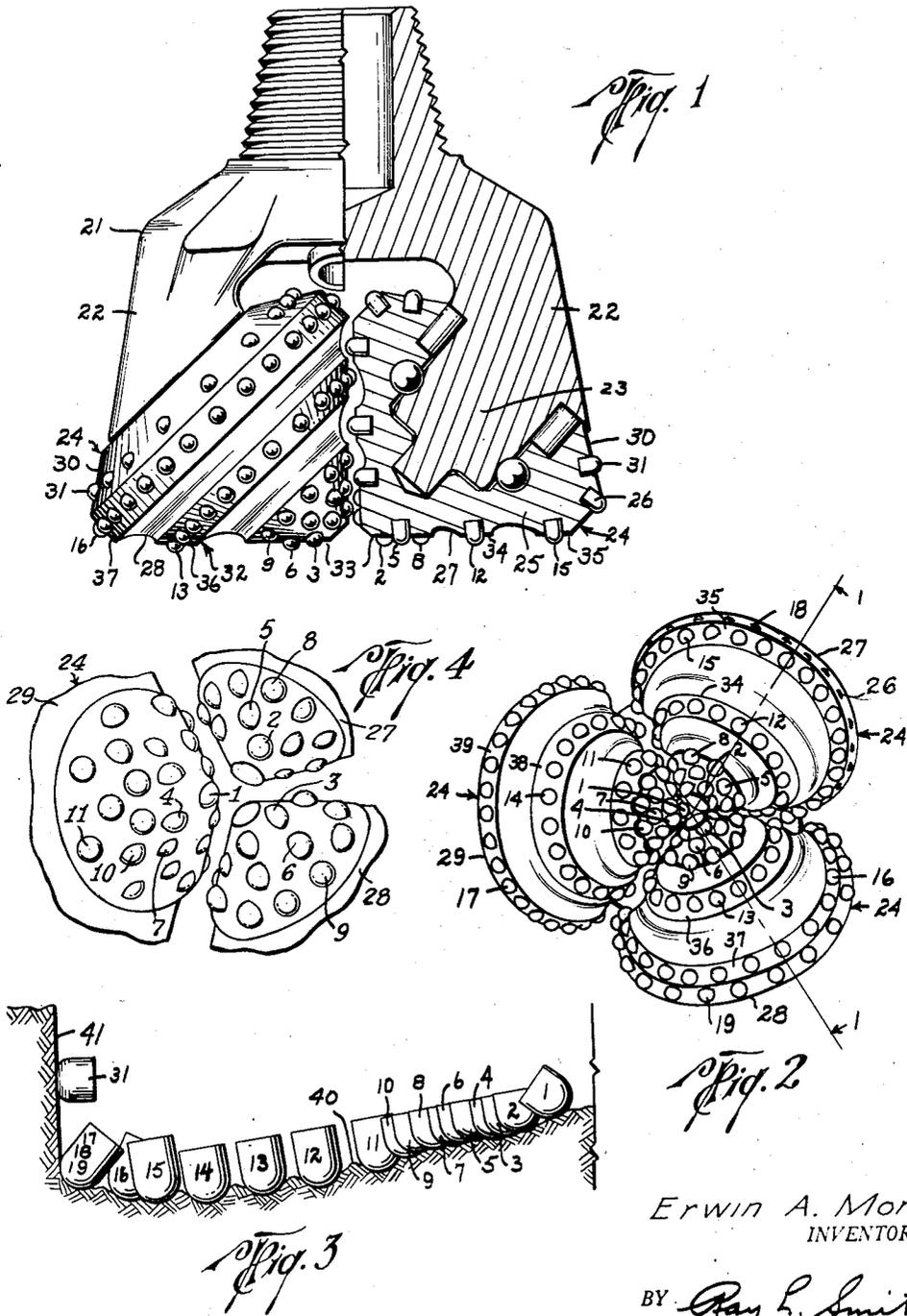


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CONE TYPE WELL DRILL
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CONE TYPE WELL DRILL

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This invention relates to well drills of the cone type in which the cutters, mounted upon inwardly extending shafts, are substantially conical in shape. More particularly the invention is concerned with well drills, of the type indicated, capable of effectively drilling hard abrasive formations.

This general type of bit is well known in the art, the invention residing in the particular cutting structure provided upon the cutter cones.

The invention relates to and broadly comprehends that disclosed and claimed in copending application No. 257,314, filed November 20, 1951, Patent No. 2,687,875, issued August 3, 1954, for well drills and comprehends an improvement over the specific structure shown therein as an illustrative embodiment of that invention.

Difficulty has been experienced in obtaining rock bits that will effectively drill at a satisfactory rate and desired footage in earth formations which have high compressive strength, which are extremely hard and which at the same time are excessively abrasive. To overcome this difficulty it has been proposed, as disclosed in said copending application, to provide a rolling cutter type of earth boring drill in which the rolling cutters are provided with series of wear resistant inserts secured in and protruding from the cutting surfaces of the cutter bodies, the protruding portion of the inserts being rounded or ovoid so that each insert presents an arcuate surface for engagement with and disintegration of the material to be removed by the cutters.

In a preferred form such a rock bit has heretofore been provided with three conical cutters, one of such cutters having a spearpoint or cutting extension at its smaller end. Such spearpoint extends across the bit axis whereby it functions to disintegrate the earth formation at and near the axis of the bit. The other cutters terminate outwardly from the axis of the bit so that there will be no interference among the cutters.

In the drilling of some extremely abrasive earth formations such as the bromides, taconite and quartzitic formations other than chert it has been found that destruction of the spearpoint on the one cutter is extremely rapid and that such destruction renders the bit unfit for further use even though the remaining cutter structure of the cutters is in such condition that considerable useful life remains.

An object of the present invention is to provide an improved well drill which is so constructed that maximum benefit is had from all parts of the cutting structure.

Another objective is to provide a drill bit having conical cutters, each cutter having a nose cutting structure extending substantially to the bit axis whereby the cutters cooperate to effect disintegration of the earth formation proximate the axis of the bore hole being formed by the bit.

Still another object is to provide an earth boring drill in which the cutters have nose cutting structures in confronting relation proximate the axis of the bit together with cutting structure outwardly thereof which are so

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constructed and arranged as to cooperate in disintegrating the entire bottom of the hole being drilled.

A still further object is to provide a cone type of well drill in which the confronting cone noses are provided with wear resistant inserts having rounded or ovoid protrusions at the surfaces of the cutter bodies, such protrusions acting as cutting elements to disintegrate the earth formation at and proximate the bit axis.

Another and more specific object is to provide, in the preferred form of the invention as herein disclosed, a cone type of well drill in which the conical cutters have confronting cone noses provided with cutting elements which operate in a noninterfering manner to cut the earth formation at and near the axis of the bore being drilled, the conical cutters having additional cutting elements outwardly from the cone noses in interfitted relation to cut the outer portion of the bottom and to provide a self-cleaning action in the drill.

The foregoing objects together with other objects and advantages of the invention will be more fully apparent from the following description considered in connection with the accompanying drawings in which:

Fig. 1 is an elevational view of a well drill or bit embodying the invention, the view being taken generally on line 1—1 in Fig. 2, a portion of the bit being shown in elevation and a portion being shown in section and rotated into the plane of the paper to better illustrate the construction and relationship of components of the drill;

Fig. 2 is a bottom view of the well drill.

Fig. 3 is a composite view showing in superposed relationship the cutting elements of the cutters of a well drill embodying the invention as they move across a selected radial plane of a well bore being drilled.

Fig. 4 is an enlarged, fragmentary, bottom view of the well drill illustrating the insert arrangement on the nose portions of the conical cutters.

An embodiment of the invention is shown in the drawings as comprising a three-cone drill bit which comprises a head 21 having three downwardly extending legs arranged symmetrically about the axis of the bit of which two are shown at 22. Each leg has an inwardly and downwardly extending shaft 23 having its inner end enclosed by a cutter shown generally at 24. Each cutter 24 is rotatably mounted upon its shaft by a suitable bearing structure which may assume any of various forms well known in the art and which is shown generally in the drawings as a combination of anti-friction and friction bearing elements.

Each of the cutters 24 comprises a body 25 as best seen in Fig. 1, the cutting elements associated with the cutter body including series of wear resistant inserts 26 secured in the body and protruding from the surface thereof, the protruding portion of the inserts being rounded, or ovoid, whereby such cutting elements function throughout the life of the bit to disintegrate the bottom of the hole being drilled. These inserts are preferably a sintered carbide and, more specifically it has been found advantageous to use sintered tungsten carbide although it is to be understood that other metal carbides such as chromium, molybdenum, tantalum or mixed carbides may be used. Also the inserts are preferably secured in place in the cutter body by being forced into openings or sockets which are slightly smaller than the outer diameter of the inserts, the interference fit causing an expansible force to be exerted upon the metal surrounding each insert as it is forced into position. This method of installation of an insert provides a high holding power upon the inserts such holding power being accentuated by the fact that the wall of the opening or socket becomes conjugate with the periphery of the insert as it is forced into terminal position. It

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is to be understood that this preferred manner of installing the inserts is presented as illustrative only and not by way of limitation of the invention.

The three cutters of the well drill must cut the entire bottom of the hole being drilled but at the same time must present a limited number of cutting elements upon bottom at a given instant else excessive weight is necessary in order to effect desired cutting action of the bit. Accordingly the three cutters 24 are not identical and are respectively further identified by the numerals 27, 28 and 29.

Each cutter has a gage cutting portion 30 (Fig. 1) which includes an annular series of wear resistant inserts 31, this portion of the cutters serving to maintain uniform gage of the hole being drilled. Each cutter also has a bottom cutting portion generally indicated at 32. This portion comprises the nose 33 and, outwardly therefrom, series of cutting elements shown in spaced annular rows. Preferably these series of cutting elements are located in spaced annular lands shown at 34 and 35 on cone 27, at 36 and 37 on cone 28 and at 38 and 39 on cone 29. These lands are so located on the respective cutter bodies that the protruding ends of the series of inserts in each land overlies or extends slightly into a groove between lands in the adjacent cutters. In other words, intervening grooves and the protruding portions of the inserts are so oriented that there is an interfitting relationship among the rows of these cutting elements of the cutters outwardly from the axis of the drill. This provides a self-cleaning action of the cutters but equally important, it enables utilization of limited space available whereby a maximum of thickness of the cutter body 25 is had to effectively hold the cutter elements 26, and in providing in the cutter structure adequate strength to withstand the severe stresses to which it is subjected in normal use.

The noses 33 of the cutters 27, 28 and 29 are specially designed to carry a sufficient number of the cutter elements 26 and so arranged as to cooperatively disintegrate bottom at and near the axis of the bore being drilled. At the same time there must be no interference between cutters. To this end the surface of each nose 33 lies on a slightly smaller cone than that defined by the surfaces of the lands on the cutter body. Thus the ovoid protruding portion of the wear resistant inserts in the noses are in close confronting relation but are free from interference. Such inserts are also so oriented on the respective noses that their tracks on bottom are such as to provide desired disintegrating action at this point.

Preferably, as shown, the nose inserts are also arranged in annular series and these series are spaced sequentially outwardly from the axis of rotation of the bit. This is best illustrated by reference to Figs. 2, 4, and 3 of which the latter shows a section through one-half of an earth bore being drilled by a bit embodying the invention. The bottom of the bore is shown at 40 and the side wall thereof is shown at 41. The respective series of cutting elements will, through successive revolutions of the bit, engage the bottom of the bore hole in the relative positions shown radially of the bore hole in Fig. 3.

For example, the element 1 in the extreme nose of the cutter 29 is closest the axis of the bore hole. This cutter element together with the inserts proximate the inner end of the adjacent noses will cut so near the axis of the bit that the earth formation will be disintegrated to and adjacent the axis. Next adjacent the element 1 is series 2 on cone 27. The series outwardly on succeeding cones are shown at 3 to 19 inclusive.

It is to be noted that the series 17, 18 and 19 are arranged substantially in a single annular path at the juncture of the bottom 40 and the side wall 41 of the well bore. This feature of construction is intended to operate effectively at this point where there is a relatively large volume of formation material to be removed and where conditions are particularly severe because the bottom and

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side walls are mutually self-supporting. This feature also facilitates cutting to gage whereby the gage cutting elements 31 are capable of maintaining accurate gage throughout the life of the bit.

The traction which determines the rate of rotation of the respective cones 27, 28 and 29 is furnished by the cutting elements outwardly from the noses 33. Hence, this portion of the bottom cutting portion 32 possesses a true rolling action. That is to say, there is little, if any, slip or tearing action due to movement of a cutting element relative to the bottom 40 as the element is in engagement with bottom. Since the wear resistant inserts in the noses 33 protrude from a conical surface which is slightly smaller than that defined by the lands outwardly therefrom, there is a slight differential movement between each of these inserts and the bottom of the hole as each such insert moves into engagement with bottom and then withdraws from such engagement. This provides a desirable disintegrating action at this point but at the same time produces a destructive action upon the nose inserts. This destructive action is offset by the concentration of the nose inserts proximate the axis of the bore and hence the objectives of the invention are attained by the structure described as a preferred embodiment of the invention.

Broadly the invention comprehends a new and improved cone type well drill capable of effectively cutting hard and abrasive formations, the cutting elements on the respective cutters being so arranged that a maximum rate of drilling and footage may be had.

The invention claimed is:

1. An earth boring drill comprising, a head, a plurality of conical cutters rotatably mounted thereon, each of said cutters comprising a body having a nose portion terminating proximate the axis of the drill, each of said nose portions having cutter elements thereon comprising a plurality of wear resistant inserts secured therein and each having an ovoid protrusion at the surface thereof, said inserts on the respective nose portions being in confronting and noninterfitting relation and being arranged thereon to engage and produce overlapping tracks upon the bottom of the bore being drilled and to thereby disintegrate the earth formation at and proximate the axis of the drill, said cutter bodies including spaced annular lands outwardly of said nose portions, said lands being spaced on the bodies so that each land overlies the space between lands on the adjacent cutters, and a series of wear resistant inserts secured in each of said lands, said inserts having ovoid protrusions at the surface of the lands, whereby said protrusions form cutting elements in interfitting relationship to effect a self-cleaning action and to disintegrate bottom outwardly of said nose portions.

2. An earth boring drill comprising, a head, a plurality of conical cutters rotatably mounted thereon, each of said cutters comprising a body having a nose portion terminating proximate the axis of the drill, each of said nose portions having a plurality of annular series of cutter elements thereon, each of said series comprising a plurality of wear resistant inserts secured therein and each having an ovoid protrusion at the surface thereof, said inserts on the respective nose portions being in confronting and noninterfitting relation and being arranged to engage the earth formation and produce overlapping tracks thereon and to thereby disintegrate the earth formation traversed by the nose portions, spaced annular lands on said cutter bodies outwardly from said nose portions, said lands being spaced on the cutter bodies to respectively overlie the space between the lands on the adjacent cutters, and a series of wear resistant inserts secured in each of said lands and having their outer ends protruding from the surfaces of the lands and in interfitting relationship with series of inserts in the adjacent cutters.

3. An earth boring drill comprising, a head, a plurality of conical cutters rotatably mounted thereon, each of said

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cutters comprising a body having a nose portion terminating proximate the axis of the drill, a plurality of axially spaced annular series of wear resistant inserts on each nose, each of said inserts protruding from the surface of the associated nose, corresponding series of inserts on the respective noses being so axially spaced along the noses that a track made by one series overlaps the track made by the corresponding series on another nose, and additional axially spaced annular series of inserts secured in each cutter outwardly from the nose portion to the base of the cutter, said additional series being so axially spaced along the cutters that the tracks made thereby are in concentric closely spaced relation and the bottom outwardly from the nose portions is disintegrated thereby.

4. In an earth boring drill having a plurality of conical cutters rotatably mounted thereon, each of said cutters having annular series of wear resistant inserts arranged thereon and protruding from the surface thereof to dis-

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integrate the entire bottom of the hole being formed by the drill; the improvement comprising nose portions on the cutters in mutually confronting relation and terminating proximate the axis of the drill, a plurality of axially spaced annular series of wear resistant inserts secured in each nose and protruding from the surface thereof, series of inserts on the respective noses being so spaced along the noses that a track made by one series overlaps the track made by the corresponding series of another nose whereby the nose portions disintegrate the formation traversed by said nose portions.

References Cited in the file of this patent

UNITED STATES PATENTS

2,117,679	Reed	May 17, 1938
2,318,370	Burch	May 4, 1943
2,626,128	Boice	Jan. 20, 1953
2,687,875	Morlan et al.	Aug. 31, 1954