Oct. 27, 1936. C. F. WILLIAMS ET AL 2,058,749

DRILL BIT

Filed March 28, 1934 2 Sheets-Sheet 1

Fig. 1.

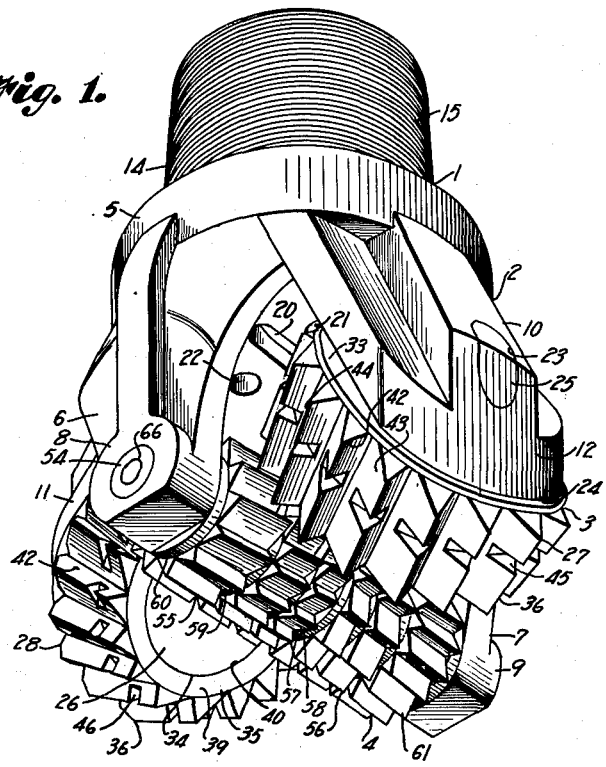
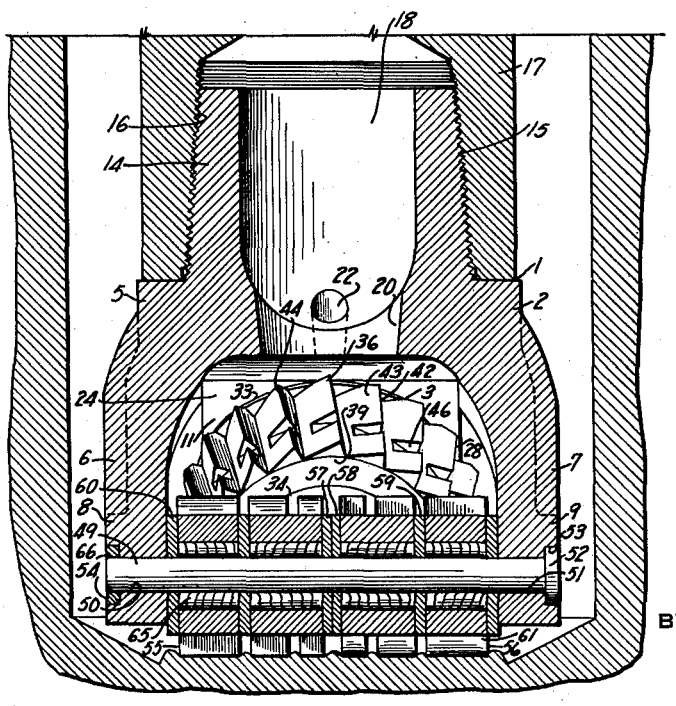


Fig. 2.



INVENTORS
Clinton F. Williams
Hans Gruner
BY
ATTORNEY

Oct. 27, 1936. C. F. WILLIAMS ET AL 2,058,749

DRILL BIT

Filed March 28, 1934 2 Sheets-Sheet 2

Fig. 3.

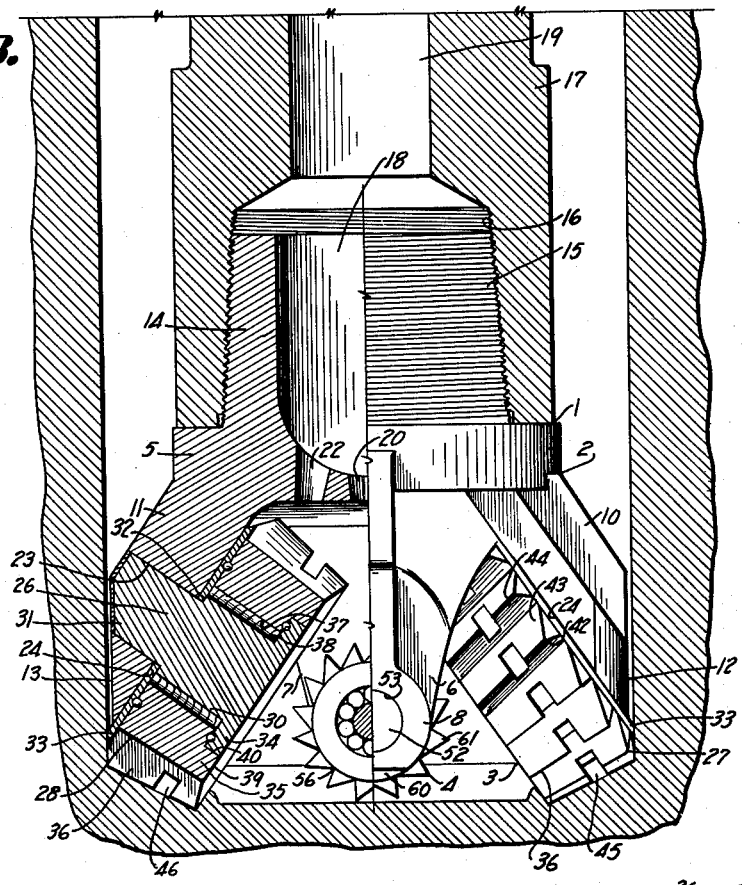


Fig. 4.

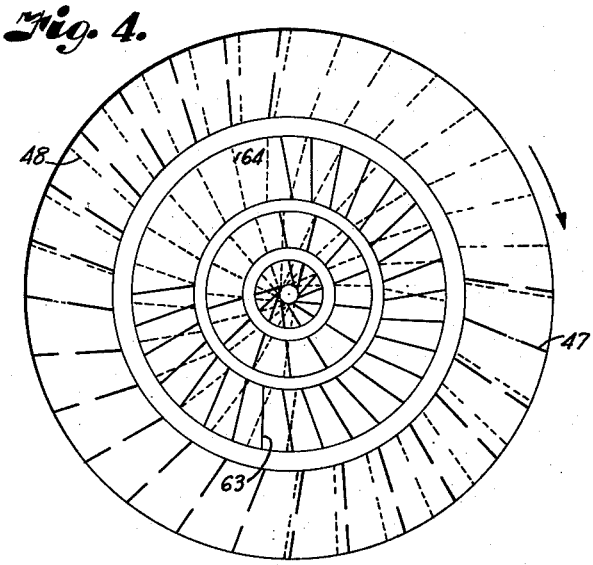


Fig. 5.

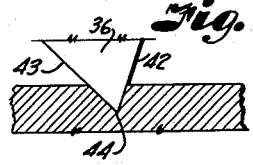


Fig. 6.

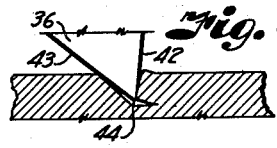
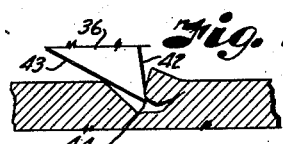


Fig. 7.



INVENTORS
Clinton F. Williams and
Hans Gruner
BY
ATTORNEY

Patented Oct. 27, 1936

2,058,749

UNITED STATES PATENT OFFICE

2,058,749

DRILL BIT

Clinton F. Williams and Hans Gruner, Tonkawa, Okla., assignors to Williams Iron Works Company, Tonkawa, Okla., a corporation of Oklahoma

Application March 28, 1934, Serial No. 717,738

5 Claims. (Cl. 255—71)

This invention relates to drill bits and more particularly to those of the rotary type, as used in drilling earth formations when prospecting sub-surface deposits or in making oil, gas and other wells and has for its principal objects to provide a bit of this character which is self-sharpening and self cleaning and which will more effectively drill through rock formations, producing a straighter hole, and having long wearing qualities.

In accomplishing these and other objects of the invention, we have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a perspective view of a rotary drill bit embodying the features of the invention.

Fig. 2 is a vertical section through the bottom of a well hole and drill bit illustrating the bit in operation.

Fig. 3 is a similar view showing the bit in three-quarter section as viewed from the side at right angles to the section shown in Fig. 2.

Fig. 4 is a plan view of the bottom of the well hole diagrammatically showing tracks made by the teeth of the bit.

Figs. 5, 6 and 7 are diagrammatic views showing the cutting operation of the cutter teeth.

Referring more in detail to the drawings:

1 designates a rotary drill bit including a head 2 carrying sets of side and cross roller cutters 3 and 4, respectively.

The head 2 includes a central substantially disk shaped portion 5 having integral cross roller lugs 6 and 7 projecting downwardly from the lower side thereof at opposite diametrical points and terminating in shaft supporting portions 8 and 9. Also projecting downwardly from the lower face of the disk portion and located at the sides thereof intermediate the lugs 6 and 7 are diverging side roller lugs 10 and 11 having rounded lower ends 12 and 13 extending in parallel relation to the axis of the bit. Extending upwardly from the plate portion 5 and located in the axis of the bit is a tapering pin 14 having external threads 15 for engaging the internal threads 16 of a box joint 17 carried at the lower end of a string of drill pipe, as in customary practice. The pin 14 is provided with an axial recess 18 opening from the upper end thereof in direct alignment with the water course 19 which extends through the box joint 17.

Extending through the plate portion 5 from the bottom of the recess 18 and in a plane passing through the center of the lugs 6 and 7 is a central transverse slot 20 for discharging drilling fluid substantially in a sheet stream in the axis of the bit and against the periphery of the cross cutters to wash the cuttings from the teeth thereof. The bit is also provided with water jets 21 and 22 offset laterally at the sides of the slot 20 in diametrical alignment with the side cutter lugs 10 and 11 for washing cuttings from the side cutters 3.

Formed in the ends of the side cutter lugs 10 and 11 are openings 23 arranged with their axes at right angles to the inner upwardly diverging faces 24 thereof for mounting side cutter pins 25 and 26, respectively, for mounting the side cutters 27 and 28. The pins 25 and 26 include bearing portions 30 having shanks 31 of suitable diameter to snugly engage in the openings 23 and have shoulders 32 for engaging thrust washers 33 that are retained thereby against the inner faces 24 of the lugs 10 and 11. The bearing portions 30 of the pins are provided at the outer ends with annular flanges 34 for retaining the side rollers.

The side rollers include substantially frustro-conical body portions 35 having cutter teeth 36 on the periphery thereof for making a circular cut upon operation of the bit, as later described.

The bearing openings 37 in the side cutters are of larger diameter than the bearing portions 30 of the pins 25 and 26 to mount roller bearings 38 therebetween, which are retained between the thrust plates and flanges 34, the front faces 39 of the side rollers being provided with annular recesses 40 to accommodate the flanges 34 whereby the outer end faces of the cutters are retained in rotary engagement with the thrust plates 33.

The teeth 36 preferably extend in the same relative direction on each side cutter and are substantially triangular in cross-section with the forward faces 42 thereof forming a greater angle with the side of the cones than their rear edges 43 whereby the cutting edges 44 are projected forwardly of the radial center lines of the teeth to provide a prying action upon the formation upon penetration of the cutting edges so that when the teeth are carried upwardly, they pry out portions of the formation, as shown in Figs. 5, 6 and 7.

In order to provide a shearing cut of the teeth, the teeth are arranged in spiral relation so that the inner end edge of the teeth engage the formation prior to engagement of the outer end edges, so that as the cutters roll over the formation, the cuts as represented by the lines in Fig. 4 are made progressively from the inner diameter of

the cut toward the outer diameter and the cut for the following tooth commences about the time of the ending of the cut made by the previous tooth.

This is an important feature because it reduces the power required in rotating the bit, produces a more positive cutting action on the formation, and distributes pressure over a greater area of the cutter, thereby reducing breakage of the teeth.

The shearing action of the cut tends to uniformly wear down the teeth, making the cutters self-sharpening and retaining the shape of the teeth for a longer period than if the teeth extended longitudinally of the axis of the cutters. It also allows the teeth to withdraw freely from the formation, thereby keeping the cutting surfaces clean.

The teeth **36** of the side cutters are provided with circumferential grooves **45** and **46** as in customary practice, the grooves being located substantially in the path of the jets of drilling fluid moving through the ports **21**, whereby the drilling fluid is circulated completely around the side rollers to retain the teeth comparatively free from cuttings.

The teeth on one of the side cutters are of different pitch than the teeth on the other cutter so that the cuts made by their respective teeth will not coincide, but will be spaced in substantially parallel relation as shown by the lines **47** for the cutter **27** and by the lines **48** for the cutter **28**, Fig. 4.

The cross cutters **4** include a plurality of cylindrical rollers having laterally extending teeth of substantially the same shape as the teeth on the side cutters.

These cutters are mounted on a shaft **49** having its ends mounted in openings **50** and **51** in the supporting portions of the lugs **6** and **7**, as clearly illustrated in Fig. 1.

In the illustrated instance, one end of the shaft is provided with a head **52** located in an annular recess **53** in the outer face of the lug **7**, while the opposite end of the shaft is provided with a washer **54** welded into a similar recess in the outer face of the lug **6**.

In the bit illustrated, the shaft is provided with four cutters, two on each side of the vertical axis of the bit to provide separate sets **55** and **56** separated by washers **57** and **58**. The individual cutters in each set are likewise separated by washers **59** and the end cutters in each set are spaced from the inner face of the lugs **6** and **7** by similar washers **60**.

The teeth **61** of the cutters are of substantially the same shape and have the same cutting characteristics as the teeth on the side cutters, but the teeth in one set are of different pitch and arranged in opposite spiral relation to the teeth in the corresponding cutter of the other set, so that when the bit is rotated, the cuts made by one set of teeth will traverse the cuts made by the other set of teeth as shown by the lines **63** and **64** in Fig. 4, the dotted lines **64** representing the cuts made by one set of cross cutters and the solid lines the cuts made by the other set of cross rollers.

The inner cutter of one set is, however, of the same pitch as the outer cutter of the other set to balance the cutting action of the bit; that is a tooth on each of the respective sets is always contacting the formation at the respective sides of the axis of the bit.

The cross rollers may also be provided with roller bearings **65** to provide free rotary movement on the shaft **44**.

The teeth of the inner cutters are also provided with water courses similar to the teeth of the side cutters which are located in alignment with the slotted course **20** opening from the recess in the drill bit.

The cross cutters are preferably arranged so that the teeth of the side cutters will make their cuts at a lower level or in advance of the cuts made by the cross cutters, thereby effecting a straighter hole, as the cut produced by the side cutters is of circular shape and forms a guide track or groove for the cutters to roll within and which prevents tendency of the bit to get out of its straight downward course.

In assembling a bit constructed as described, the side rollers are mounted on the bearing portions of the pins **25** and **26**, so that the head flanges of the pins enter the recess in the outer faces of the side cutters.

The shanks of the pins are then driven into the openings formed in the lugs **6** and **7**, after which the ends of the shanks are welded to the lugs, as shown in Fig. 3.

The cross cutters are assembled together with the washers and bearings between the lugs **6** and **7**, after which the shaft is projected through the lugs and cutters to seat the head **52** in the recess **53** in the lug **7**.

The washer **54** is then applied in the recess in the lug **6** and welded to the end of the shaft as shown at **66** to complete the assembly of the cutter.

The threaded pin **14** is then screwed into the box coupling on the lower end of the drill stem and the drill stem lowered into the well.

Upon rotation of the bit as in customary practice, the teeth roll over the formation upon which the bit is supported and as pressure is applied, the teeth are caused to cut into and pry out sections of the formation as shown in Figs. 5, 6 and 7, the teeth being cleaned and sharpened by the shearing action of the cutters.

Because of the different spacing or pitch of the teeth in the respective cutters, the teeth will not track and therefore cut the formation at different points in their gyration about the well hole.

In the present instance, due to the staggered relation of the cuts, it is only necessary for one tooth to remove that portion of the material between it and the corresponding preceding tooth on the mating cutter.

The bit, therefore, not only cuts the formation at a faster rate, but is capable of producing a straighter hole since there is less tendency for deviation of the drill from its perpendicular course.

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

1. A drill bit including a bit head having diametrically spaced lugs, a shaft having its ends fixed in said lugs, sets of cross cutters rotatably mounted on the shaft, each set having spiral teeth of different pitch whereby the teeth of one set produce inter-crossed cuts in a formation being drilled by the bit with the cuts made by the other set, and side cutters rotatably mounted on the bit head for rotation about an axis inclined toward the axis of the cross cutters and having teeth provided with cutting portions extending below the cutting portions of the cross cutters for effecting an annular cut below the cut made by the cross cutters.

2. A drill bit including a bit head having diametrically spaced lugs, a shaft having its ends

fixed in said lugs, sets of cross cutters rotatably mounted on the shaft, each set having spiral teeth of different pitch whereby the teeth of one set produce inter-cross cuts in a formation being drilled by the bit with the cuts made by the other set, and side cutters rotatably mounted on the bit head for rotation about an axis inclined toward the axis of the cross cutters and having spiral teeth with cutting portions extending below the cutting portions of the cross cutters for effecting an annular cut below the cut made by the cross cutters.

3. A drill bit of the character described including a bit head, sets of cross cutters, each having spiral teeth of different pitch, means rotatably mounting the cross cutters on the bit head, whereby the teeth of one set produce intercrossed cuts in a formation being drilled by the bit with the cuts made by the other set, side cutters rotatably mounted on the bit head for rotation about axes inclined relatively to the axis of the cross cutters for effecting an annular cut below the cuts made by the cross cutters.

4. A drill bit of the character described including a bit head, sets of cross cutters, each having spiral teeth of different pitch, means rotatably mounting the cross cutters on the bit head, whereby the teeth of one set produce intercrossed cuts in a formation being drilled by the bit with the cuts made by the other set, side cutters rotatably mounted on the bit head for rotation about axes inclined relative to the axis of the cross cutters and each having spiral teeth extending in the same relative direction to effect a circular series of substantially parallel cuts in advance of the cuts produced by the cross cutters.

5. A drill bit of the character described including a bit head, sets of cross cutters, each having spiral teeth of different pitch, means rotatably mounting the cross cutters on the bit head, whereby the teeth of one set produce intercrossed cuts in a formation being drilled by the bit with the cuts made by the other set, side cutters rotatably mounted on the bit head for rotation about axes inclined relative to the axis of the cross cutters and each having spiral teeth of different pitch extending in the same relative direction to effect a circular series of substantially parallel cuts in advance of the cuts produced by the cross cutters.

CLINTON F. WILLIAMS.
HANS GRUNER.