

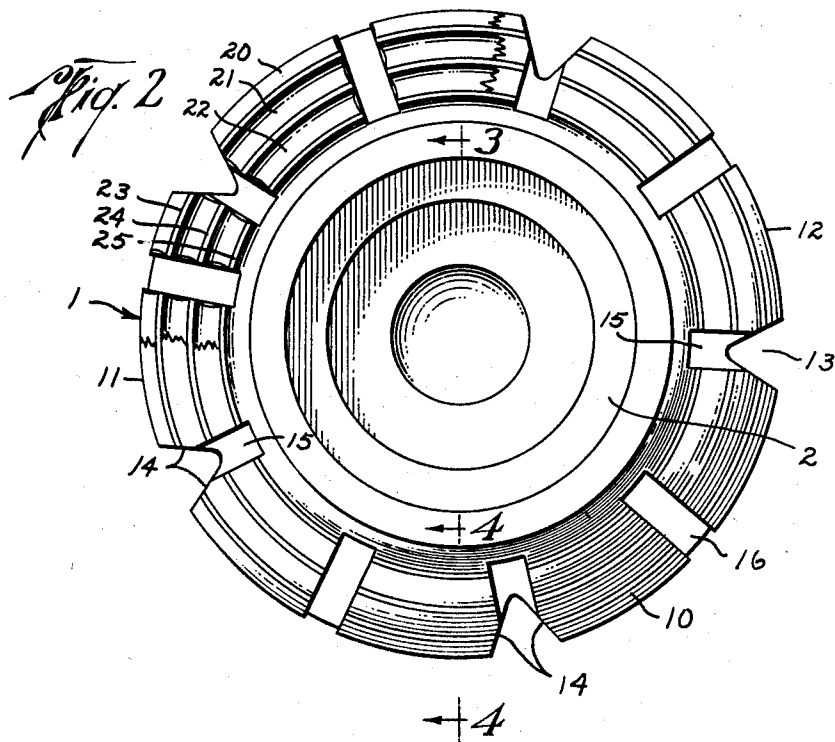
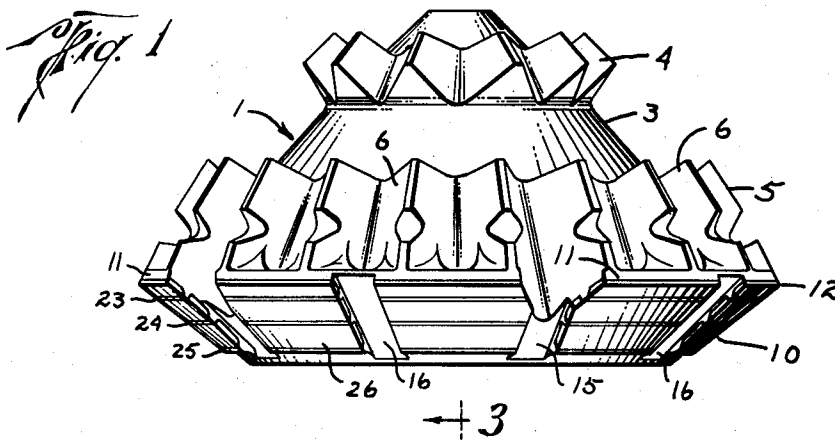
June 7, 1960

L. L. PAYNE
CUTTER FOR WELL DRILLS

2,939,684

Filed March 22, 1957

2 Sheets-Sheet 1



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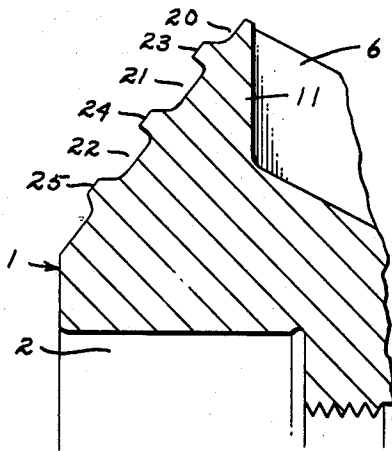


Fig. 3

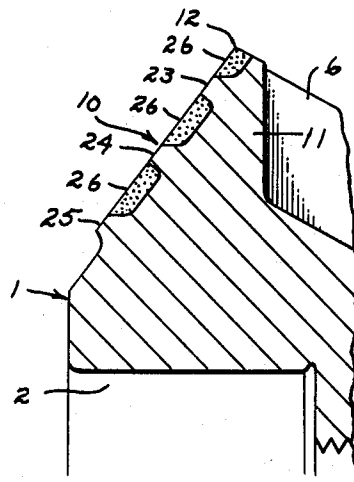


Fig. 4

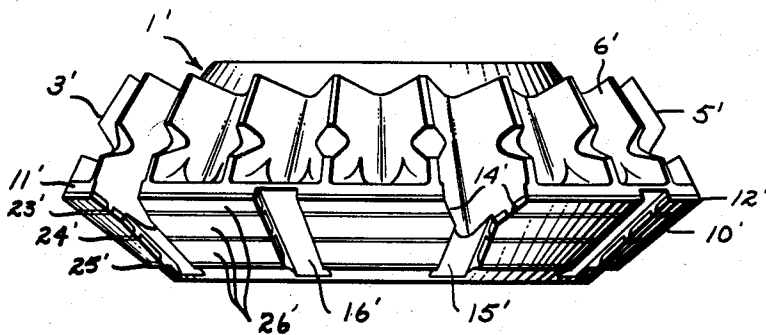


Fig. 5

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CUTTER FOR WELL DRILLS

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This invention relates to earth boring drills and more particularly to cutters therefor having new and improved gage cutting structure.

Cutters for earth boring drills have an arcuate portion provided with cutting elements which disintegrate the bottom of a hole being drilled and an annular end portion or gage surface which engages and produces a disintegrating action upon the side wall of the well bore to maintain a uniform diameter of the bore.

The base metal of the cutter body is conventionally tough and strong but is not sufficiently abrasion resistant to provide adequate disintegrating action upon the wall of the well bore to maintain full gage of the bore throughout the useful life of the remainder of the cutter. To overcome this difficulty, it has been proposed to superpose a layer of wear resistant metal upon the outer ends of the heel teeth and the adjacent metal of the cutter such layer comprising a carbide, such as particles of tungsten carbide, secured in place by a matrix of suitable metal such as mild steel applied by a torch so that the matrix metal wets the surface of the base metal of the cutter and the carbides thus providing an effective interbond to hold the particles in place to serve their intended purpose.

To facilitate application of the layer of wear resistant metal upon the cutter body it has also been proposed to provide radially extending ribs of the base metal on the gage surface of the cutter and to then apply wear resistant material and matrix metal bonded to the base metal and of a depth that the gage surface is flush with the crests of the ribs.

Such prior art structures have been found to be inadequate, especially when drilling hard rock formations, to assure maintenance of gage, or diameter of the bore hole, throughout the useful life of the remainder of the cutter. Thus, for some time prior to withdrawing and replacing the bit a tapered hole is being drilled. Then the succeeding bit, which is of full gage, must ream the tapered hole before it reaches bottom. This reaming operation is time consuming and also effects destructive action upon the new bit and especially upon the gage cutting portion thereof whereby the useful life of the bit is materially reduced. In some cases the new bit is rendered unfit for advancing the bore and another new bit is required before further drilling is resumed.

The principal difficulty arises from initial chipping or breaking away of the wear resistant material at the outermost portion of the gage surface. Since the composite wear resistant material and its matrix metal are relatively brittle the chipping action is progressive thus causing a so-called "heeling over" or reduction of gage beginning at the point of maximum diameter of the roller cutter and ultimately leading to complete destruction of the gage surface. This of course gives rise to under gage hole as well as early failure of the cutter.

It is therefore the primary object of the invention to provide a structure which minimizes the difficulties to which reference has just been made.

The invention comprehends the provision of a gage

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surface comprising areal deposits of wear resistant material backed up by ribs of base metal of the cutter body extending transversely of the direction of the principal destructive forces to which the gage cutting portion of the cutter is subjected when in normal use. Such forces are directed substantially radially inwardly along the gage surface.

Another object is to provide a gage cutting structure which may be embodied in any type of rolling cutter having a gage cutting function.

Still another and more specific object is to provide a rolling cutter having bottom cutting elements which cut the outer bottom portion of the well bore and a web interconnecting the outer ends of said elements, the outer surface of said web being a gage surface having spaced annular ribs of the base metal of the cutter and wear resistant material filling the space between successive ribs and bonded thereto.

These and other objects will be more fully apparent from the following description and the accompanying drawings in which:

Fig. 1 is a side elevational view of a cone type cutter embodying the invention;

Fig. 2 is a view showing in elevation the gage of the cutter, a portion of the wear resistant material being broken away to enhance the showing of the structure;

Fig. 3 is a sectional view taken on line 3—3 in Fig. 2;

Fig. 4 is a sectional view taken on line 4—4 in Fig. 2;

Fig. 5 is a side elevational view of a side roller type of cutter embodying the invention.

The invention as shown in Figs. 1 and 2 comprises a cone type cutter 1 contoured internally as shown generally at 2 (Fig. 2) to receive bearing elements and a mounting shaft (not shown) upon which the cutter revolves as is well known in the art. The cutter body 1 is symmetrical about its axis of rotation and is provided on its arcuate bottom cutting portion 3 with rows of heel teeth 4 and 5 the latter of which are known as heel teeth and an individual tooth is referenced at 6. The base metal of the cutter 1 and the teeth thereon is an alloy steel and may be fortified against abrasion by suitable heat treatment or selective placement of wear resistant material especially upon the flanks or ends of the teeth. Since such specific structure is relatively conventional and is not specifically concerned in the present invention, a general reference only is made thereto.

The gage surface or gage cutting portion 10 comprises an interrupted web 11 which is a component part of the cutter 1 and integral with the heel teeth 5 at their outer ends. It is to be noted that the gage surface 10 is generally conical, or frusto-conical, and intersects the bottom cutting portion 3 at 12, the maximum diameter of the cutter. It is at this point, which rolls at the juncture of the bottom and the side wall of a well bore that the most excessive stresses and abrading action are incurred. Because of the rolling action of the cutter the stresses are directed substantially radially inwardly of the cutter and initiate breakdown of gage structure at the point 12.

Reference to the web 11 as interrupted means that at intervals the web is cut away between successive heel teeth 6 as shown by the notches 13. Preferably the side walls 14 of each of these notches follow the flanks of the two teeth inwardly therefrom. Also the gage surface is recessed inwardly from each of the notches 13 as shown at 15. This notching and recessing enhances ventilation of the gage structure to minimize grinding action upon formation material which has been severed and which tends to wedge between the gage surface and the wall of the hole being drilled. This ventilation is further enhanced by radial grooves 16 in the gage surface, which grooves are approximately or slightly deeper than the wear resistant portion of the gage surface 10.

Attention is also directed to the fact that the various uninterrupted portions of the web 11 interconnect groups of heel teeth 6 which may be two, three or four in number which depends upon the amount of ventilation necessary for the type of formation being drilled. Especially if there is an odd number of heel teeth 6 in the row 5, the number of teeth interconnected by uninterrupted portions of the web 11 will vary.

An important aspect of the invention resides in that portion of the gage surface 10 intermediate the notches 13 and the grooves 16. As best seen in Figs. 2 and 3 this feature of construction is effected by cutting a plurality of concentric grooves 20, 21, and 22 in the outer face of the web 11 leaving upstanding concentric ribs 23, 24, and 25 of a height that their crests lie upon, or substantially upon, the finished gage surface 10 of the cutter.

A body of wear resistant metal 26 is then deposited in each of the groove segments and bonded to the bottoms of the segments and the side walls of the ribs 23, 24, and 25 as best seen in Fig. 4. Preferably, though not limited thereto, the body of metal 26 comprises particles of a carbide, such as tungsten carbide, interbonded with each other and with the adjacent base metal of the cutter 1 by means of a suitable matrix metal such as mild steel or a suitable alloy.

It is here noted that the outermost groove 20 extends to the point 12 of the cutter and that hence the outermost body of metal 26 engages the bottom of the well bore at the juncture of the bottom with the side wall of the bore. While it is uncertain as to the reason for the superior qualities of the cutter thus far described it is believed that the rib 23 of base metal of the cutter serves to stabilize the adjacent body of wear resistant metal against chipping or breaking away. In any event if excessive weight is applied and chipping or breaking away occurs such chipping or breaking extends only to the adjacent rib of base metal and does not extend a major portion or all the way across the gage cutting portion 10.

Fig. 5 is similar to Fig. 1 but shows a rolling cutter of the type usable as side cutters on cross roller bits or as cutters on reaming bits to maintain gage of the hole cut thereby. Like parts are identified by like but primed reference characters.

By way of summary it is pointed out that the bottom cutting portion and the gage cutting portion 10 of the cutter 1 are referred to as generally conical. While generally conical, or frusto-conical, surfaces are illustrated and described it is to be understood that reference is had to the preferred embodiment but that modified generatrices of these respective portions of the cutter may be used without departing from the spirit of the invention.

Broadly the invention comprehends a new and improved roller cutter for well drills and more particularly a cutter having as a component part a gage cutting structure which facilitates the maintenance of gage throughout the useful life of the cutter.

The invention claimed is:

1. A rotary drill cutter comprising a frusto-conical body having a series of circumferentially spaced longitudinally extending heel teeth on one end thereof, a circumferential web joining the outer ends of at least some of said teeth and forming an outwardly facing frusto-conical gage surface, a plurality of concentric grooves in the face of said web, and a wear resistant material filling said grooves and bonded to the sides and bottoms thereof.

2. A rotary drill cutter comprising a frusto-conical body having a series of circumferentially spaced longitudinally extending heel teeth thereon, a circumferential web joining the outer ends of said teeth and forming an outwardly facing frusto-conical gage surface, said web having a plurality of radially extending grooves in its

outer face, a plurality of concentric grooves in said outer face of the web transecting said radially extending grooves, and a wear resistant material filling each of said concentric grooves and bonded to the sides and bottoms thereof.

3. In an approximately conical shaped cutter for well drills, a series of substantially longitudinally crested heel teeth thereon, a circumferential web joining the outer ends of said teeth and forming an outwardly facing frusto-conical gage surface, said web having a crest extending to approximately the same height as said heel teeth, a plurality of concentric grooves in the face of said web, and a wear resistant material filling said grooves and bonded to the base metal of the cutter.

4. In an approximately conical shaped cutter for well drills, a series of substantially longitudinally crested heel teeth thereon, a circumferential web joining the outer ends of said teeth and forming an outwardly facing frusto-conical gage surface, said web having a crest extending to approximately the same height as said heel teeth, a plurality of concentric grooves in the face of said web, the outermost of said grooves extending to the crest of the web, and a wear resistant material filling said grooves and bonded to the base metal of the cutter.

5. In an approximately conical shaped cutter for well drills, a series of substantially longitudinally crested heel teeth thereon, a circumferential web joining the outer ends of said teeth and forming an outwardly facing frusto-conical gage surface, said web being cut away between successive heel teeth at spaced intervals whereby the teeth are interconnected in groups, a plurality of concentric grooves in the face of said web, and a wear resistant material filling said grooves and bonded to the base metal of the cutter.

6. In an approximately conical shaped cutter for well drills, a series of substantially longitudinally crested heel teeth thereon, a circumferential web joining the outer ends of said teeth and forming an outwardly facing frusto-conical gage surface, said web having its crest extending to substantially the height of said heel teeth, said web being cut away between successive heel teeth at spaced intervals whereby the teeth are interconnected in groups, a plurality of concentric grooves in the face of said web, the outermost of said grooves extending to the crest of the web, and a wear resistant material filling each of said grooves and bonded to the base metal of the cutter.

7. A rotary drill cutter for earth boring drills comprising a body having a pair of integral oppositely extending frusto-conical portions symmetrical about a common axis of rotation and having a common base intermediate the ends of the cutter body, one of said frusto-conical portions having a series of circumferentially spaced, longitudinally extending heel teeth thereon, the other of said frusto-conical portions forming a gage surface, a web integral with said frusto-conical portions located at the common base, connected to said heel teeth and forming an extension of the gage surface, a plurality of concentric grooves in said gage surface and web, and a wear resistant material filling said grooves and bonded to the cutter body.

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