United States Patent [19]

Newman

[11] **3,727,705**

[45] **Apr. 17, 1973**

[54] **DRILL BIT WITH IMPROVED GAGE COMPACT ARRANGEMENT**

[75] Inventor: **Elmer F. Newman,** Houston, Tex.

[73] Assignee: **Hughes Tool Company,** Houston, Tex.

[22] Filed: **Jan. 21, 1972**

[21] Appl. No.: **219,669**

[52] **U.S. Cl.**.....**175/374,** 175/376

[51] **Int. Cl.**.....**E21b 9/08,** E21b 9/36, E21c 13/01

[58] **Field of Search**.....175/374–378, 341, 353

[56] **References Cited**

UNITED STATES PATENTS

2,527,838	10/1950	Morlan et al.	175/376
2,533,260	12/1950	Woods	175/378 X
2,774,570	12/1956	Cunningham	175/374
2,887,302	5/1959	Garner	175/374
2,907,551	10/1959	Peter	175/375
2,939,684	6/1960	Payne	175/375
3,186,500	6/1965	Boice	175/374
3,389,761	6/1968	Ott	175/374

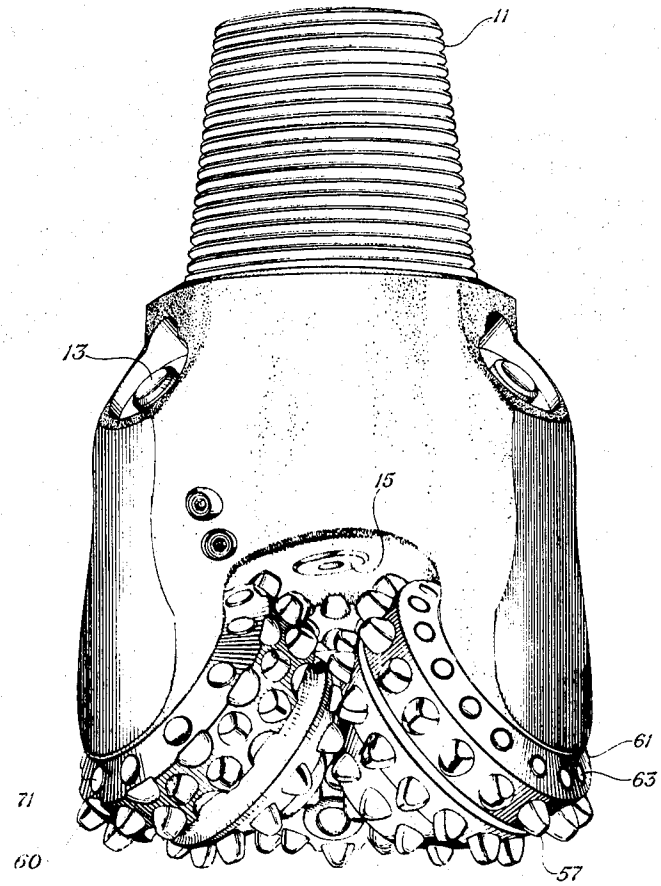
Primary Examiner—David H. Brown

Attorney—Robert A. Felsman

[57] **ABSTRACT**

A drill bit is disclosed as having a gage compact arrangement by which the resistance to gage wear is increased, gage wear is balanced and the tendency toward off-center wear decreased. The heel row compacts on each cone generally are equally spaced. However, the spacing between the heel row compacts differs from cone to cone to prevent tracking of the compacts in impressions previously made on the bore hole bottom. The cross-sectional dimension of the gage compacts that project from, and protect, the gage surface of each cone is different from cone to cone. As a consequence, the total exposed area of all the gage compacts of one cone approaches the total exposed area of all the gage compacts of each of the other cones.

4 Claims, 2 Drawing Figures



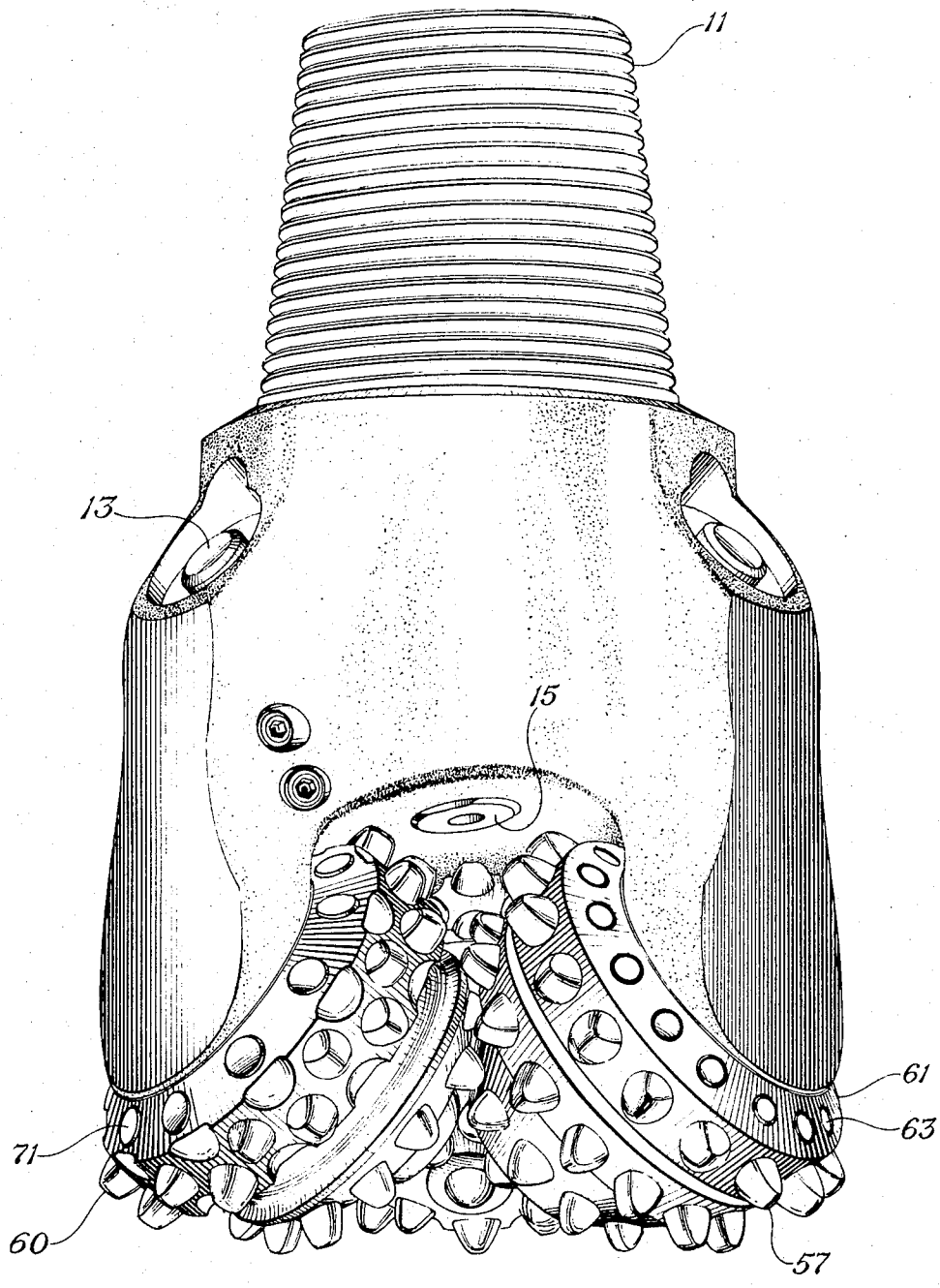


Fig. 1

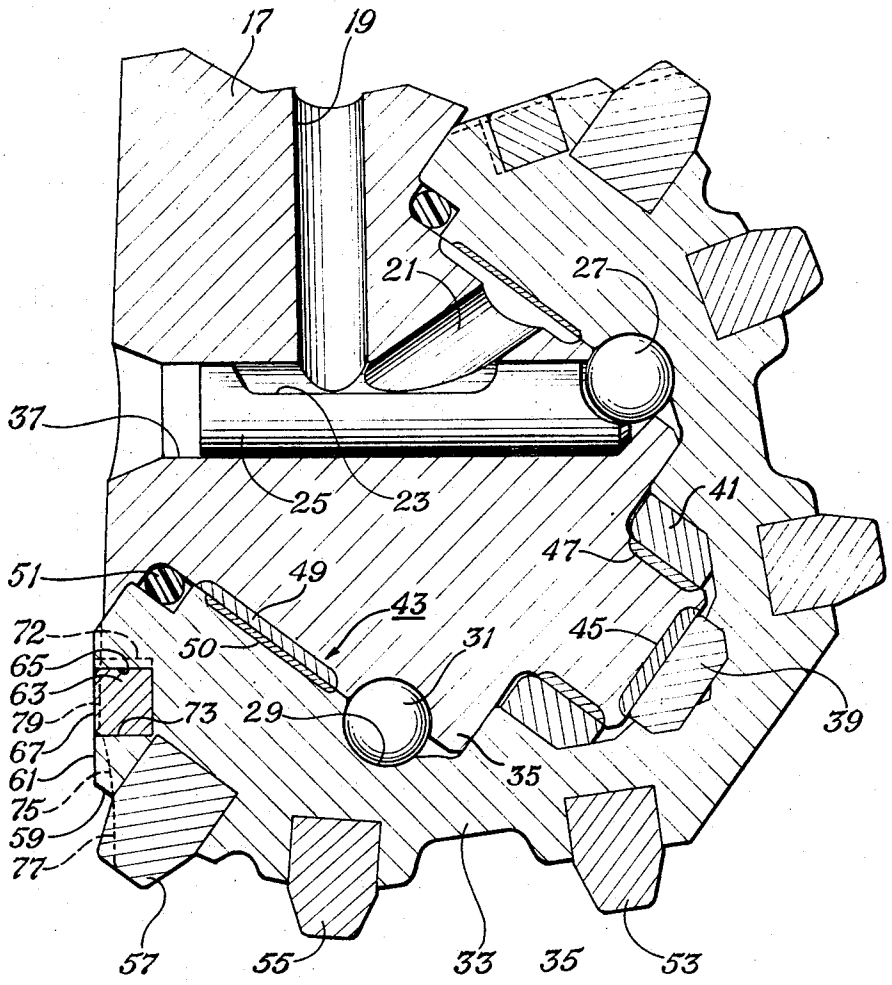

17
19
21
27
37
25
23
41
47
51
49
43
72
50
31
45
65
63
73
29
39
79
67
61
35
75
59
77
57
55
33
35
53

Fig. 2

DRILL BIT WITH IMPROVED GAGE COMPACT ARRANGEMENT

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates in general to improved drill bits used for earth boring, and in particular to improvements in those drill bits having cutting structures of wear resistant inserts or compacts secured in rotatable cones. Improved compact arrangement on the gage surfaces of the rotatable cones is provided to achieve more balanced wear among the cones, decreased tendency toward off-center wear and increased capacity for gage wear resistance.

2. Description of the Prior Art

In rotary well drilling some geological formations are drilled with bits having cutting structures of wear resistant (usually sintered tungsten carbide) compacts held in receiving apertures in rotatable cones. In such bits there is usually on each cone a group of cylindrical compacts that define a circumferential heel row that removes the earth at the corner of the bore hole bottom. Further, it is common to insert additional cylindrical compacts, called "gage" compacts, on a "gage" surface that intersects a generally conical surface that receives the heel row compacts. These gage compacts protect the gage surfaces to prevent erosion of the metal of the cones that supports the heel row compacts. Therefore, fewer heel compacts are lost during drilling and the original diameter of the bit is better maintained due to decreased wear. Moreover, the gage compacts also ream the hole to full "gage" after the heel compacts are worn to an undersized condition.

To prevent tracking of the compacts of the heel rows in the impressions previously formed on the bore hole bottom, the spacing of heel row compacts varies from cone to cone. In the prior art bits, gage compacts of the same cross-sectional diameter were utilized in each cone. Since the spacing of the gage compacts corresponded with the differing spacing of the heel row compacts, there was less total exposed area of gage compacts on one cone than another. This resulted in increased wear of the gage surface of one cone relative to the wear of the gage surfaces of the other cones. This seems to have caused in some instances off-center wear, which appears when a bit rotates about an axis off-set from the true geometric center of the bit. Off-center rotation enables the build-up of rock ridges on the bore hole bottom that eventually erodes prematurely the cone metal that supports the compacts, if not the compacts themselves. Consequently, the useful life of the drill bit was often decreased due to the resulting differential wear of the gage compacts.

SUMMARY OF THE INVENTION

The invention is summarized as one relating to drill bits in which wear resistant compacts are retained by suitable means such as interference fit in receiving apertures in rotatable cones. Further, a group of compacts in each cone define a heel row of generally equally spaced compacts, with the spacing of the compacts of the heel rows being different from cone-to-cone to prevent tracking. A plurality of gage compacts protrude from gage surfaces of the cones. The total exposed area of compacts on the gage surface on one cone approaches as close as practicable the total exposed area of compacts on the gage surface of the other cones. This object is accomplished by using gage compacts of a different cross-sectional dimension on cones which differ in their heel row spacing. By using gage compacts of greater cross-sectional area between heel row compacts of greater spacing, the total exposed area of the gage compacts has improved balance among the cones.

The above as well as additional objects, features and advantages of the invention will become more fully apparent in the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing a drill bit that embodies the principles of the invention.

FIG. 2 is a fragmentary view in longitudinal section of a portion of a head section having a rotatable cutter supported thereon.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring initially to FIG. 1, the numeral 11 designates the threaded upper portion of a plurality of connected head sections that form a bit body adapted to be connected with a drill string member (not shown). The head sections in this instance have a typical lubricating system beneath the caps 13, and in addition are provided with suitable nozzle means 15 to discharge drilling fluid against the bore hole bottom to remove cuttings.

As seen in FIG. 2, each head section 17 has passages 19 and 21 that intersect a groove 23 in a ball plug 25 used to retain the balls 27 in associated raceways 29, 31 formed respectively in the rotatable cone 33 and in the bearing pin 35. The ball plug is retained in an associated aperture 37 by suitable means (not shown) such as welding.

Additional bearing means, such as the thrust button 39, bushing 41, and journal bearing 43, are treated respectively with improved bearing metals at locations indicated by the numerals 45, 47, 49 and 50. In addition, seal means (here an O-ring 51) is used to retain lubricant inside the bearing means.

In each cutter are a plurality of wear resistant inserts or compacts, generally formed of sintered tungsten carbide. These compacts are preferably arranged in circumferential rows such as the nose row 53, intermediate row 55 and heel row 57. The heel row protrudes from a generally conical surface 59 that intersects a generally conical gage surface 61, and gage compacts 63 are inserted in receiving apertures 65 in the gage surface. Preferably, the outermost exposed surface 67 of each gage compact is ground parallel with the gage surface 61. The resulting exposed surface area of all the gage compacts provides sufficient wear resistance to retard erosion or wear of gage surface 61. Thus, heel compact loss is minimized and the original bit diameter is better maintained during drilling.

As seen in FIG. 1, the heel row compacts 57 of one cone have a selected, generally equal spacing, and the heel row compacts 60 of each of the other cones have differing spacings. This helps prevent tracking of the heel row compacts in the impressions previously formed by the rotation of the compacts against the bore hole bottom, and increases the useful life of the drill bit, as has long been known.

The invention relates, however, to an improved arrangement of the gage compacts. The gage compacts **63** in gage surface **61** of one cone have a selected cross-sectional dimension (here diameter for the cylindrical compacts shown), and the gage compacts **71** in each of the other cones have different cross-sectional dimensions. For example, if the heel row compacts **60** of one cone (see FIG. **1**) have greater spacing than heel row compacts **57** of another cone, the gage compacts **71** between heel compacts **60** should have individually greater cross-sectional dimensions than do gage compacts **61**. By thus varying the cross-sectional dimensions of the gage compacts from cone-to-cone, the total exposed area of all of the gage compacts on each cone is made as close as practicable to being balanced or equal. This tends to produce uniform or balanced wear of the gage surfaces of all cones such that the useful life of the bit is prolonged. Further, the resulting increase in the area of compacts on gage provides increased gage wear resistance.

With reference to FIG. **2**, the placement **72** (indicated in phantom) of gage compacts **71** is such that the lowermost edge **73** of the compacts of each cone is on the same elevation. This causes the gage compacts to operate on a common rock ledge on the wall of the bore hole when the gage surface wears as indicated by the numeral **75**, when the heel compacts wear as indicated by numeral **77**, and when the gage compacts wear as indicated by the numeral **79**.

It should be apparent from the foregoing description that the invention provides significant advantages. The wear of gage surfaces and compact metal is balanced by using the above described structure, and hence the useful life of the drill bit is increased since none of the heel row compacts fall prematurely from their receiving apertures.

Also, the tendency toward off-center wear is eliminated since the gage surfaces of the cones wear more uniformly. If on the otherhand, the gage surfaces were to wear at different rates, as in the prior art, the outer diameter of the fastest wearing cone would cease to engage the wall of the bore hole unless the bit moved to a rotational axis other than the true longitudinal axis of the bit.

While I have shown my invention in only one of its forms, it should be apparent to those skilled in the art that it is not so limited, but is susceptible to various modifications without departing from the spirit thereof.

I claim:

1. A drill bit with improved gage compact arrangement, said bit comprising:

a bit body adapted to be connected with a drill string member;

at least two cones rotatably supported on said bit body; wear resistant compacts retained by said cones;

a group of compacts in each cone defining a row of heel compacts, the spacing of heel row compacts being greater on one cone than the other;

a row of gage compacts in a gage surface of each cone, said gage compacts being positioned between the compacts of the associated heel row;

the cross-sectional area of gage compacts between the heel row compacts of greater spacing being greater than the cross-sectional area of the gage compacts between the heel row compacts of lesser spacing to improve balance of the total exposed area of the gage compacts among the cones.

2. The improved drill bit defined by claim **1** in which the lowermost edge of each gage compact is located at the same elevation from the bottom of the drill bit.

3. A drill bit with improved gage compact arrangement, said bit comprising:

a bit body adapted to be connected with a drill string member;

at least two cones rotatably supported on said bit body; wear resistant compacts retained by said cones;

a row of gage compacts of selected cross-sectional dimension in a gage surface of the cone having the lesser heel row spacing; and

a row of gage compacts of greater cross-sectional dimension in the gage surface of the cone having the greater heel row spacing to improve balance of the total exposed area of the gage compacts among the cones.

4. The improved drill bit defined by claim **3** in which the lowermost edge of each gage compact is located at the same elevation from the bottom of the drill bit.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,727,705 Dated April 17, 1973

Inventor(s) Elmer F. Newman

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 5. The drill bit defined by Claim 1 wherein the cross-sectional areas of gage compacts on one cone is substantially equal to that of the other gage compacts of the other said cones.

On the cover sheet, after the abstract, "4 Claims" should read -- 5 Claims --.

Signed and sealed this 22nd day of January 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents