Sept. 20, 1960 E. B. WILLIAMS, JR 2,953,354

DRILL BIT

Filed May 15, 1958 2 Sheets-Sheet 1

Fig. 1.

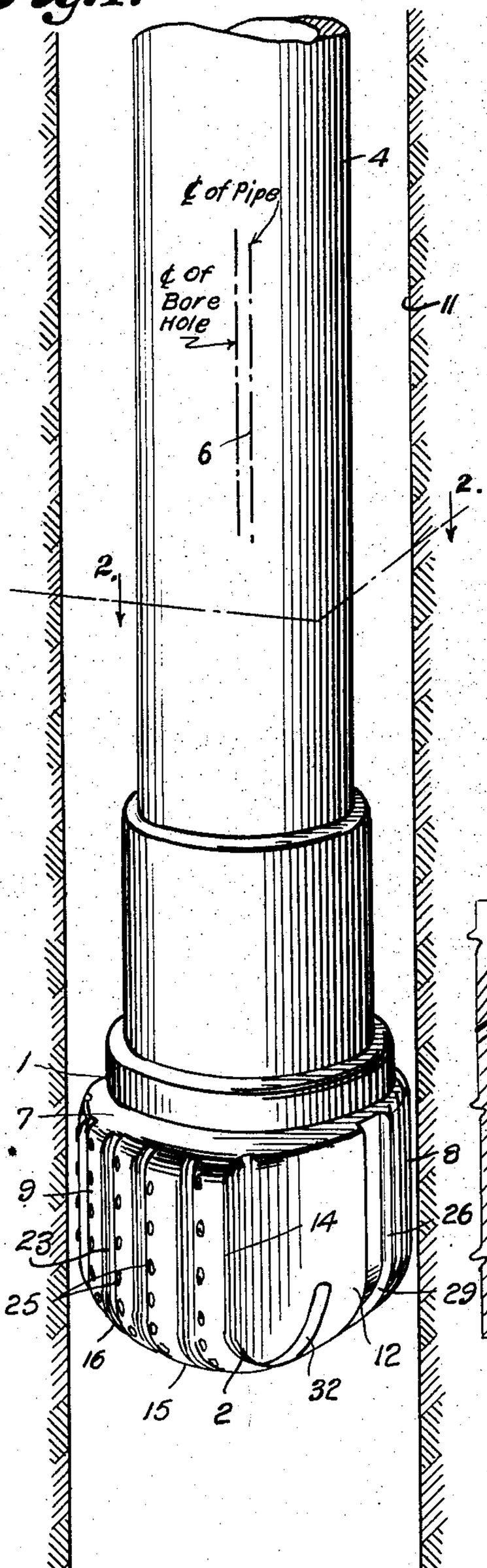


Fig. 2.

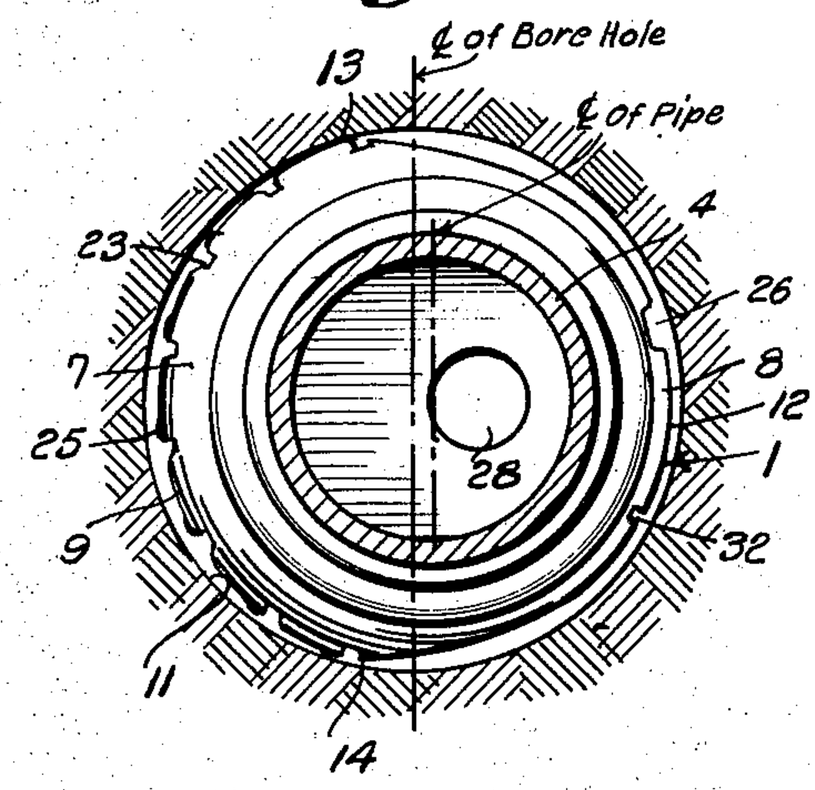
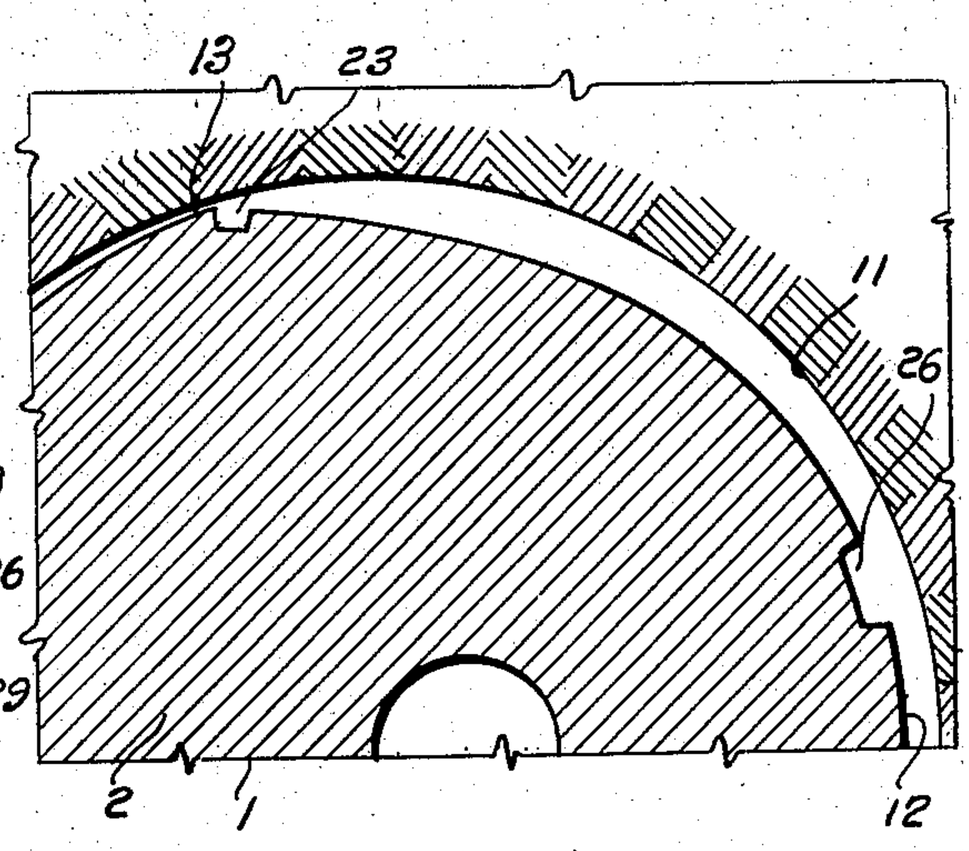


Fig. 3.



INVENTOR.
Edward B. Williams Jr.
BY
Paul E Mullendore
ATTORNEY

Sept. 20, 1960 E. B. WILLIAMS, JR 2,953,354

DRILL BIT

Filed May 15, 1958 2 Sheets-Sheet 2

Fig. 4.

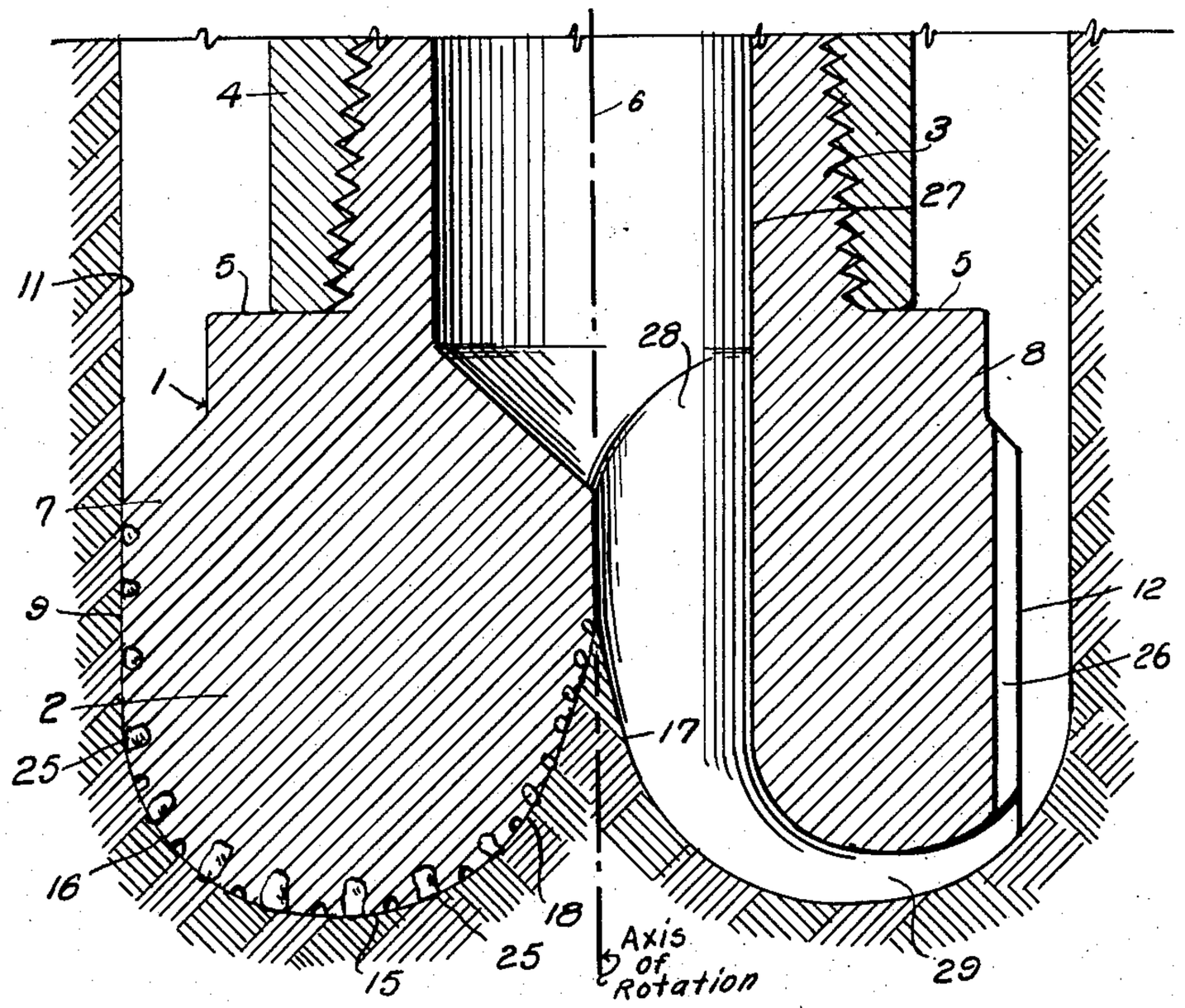
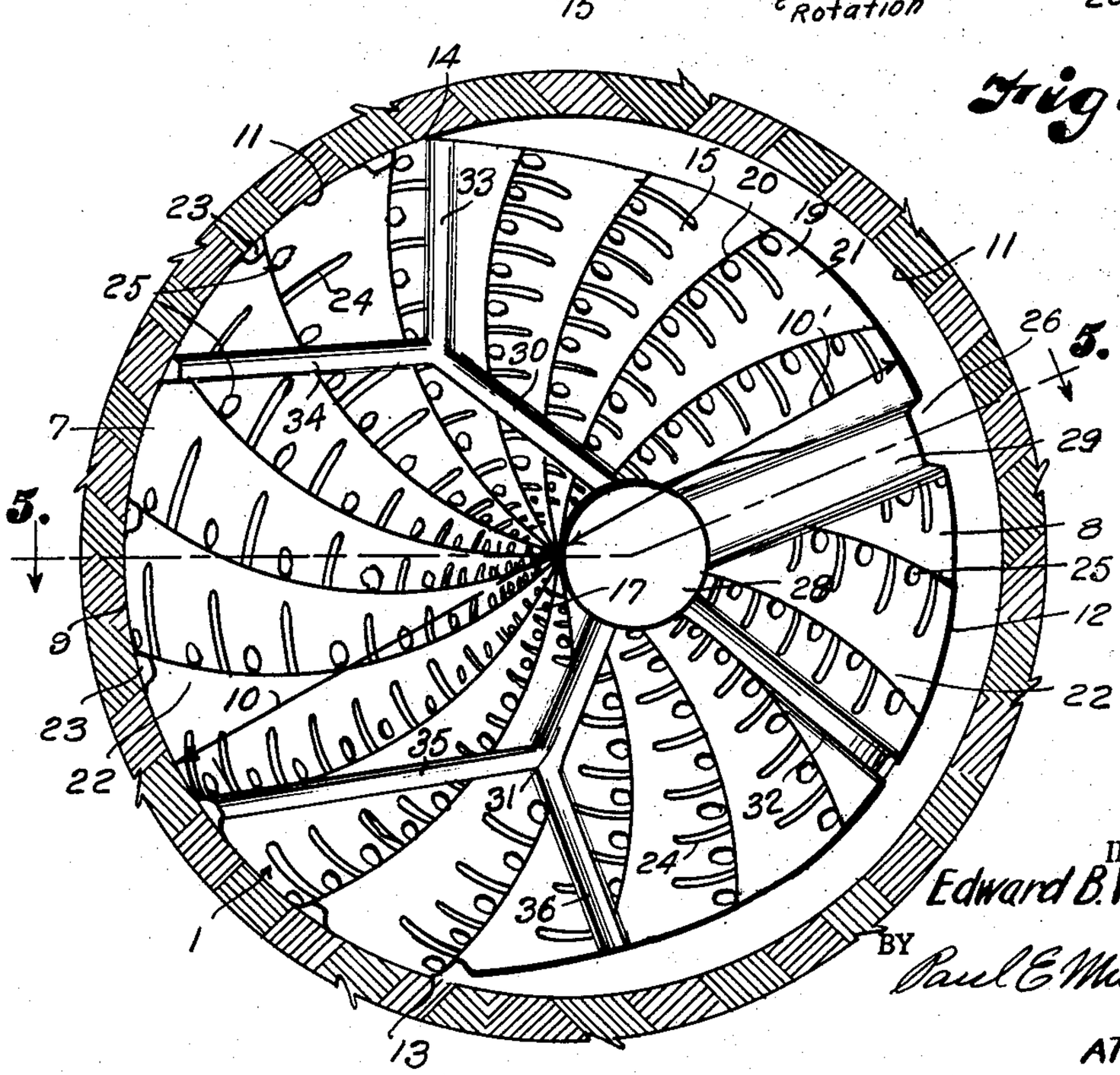


Fig. 5.



INVENTOR.
Edward B. Williams Jr.
BY Paul E. Mullendore
ATTORNEY

United States Patent Office

2,953,354

Patented Sept. 20, 1960

2,953,354

DRILL BIT

Edward B. Williams, Jr., Greenville, Tex., assignor of one-third each to Edward B. Williams III, Joseph W. Williams, and David B. Williams, all of Greenville, Tex.

Filed May 15, 1958, Ser. No. 735,452

5 Claims. (Cl. 255—61)

This invention relates to drill bits for drilling bore holes into earth formations, and particularly to drill bits of the type having cutting elements composed of diamonds and similar materials for cutting rock, chert, and other hard formations encountered in the drilling of such bore holes.

Drill bits of this type usually comprise an end cutting face for making hole and a circumferential cutting face for maintaining the bore thereof, consequently the cutting elements are apt to be damaged when running the drilling string into and out of the bore hole, as when changing drill bits. Also, it may be desirable to continue drilling of a bore hole with a larger diameter bit and the clearance may not be sufficient to run the bit without endangering the cutting elements, or, in fact, the bit to make the larger hole may be too large to enter the bore hole that has been previously drilled. It may also be desirable to ream a lower portion of a bore hole to a larger size, in which case it becomes necessary to continue the drilling with a larger size bit that can be lowered through the existing bore hole.

It is, therefore, a principal object of the present invention to provide a bit of the diamond type that may be safely run through a bore hole without damage to the cutting elements, and which may be run through holes of smaller diameter, as when continuing drilling to a greater depth or to ream portions of the original hole.

Other objects of the invention are to provide a drill bit with a cutting face offset outwardly from the axis of rotation a greater distance than the corresponding face at the opposite side of the bit, so that the overall diameter will permit lowering of the bit through a bore hole of smaller diameter than the bore hole to be produced by the cutting face of the bit; to provide a drill bit with ample watercourses in the cutting faces to assure sufficient flow of drilling fluid to protect the cutting elements from overheating and to assure removal of the cuttings; and to provide for maintenance of such distribution of the drilling fluid in balance with the flow of drilling fluid upwardly of the side of the bit that is opposed to the cutting face.

In accomplishing these and other objects of the invention as hereinafter pointed out, I have provided improved structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a perspective view of a drill bit embodying the features of the present invention as it appears when attached to the lower end of a drill pipe and lowered through a bore hole to a drilling position.

Fig. 2 is a horizontal cross section on the line 2—2 of Fig. 1, particularly illustrating clearance at sides of the drill bit.

Fig. 3 is an enlarged fragmentary cross section to better illustrate the clearance of the bit across the largest diameter thereof with respect to the walls of the bore hole through which the bit is lowered.

Fig. 4 is an enlarged vertical section through the bit,

showing the bit in drilling position at the bottom of the bore hole.

Fig. 5 is an end view of the bottom cutting face of the bit when in drilling position.

Referring more in detail to the drawings:

1 designates a drill bit constructed in accordance with the present invention and particularly adapted for drilling hard earth formations, such as chert and the like. The bit 1 includes a body 2 formed of suitable material to withstand stress under operation, and has an exteriorly threaded neck 3 adapted for attachment to a drill pipe 4. The neck 3 is concentric with the axis 6 of the neck 3, and forms with the body 2 an annular shoulder 5, as best shown in Fig. 4. One side 7 of the body 2 extends radially beyond the shoulder 5, while the opposite side 8 is generally in registry with that side of the shoulder 5. The side 7 has an arcuate cutting face 9 formed on a radius 10 from the axis 6, and which constitutes the radius of the bore hole 11 to be drilled by the bit. The opposite side of the body 2 has an arcuate face 12 of less radius 10 and joins with terminal edges of the cutting face as indicated at 13 and 14 (Fig. 5) which termini are in a chordal plane offset from and parallel with the axis 6. The spacing of the edges 13 and 14 is no greater than the major dimension between the cutting face and the arcuate face 12 whereby the bit is adapted to be lowered through a bore hole of less diameter than the bore hole to be produced by the drilling or cutting face 9. The end of the body of the bit opposite the neck 3 also constitutes a cutting face 15. The outer circumference of the drilling face 15 curves into the cutting or drilling face 9, as indicated at 16, and into a recess 17 in the axis of the bit on a rounding curve 18, as best shown in Fig. 4. The recess 17 is preferably conical, as shown.

The drilling face 15 is preferably provided with teeth 19 having advance faces 20 and rearward faces 21 that slope downwardly from an upper edge of a face 20 to the lower edge of a face 20 of a preceding tooth. The teeth are generally spiral and provide generally spiral channels or recesses 22 alternating with the ridges of the teeth and extending from the axis of the face 15 outwardly to the periphery of the bit, where the channels 22 join with upwardly extending channels 23. The channels 22 and 23 provide passages for the movement of cuttings radially and upwardly of the body of the bit under flow of drilling fluid to the upper end of the bore hole. The sloping faces 21 of the tooth portions of the bit may be provided with transverse grooves arranged spirally that form watercourses 24 to facilitate flow of water and cuttings under the forward edges of the teeth to the channels 22.

The teeth are provided adjacent their forward edges with cutting elements 25, which may be commercial diamonds, borts, or other material of sufficient hardness to cut the material being drilled. The cutting elements extend upwardly along the arcuate drilling face 9 of the bit to provide the cuts necessary for maintaining the gauge of the hole. The opposite face 12 of the body of the bit 2, since it is not depended upon for cutting, is provided only with upwardly extending watercourses 26 corresponding with the watercourses in the drilling face 9 of the bit.

The neck 3 and upper body portion of the bit has a bore 27 substantially conforming to the inner bore of the drill pipe to supply drilling fluid to a port 28 that is offset from the axis of the bit and located within the body portion 2, as best shown in Fig. 4. The bore terminates in the bottom face of the bit in an outwardly and upwardly extending channel 29, as best shown in Figs. 4 and 5, to provide an upward jet of drilling fluid. The port 28 also supplies drilling fluid across the bottom cutting face of the bit through watercourses 30, 31 and 32

that extend outwardly from the port **28**, as shown in Fig. 5. The watercourses **30** and **31** terminate in diverging channels **33—34** and **35—36** to distribute drilling fluid in quantity to maintain the cutting elements in cool condition and to supply the drilling fluid necessary for carrying the cuttings to the top of the bore hole. The port also communicates directly with the conical recess to supply drilling fluid to all of the channels or recesses that are formed between the teeth of the bit. The channels and watercourses are preferably designed to have a combined capacity relatively to the space provided between the side **8** of the bit and the wall of the bore hole, so as to assure adequate flow of water over the cutting faces.

It is obvious that the side drilling face **9** curves on the common radius about the axis of rotation **6** and terminates at sides thereof in a chordal plane offset from the axis **6** on the side of the curved drilling face **9** and that the body portion of the bit has a plain opposite face **12** curving about the axis **6** on a shorter radius and which joins with the sides **13** and **14** of the curved drilling face to cooperate with the wall of the bore hole in leaving an arcuate space coextensive with said plain face and whereby a bottom portion of the bore hole is progressively uncovered across said plain face from one side of the curved drilling face to the other incidental to rotation of the bit. It is also obvious that the arcuate space and said uncovered bottom portion of the bore hole provide a common uninterrupted discharge for the cuttings from all of the generally radial recesses on the side of the chordal plane opposite the curved drilling face, and that the supply of drilling fluid from the downflow passageway or port **28** supplies drilling fluid to all of the recesses for washing the cuttings from said recesses and carrying the cuttings upwardly of the drill bit under the high volume flow through the arcuate space by the freedom of the flow from under the drill bit and into the arcuate space.

In using the drill, constructed as described, it is attached to the drill pipe **4** and lowered through the bore hole **11**. When lowering the drilling string through the bore hole, the drill pipe is off center with respect to the bore hole, as indicated by the center lines in Figs. 1 and 2. In this position, all sides of the bit will clear the walls of the bore hole. When the drill bit reaches the bottom of the bore hole, with the end drilling face resting thereon and with the drilling fluid being circulated downwardly through the drill pipe, bore **27**, and port **28**, for upward flow through the bore hole **11**, the drill pipe is rotated so that the arcuate cutting face **9** will enlarge the diameter of the bore hole while the end drilling face penetrates the formation. During rotation, the conical portion of the cutting face cuts the pilot core to facilitate centering of the bit.

During the cutting operation, the drilling fluid is discharged from the port **28** through the channels **30** and **31** and branches **33—34** and **35—36** thereof for flow through the channels **22** and grooves **24** to keep the cutting elements cool and to wash the cuttings from under the bit and upwardly through the channels **23** to the top of the bore hole. Simultaneously, a jet of drilling fluid is discharged through the channel **29** and upwardly at that side of the drill bit to induce upward flow of the drilling fluid and cuttings carried therewith. The deepened bore hole made by the bit is of a radius corresponding to the radius of the cutting face **9** and results in a larger bore hole than the bore hole immediately above the place where the drilling started.

When it becomes necessary to remove the drill bit, the drilling string is lifted in the bore hole, and when the bit reaches the upper portion of the hole, the bit shifts the drill pipe out of center position, whereupon the bit is readily removed without damage to the cutting elements.

From the foregoing, it is obvious that I have provided a drill bit of the diamond type which may be lowered through a bore hole and operated to deepen and/or enlarge the bore hole.

What I claim and desire to secure by Letters Patent is:

1. A rotary drill bit having a body portion provided with a drilling face curving on a common radius about an axis of rotation and terminating at sides thereof in a chordal plane offset from said axis of rotation on the side of said curved drilling face, cutting elements carried in said curved drilling face for maintaining gauge of a bore hole having the radius of said curved drilling face when the bit is in use, said body portion having a plain opposite face curving about the axis of rotation on a shorter radius and joining with said sides of the curved drilling face to cooperate with the wall of the bore hole in leaving an arcuate space coextensive with said plain face and whereby a bottom portion of the bore hole is progressively uncovered across said plain face from one side of the curved drilling face to the other incidental to rotation of said bit, said body portion having an end drilling face provided with generally radial alternating ridges and recesses extending from said axis of rotation, cutting elements in said ridges and said recesses providing relief for the cuttings produced by the cutting elements, said arcuate space and said uncovered bottom portion of the bore hole providing a common uninterrupted discharge for the cuttings from all of said recesses on the side of the chordal plane opposite said curved drilling face, and said body portion of the drill bit having a downflow passageway opening through said end face for supplying drilling fluid to said recesses for washing the cuttings from said recesses and carrying the cuttings upwardly of the drill bit under the high volume flow through said arcuate space by freedom of the flow from under the drill bit and into said space.

2. A rotary drill bit as described in claim 1 wherein the plain face of the drill bit has a vertical channel directly connected with the downflow passageway for providing an upwardly directed jet.

3. A rotary drill bit having a body portion provided with a drilling face curving on a common radius about an axis of rotation and terminating at sides thereof in a chordal plane offset from said axis of rotation on the side of said curved drilling face, cutting elements carried in said curved drilling face for maintaining gauge of a bore hole having the radius of said curved drilling face when the bit is in use, said body portion having a plain opposite face curving about the axis of rotation on a shorter radius and joining with said sides of the curved drilling face to cooperate with the wall of the bore hole in leaving an arcuate space coextensive with said plain face and whereby a bottom portion of the bore hole is progressively uncovered across said plain face from one side of the curved drill face to the other incidental to rotation of said bit, said body portion having an end drilling face provided with generally radial alternating ridges and recesses extending from said axis of rotation, cutting elements in said ridges and said recesses providing relief for the cuttings produced by the cutting elements, said arcuate space and said uncovered bottom portion of the bore hole providing a common uninterrupted discharge for the cuttings from all of said recesses on the side of the chordal plane opposite said curved drilling face, said curved drilling face having vertical channels connected with the recesses on that side of the chordal plane, said body portion of the drill bit having a downflow passageway opening through said end face for supplying drilling fluid to said recesses for washing the cuttings from said recesses and carrying the cuttings upwardly of the drill bit under the high volume flow through said arcuate space by freedom of the flow from under the drill bit and into said space, and said end drilling face having channels connecting said downflow passage and extending across said ridges to certain

of the vertical channels to assure a proportional flow of drilling fluid to the curved drilling face.

4. A rotary drill bit as described in claim 3 wherein the plain face of the drill bit has a vertical channel directly connected with the downflow passageway for providing an upwardly directed jet.

5. A rotary drill bit having a body portion provided with a drilling face curving on a common radius about an axis of rotation and terminating at sides thereof in a chordal plane offset from said axis of rotation on the side of said curved drilling face, cutting elements carried in said curved drilling face for maintaining gauge of a bore hole having the radius of said curved drilling face when the bit is in use, said body portion having a plain opposite face curving about the axis of rotation on a shorter radius and joining with said sides of the curved drilling face to cooperate with the wall of the bore hole in leaving an arcuate space coextensive with said plain face and whereby a bottom portion of the bore hole is progressively uncovered across said plain face from one side of the curved drilling face to the other incidental to rotation of said bit, said body portion having an end drilling face, cutting elements in said end drilling face, said end drilling face having watercourses leading to said arcuate space at said uncovered bottom portion of the bore hole for discharge upwardly through said arcuate space, and said body portion of the drill bit having a downflow passageway opening through said end drilling face for supplying drilling fluid to said watercourses for washing the cuttings from said cutting elements in the end drilling face and carrying the cuttings upwardly of the drill bit under a high volume flow through said arcuate space by freedom of the flow from under the drill bit into said space.

References Cited in the file of this patent

UNITED STATES PATENTS

443,072	Chapman	Dec. 16, 1890
1,256,968	Young	Feb. 19, 1918
1,463,566	Akins	July 31, 1923
1,587,266	Zublin	June 1, 1926
2,425,132	Stokes	Aug. 5, 1947
2,614,809	Zublin	Oct. 21, 1952
2,802,642	Feucht	Aug. 13, 1957