

Jan. 20, 1953

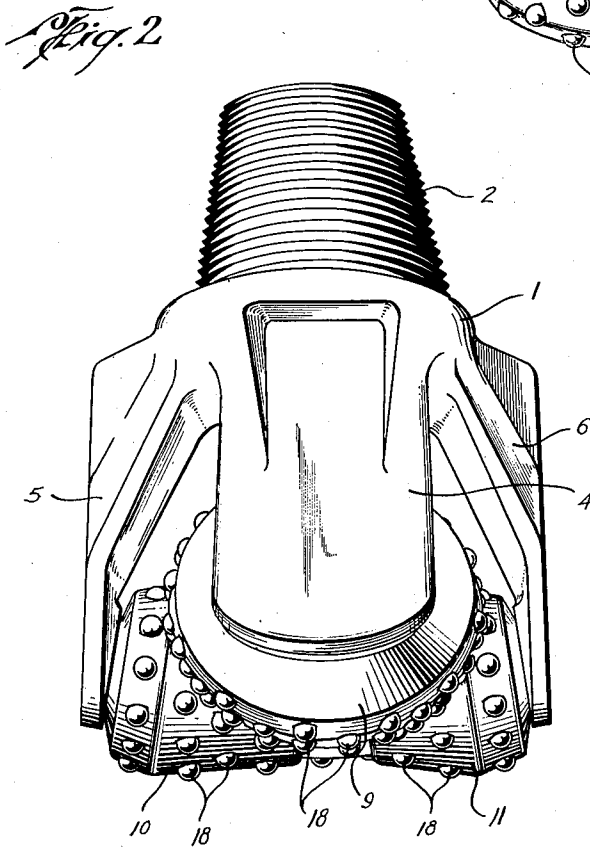
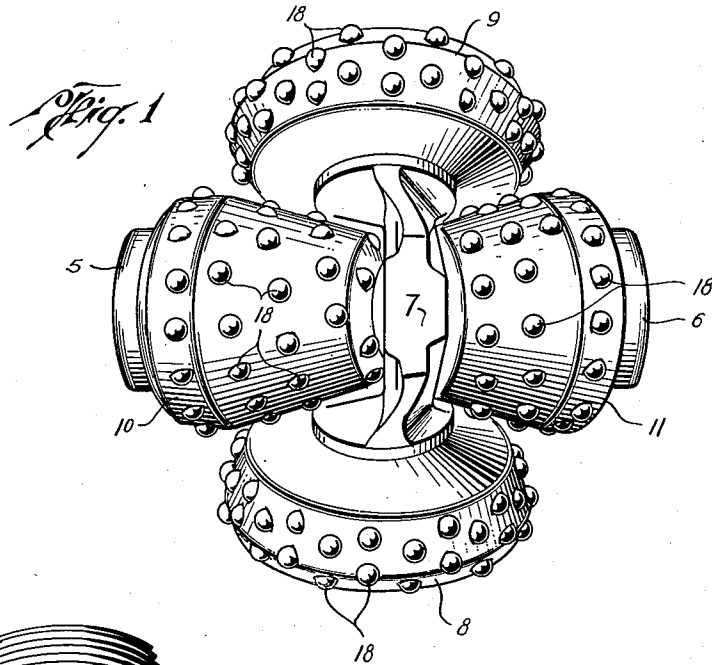
E. G. BOICE

2,626,128

DRILL BIT

Filed Sept. 24, 1951

3 Sheets-Sheet 1



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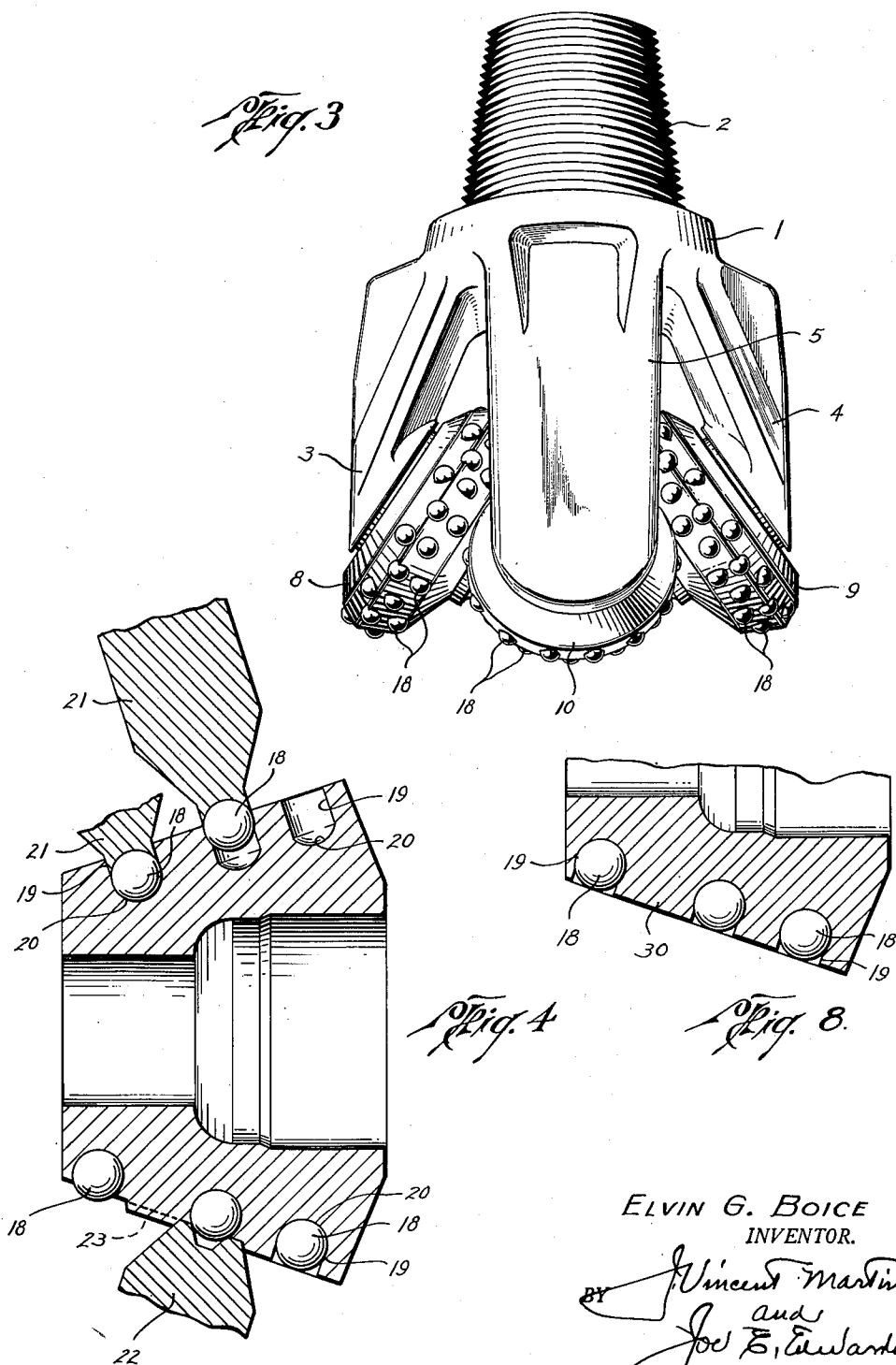
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DRILL BIT

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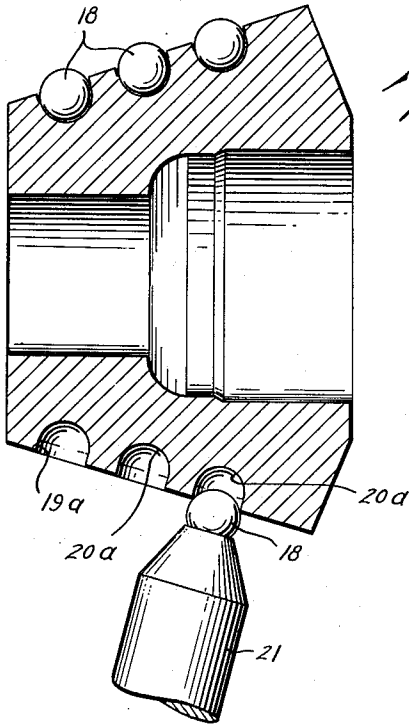


Fig. 5

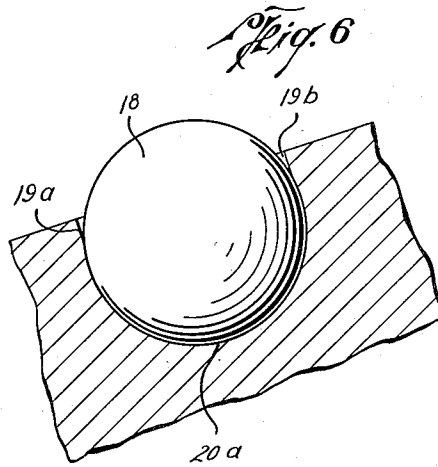


Fig. 6

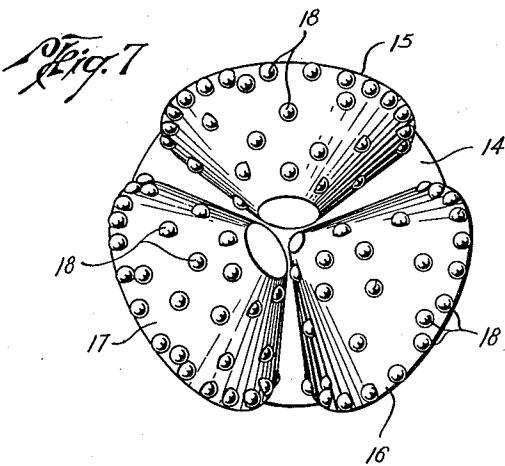


Fig. 7

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UNITED STATES PATENT OFFICE

2,626,128

DRILL BIT

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6 Claims. (Cl. 255—71)

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This invention relates generally to drill bits, and particularly to drill bits for deep well drilling.

One of its general objects is to provide a new and improved drill bit that will efficiently drill hard formations.

A specific object of the invention is to provide in a drill bit new and improved rollers having hard balls embedded therein and protruding therefrom to crush hard formation.

Other objects will hereinafter appear.

The preferred embodiments of the invention are illustrated by the accompanying drawings, in which:

Figure 1 is a bottom plan view of a cross roller bit embodying the invention,

Figure 2 is a side elevation of the embodiment shown by Figure 1,

Figure 3 is a side elevation at a right angle to Figure 2,

Figures 4 and 5 are diagrammatic views illustrating equipment which may be employed in practicing the method of embedding the balls in the rollers in accordance with my invention,

Figure 6 is a fragmentary view illustrating a ball embedded in a roller in accordance with my invention,

Figure 7 is a bottom plan view of a cone bit constructed in accordance with my invention,

Figure 8 is a fragmentary view illustrating the balls mounted within the roller with their surfaces substantially flush with the outer surface of said roller.

Figures 1, 2 and 3 illustrate a cross roller bit embodying a number of conventional parts, and the new and improved rollers provided by my invention. In these figures, bit head 1 has the usual threaded shank 2 by which it may be connected to the usual drill stem (not shown). This head may have the usual four depending legs 3, 4, 5 and 6 and bridge 7 to support the usual pins (not shown) upon which may be rotatably mounted my new and improved side rollers 8 and 9 and cross rollers 10 and 11. The construction of the head 1, legs 3, 4 and 5, bridge 7 and the pins (not shown) may be of the conventional type well known and heretofore extensively used to rotatably support side and cross roller cutters in the conventional cross roller cutter bit.

Figure 7 illustrates a cone bit which may embody conventional parts, and the new and improved rollers provided by my invention. In this figure, the bit head is indicated at 14. This head may be provided with three downwardly and in-

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wardly inclined spindles (not shown) to rotatably support the three new and improved substantially conical rollers 15, 16 and 17 provided by my invention. The construction of the head 14 and the spindles (not shown) may be of the conventional well known type heretofore extensively used to rotatably support cone cutters in the conventional cone bit.

Referring again to the cross roller bit illustrated by Figures 1, 2 and 3, side rollers 8 and 9 and cross rollers 10 and 11 have embedded therein and protruding from the surfaces thereof a plurality of balls 18. When the bit head 1 is rotated by the usual drill stem (not shown) in a well, the side rollers 8 and 9 and the cross rollers 10 and 11 will rotate on their pins (not shown) and, as a very great pressure is applied by the weight of the drill stem, the balls 18 will crush the hard formation on which the bit is rotated. The particles of formation crushed by the balls will be removed by the drilling fluid which is pumped in the usual manner down through the drill stem (not shown) and through the bit head 1, returning to the surface of the earth in the space between the drill stem and the wall of the hole and carrying the particles of the formation with it. The arrangement of the balls may be of a staggered and spiral nature as shown by the drawings, so that they will crush substantially the entire area of the bottom of the hole.

Referring again to the cone bit illustrated by Fig. 7, the three substantially conical rollers 15, 16 and 17 have embedded therein and protruding from the surfaces thereof the balls 18. The arrangement of these balls may be of a staggered and spiral nature so that they will crush substantially the entire area of the bottom of the hole when the bit head 14 is rotated.

In an $8\frac{3}{4}$ inch deep well rock bit, the balls 18 may be $\frac{7}{8}$ of an inch in diameter and may be arranged so that they will contact the bottom of the hole on points approximately $\frac{7}{8}$ of an inch apart. The balls may be so embedded in the rollers that they will protrude from the surfaces of the rollers approximately $\frac{1}{8}$ of an inch.

The balls are of such composition and so manufactured as to have an extremely high compressive strength, and to be extremely resistant to transverse rupture and to abrasion. For example the ball may be made of a composition of tungsten, cobalt, iron and carbon processed to produce the desired properties just referred to.

The body of the rollers may be made of an

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alloy steel of the composition ordinarily used in making roller cutters for deep well rock bits.

The manufacture of the rollers with the balls embedded therein may be as follows:

The body of the roller having been carburized, the carbon on the periphery may be skimmed off so that when the body is heat treated, the carbon will not form a hard crust to resist turning and drilling of the body. The body may then be hardened by heating it to say 1650°, immersing it in oil, and then removing it from the oil and heating it to about 600°. It may then be turned on a lathe to cut off about $\frac{1}{8}$ of an inch to remove the hard surface or crust and thereby reduce the resistance encountered by the drill used for drilling the sockets for the reception of the balls. The sockets may then be drilled.

As will appear from Figure 4, the sockets may consist of a cylindrical bore 19 and a rounded bottom 20. The radius of the rounded bottom 20 is substantially equal to the radius of the ball 18, and the radius of the bore 19 is slightly less so that the ball 18 must be forced into the bore 19 until it engages the bottom 20. It will be understood that the distance across the rounded bottom where it joins the bore is equal to the diameter of the bore but less than the diameter of the ball. For example, the diameter of the bore 19 may be 5,000ths of an inch less than the diameter $\frac{1}{8}$ of an inch ball. In Figure 4, the tool 21 is shown forcing the ball 18 into the bore 19 and the ball engages the bottom 20. The ball is thus snugly engaged and held in place by the walls of the socket. In other words, by what may be called an interference fit. Figure 4 also illustrates the use of the tool 22 for swaging the steel of the roller around the ball. After this swaging is effected the metal of the roller between the balls may be removed to the dotted line 23 so that the balls will protrude from the surface of the roller the desired distance, say $\frac{1}{8}$ of an inch.

Figures 5 and 6 illustrate the insertion of the balls in the manner shown by Figure 4 except that the depth of the sockets 19a, 20a in Figures 5 and 6 is less than the depth of the sockets 19, 20 in Figure 4, and the embrace of the metal without swaging is depended upon to hold the balls in place.

It is noted that in the form shown in Figures 5 and 6, an annular space indicated at 19b is formed between the wall 19a and a portion of the spherical surface of the ball 18. When this bit is employed for drilling purposes, the contact of the sub-surface formation with the surface of the roller will result in a displacement or deformation of that material of the roller adjacent the annular space 19b and will function to displace this material inwardly into engagement with the ball. Such displacement of the material is in effect a peening action which will serve to further secure the ball 18 within the sockets 19a, 20a.

Although it has been found preferable to mount the balls so that a portion thereof protrudes beyond the surface of the roller, it is not absolutely essential that these elements be initially mounted in this manner. In Figure 8 the balls 18 are illustrated as mounted within their respective sockets 19 with the outer surface of the ball substantially flush with the outer surface of the roller. In this form, when a drilling operation is carried out, the portions 30 of the the material of the roller which is softer than the balls, will be displaced or deformed into closer contact with

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the surfaces of the balls, and this will create sufficient clearance to expose the surface of the cutting balls to the formation.

The balls 18 will take the extreme loads required in drilling hard rock. No bending moment is imposed upon the hard metal of which the balls are made. The balls will take loads imposed upon them from any direction under operating conditions. The use of balls eliminates sharp corners in the roller body from which cracks in the roller might start.

Also, it has been found that the use of balls as the insert elements not only simplifies and reduces the cost of manufacture but also facilitates the final assembly of the bit.

It will be understood that the invention is not limited to the particular embodiment shown nor to the particular methods herein described. Various changes within the scope of the following claims will be apparent to those skilled in the art.

Having described my invention, I claim:

1. A drill bit roller having a plurality of circumferentially and axially spaced sockets and a formation crushing ball in each of said sockets, said balls being harder than said roller, each of said sprockets having a rounded bottom to fit the ball therein, the depth of said socket being greater than the radius but less than the diameter of the ball, the ball having an interference fit in said socket, the rim portion of the wall of said socket thereby being disposed to be pressed by the formation into retaining engagement with said ball.
2. A drill bit roller having a plurality of circumferentially and axially spaced sockets and a formation crushing ball in each of said sockets, said balls being harder than said roller, each of said sockets having a rounded bottom to fit the ball therein, the outer portion of the ball being adjacent the surface of the roller, the ball having an interference fit in said socket, the rim portion of the wall of said socket thereby being disposed to be pressed by the formation into retaining engagement with said ball.
3. A drill bit roller having a plurality of circumferentially and axially spaced sockets and a formation crushing ball in each of said sockets, said balls being harder than said roller, the outer portion of the ball being adjacent the surface of the roller, the ball having an interference fit in said socket, the rim portion of the wall of said socket being disposed to be pressed by the formation into retaining engagement with said ball.
4. A drill bit roller having at least one socket in the exterior face thereof and a formation crushing ball therein, said ball being harder than said roller, said socket being shaped to fit said ball, the depth of said socket being greater than the radius but less than the diameter of said ball, the rim of said socket serving to retain said ball in said socket.
5. A cross roller bit having side and cross rollers, each of said rollers having a plurality of circumferentially and axially spaced sockets and a formation crushing ball in each of said sockets, said balls being harder than said roller, each of said sockets having a rounded bottom to fit the ball therein, the depth of said socket being greater than the radius but less than the diameter of the ball, the ball having an interference fit in said socket, the rim portion of the wall of said socket thereby being disposed to be pressed by the formation into retaining engagement with said ball.

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6. A drill bit having cone rollers, each of said rollers having a plurality of circumferentially and axially spaced sockets and a formation crushing ball in each of said sockets, said balls being harder than said roller, each of said sockets having a rounded bottom to fit the ball therein, the depth of said socket being greater than the radius but less than the diameter of the ball, the ball having an interference fit in said socket, the rim portion of the wall of said socket thereby being disposed to be pressed by the formation into retaining engagement with said ball.

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REFERENCES CITED

15

The following references are of record in the file of this patent:

6

UNITED STATES PATENTS

Number	Name	Date
92,014	Case	June 29, 1869
474,297	Hoffman	May 3, 1892
1,010,127	Dingley	Nov. 28, 1911
1,302,967	Pickin	May 6, 1919
1,502,851	Gale	July 29, 1924
1,540,882	Hansen	June 9, 1925
1,885,085	Dalzen	Oct. 25, 1932
2,121,202	Killgore	June 21, 1938
2,177,332	Reed	Oct. 24, 1939
2,200,281	Koebel	May 14, 1940
2,213,351	Smith	Sept. 3, 1940
2,290,933	Andreasson	July 28, 1942