRILLING APPARATUS

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Application July 8, 1941, Serial No. 401,493

5 Claims. (Cl. 255-4.4)

This invention relates to an improvement in well drilling apparatus of the type used for the drilling of oil or other deep wells by means of reciprocating bits.

Various attempts have been made heretofore to operate reciprocating bits by fluid pressure, but, due to the complexity of their design and to the special equipment necessary for their operation, they have proved to be impractical for deep well drilling.

The object of this invention is to improve the construction of well drilling apparatus to provide for the practical utilization of reciprocating bits which may be operated by percussion, such as may be imparted by hydraulic pressure with provision for the utilization of the spent liquid in removing the debris from the hole as it is loosened by the bits without interruption of the drilling process for cleaning out as has been the practice heretofore in percussion drilling.

In this invention, positive blows are imparted to a plurality of drill bits of relatively small size or area, which permits quick successive blows on the various bits with mechanical uniformity, whereby they cut the formation into relatively small particles without undue vibration being created at the lower end of the drill stem. The drilling fluid which is forced down through the drill stem to operate the drill bits may be circulated back through the hole in a manner that will float out or remove the cuttings, thus allowing for continuous drilling operation.

Since the drill stem and drill bit are not rotated bodily during the drilling operation, but are lowered vertically into the well, it is possible to direct the well as may be desired either in a straight line or at an angle which is often desired.

A preferred embodiment of the invention, together with a modification thereof, is illustrated in the accompanying drawings in which:

Fig. 1 is a vertical sectional view through a deep well showing the invention in elevation installed therein;

Fig. 2 is a vertical sectional view through the drill, with parts in elevation;

Fig. 3 is a transverse sectional view there-through on the line 3-3 of Fig. 2;

Fig. 4 is a fragmentary vertical section there-through on the line 4-4 of Fig. 3;

Fig. 5 is a transverse sectional view through the drill on the line 5-5 of Fig. 2;

Fig. 6 is a similar view on the line 6-6 of Fig. 2;

Fig. 7 is a similar view on the line 7-7 of Fig. 2;

Fig. 8 is a similar view on the line 8-8 of Fig. 2;

Fig. 9 is a bottom plan view of the drill bits, with other parts omitted for clearness;

Fig. 10 is a detail vertical section through the impeller vanes, on the line 10-10 of Fig. 5;

Fig. 11 is a vertical sectional view through a modified form of drill provided with a core barrel; and

Fig. 12 is a bottom plan view thereof.

Referring to Fig. 1 of the drawings, the numeral 1 designates the bore hole of a deep well, such as an oil well, in which a drill stem 2 is suspended by a travelling block and tackle structure designated generally by the numeral 3. The lower end of the drill stem 2 carries a drill 4 which accomplishes the drilling operation.

The drill stem 2 is hollow or tubular and is adapted for the circulation of drilling fluid there-through in a manner customary with the rotary method of drilling, which fluid is usually of the nature of artificial mud, relatively fluid, which is circulated into the drill stem 2 by a pump 5 from within a pit 6, the pump being connected with the upper end of the drill stem through a pipe or hose 7. After the fluid is circulated downwardly through the drill stem, it is discharged at the drill 4 into the annular space between the drill stem and the wall of the bore hole 1, being circulated upwardly through the latter and discharged through a pipe 8 back into the pit 6, carrying out with it the cuttings and debris, loosened by the drill.

The drill 4 which constitutes this invention is constructed of a body 9 which has a reduced threaded upper end 10 for connection with the drill stem 2, and with a passage 11 through said end of the body into a chamber 12 formed therein.

The body 9 has a partition 13 extending transversely therein beneath the chamber 12, with passageways 14, extending downwardly there-through for the circulation of the fluid from the chamber 12. As shown in Fig. 4, the passageways 14 are formed by and between louvers 15 which are spaced circumferentially from each other as shown in Fig. 3, and are curved longitudinally to impart an angular direction to the jets of fluid forced through the passageways 14 therebetween. Immediately beneath the partition 13 is an impeller 16 having passageways 17 transversely therethrough and formed by vanes 18 arranged in circumferentially spaced relation as shown in Fig. 8. The vanes 18 are also curved

longitudinally, but in the opposite direction from those shown in Fig. 4, whereby the jets of fluid discharged under pressure from the passageways 14 against the curved faces of the vanes 18 impart rotary movement to the impeller 16. The impeller 16 is journaled on antifriction bearings 19 on an axle 20 extending downward from the under side of the partition 13, and which axle supports the impeller 16 for rotary movement.

The lower portion of the body 9 is cylindrical as indicated at 21, and has a head 22 secured to the lower end thereof by a screw-threaded connection therewith. A guide disc 23 is also mounted in the cylindrical portion 21 of the body, spaced above the head 22, on which it is supported by spacing bolts 24 extending therebetween.

Slidably mounted in the head 22 are the stems 25 of the drill bits, which bits are designated 26 and 26', the bits 26 being arranged inwardly of the bits 26', while the latter are spaced around the periphery of the drill, as shown more in detail in Fig. 9. The bits 26—26' have sharp raised ribs across the faces thereof, substantially like a star drill, and are arranged in such overlapping relation that they cover substantially the entire bottom face thereof projecting outwardly somewhat beyond the periphery of the body 9, as will be evident from Fig. 2.

Each of the stems 25 has a coiled spring 27 sleeved thereover and interposed between the upper face of the head 22, and a plate confined by a pin 28 attached to said stem, thereby tending to raise the stem 25 and the bit attached thereto. The upper end of each stem 25 is attached to a tappet 29 slidably mounted through the disc 23 and carrying a roll 30 thereon in position to coact with a cam 31 attached to the under face of the impeller 16.

The disc 23 and head 22 have axial openings 32 and 32' therethrough respectively and also spaced openings 33 and 34 therein, as shown in Figs. 6 and 7, to permit freedom of passage of the drilling fluid and to direct the same downward through the lower end of the drill to a point where it will wash the cuttings and debris away from the bits and circulate the same to the top of the well during the return movement, as indicated in Fig. 1.

In the operation of the drill, it is lowered in the well as the drilling progresses, being moved down gradually by the lowering movement of the drill stem 2 in the usual manner, during which time fluid will be pumped down through the drill stem by the pump 5 and circulated out from the top of the well bore.

This circulation of the drilling fluid down through the drill stem is under sufficient pressure to force it through the chamber 12 in the drill body, thence through the passageways 14, and against the impeller vanes 18 under sufficient pressure to impart rotary movement to the impeller 16.

Two rows of cams 31 are provided on the under face of the impeller 16 in radial alignment with each other, while the stems 25 of the respective bits 26, 26' are arranged in staggered relation to each other, as shown in Figs. 6 and 7. Thus the rotation of the impeller 16 will cause first one set of bits and then the other to be actuated, as the tappet rollers thereof alternately are engaged and depressed by the respective sets of cams 31. Any desired number and arrangement of the cams may be provided to produce the desired drilling action, but the arrangement

shown causes the actuation of the drill bits in sets of six, uniformly spaced circumferentially of the drill thereby giving a balanced drilling action.

This reciprocating movement of the bits against the bottom of the hole, causes the strata to be loosened thereby, and the circulation of the fluid downward through the drill will cause the cuttings to be washed out of the bottom of the well and floated upward by the fluid to the top of the bore from where the fluid is discharged back into the pit in the usual manner.

The drill stem 2 remains in a non-rotary position during this drilling operation, although it is gradually lowered, and in this way, it is possible to direct the course of the drilling more accurately than with a rotary drill stem. In some instances, it might be desirable to drill in a specified direction so as to intercept a bore hole previously drilled, which is possible with this invention, and even a sharp turn may be made in the course of the bore hole by providing a whip stock to guide a hinged drill joint.

It is also possible to operate the drill so as to take out a core from the well, in which event, only the outer row of bits is used, as shown in Figs. 11 and 12. In this form, the body 9' has the impeller 16' journaled on a tubular support 20', and operates the bits in the same manner set forth above in connection with Figs. 2 to 10. However, to cut out a central core, the bits 26a, may be modified in shape for this purpose, if desired, as shown in Fig. 12.

A core barrel 41 may be lowered down through the tubing and the body 9', being supported by a cable, and through the openings 32a and 32b to a point just above the bits 26a in position to receive the core thus formed. The core barrel 41 is shown as provided with barbs 42 in the lower end thereof to engage in the core and hold the same in the core tube during the lifting movement thereof.

Provision is made for retaining the core barrel 41 in proper position in the body 9', for which purpose a pin 43 projects from a side of the axial opening in the body in position to engage a guide or seat 44 fixed on opposite sides of the core tube 41 as the latter is lowered in the body. This makes it possible to mark the drill stem, and as it is maintained in the same circumferential position throughout the depth of the hole, the cores retrieved from the well can be examined to determine the inclination and direction of the subsurface strata, to enable this to be disclosed immediately, thereby greatly simplifying and improving the drilling operation.

I claim:

1. A drill comprising a body having a cylindrical portion, a head mounted in the lower end of said cylindrical portion, a disc mounted in the cylindrical portion spaced above said head, a plurality of bits having stems slidably mounted in said head and disc, each of said stems having a spring connected therewith tending to move the same in an upward direction and having a tappet roller thereon, and an impeller mounted in the body for rotary movement and having means thereon for engaging and actuating the tappet rollers of the stems, said actuating means including a plurality of circumferential rows of cams on the under face of the impeller and having the cams of one row aligned radially with the cams of the other row in position to bear upon the tappet rollers, the stems of the bits being arranged in a plurality of circumferential rows radially spaced from each other and with the stems of one row staggered relative to the

stems of the other row for alternate engagement and actuation by the cams.

2. A drill comprising a body supported in stationary position and held against rotation, a plurality of bits carried by the body and having face portions approximately normal to the axes thereof and having ribs extending over said faces, said bits being arranged in side by side relation and interfitting with each other, so that the faces thereof extend over substantially the entire end of the drill, and means for reciprocating the bits.

3. A drill comprising an elongated body supported in stationary position and held against rotation and having an opening extending lengthwise therethrough, a plurality of bits carried by the body in circumferential spaced relation around said opening, means within the body for operating said bits relative to the body while the body is retained in a fixed position, a core tube extending into the opening in the body, and means for supporting said core tube therein.

4. A drill comprising an elongated body having an opening extending lengthwise therethrough, one or more bits mounted on the body, means for operating said bit or bits relative to the body while said body is retained in a fixed position, and a core tube extending into the opening in the body to receive a core therein.

5. A drill comprising an elongated body having an opening extending lengthwise therethrough, one or more bits mounted on the body, means for operating said bit or bits relative to the body while said body is retained in a fixed position, a core tube extending into the opening in the body to receive a core therein, and means for supporting the core tube in the body and constructed for orienting the core tube into a predetermined position relative thereto.

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