June 5, 1956 R. G. PETER 2,749,093

DRILL BIT

Filed Sept. 12, 1952 3 Sheets-Sheet 1

Fig. 1

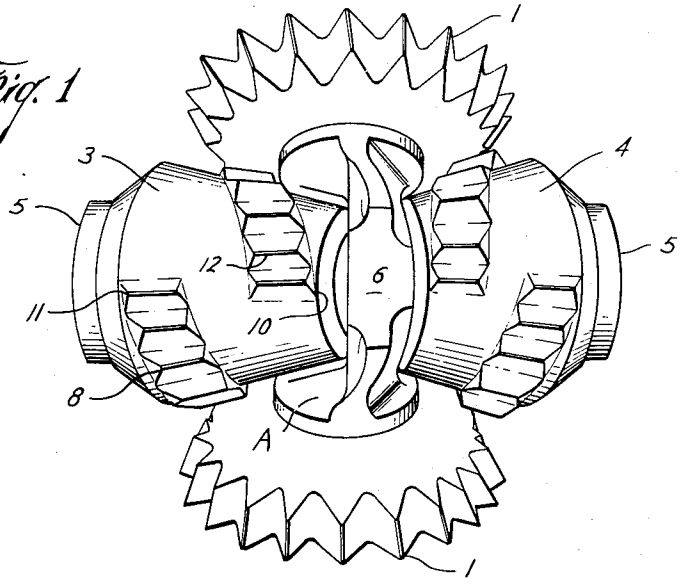
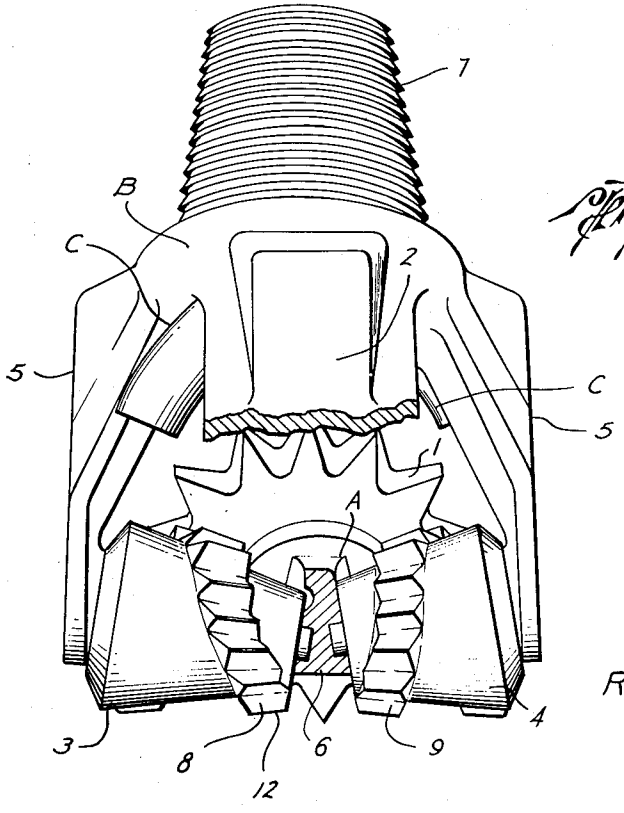


Fig. 2



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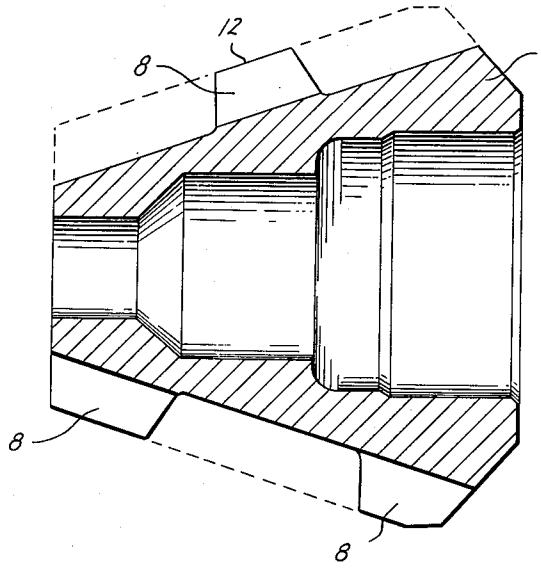

Fig. 3

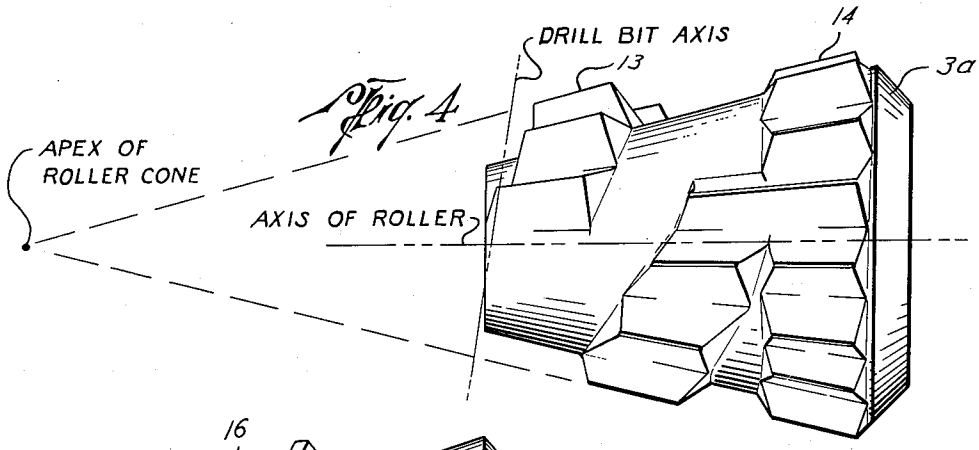

Fig. 4

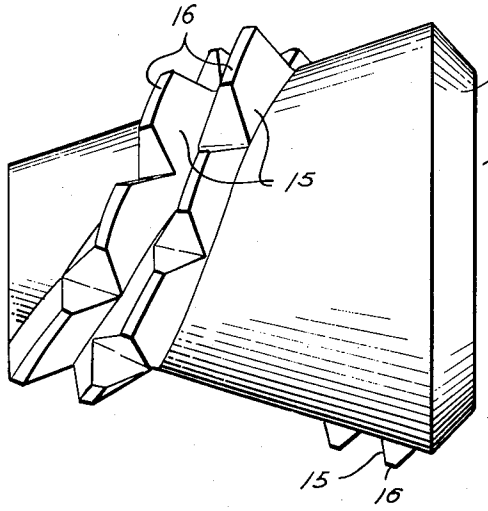

Fig. 5

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DRILL BIT

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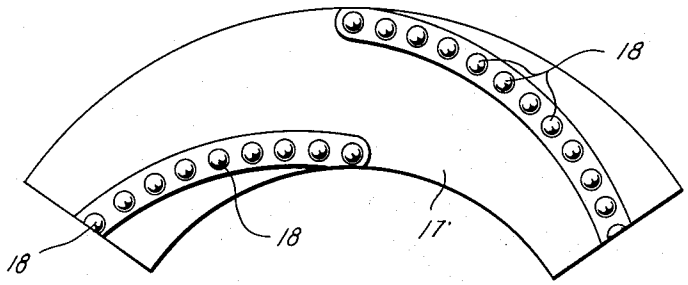

Fig. 6

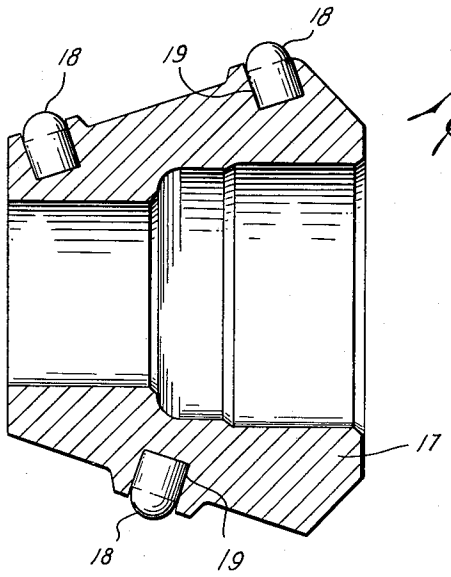

Fig. 7

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DRILL BIT

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Application September 12, 1952, Serial No. 309,258

2 Claims. (Cl. 255—350)

This invention relates generally to drill bits and more particularly to rotary drill bit rollers.

A general object of this invention is to provide a rotary drill bit adapted to drill earth formations faster and more efficiently.

Rotary drill bits in common use may employ two gage or side rollers to maintain the gage of the hole, and two frusto-conical cross rollers to remove that portion of the bottom of the hole not removed by the said side rollers. The side and cross rollers are mounted in the bottom of the drill bit. As the drill bit is rotated by the drill stem, the side and cross rollers roll upon the bottom of the hole. The cross roller cutters are usually of frusto-conical form. Each of the cross roller cutters is located on one side of the longitudinal axis of the drill bit, which is the axis of rotation of the drill bit. The apex of neither of these frusto-conical cross roller cutters coincides with the axis of rotation of the drill bit. Therefore, neither of these frusto-conical cross roller cutters have a true rolling action upon the bottom of the hole. In traveling about the drill bit axis, the frusto-conical rollers will rotate on their axes but only one point on each roller will be in substantially true rolling engagement with the bottom of the bore hole. This point on the roller is commonly known as the "neutral point." The neutral point on the roller is found at that distance from the drill bit axis where the peripheral speed of the roller is equal to the circumferential speed of the drill bit. Thus it will be apparent that cross rollers now in common use have substantially only one point of the teeth on each cross roller in true rolling engagement with the bottom of the hole as the rollers travel in an orbit about the drill bit axis. Roller teeth which are located farther from the drill bit axis than the neutral point will tend to turn faster, and roller teeth which are located nearer to the drill bit axis than the neutral point will tend to turn slower, than a tooth located on the neutral point which is turning in substantially true rolling engagement with the bottom of the bore hole. Thus the teeth farther from, and nearer to, the drill bit axis do not roll upon the bottom of the bore hole, but instead are scraped, or dragged upon the formation. In some softer formations, a certain amount of scraping, or dragging as it is commonly known, of the roller teeth, may be desirable because of the ripping or tearing action on the formation; however, in the harder, more abrasive formations, this tooth drag does not enhance the drilling of the formation because such formations can not be readily ripped or torn apart, but rather are usually drilled by crushing the formation. When the roller teeth drag on hard, abrasive formations, they may abrade away, causing accelerated wear of the teeth, and a corresponding impairment of the useful life of the drill bit. In order to alleviate premature wear of the roller teeth, I provide a drill bit roller wherein the drag action of the teeth on the formation may be predetermined, to facilitate the drilling of various types of formations, by

predetermining the area of formation engaging teeth contacting the formation at a given time.

An object of this invention is to provide a new and improved cross roller type drill bit.

A specific object is to provide new and improved cross rollers for a deep well drill bit wherein the cutting or crushing elements of the cross rollers may be substantially in true rolling engagement with the formation being drilled by the drill bit.

Another object is to provide a new and improved roller drill bit wherein the drag action of the rollers—as opposed to rolling action thereof—may be controlled or predetermined.

Another object is to provide a drill bit which will not readily pack or "ball up" with cuttings dislodged during the drilling operation.

Another object is to provide a drill bit having new and improved rollers wherein a greater unit of pressure may be applied to the formation by the roller teeth, for a given weight on the drill bit.

Another object is to provide a new and improved drill bit roller which may be adapted to drill various types of formation.

Another object is to provide a drill bit roller having formation engaging elements of a substantially constant or uniform cross-sectional shape so that the area of the elements contacting the formation remains substantially the same, as the formation engaging elements are worn away.

Another object is to provide a drill bit with rollers having relatively few formation engaging elements or teeth to enable rapid penetration of the formation being drilled, and to effect economy in the manufacture and cost thereof.

Other objects will hereinafter appear from the following description and accompanying drawings wherein, by way of example, certain embodiments of this invention are set forth.

In the drawings:

Fig. 1 is a bottom plan view of a cross roller type drill bit illustrating an embodiment of this invention.

Fig. 2 is a view partly in section and partly in side elevation showing the new type cross rollers.

Fig. 3 is a sectional view taken through a cross roller of the type shown in Figs. 1 and 2.

Fig. 4 is a side elevation view of a cross roller illustrating a modification of the invention and illustrating schematically the relationship of the roller cone apex to the drill bit axis.

Fig. 5 is a side elevation view of a cross roller illustrating a further modification of the invention.

Fig. 6 is a view showing a development of the conical surface of the cross roller shown in Fig. 7.

Fig. 7 is a sectional view taken through a cross roller having hard metal inserts for formation engaging elements.

Referring to Figs. 1 and 2, a drill bit is indicated generally at A. The drill bit is composed of two oppositely disposed gage, or side, rollers 1 which are adapted to be rotatably mounted on the lower ends of the side roller bearing extensions 2. A long cross roller 3 and a short cross roller 4 are adapted to be rotatably mounted on the lower ends of cross roller bearing extensions 5. The lower, inner ends of the bearing extensions 2 and 5 are secured to a bridge 6. The upper ends of the bearing extensions 2 and 5 are adapted to fit and be secured together by a weld to form a bit head B and a shank 7 which may be threaded for connection to the lower end of a drill stem (not shown). The bit head B has the usual fluid passageway C therein for communication with the fluid passageway in the drill stem (not shown) for

the purpose of flushing out from the bore hole, cuttings dislodged by the drilling operation. The long cross roller 3 has teeth 8 on its conical surface for the purpose of drilling the formation. The short cross roller 4 has teeth 9 on its conical surface which are similar to the teeth 8 on the long roller 3. The action and construction of the long roller 3 and the short roller 4 and the rollers hereinafter described are substantially similar; therefore, a description of the action and construction of one will describe the others. The teeth 8 of the roller 3 are all contained in a single spiral or thread form which commences at the inner end 10 of the conical surface of the cutter 3 and ends at the outer end 11 of the said conical surface after passing around the axis of the roller 3 substantially only a single time. In other words, the teeth 8 may be contained in a single thread, or spiral, having a pitch and lead greater than one-half the conical length of the roller 3. If desired the crests 12 of the teeth 8 may be reduced in length whereby the teeth 8 may approximate a pyramidal shape, whereupon the pitch and lead of the thread form containing the teeth 8 may be substantially equal to the conical length of the roller 3. (Figs. 1, 2 and 3.)

It will be apparent that if all of the teeth 8 are contained substantially in a single spiral form, as above described, substantially only one tooth of the roller teeth 8 will engage the formation at a given time, and, if only one point on the roller contacts the formation at a time, this point will be substantially in true rolling engagement therewith, and will control the rotational or peripheral speed of the roller irrespective of the distance of the said contacting point from the drill bit axis. Also, since only a relatively small tooth area is in contact with the formation at a given time, greater penetration thereof is afforded for a given weight on the drill bit. Merely to reduce the number of teeth on a conventional roller may not be practical since the teeth may become too widely spaced angularly, and the roller may skid rather than turn about its axis as the drill bit is rotated on the bottom of the bore hole. In my invention, the angular or circular spacing of the teeth 8 may be close enough to prevent skidding of the rollers 3, and still have a relatively small area of the teeth contacting the formation at a given time. Since the roller teeth 8 are in substantial true rolling engagement with the formation, the bending stress of each tooth is reduced since the tooth drag is reduced; accordingly, the cross-sectional area of each tooth may be reduced correspondingly, thus affording faster penetration of the formation, and affording a substantially uniform or constant cross sectional tooth shape so that the area of the roller teeth contacting the formation remains substantially constant as the roller teeth are worn away during the drilling operation. The paucity of teeth on the roller facilitates the cleaning thereof by the drilling fluid, and the drill bit is not as likely to pack or "ball up" with cuttings dislodged by the drilling operation.

Fig. 4 illustrates a modification of the invention wherein the cross roller 3*a* has a single spiral row of teeth 13 and an annular row of teeth 14. This type of roller may be adapted to drill relatively soft formations which will not readily abrade the roller teeth. The annular row of teeth 14 may be adapted to drive the cutter 3*a*, as it is rotated on the formation, and cause the teeth 13 to rip or tear the formation being drilled. Fig. 4 also illustrates schematically the relationship of the roller cone apex to the drill bit axis. As above stated, the cross roller is usually constrained to move in an orbit about the drill bit axis rather than about an axis passing through the apex of the roller cone.

Fig. 5 illustrates a still further modification of the invention wherein the cross roller 3*b* has a double row of teeth 15 contained in a basic single spiral, and wherein the tooth crests 16 are more nearly substantially parallel to that tangent to the helix which lies adjacent to any given tooth. This type of roller may be adapted to drill harder formations that are subject more readily to being crushed than ripped or torn apart.

Figs. 6 and 7 illustrate a still further modification of the invention wherein the cross roller 17 may have on the surface thereof a basic single spiral into which are disposed hard metal inserts 18. The inserts 18 may be composed of tungsten carbide, and may be pressed or otherwise secured in sockets 19 in the roller 17. This type of roller may be adapted to drill extremely hard, abrasive formations by the crushing action of the inserts 18 on the formation being drilled. It will be apparent that only a relatively small number of hard metal inserts are required in this type of roller to obtain satisfactory results.

All of the cross rollers herein described have relatively few formation engaging elements; accordingly, less machining is required therefor, and a corresponding economy in the manufacture and cost of the cross rollers is effected.

The foregoing disclosure and description is illustrative of the invention, and is not to be limited to the embodiments shown. Various changes, within the scope of the following claims, will occur to those skilled in the art.

I claim:

1. A cross roller drill bit having a head; said head having two oppositely disposed cross roller bearing extensions and two oppositely disposed side roller bearing extensions; frusto-conical cross rollers rotatably mounted on the lower portions of said cross roller bearing extensions, the axis of each roller extending substantially radially outwardly of the bit axis; side rollers rotatably mounted on the lower portions of said side roller bearing extensions; said head having a drilling fluid passageway therethrough; each of said cross rollers having formation engaging elements contained in a single spiral passing around the axis of the roller only a single time and on the surface of each cross roller, each element adapted to engage only one area on the bottom of a bore hole at a time, each of said spirals having a pitch substantially equal to its cross roller surface length.

2. A cross roller drill bit according to claim 1 wherein each of said spirals has a pitch and lead greater than one-half the conical length of its respective roller.

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