

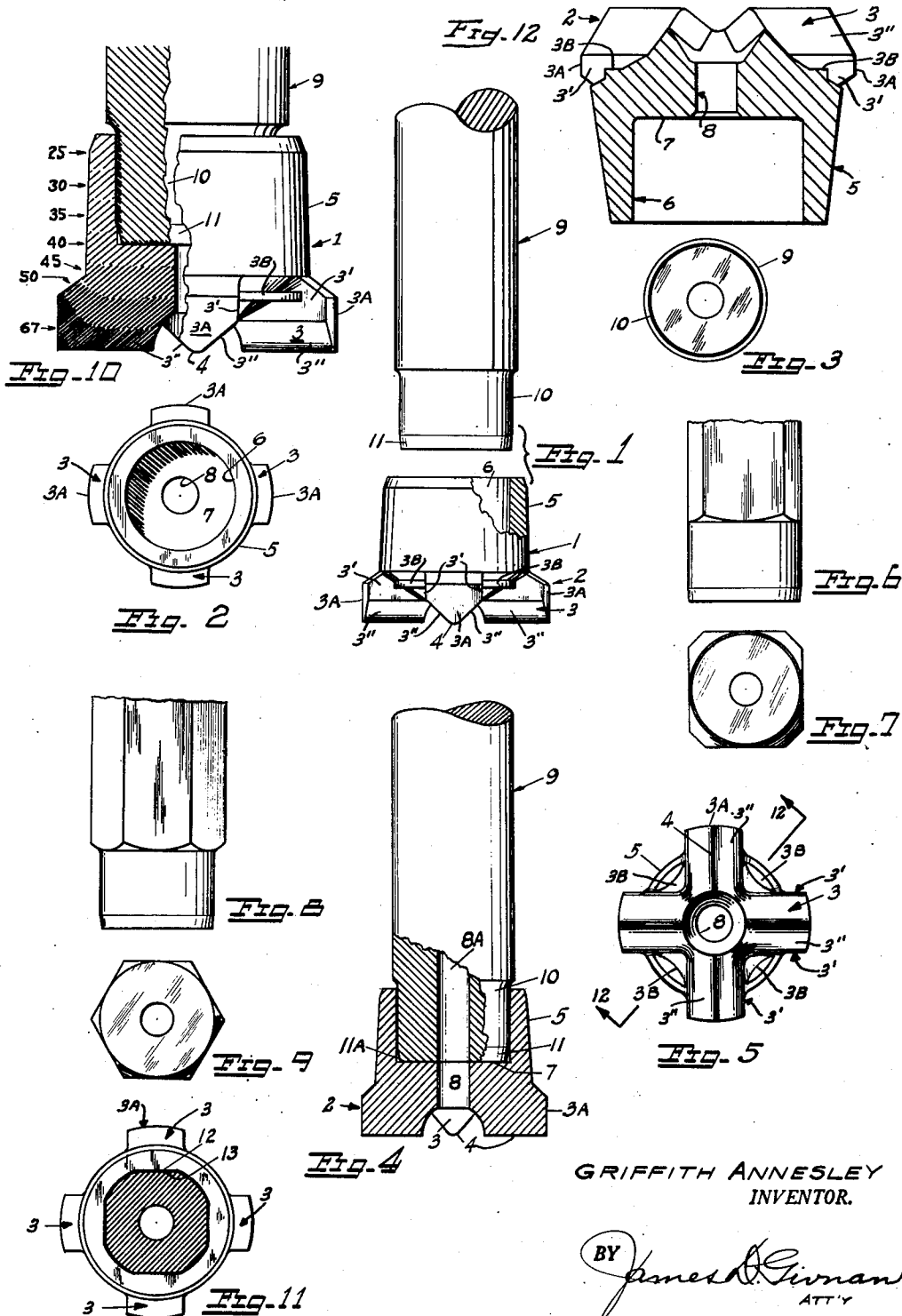
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DETACHABLE ROCK DRILL BIT

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DETACHABLE ROCK DRILL BIT

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This invention is directed to rock drill bits used in percussive drilling operations and more especially to the structure of the drill bit and the method of uniting the bit with a drill rod.

It is one of the principal objects of the invention to provide an efficient and durable drill bit capable of being manufactured inexpensively by quantity production methods and at such relatively low cost that they may be advantageously discarded after they become incapable of further profitable operation.

Another important object of the invention is the provision of a drill bit especially designed and constructed from special steel and a novel method of zone hardening the same.

By this special zone hardening process, I harden the drill bit in its entirety in varying degrees ranging from a maximum of 67 Rockwell C at the cutting head diminishing to 40 Rockwell C in the proximity of the emergence of the cutting head with the base portion of the socket, then further and gradually diminishing to approximately 25 Rockwell C at the open end of the socket. These blending zones of hardness have been calculated and located to render the socket walls radially deformable within critical limits into cylindrical zones of unlike diameters upon the forcible entry of the drill rod. This limited deformation causes the walls of the socket to adhere in parallel relationship throughout the major portion of their length to the drill rod above the said tapered end thereof, and flare outwardly to a slight degree only at their upper or open end in the lesser hardened area.

The novel hardening process enables me to utilize maximum hardness from the steel and at the same time maintain sufficient toughness in the cutting or impact surfaces of the bit to prevent breakage, chipping or other mutilation which would normally occur under the severe conditions of shock and vibration to which the bit is continuously subjected.

Moreover, the said hardening process and the unique design of the drill bit distinguish the wedged relationship between the end of the drill rod and the interior of the socket from a conventional forced fit of a slightly oversized rod or shaft through an aperture open at both of its ends.

The bottom edge of the drill rod is reduced slightly to a lesser diameter than the inside diameter of the socket so that when the drill rod is driven into "home" position within the socket there is an annular space between the lowermost side wall of the socket and the end of the drill rod.

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As a result of extensive experiment, I have found that the reduced end of the drill rod as aforesaid in conjunction with the hardening process as above pointed out prevents "mushing" of the end of the drill rod and the resultant bursting of the socket walls at their base when the rod is driven home. Moreover the skin hardening of the rod is designed to and does overcome what is known in the industry as "buttoning" or breaking of the drill rod just above where it emerges from the skirt of the socket.

The drill rod is driven to the full depth of the socket for intimate contact with the bottom wall thereof so that the percussive shock is absorbed by the drill bit and the rod as a solid shaft.

This wedged union between the bit and the drill rod is such that a pull in the neighborhood of several tons is required to effect their separation.

The drill rod is of medium to high carbon or alloy steel, heat treated as above pointed out to provide a core having maximum resistance to deformation and fatigue and to provide an outside surface hardened to a depth of approximately $\frac{1}{64}$ " to $\frac{1}{32}$ " to approximately 60 Rockwell C, to resist the abrasion which would otherwise occur when the drill rod is being repeatedly driven into sockets or when being withdrawn therefrom. The base portion of the socket remains undisturbed when the drill rod is driven to the full depth of the socket by reason of the annular space 11A provided for by the reduced end of the drill rod as aforesaid. At the uppermost end of said reduced portion the walls of the socket, in the lesser hardened area, will deform into parallel gripping contact with the drill rod throughout the major portion of their length. Thus it will be seen that the invention enables an oversize rod to be driven into an open ended socket of less diameter than the rod without the walls of the socket flaring gradually throughout their length from the base to the open end as would ordinarily occur if the socket walls were uniformly hardened throughout their length.

A still further object of the invention is to provide a series of secondary impact surfaces formed circumferentially intermediate said first mentioned cutting or impact surfaces for the purpose of minutely breaking up or pulverizing large chips broken out by the bit in certain types of rock and more especially in downwardly inclined drilled holes wherein large particles of rock tend to pack at the bottom thereof. The secondary impact surfaces momentarily hold the rock particles as they are pounded and pulver-

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ized until washed out by the water under pressure coming through the bit.

The foregoing and other objects will appear as my invention is more fully hereinafter described in the following specification, illustrated in the accompanying drawing and finally pointed out in the appended claims.

In the drawing:

Figure 1 is a side elevation of a drill rod and drill bit made in accordance with my invention and in position to be united;

Fig. 2 is a top plan view of the drill bit;

Fig. 3 is a bottom plan view of the drill rod;

Fig. 4 is a view similar to Fig. 1 showing the drill rod and bit securely united and with fragments broken away for convenience of illustration;

Fig. 5 is a bottom plan view of the drill bit;

Fig. 6 is a fragmentary side elevation of a drill rod of quarter-octagon formation turned at one of its ends to a diameter slightly greater than the inside diameter of the socket;

Fig. 7 is an end elevation of Fig. 6;

Fig. 8 is a fragmentary side elevation similar to Fig. 6 showing the drill rod made of hexagonal material;

Fig. 9 is an end elevation of Fig. 8;

Fig. 10 is an enlarged side elevation of the bit and drill rod united and with fragments broken away and indicating zones of hardness of the bit diminishing upwardly from the cutting head;

Fig. 11 is a top plan view of a modified form of socket and correspondingly shaped drill rod (in section) united therewith; and

Fig. 12 is a transverse sectional view taken on line 12-12 of Fig. 5.

Referring now more particularly to the drawing:

The drill bit generally indicated at 1 is forged from a single piece of material into a cutting head 2 formed with blunt cruciform cutting or impact surfaces 3 which are preferably rounded or flat, as at 4 throughout their length. Extending upwardly from the cutting head is a cylindrical socket 5 having straight vertical inside walls 6 and a flat bottom wall 7. The bottom wall is formed with an opening 8 which extends through the cutting head and through which water and/or compressed air is blown in the conventional manner to remove dust and rock particles from the work being dealt with in the drilling operation.

The cutting surfaces 3 of the cutting head all terminate in substantially cylindrical side portions or reaming edges 3A which extend outwardly from the base of the socket and are vertically disposed or parallel to the vertical axis of the bit for gauging the hole which is formed by the drill bit. The cutting faces each taper from the relatively cylindrical side portions or reaming edges 3A, to the side walls of the socket.

Intermediate the cutting surfaces 3 which I term primary impact surfaces I provide a series of circumferentially formed secondary cutting surfaces 3B shown in Figs. 1, 5, 10 and 12. These secondary cutting surfaces 3B break up large chips of rock into minute particles which are readily washed out of the drilled hole by the water pressure. The secondary cutting surfaces 3B are arcuate in contour as represented in Fig. 5 and are disposed intermediate the side walls of the primary impact surface 3, that is to say the primary cutting surfaces lie on segments that have an arcuate length which is the difference between the quadrant of 90° and one-half of the

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thickness of each of the primary cutting surfaces 3 as represented in Fig. 5. The secondary cutting surfaces 3B are bounded at each end by the substantially vertically extending side walls 3' of the primary impact surfaces 3. The secondary impact surfaces 3B are disposed at levels offset from the level of the plane that includes all of the termini of the impact cutting surfaces 3 and between the substantially vertically extending side walls as distinguished from the tapered primary impact surfaces 3'. That is to say the secondary impact surfaces 3B are disposed in a plane intermediate the plane of the termini of the impact cutting surfaces 3 and the plane of the base of the cylindrical socket 5 from which the primary impact surfaces project. The secondary impact surfaces 3B are remote from the plane of the primary impact surfaces. The primary impact surfaces extend in a plane which passes through the substantially vertically extending side walls of the primary impact surfaces above the upper limits of the tapered primary impact surfaces.

Other extensive experimenting has shown that short and narrow reaming edges joined by a flat buttress to the body of the bit allow further penetration without binding in a hole as heretofore. These experiments further showed that by using blunt cutting edges or impact surfaces with my special heat treatment, a much stronger structure was effected allowing the full hardness of the steel to be realized without tempering or the use of other methods of special protection which require considerable reduction in maximum hardness obtainable to guard against premature fracture of the more delicate sharp cutting edges used in old conventional designs.

The drill rod in any of the forms shown, and generally indicated at 9 in Figs. 1 and 4, is of a diameter, as at 10, slightly greater than the inside diameter of the socket 5, and the lowermost end of the drill rod is slightly reduced or tapered as at 11 to a lesser diameter to facilitate the initial introduction of the drill rod into the socket preparatory to forcibly uniting the drill bit with the drill rod.

It will be noted in Figs. 4 and 10, particularly, that the reduced end 11 of the drill rod has provided a small annular space 11A adjacent the lower end wall of the socket; the socket is therefore not subjected, within that area, to deformation. This is an important attribute because the combination of a very hard surface and a strained condition might render the drill bit subject to fatigue failure at the root of the socket. However, by relieving the strain at the socket end, and the gradually diminishing degrees of hardness of the socket walls, as aforesaid, deformation by the drill rod is only that which is relatively deformable without severe internal structural strain.

The end of the drill rod has a surface matching the bottom wall of the socket whereupon the entire impact is distributed over the end of the drill rod. This insures the correct alignment of the drill bit on the drill rod and the freedom of either the drill bit or drill rod from localized impact strains.

The drill rod has an axial passage 8A, concentric with the passage 8 through the drill bit.

It is to be understood that other shapes and arrangements may be employed for uniting the drill rod and drill bit. In Fig. 11, for example, I have illustrated the socket portion as formed with opposed flattened surfaces 12 coacting with

corresponding flattened surfaces 13 formed in the end of the drill rod. Thus the drill bit is prevented from rotating with respect to the drill rod and is retained on the drill rod by virtue of the deformation of the socket as heretofore explained.

Although the invention has been described by making a fully detailed reference to the certain presently preferred embodiments, such detail of description is to be understood in an instructive rather than a limiting sense, many changes being possible within the spirit and scope of the claims hereto appended.

What I claim is:

1. A drill bit comprising a rod receiving socket 15 having a plurality of radially disposed primary impact surfaces and a series of secondary impact surfaces disposed intermediate the primary impact surfaces at levels offset from the level of the plane that includes all of said primary impact surfaces, said secondary impact surfaces terminating short of the external side walls of said rod receiving socket and said secondary impact surfaces extending in arcs bounded at each end by a radial side wall of said primary impact surfaces.

2. A rock drill bit comprising a body structure, a plurality of radially disposed primary impact surfaces projecting from said body structure and including tapered faces and substantially vertically extending side walls coextensive with the body structure connected with said tapered faces along parallel extending junctions, a plurality of secondary impact surfaces disposed between the substantially vertically extending side walls of said primary impact surfaces and projecting downwardly from said body structure and terminating in planes above the junctions of the inclined faces of said radially disposed primary impact surfaces and the sub-

stantially vertically disposed side walls of said primary impact surfaces, the external peripheries of said secondary impact surfaces being spacially inset from the external periphery of said body structure.

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