United States Patent

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[54] **GAUGE CUTTING BIT**
6 Claims, 4 Drawing Figs.

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[51] Int. Cl. E21c 13/06
[50] Field of Search 175/389, 398, 410

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ABSTRACT: A solid, button-insert-type percussion bit having a generally cylindrical body with a forwardly facing surface and hardened cutter inserts mounted therein and projecting therefrom. A portion of the surface is of conical or frustoconical contour, and the cutter inserts in this portion are arranged asymmetrically so as to produce a lateral component of body motion under axial percussive blows so that other inserts mounted at the periphery of the bottom surface may more effectively cut and maintain the gauge of the hole.

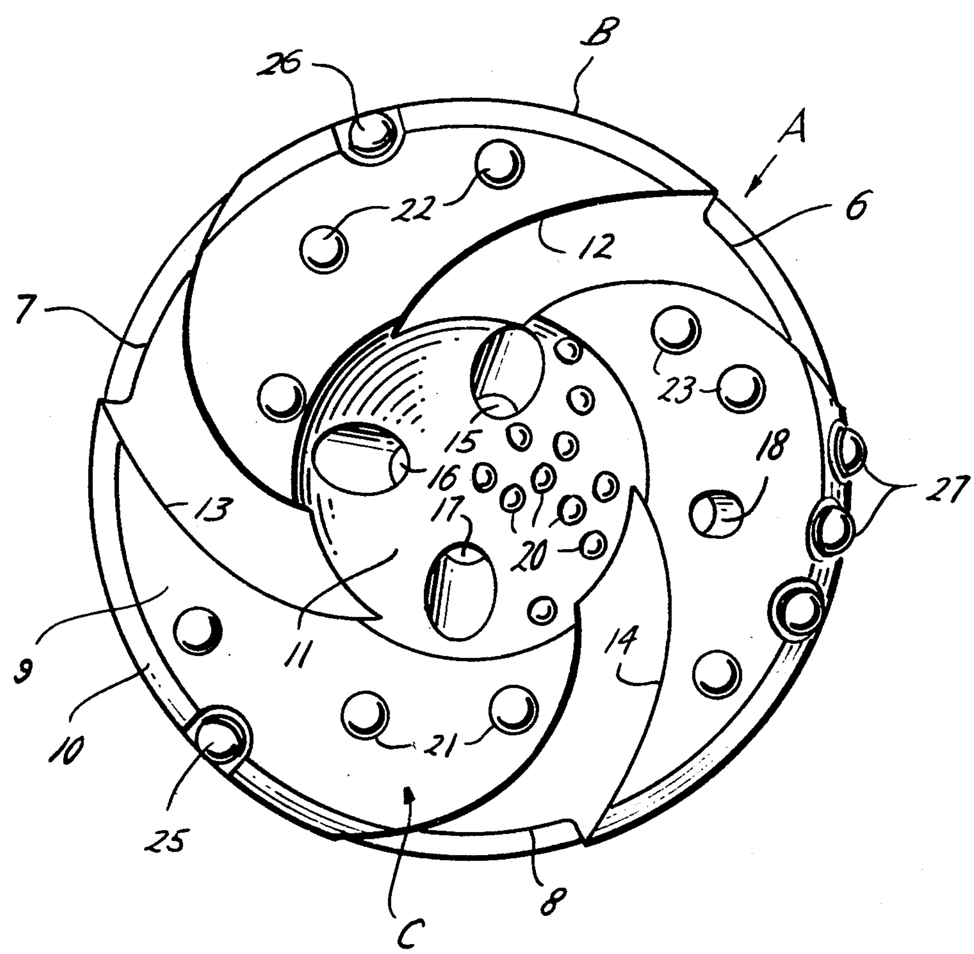

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Fig. 1

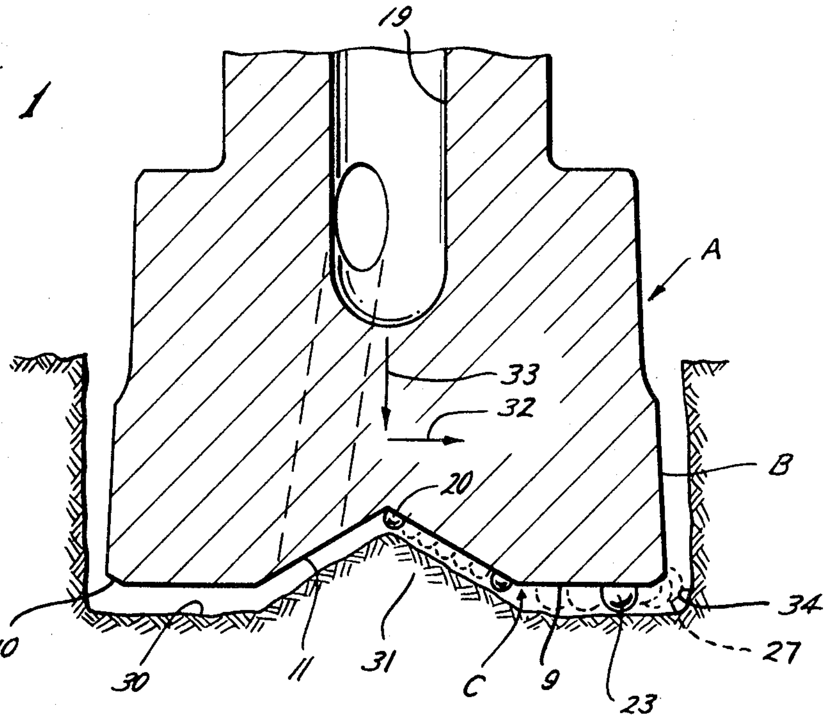

Fig. 2

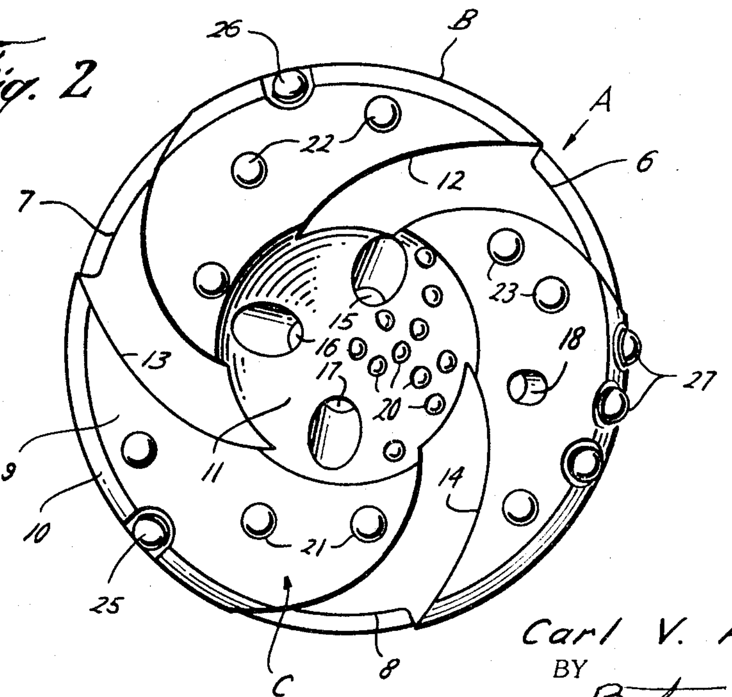

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Fig. 3

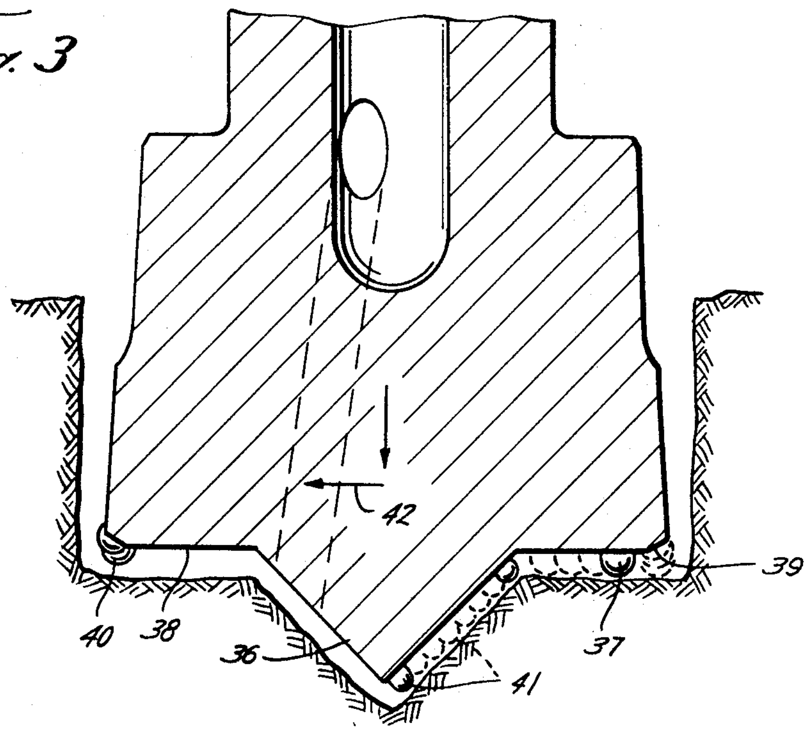
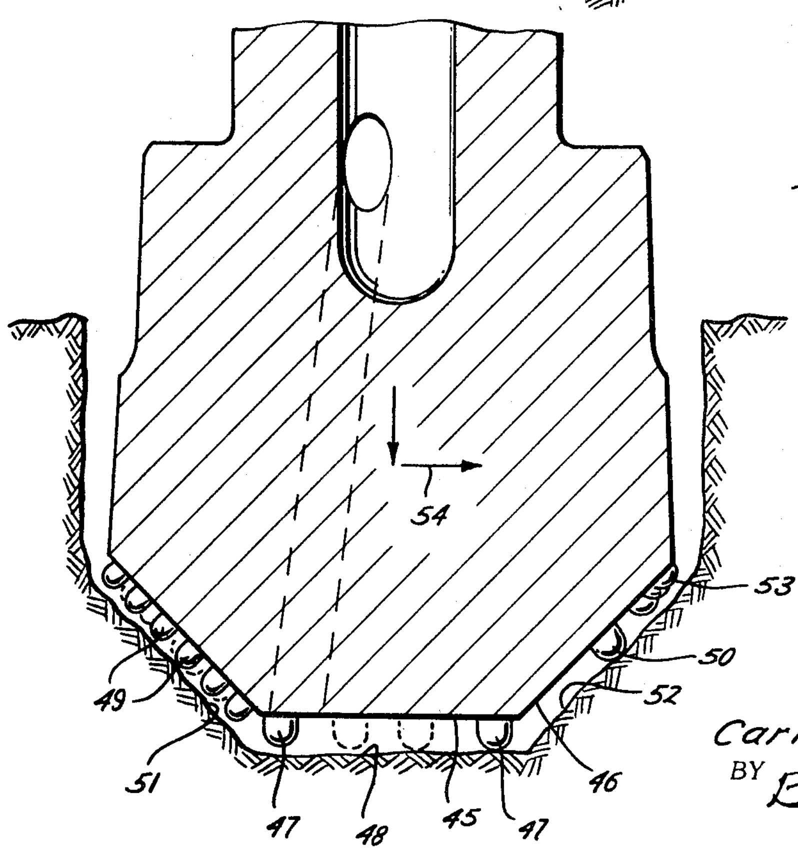


Fig. 4



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GAUGE CUTTING BIT

The invention relates to percussion rock bits, particularly of the solid type, having hardened cutter inserts mounted in and projecting from the forward face and periphery thereof. Normally, rotary cone-type bits are used for deep hole percussion drilling since no fully satisfactory way has been provided for maintaining the size of the hole when solid bits are used for this purpose. However, rotary cone bits do not possess the strength characteristics of solid-type bits and, therefore, cannot be subjected to the full potential energy output of modern, downhole percussion tools. More particularly, with the use of solid-type bits, rapid wear on the outside diameter of the body results in unacceptable loss of hole gauge long before the face cutters of the bit are worn out. In some cases, complete failure of the peripheral cutting elements due to the pinching effect on the outside diameter of the bit makes it necessary to pull the bit early. Furthermore, there is a reentry problem in the insertion of a new full-size bit into the undersized hole.

Accordingly, an object of the present invention is to provide a solid-type rock bit which is sufficiently rugged for use with high pressure percussive-type downhole tools and which will effectively maintain the desired hole gauge.

Another object is to provide such a bit having means whereby an axial percussive blow upon the bit body will cause a lateral component of bit motion for sideward penetration into the hole wall during each percussive blow.

Another object is to provide a percussion-type bit of the above type which will drill a hole of slightly larger diameter than the maximum diameter of the bit itself so as to reduce bit wear and facilitate reinsertion of a new bit into the hole.

These objects and others are attained by the invention herein disclosed in which a generally cylindrical, solid-type bit body is provided with hardened cutter inserts in its forward working surface. A portion of the inserts are mounted asymmetrically in a first, generally conical or inclined part of the forwardly facing surface and the remainder are mounted in and project axially from another part of the surface which is generally normal to the body axis, while still other cutter inserts are mounted at or adjacent to the intersection between the sidewall and forwardly facing surface of the bit body for maintaining the gauge. During drilling, the bit is subjected to axial percussive blows developed by a downhole percussion drilling tool and also to rotary indexing action applied through the supporting drill stem and the rotary table. During this drilling action, the asymmetrically disposed cutter inserts bear against an inclined portion of the hole bottom so as to produce a lateral component of body movement due to sliding or wedging action. Accordingly, cutter inserts mounted at the periphery or side of the body are caused to bite laterally into the hole sidewall incident to each vertical percussive blow applied to the body, thus, drilling a hole which in diameter is slightly larger than the maximum diameter of the body.

In the accompanying drawings which illustrate the invention,

FIG. 1 is a partial axial section through a bit embodying one form of the invention.

FIG. 2 is a forward or bottom view of the bit in FIG. 1.

FIGS. 3 and 4 are views similar to FIG. 1 but showing other modifications of the bit.

The bit in FIGS. 1 and 2 comprises a generally cylindrical body, designated A, having sidewall structure B and a forwardly facing bottom surface, generally designated C. Sidewall structure B slopes slightly upwardly and inwardly and has flutes 6, 7, and 8 arranged symmetrically thereabout. Bottom surface C includes an outer annular portion 9 which merges with sidewall structure B in a chamfer 10. Within surface part 9 is a conical, recessed surface portion 11. Spirally traversing annular surface portion 9 are wash grooves 12, 13, and 14 connecting recess 11 with flutes 6, 7, and 8. Wash passages 15, 16, 17, and 18 connect with a central passage 19 in the bit for conducting bit cooling and lubricating and cuttings-removing fluid, either liquid or gas, to the cutting surface of the bit and thence outwardly through grooves 12, 13, and 14 and upwardly through flutes 6, 7, and 8 and the annulus between the percussion drill, drill collars, and drill stem, as is well known.

Mounted in and projecting from conical surface portion 11, at one side thereof, that is, asymmetrically with respect to surface C and the axis of the bit body, are hardened, button-type cutter inserts 20. Mounted in and projecting forwardly from the part 9 of the cutter surface, which part extends normal to the body axis, are sets of hardened, button-type inserts 21, 22, and 23. Mounted in or adjacent chamfer 10 at the periphery of the cutter surface are hardened inserts 25, 26, and 27 which, preferably, extend both forwardly and sidewardly of the bit body. As shown in FIG. 2, these inclined, gauge-cutting inserts are located predominantly at the same side of the bit as the asymmetrical inserts 20 previously mentioned.

In operation of the bit disclosed in FIGS. 1 and 2, body A will be mounted at the bottom or forward end of a drill string with a percussion drill motor inserted therein and drill collars or other weighting means as needed. The drill fluid will then be supplied through the drill string under pressure for operating the percussion motor and cooling and lubricating the bit while washing the cuttings upwardly through the annulus around the drill string. Upon the delivery of each downward percussive blow to body A, the bottom surface portion 30 of the hole will be chipped by cutter inserts 21, 22, and 23. At the same time, a short core or projection 31 will be formed at the center of the hole bottom and, due to inserts 20 and the rotary motion of the bit, ultimately, will assume the conical shape as shown in FIG. 1. Thereafter, asymmetrical insert buttons 20 in the conically recessed portion 11 of the bit forward surface will strike the conical projection 31 at one side only, so that the bit body will receive a lateral component of motion, represented by the arrow 32, as well as a vertical component of motion, represented by the arrow 33. The vertical component of bit motion, acting through inserts 20—23, inclusive, will chip the bottom surface of the hole and, due to the indexing action, ultimately, the entire hole bottom will be evenly cut. At the same time, the lateral component of bit motion will cause gauge inserts 27 to strike the peripheral portion 34 of the hole bottom with an outward as well as downward motion which will extend the hole laterally a greater distance than the radius of the bit body. Thus, wear on side surface B of the body is reduced, while the hole is drilled at a diameter slightly greater than the diameter of the bit to facilitate withdrawal and replacement thereof. The motion of the bit may cause inserts 21, 22, and 23 to strike the hole bottom with a glancing blow which helps in the chipping action. Alternatively, inclined buttons 20 may be positioned so that inserts 21—23 strike the hole bottom only near the end of the bit motion enforced by engagement of buttons 20 with cone 31.

FIG. 3 shows a modification in which the conical recess 11 of FIGS. 1 and 2 is replaced by a conical projection 36. Hardened inserts 37 and 40 are provided, respectively, in the annular outer surface portion 38 which is generally normal to the axis of the body, and in peripheral chamfer 39. Inner cutter inserts 41 are mounted in and project from one side only of conical projection 36. In this form, the sideward component of bit motion, upon each percussive blow, will be leftwardly, as indicated by arrow 42, so that the leftward peripheral inserts 40 will serve to maintain the gauge of the hole.

FIG. 4 illustrates still another arrangement of the bit bottom surface, including a flat, central portion 45 which is generally normal to the bit axis and a frustoconical outer surface part 46. Inserts 47 at the center of the bit cut the central part 48 of the hole bottom. In this form, however, while the cutter inserts in conical surface portion 46 are predominantly at the left side, as at 49. Other inserts 50 are disposed oppositely thereto. With this arrangement, the actual cutting effect produced by the more numerous inserts 49 at the left side of the bit will be less than in the case of the less numerous inserts 50 at the opposite side. This is because the force of the percussion blow on each button 49 will be less than the force applied to each button 50. Inserts 40 will tend to slide downwardly along the inclined bottom surface part **51** causing less numerous inserts **50** opposite thereto to cut into inclined bottom surface part **52** while peripheral buttons **53** cut into the sidewall of the hole, due to the rightward lateral motion, symbolized by arrow **54**.

Thus, it is only necessary that cutter elements located on an inclined part of the forward or bottom surface of the bit be disposed asymmetrically in order to produce a lateral component of bit motion which, acting through the insert buttons located at the periphery of the body, will cause direct lateral cutting action on the sidewall of the hole. This has the effect of drilling a hole which is larger in diameter than the bit itself so as to reduce wear on the bit sidewall structure while greatly facilitating withdrawal and reinsertion of the bit. The bit body may be of the separate type, with means for attachment to the drill string or percussion tool, or may be formed integrally with the anvil part of the tool. The particular configuration of the bit as well as the type of cutter elements used also may be varied as will occur to those skilled in the art.

I claim:

1. A percussion-type drill bit comprising a body with a forwardly facing surface including at least a portion which is inclined to the axis of the body, cutting elements mounted on said head and projecting laterally therefrom for cutting the sidewall of the hole being drilled and wear-resistant elements applied to said surface portion asymmetrically with respect to said surface for causing lateral cutting motion by said cutting elements responsive to each axial percussive blow applied to said head to maintain the hole at gauge.

2. A drill bit as described in claim **1** in which said cutting and wear resisting elements comprise discrete, hardened inserts.

3. A drill bit as described in claim **1** in which said surface portion is located substantially centrally of said surface and is generally conical.

4. A drill bit as described in claim **1** in which said surface includes a part disposed normal to the body axis and further including bottom cutting elements mounted in and projecting forwardly of said surface.

5. A drill bit as described in claim **1** in which said body has a sidewall structure merging with said forwardly facing surface, said laterally projecting cutting elements projecting outwardly and downwardly from said body substantially along the intersection of said wall structure and said surface for maintaining the gauge of the hole being drilled.

6. A percussion-type drill bit comprising a body with sidewall structure and a forwardly facing surface including a generally conical portion and a second portion disposed normal to the body axis, wash passages in said body and said surface for lubricating the bit and removing cuttings, first cutter inserts mounted in said conical surface portion asymmetrically with respect to said surface for causing lateral motion of the body when subjected to axial percussive blows in drilling, bottom cutting inserts mounted in and projecting forwardly from said second surface portion, and gauge cutting inserts mounted adjacent the intersection of said sidewall structure and said surface.