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ROCK BIT

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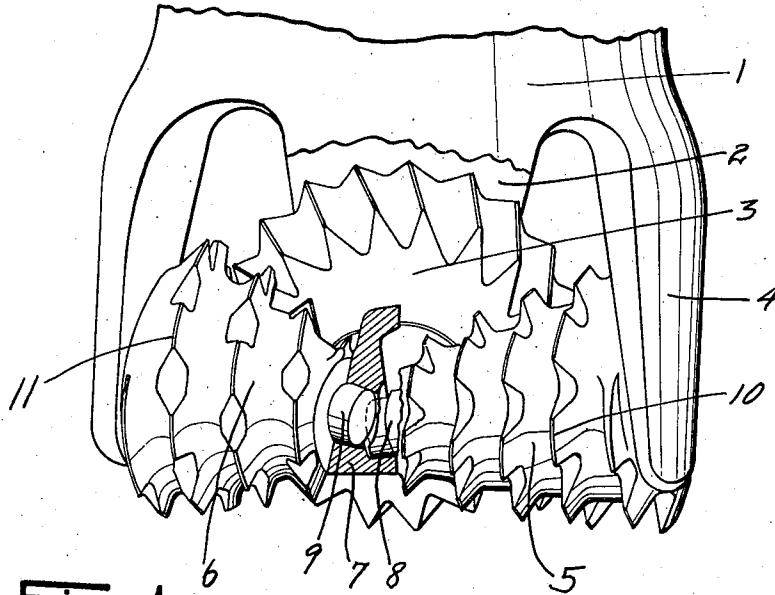


FIG. 1.

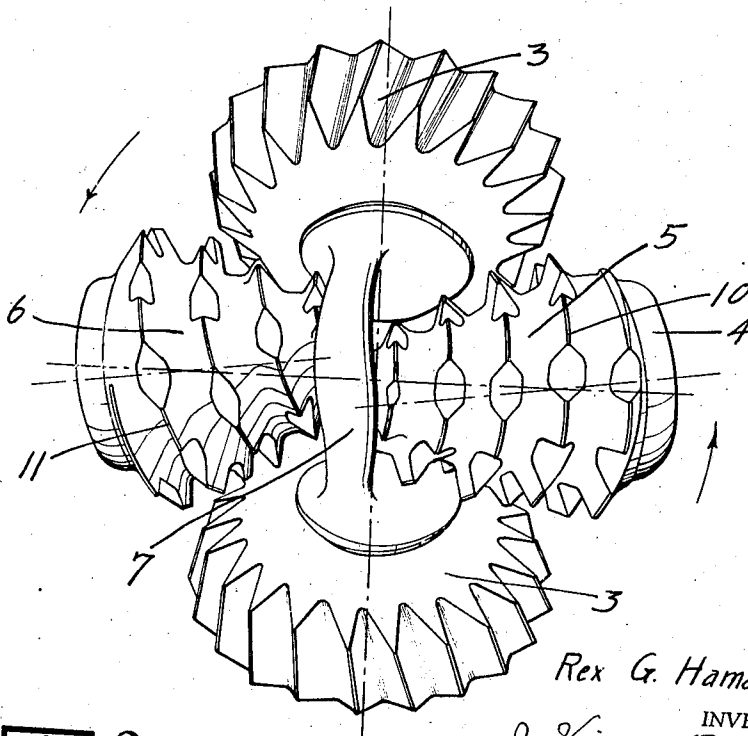


FIG. 2.

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ROCK BIT

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2 Claims. (Cl. 255—71)

This invention relates to rock bits and has for its general object the arrangement of the roller cutters of a rock bit so that they will more efficiently cut the formation as the bit is rotated.

The particular illustration shown in the drawing accompanying this specification is of the so-called cross roller type of bit, and the invention to which this specification relates is illustrated in that drawing by the disposition of the cross roller cutters with respect to each other and with respect to the remainder of the bit.

A more specific object of this invention is to provide an arrangement of cutters for cutting the formation at the bottom of a hole whereby those cutters, when the bit is rotated, will not only dig into the formation but will move the cuttings outwardly toward the outer periphery of the hole where they can be picked up by the flow of slush and conveyed to the surface of the ground.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawing wherein is set forth by way of example one embodiment of this invention.

In the drawing:

Fig. 1 is a side elevation of a cross roller bit constructed in accordance with this invention, one of the side cutters and its supporting arm having been broken away and the bridge of the bit shown in cross section for purposes of illustration;

Fig. 2 is a bottom plan view of the structure shown in Fig. 1.

In the device illustrated there is the usual bit head 1 having oppositely disposed downwardly extending legs 2 for supporting side cutters 3 adapted to cut at the sides and bottom of the hole along a marginal portion thereof. This head also has downwardly extending legs 4 midway between the legs 2 for the purpose of supporting the bearing shafts for the cross roller cutters 5 and 6.

Extending between the inner ends of the side cutters 3 is a bridge 7, this bridge having openings therein for the purpose of receiving the inner ends 8 and 9 of the bearing shafts for the respective cross roller cutters.

It is noted that the cross roller cutter 5 is provided with teeth 10, which extend generally circumferentially about the cutter in a spiral line. It is noted also that this spiral is a left hand spiral and that it is a double spiral, that is there are two rows of teeth 10 on the cutter 5, both rows extending from one end of the cutter to the other along a generally circumferentially spiral line. Likewise, the cutter 6 is provided

with spirally aligned teeth 11 extending in generally circumferential direction from end to end of the cutter. As in the previous instance, there are two such spiral rows of teeth 11 on the cutter 6 thus forming a double spiral but in this instance the spiral is a right hand spiral instead of a left hand spiral as on the cutter 5.

In addition to the foregoing, attention is directed to the fact that the cutters 5 and 6 are not in the same vertical plane. On the other hand, although the outer ends of the cutters 5 and 6 are located on a line which is substantially at right angles to a line through the centers of the cutters 3, the inner ends of the cutters 5 and 6 are offset from each other in such a direction that when the bit is rotated in normal use the inner ends of the cutters will be trailing behind the outer ends. In the instance shown, the inner end of each cutter is offset to substantially the same degree so that the cutter axes are in substantially parallel planes.

It is appreciated that the use of spirally arranged teeth, such as the teeth 10 and 11 above described, on the cross roller cutters of a cross roller bit is old as shown in the patent to Stancliff No. 1,998,793, issued on April 23, 1935. It is appreciated also that heretofore the cross roller cutters of a cross roller bit have been offset from each other. Furthermore, it is understood that in the prior art cutters have been arranged for cutting the central portion of the bottom of a hole, such cutters having been offset from each other and provided with spirally arranged teeth.

However, in the case of the previous cross roller bit with spiral teeth on the cross roller cutters as shown in the patent to Stancliff above mentioned, the axes of the cutters are not offset from each other but are in line with each other. In the case of the cross roller bit in which the cutters were offset from each other, the teeth on such cross roller cutters were not spirally arranged and aligned but extended generally in a direction parallel to the axes of the cutters. In the instance where cutters for cutting at the bottom of a hole were offset from each other so that their axes were not in alignment and were provided with spiral teeth, the cutters were offset in such a direction that in operation the inner ends of the cutters would lead instead of follow the outer ends.

It has been found that a most unexpected result occurs when the previously known double spiral cutters are offset from each other in a cross roller bit in such direction that the inner ends of the cutters will trail in the normal opera-

tion of the bit and these results are not obtained and are not indicated in the previous usage of bits with spiral tooth cutters in alignment with each other or in bits with cutters offset from each other but with a different type of teeth.

The arrangement just described is of a very great advantage especially in drilling certain types of formations, such as shale and the like. Such formations when mixed with drilling fluid tend to accumulate at the center of the bit to form a ball. With the ordinary bit this may even go to the extent of packing the cutter teeth and cutters to such a degree that they become locked and the bit is either rendered inefficient or without further usefulness. By disposing the inner ends of the cross cutters in an offset position toward the rear with respect to the direction of the rotation of the bit, so that the inner ends of the cross cutters trail the outer ends thereof, these cutters will tend to throw the formation outwardly and away from the center of the bit. This effect is emphasized when the cutters are provided with teeth having their crests extending circumferentially with respect to the cutters, and especially when such teeth are disposed in a helical or spiral direction with respect to the cutters.

Preferably the amount of offset of the inner ends of the cutters should be such that the teeth at the instant of coming into contact with the formation will make such contact as nearly as possible along a single radial line, so that the teeth will move into the formation with substantially no radial component of movement. That is, at any given instant those portions of the teeth which are just beginning to enter the formation will lie along a radius or line drawn through the central axis of the bit. As the cutter rolls, however, and is moved around by the rotation of the bit, these cutter teeth will, as they are withdrawn from the formation, drag in an outward direction, thus tending to move the formation directly outwardly.

Preferably also the teeth on the cutter and especially the teeth near the inner end of the cutter are to be arranged so that their crests extend at a substantial angle to and as nearly as possible at a right angle to the direction in which they will be dragged as they are withdrawn from the formation. In the example set forth, spirals have been selected which most nearly accomplish this result, and still permit the use of a right hand spiral on one cutter and a left hand spiral on the other. The exact angle of the spiral or helix along which the teeth are disposed should be determined in each case by arranging the teeth as nearly as possible in a line at right angles to the line along which the teeth of that particular cutter will drag as they leave the formation in the operation of the bit. It will be understood that it is not necessary that the tooth be disposed precisely at right angles to the direction of its drag as it leaves the formation but that it should be disposed at a substantial angle to such direction of drag and not directly along such direction of drag so that as it drags in leaving the formation it will not merely slip through the formation but

it will withdraw a chip or cutting with it from the formation.

With this type of cutter arrangement, it is apparent there will be a reaction on the cutter tending at all times to move the cutter inwardly toward the center of the bit. In order to counteract this end thrust, the bridge 7 has been utilized to take the inward thrust directly from the inner ends of the cross cutters. Thus, the present embodiment has the advantage of providing a strong support for taking the inward thrust which is imparted to the cross cutters in the cutter arrangement hereinbefore described and it is unnecessary in this arrangement to depend upon some form of thrust bearing within the cutter itself for taking this thrust.

It will thus be seen that there has been provided a structure in which a highly desirable cutter tooth action is brought about permitting penetration of the cutter teeth without objectionable skidding or rubbing onto and into the formation, yet in which the cutter teeth as they leave the formation will drag so as to remove chips from the formation and simultaneously move them outwardly away from the center of the bit. The result is a cutter tooth action of higher digging efficiency and less tooth wear results for each cutting contact of each tooth.

Having described my invention, I claim:

1. In a drilling bit adapted to be rotated in one direction in drilling, a frusto-conical cutter having spirally arranged teeth thereon, the inner end of said cutter being offset from a radial vertical plane extending from the vertical axis of the drilling bit to the center of the outer end of the cutter, the direction of such offset being such that the inner end of the cutter follows or trails behind a radial line from the vertical axis of the bit through the center of the outer end of said cutter when the bit is rotated in said one direction, whereby the cutter teeth are caused to progress outwardly as they leave the formation in the bottom of the bore hole and thereby move formation chips outwardly away from the center of the bore hole.

2. In a drilling bit adapted to be rotated in one direction in drilling, the combination of a frusto-conical cutter having spirally arranged teeth thereon, the inner end of said cutter being offset from a radial vertical plane extending from the vertical axis of the drilling bit through the center of the outer end of said cutter, the direction of such offset being such that the inner end of the cutter follows or trails behind the radial line from the vertical axis of the bit through the center of the outer end of said cutter as the bit is rotated in said one direction in drilling, whereby the cutter teeth will be caused to progress outwardly as they leave the formation in the bottom of the bore hole and thereby move formation chips outwardly away from the center of the bore hole, and an abutment at the inner end of said cutter providing a thrust bearing for taking the inward thrust from said cutter.

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