

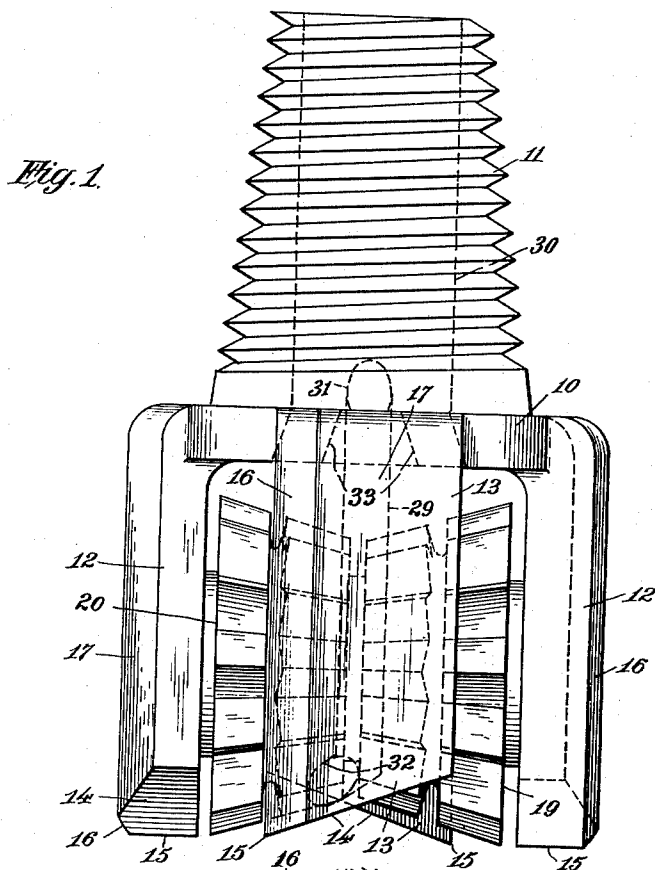
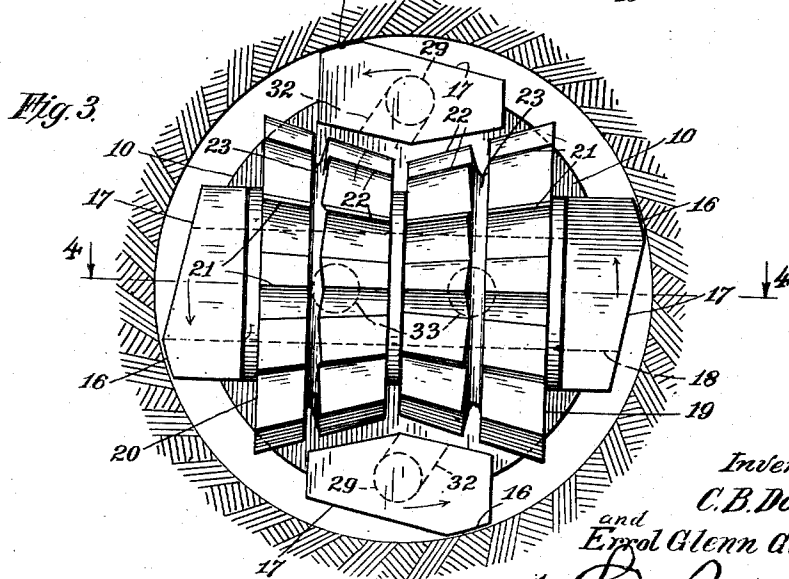
Oct. 3, 1950

C. B. DAY ET AL
EARTH DRILL BIT

2,524,428

Filed March 27, 1946

2 Sheets-Sheet 1



Inventors:
C. B. Day
and
Errol Glenn Gaultt.
by Carl R. Allen
Attorney.

Oct. 3, 1950

C. B. DAY ET AL
EARTH DRILL BIT

2,524,428

Filed March 27, 1946

2 Sheets-Sheet 2

Fig. 2.

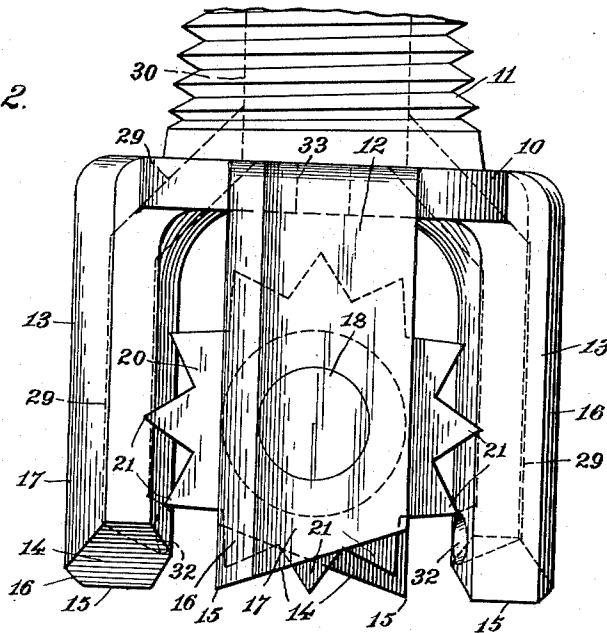
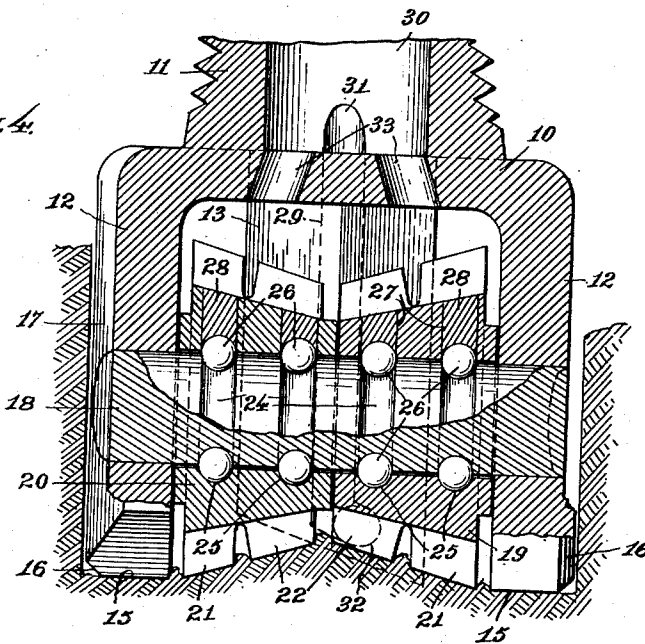


Fig. 4.



Inventors:
C. B. Day
and
Eugene Glenn Gault
by *Rash Allen*
Attorney

UNITED STATES PATENT OFFICE

2,524,428

EARTH DRILL BIT

Chester B. Day and Errol Glenn Gault,
Wewoka, Okla.

Application March 27, 1946, Serial No. 657,371

5 Claims. (Cl. 255—71)

1

This invention relates to the art of earth boring or drilling, and particularly to the drilling of deep wells, such as oil wells or the like.

More specifically, the invention relates to an improved bit for use in drilling such wells; and to an improved method of flushing the hole being drilled to remove the material disintegrated by the bit.

Drill bits of the class under consideration are connected to a pipe, or line of pipes which constitute a drill stem by means of which the drill is pressed downwardly and rotated in a well known manner. As the drilling proceeds, water is pumped downwardly through the stem to flush the cuttings from the hole.

The bits are usually designed for drilling conditions wherein both hard and soft earth formations are encountered; but commonly, such bits are so constructed that the outer or peripheral cutting edge portions wear away resulting in either a gradual lessening of the diameter of the bore, which necessitates later reaming; or results in a lateral drift from the perpendicular, which is also objectionable.

Furthermore, the methods used in flushing the disintegrated material from the hole have not been of maximum efficiency, as the down jets of water used for flushing oppose or interfere more or less with the return upward flow of the flush water and solid material.

An object of the present invention is to provide an improved bit of the class mentioned which will maintain a constant cutting diameter whereby a hole of uniform diameter will be drilled.

A further object of the invention is to provide an improved construction of bit whereby lateral drift of the bit will be prevented.

A further object of the invention is to provide a bit of the class mentioned which will operate efficiently in drilling through hard rock, shale, or soft formations.

A further object of the invention is to provide a bit which shall be of simple design, simple to operate, and which may be readily repaired and reconditioned at low cost.

A further object of the invention is to provide an improved method of flushing the detached or disintegrated material from the hole being drilled.

Other objects will appear hereinafter.

With these objects in view, the invention consists generally in a bit including a plurality of depending outer drag blades the lower ends of which are forwardly and downwardly inclined with respect to the direction of rotation, present-

2

ing forward cutting edges, and in which the outer faces of the blades are substantially cylindrical for a distance rearward from the forward edge, providing for wear of the blades to the extent of their usefulness without diminishing the outer radius of the cutting edge.

The invention further consists in a bit as above stated in which the outer walls of the drag blades to the rear of the cylindrical portions mentioned are tapered inwardly thereby enlarging the upward passageway for the material being flushed from the hole, and avoiding wedging of particles of solid matter between the blade and the side of the hole.

The invention further consists in a bit including four parallel depending drag blades, a transverse shaft mounted in two of said blades and a pair of frusto-conical cross-roller cutters mounted on said shaft and tapering inwardly toward the axis of rotation of the bit, whereby the cross-roller cutters will chip away the earth formation for the major area of the hole being drilled and form and maintain an upwardly extending, centrally located conical portion to the bottom of the hole which will prevent lateral drift of the bit.

The invention further consists in a bit as above stated in which the drag blades intermediate those in which the shaft for the roller cutters is mounted, are provided with ducts extending to adjacent the lower ends thereof and terminating in inwardly extending openings whereby the flushing fluid will be ejected inwardly across the bottom of the hole, sweeping the chips and disintegrated matter toward the periphery of the hole and not interfere with the upward passage of the fluid and solid matter.

The invention further consists in various details of construction and combination and arrangement of parts, as will be fully described hereinafter and particularly pointed out in the claims.

The invention will be more readily understood by reference to the accompanying drawings forming a part of this application and in which:

Figure 1 is a side elevation of a drill bit embodying the invention.

Figure 2 is a similar view taken at right angles to that illustrated in Figure 1.

Figure 3 is a bottom plan view of the device, and

Figure 4 is a transverse section on the lines 4—4 of Figure 3.

Referring to the drawings, the body of the bit which is of integral construction, comprises a

horizontal, substantially circular disc portion 10, an upwardly extending threaded stem 11 of the type to connect readily to a standard drill collar (not shown), and four depending parallel drag blades 12, 12 and 13, 13. These blades are preferably spaced equidistant from each other and together provide a substantially cylindrical body of maximum rigidity and strength and of greater diameter through the blades than the diameter of the disc portion 10. The lower ends of said drag blades are inclined downwardly and forwardly in the path of rotation, as at 14, presenting chisel edges 15 which produce a scraping and tearing action of the blades on the peripheral portion of the formation being drilled.

The vertical outer face of each of the blades 12 and 13 is of cylindrical form, as indicated at 16, for a distance from the front edge of the blade sufficient to give maximum strength to the blade, to prevent lateral drift of the tool and to maintain full cutting width to the chisel edge 15 as the blade wears away in use; and is then beveled or inclined inwardly as at 17 for a purpose hereinafter described. It is obvious that with the outer cutters formed as above described, a uniform cutting radius will be maintained irrespective of the wear on the cutting edges 15, and that the hole being drilled will be of constant uniform diameter.

Welded into the blades 12—12, which are diametrically opposite, is a horizontal shaft 18 upon which is mounted a pair of frusto-conical cross-roller cutter members 19 and 20. Each of said cutters is formed on its periphery with longitudinally disposed chisel-like cutting edges, which are separated into two peripheral series of cutters 21 and 22, by an annular groove 23. It should be noted that the cutters 22 of the member 19 terminate at their inner ends in a plane incident with the axis of rotation of the bit, so that as the bit turns these cutters disintegrate the earth formation immediately about said axis. The corresponding cutters 22 of the member 20 are spaced from the center of rotation and are of sufficient length to span the gap made by the groove 23 in the cutter member 19 as the tool rotates. Likewise, the cutters 21 of the member 19 bridge the gap of groove 23 in member 20. The outer ends of the cutters 21 of both roller members 19 and 20 terminate equidistant from the center. By this arrangement, when the bit is turned in the usual manner, the frusto-conical cutting members are forced to rotate on their axes, and as the apexes of the said members are considerably remote from the axis of rotation of the bit, a combined chopping and tearing action is obtained over the entire circular area covered by said members during the rotation of the bit.

To lessen the friction and permit maximum action as above described, the members 19 and 20 are each provided with two sets of ball bearings. This is illustrated in Figure 4. As shown therein, the shaft 18 is formed with inner ball races 24 and the members 19 and 20 with outer ball races 25, for the balls 26. In assembling, after the races 24 and 25 are brought into register, the balls 26 are inserted through holes 27 in the members 19 and 20, and the holes closed by plugs 28, which are then welded in place. The inner ends of the plugs 28 form a part of the outer ball races.

The frusto-conical members 19 and 20 taper inwardly from their outer ends with the smallest diameter of these members at the axis of rotation of the bit; so that, when in operation the

action of the cutters 21 and 22 produces and maintains an upwardly projecting conical bottom to the hole, about which the entire bit will turn, as illustrated in Figure 4 of the drawings. This keeps the bit centered and prevents lateral drift, thereby assuring a straightly drilled hole.

The bit is especially designed for use where both hard and soft sub-surface formations are to be encountered. In cutting through hard rock, the inner roller cutters 19 and 20 will cut and chip away enough of the rock so that the outer or drag blades 12 and 13 can readily cut and ream the remaining outer annulus. In soft formations, the drag blades 12 and 13 will speedily cut the outer annular portion, while the inner roller cutters 19 and 20 will constantly agitate the material at the inner portion of the hole and assure quick and thorough flushing of the loosened material from the hole, as will be presently described.

As hereinbefore stated, the bit is attached to the end of a pipe, or line of pipes by which it is forced downwardly and turned from the surface by well known means; and that this pipe affords means for supplying flushing fluid to the bottom of the hole for removing the material detached by the bit, and to keep the movable bit members from becoming clogged.

One of the objects of the present invention is to so improve the method of flushing that the downwardly projected jets will not buck, or more or less interfere with, and check the upward movement of the fluid and solid particles.

To this end means are provided whereby a major portion of the flushing fluid is directed inwardly from adjacent the outer edge, in jets at an angle across the bottom of the hole to the other side so that as the bit turns the entire bottom of the hole is swept by said jets, moving the detached material toward the periphery of the hole, so that the influx of the fluid does not check or retard the upflow of the fluid and solid matter, but materially assists therein. The remaining portion of the flushing fluid is directed downwardly at substantially the center of the device to further clean the rotary cross cutters, and as this approaches the bottom it is entrained by the first mentioned jets and aids in rapidly agitating the material and forcing the same upwardly about the periphery of the hole.

Each drag blade 13 is provided with a duct 29 which communicates at its upper end with the bore 30 of the stem 11, as at 31. The lower end of the duct 29 terminates in a port 32 in the inner face of the blade and as close to the lower edge thereof as possible to permit normal wear of the blade without interfering with the port.

These ports 32 are but slightly inclined from the horizontal and are angularly arranged with relation to the radius of the bit, so that the jets of fluid issuing therefrom will pass in opposite directions on opposite sides of the axis of rotation without interference. Furthermore the angle of the port with relation to the radius is forwardly, or toward the direction of movement of the blades, so that the entire bottom of the hole is swept clean as the bit rotates, and the jets assist in creating and maintaining a constant agitation of the fluid and solid matter without any portion of the inflow interfering with the egress of the fluid and solid matter. These jets also keep the cutting edges of the drag blades and the lower portions of the cross cutters clean and the loosened material removed from in front of the same, thereby materially increasing the efficiency of the device and minimizing the wear on the blades.

5

Extending through the portion 10 of the bit and communicating with the bore 30, are a pair of ports 33 which are arranged directly above the cross cutters 19 and 20 respectively, and arranged to direct jets of fluid downward thereon, preferably at the area of the peripheral grooves 23. This jet will remove any solid matter from the cross cutters 19 and 20 which escaped the jets issuing from the ports 32. The fluid from the ports 33 passes downwardly at substantially the center of the bit and merges with or is entrained by the jets issuing from the ports 32. It is obvious that by this arrangement a constant swirling and agitation of the fluid and solid matter is maintained without any interference of cross currents with consequent settling of solid matter in the hole.

By reference to Figure 3 of the drawings it will be noticed that a large uninterrupted passageway for the upflow of the fluid and solid matter is provided between the bit and the walls of the hole, and it is for the purpose of increasing this area that the major portion of the outer faces of the blades 12 and 13 are inclined, as at 17. Furthermore these inclined faces 17 prevent solid matter from wedging between the blades and the walls of the hole.

While the preferred construction of the bit is above described, it is obvious that various modifications may be made in the combinations and arrangements of parts without departing from the invention as set forth in the following claims:

We claim:

1. A drill bit of the class described including four parallel depending outer diametrically opposed drag blades, the lower ends of which are forwardly and downwardly inclined in the direction of rotation of the bit, a shaft fixed in two of said diametrically opposed blades, a pair of frusto-conical cross cutters rotatably mounted on said shaft, and tapering inwardly toward the axis of rotation of the bit, and flushing fluid ducts in the other two of said drag blades terminating in ports on the inner faces of said blades adjacent the lower ends thereof, substantially as described.

2. A drill bit of the class described including four parallel depending outer diametrically opposed drag blades, the lower ends of which are forwardly and downwardly inclined in the direction of rotation of the bit, a shaft fixed in two of said diametrically opposed blades, a pair of frusto-conical cross cutters rotatably mounted on said shaft and tapering inwardly, and flushing fluid ducts in the other two of said drag blades terminating in ports on the inner faces of said blades adjacent the lower ends thereof, said ports being angularly arranged with relation to the radius of said bit.

3. A drill bit of the class described including four parallel depending outer diametrically opposed drag blades, the lower ends of which are downwardly and forwardly inclined in the direction of rotation of the bit, a shaft fixed in two of said diametrically opposed blades, a pair of frusto-conical cross cutters rotatably mounted

6

on said shaft and tapering inwardly, flushing fluid ducts in the other two of said drag blades terminating in ports on the inner faces of said blades adjacent the lower ends thereof, said ports being angularly arranged to extend angularly forwardly with relation to the radius of the bit to project jets of fluid inwardly and toward the direction of rotation of the bit.

4. A drill bit of the class described including four parallel depending outer diametrically opposed drag blades the lower ends of which are downwardly and forwardly inclined in the direction of rotation of the bit, a shaft fixed in two of said diametrically opposed blades, a pair of frusto-conical cross cutters rotatably mounted on said shaft and tapering inwardly, flushing fluid ducts in the other two of said drag blades terminating in ports on the inner faces of said blades adjacent the lower ends thereof, said ports being inclined slightly downwardly and angularly arranged with relation to the radius of the bit to project jets of fluid inwardly and toward the direction of rotation of the bit, and ports above said frusto-conical cross cutters to project jets of fluid downwardly thereon.

5. A drill bit of the class described including four parallel depending outer diametrically opposed drag blades having forwardly and downwardly inclined lower ends, a shaft fixed in two of said diametrically opposed blades, a pair of frusto-conical cross cutters rotatably mounted on said shaft and tapering inwardly, flushing fluid ducts in the other two of said drag blades terminating in ports on the inner faces of said blades and adjacent the lower ends thereof, said ports being angularly arranged with relation to the radius of the bit to project jets of fluid inwardly and toward the direction of rotation of the bit, and outer faces of said blades being cylindrical for a distance rearwardly from the forward edges and then tapered inwardly.

CHESTER B. DAY.

ERROL GLENN GAULT.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
923,513	Hardsocg	June 1, 1909
1,096,134	Sims	May 12, 1914
1,118,292	Knapp	Nov. 24, 1914
1,297,708	Maier	Mar. 18, 1919
1,306,371	Culmore	June 10, 1919
1,426,681	Smith et al.	Aug. 22, 1922
1,666,711	MacDonald	Apr. 17, 1928
1,742,641	Armentrout	Jan. 7, 1930
1,775,774	Murphy	Sept. 16, 1930
1,928,451	Hammerberg	Sept. 26, 1933
2,040,074	Brenholm	May 12, 1936
2,061,933	Crum	Nov. 24, 1936
2,118,524	Rea	May 24, 1938
2,200,482	Winslow	May 14, 1940
2,357,835	Leissler	Sept. 12, 1944