Dec. 18, 1956 R. A. CUNNINGHAM 2,774,570

ROLLER CUTTER FOR EARTH DRILLS

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Fig. 1

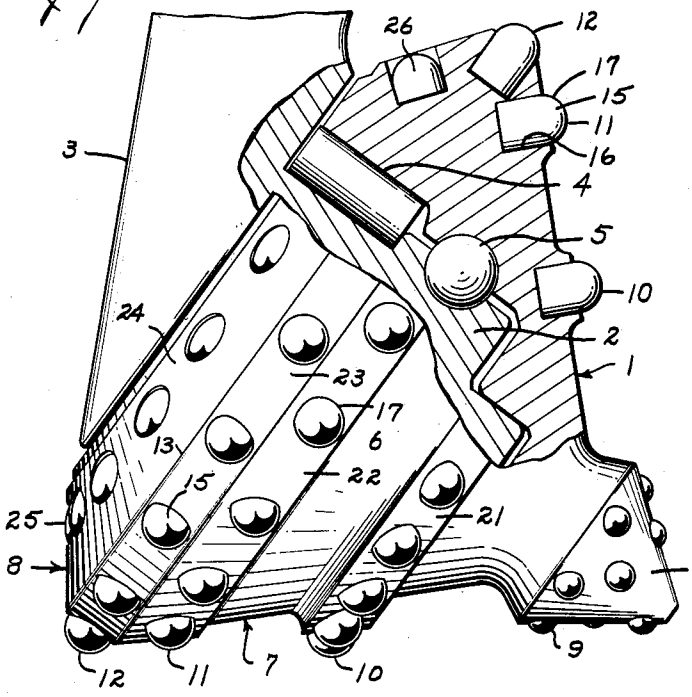


Fig. 3

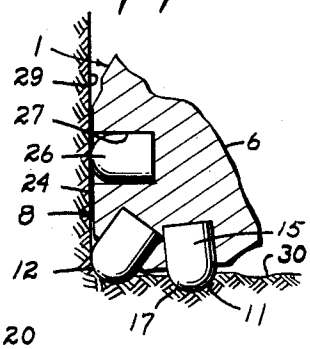


Fig. 2

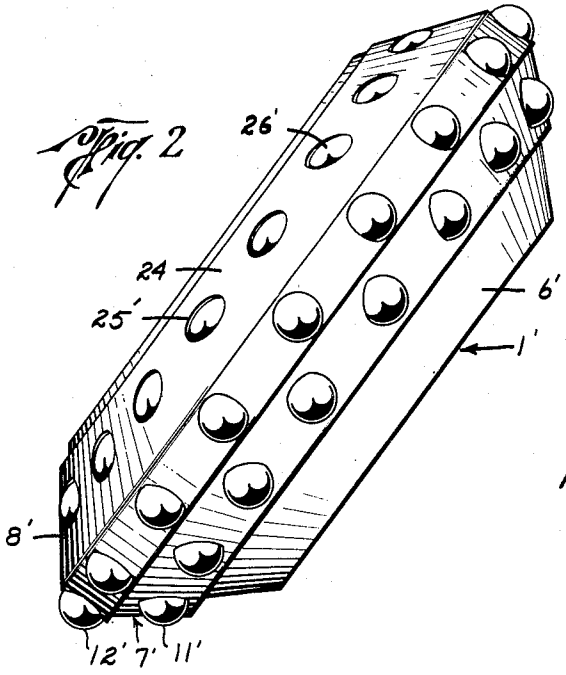
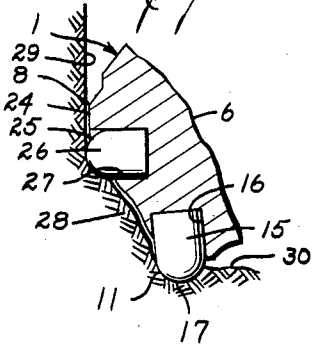


Fig. 4



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ROLLER CUTTER FOR EARTH DRILLS

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This invention relates to the rolling cutter type of earth boring drills or bits, and pertains particularly to the cutters used on such drills.

It is customary in the rolling type of earth boring drills to provide roller cutters each having a bottom cutting portion and a gage cutting portion. Even though a welded-on wear resistant material is provided upon the gage cutting portion and upon selected surfaces of the teeth, or cutting elements, of the bottom cutting portion, destructive effects of the rigorous action to which these cutters are subjected produces rapid deterioration from wearing away, chipping and deformation of the metal of the cutter. Because of these destructive effects the operating life of the cutter is shortened, the rate of drilling is increasingly reduced and reduction of diameter, or loss of gage of the hole being drilled takes place. Also, in event of failure of any portion of the cutting structure utility of the drill is terminated.

It is a general object of the invention to provide a roller cutter for drill bits capable of overcoming the difficulties to which reference has just been made.

It is also an object of the invention to provide a roller cutter having an improved gage cutting structure comprising wear resistant inserts secured in the cutter body and presenting protrusions at the gage surface to serve as gage cutting elements.

The invention also comprehends the use of wear resistant inserts as cutter elements in both the bottom cutting portion and the gage cutting portion of the cutter, such inserts being so located as to provide a maximum of cutting efficiency of full gage well bore.

Still another object is to provide a roller cutter having heel and gage cutting elements so arranged that useful life is maintained even after cutting elements at the juncture of the well bottom and side wall of the well bore have been destroyed.

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

Fig. 1 is an elevational view of a cone type of roller cutter embodying the invention, a portion of the cutter being cut away to more clearly show the details of construction;

Fig. 2 is an elevational view of a side roller type of cutter embodying the invention;

Fig. 3 is a fragmentary view showing the relative positions of the cutter elements in a roller cutter and their operative positions relative to the bottom and side wall of a well bore;

Fig. 4 is a fragmentary view similar to Fig. 3 but showing the structural detail after destructive use has removed a portion of the bottom cutting structure.

In Fig. 1 the roller cutter 1 is shown mounted upon a shaft 2 integral with the bit leg 3. It is customary for two or three cone type cutters to be mounted upon downwardly extending legs of a bit head to provide the well known two-cone and three-cone bits.

The shaft 2 is contoured peripherally to form races for anti-friction bearings shown as a roller bearing 4 and a ball bearing 5, the latter of which is so arranged as to assume both radial and axial thrusts and to hold the cutter on its shaft. These features are described generally only inasmuch as they form no part of the present invention and are well known in the art.

The cutter 1 is generally conical in shape and is symmetrical about its axis of rotation upon the shaft 2. It comprises a body 6 which presents a conical bottom cutting portion 7 and a conical end or gage cutting portion 8. These oppositely extending portions intersect in a common base defined by the line 13 (Figs. 1 and 2). For convenience of reference the two conical portions are herein also referred to as a first conical portion and a second conical portion respectively. Their initial designations above are so-called because the former serves to produce disintegrating action upon the bottom of a well bore being drilled and thus to cause the bit to advance while the latter serves to disintegrate material on the wall of the well bore and thus to maintain gage thereof. Each of these functions is of extreme importance as they determine the rate of drilling, the useful life of the drill bit and whether the well bore becomes under gage as drilling progresses and hence requires reaming before drilling can proceed when a new bit is used to replace the one which has served its useful life.

The bottom cutting portion 7 is provided with series of wear resistant inserts, such as sintered carbide or other abrasion resistant material, and these series of inserts are identified as 9, 10, 11 and 12. An individual insert is identified as 15.

The insert 15 is shown as cylindrical and is of such diameter as to have an interference fit in the opening 16 drilled in the cutter body 6. It is also of such dimension radially of the cutter as to present a protrusion 17 which is preferably of rounded or ovoid contour. It thus seems apparent that the individual wear resistant insert 15 is securely held in the cutter body 6 and presents a protrusion at the surface of the body, such protrusion serving as a cutter element which disintegrates, by a crushing action, the formation being drilled.

The series 9 of wear resistant inserts are so located in the spearpoint 20 as to efficiently use the limited amount of metal in the spearpoint but without weakening this portion of the cutter structure and at the same time to entirely cover that area of the bottom of the well bore which must be drilled by the spearpoint. The series 10, 11 and 12 on the other hand are preferably arranged in annular rows, it being desirable that the inserts of such rows be secured in lands or annular ridges shown at 21, 22 and 23. Such structure enables the use of a maximum of metal in the cutter permitted by the space limitations imposed upon the well drill of which the cutter forms a part. Also it is to be understood that there will be such relative location of series of cutting elements on all the roller cutters used on a well drill that they will cooperate to disintegrate the earth formation over the entire bottom of the well bore.

The surface 24 of the gage cutting portion 8 of the roller cutter 1 extends parallel to the side wall 29 of the well bore and is provided radially inwardly from the intersection of the bottom and gage cutting portions with a series 25 of wear resistant inserts, one of which is clearly shown at 26 in each of Figs. 3 and 4. Each of these inserts extends substantially normal to the surface 24 and is likewise secured in the body 6 by means of an interference fit within the opening 27 and is of such dimensions that it forms a slight protrusion beyond the gage surface 24 and such protrusion is rounded or ovoid as shown in order to most effectively accomplish its intended purpose.

The heel series 12 of wear resistant inserts are at the juncture of the well bottom 30 and the side wall 29 of the well bore, Fig. 3, where operating conditions are most severe. These inserts are, therefore, preferably closely spaced from the series 11 and also, as shown, preferably oriented so that the axes are directed toward the juncture of the bottom 30 and the side wall 29 of the well bore.

Hence, as shown, the inserts of series 12 preferably extend in such direction as to substantially bisect the angle formed by the bottom cutting portion 7 and the gage cutting portion 8. In such case the rounded or ovoid outer ends together with those of the gage inserts 26 are tangent to a common plane whereby the series 12 not only serves to disintegrate bottom at this portion of the well bore but also cooperates with the gage inserts 26 to cut and maintain gage.

It has been found that the structure herein described is extremely effective in drilling hard, abrasive earth formations. The gage cutting portion 8 is capable of maintaining gage throughout a long period of useful life of the bit of which the cutter forms a part.

Attention is further directed to the fact that the heel series 12 of wear resistant inserts may disintegrate rapidly because of the severe conditions to which they are subjected. Hence, part or all of the cutter body 6 at the juncture of the bottom cutting portion 7 and the gage cutting portion 8 may be destroyed while the remainder of the cutter possesses useful life. This condition would normally require replacement of the drill bit upon which the cutter is mounted were it not for the fact that the condition of the cutting structure is thereby modified in the manner illustrated in Fig. 4 of the drawings. The series 12 of wear resistant inserts as here shown has completely disappeared. It has been found, however, that even though such condition develops the gage inserts will continue to maintain gage and will at the same time serve to disintegrate that portion of the earth formation shown at 28 between the series 11 and the wall 29 of the well bore. This feature of continued and effective functioning of the cutter enables the drilling of additional hole and thus permits the driller to obtain the maximum of useful life of the bit.

In Fig. 2 the invention is shown embodied in a side roller type of cutter such as are used in conventional cross roller bits. In this alternate embodiment parts corresponding to those referenced in the description of Fig. 1, 3 and 4 are identified by like but primed reference characters.

By way of summary it is noted that the bottom cutting portion or first conical portion 7 or 7' which includes the land 23 is generally conical and is intersected by the gage cutting portion, or second conical portion, 8 or 8'. While generally conical surfaces are illustrated because the use of such surfaces encompasses the disclosed preferred embodiments it is to be understood that slightly modified generatrices for the respective portion of the cutters may be utilized without departing from the spirit of the invention.

Broadly the invention comprehends a new and improved roller cutter for well drills, such cutter utilizing bottom and gage cutting elements which are so constructed and arranged as to give a maximum of effective cutting life and at the same time capable of maintaining gage of a well bore throughout the useful life of the cutter.

The invention claimed is:

1. In a roller cutter for earth boring drills, a cutter body comprising, a pair of integral oppositely extending conical portions symmetrical about a common axis and having a common base intermediate the ends of the cutter body, one of said portions having a plurality of cutting elements thereon adapted to engage and disintegrate the bottom of a hole being drilled, said cutting elements including a series of cutters surrounding the body proximate said base, and an annular series of cylindrical inserts of hard wear resistant material secured in the other of said portions and spaced from said base, said inserts having their axes extending outwardly and substantially normal to the surface of said other portion and presenting protrusions at the surface thereof to effect disintegrating action and to maintain gage of the well bore being drilled.

2. In a roller cutter for earth boring drills, a cutter body comprising a pair of integral oppositely extending conical portions symmetrical about a common axis and intersecting in a common base intermediate the ends of the body, one of said portions having a plurality of cutting elements thereon adapted to engage and disintegrate the bottom of a hole being drilled, said cutting elements including a series of cylindrical wear resistant inserts secured in the body proximate the intersection of said portions, and an annular series of cylindrical inserts of hard wear resistant material secured in the other of said portions and spaced from said base, said last mentioned inserts having their axes extending outwardly and substantially normal to the surface of said other portion, all of said inserts presenting protrusions at the surface of the body so that said series, respectively, disintegrate bottom and maintain gage of the well bore being drilled.

3. In a roller cutter for earth boring drills, a cutter body comprising a pair of integral oppositely extending conical portions symmetrical about a common axis and intersecting in a common base intermediate the ends of the body, one of said portions having a plurality of cutting elements thereon adapted to engage and disintegrate the bottom of a hole being drilled, said cutting elements including a series of cylindrical wear resistant inserts secured in the body at the intersection of said portions and having their axes extending in a direction to substantially bisect the angle formed at the intersection of said portions, and an annular series of cylindrical inserts of hard wear resistant material secured in the other of said portions, spaced from said base and having their axes extending substantially normal to the surface of said other portion, all of said inserts presenting protrusions at the surface of the body, whereby both of said series cooperate to cut and maintain gage of the well bore being drilled.

4. In a roller cutter for earth boring drills, a cutter body comprising a first conical portion and a second conical portion, said portions being integral and symmetrical about a common axis and intersecting in a common base, a plurality of wear resistant inserts secured in said first conical portion and adapted to engage and disintegrate the bottom of a hole being drilled, at least some of said inserts being at the intersection of said portions, and a series of wear resistant inserts secured in said second conical portion, spaced from the intersection of said conical portions and extending outwardly and substantially normal to the surface of said second conical portion, all of said inserts being cylindrical and having protruding ends at the respective surfaces.

5. In a roller cutter for earth boring drills, a cutter body comprising a first conical portion and a second conical portion, said portions being integral and symmetrical about a common axis and intersecting in a common base, annular lands on said first conical portion, parallel series of wear resistant inserts secured in said lands and adapted to disintegrate a portion of the bottom of a hole being drilled, at least one of said series being proximate the intersection of said conical portions, and a series of wear resistant inserts secured in said second concical portion, spaced from the intersection of said conical portions and having their axes extending substantially normal to the surface of said second conical portion, each of said inserts being cylindrical and having a portion protruding from the surface of the cutter body, whereby said inserts cooperate to effect disintegrating action at the juncture of the bottom and the wall of a well bore being drilled.

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