



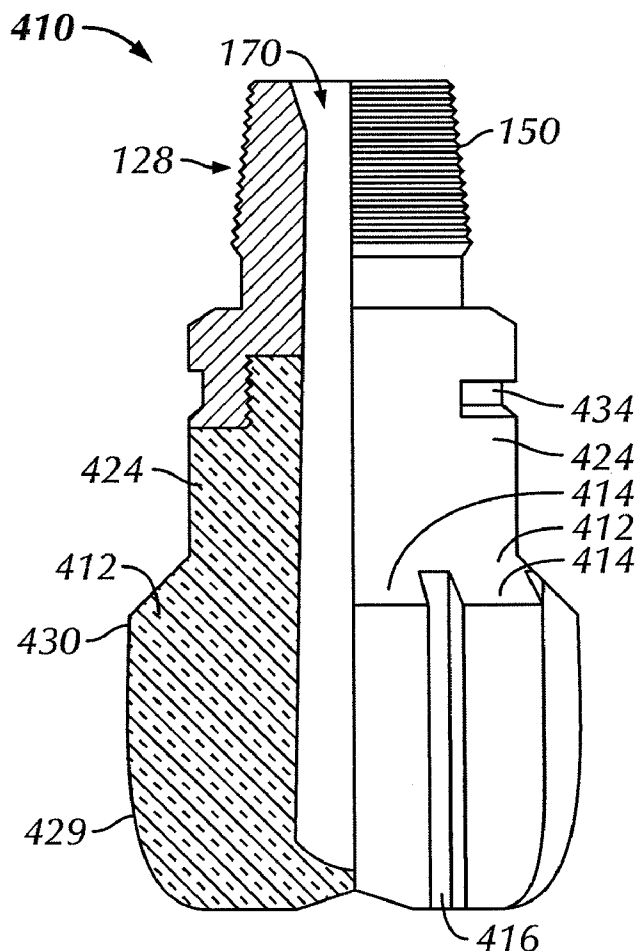
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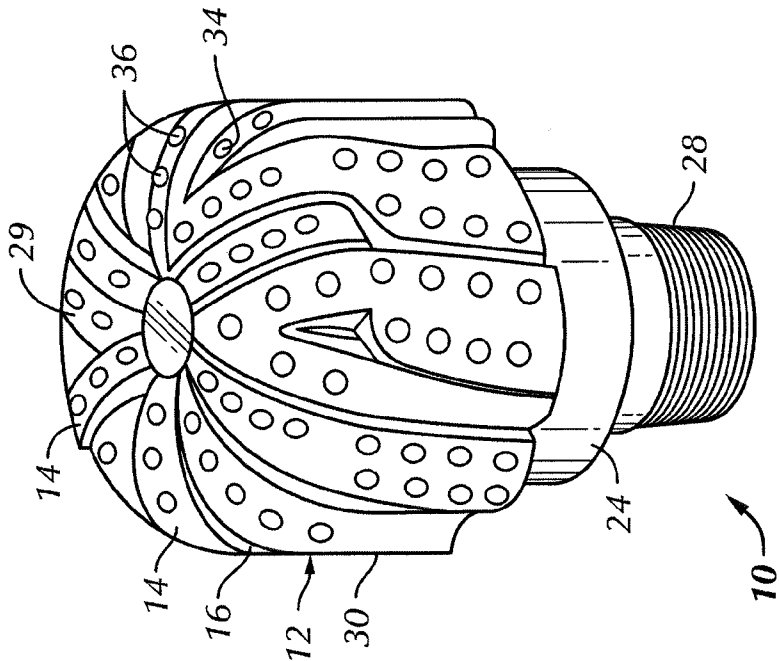
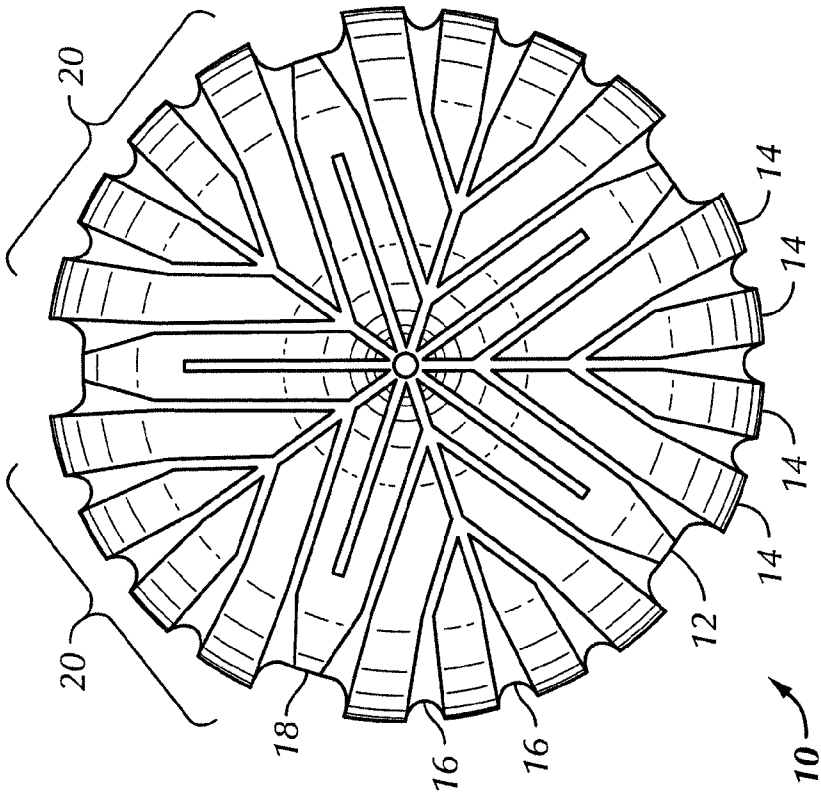
(19) **United States**(12) **Patent Application Publication**
Bankes et al.(10) **Pub. No.: US 2011/0000718 A1**(43) **Pub. Date: Jan. 6, 2011**(54) **INTEGRATED CAST MATRIX SLEEVE API
CONNECTION BIT BODY AND METHOD OF
USING AND MANUFACTURING THE SAME**(21) Appl. No.: **12/497,389**(22) Filed: **Jul. 2, 2009**(75) Inventors: **Steve Bankes**, Willis, TX (US);
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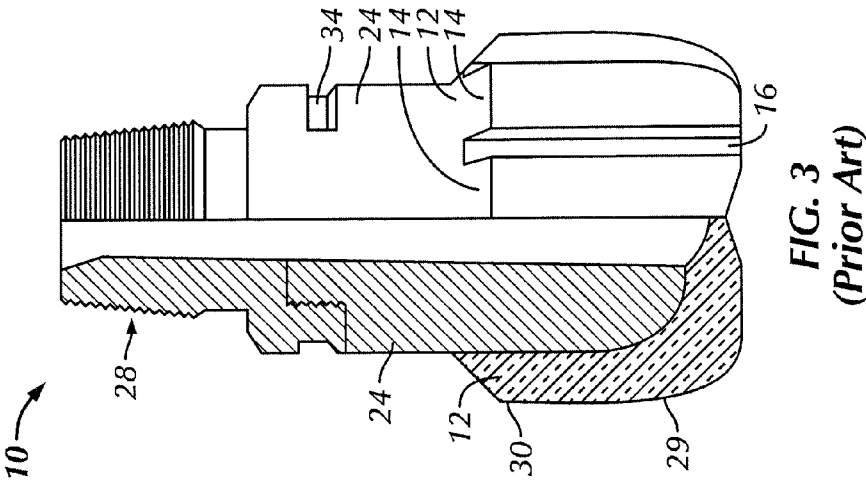
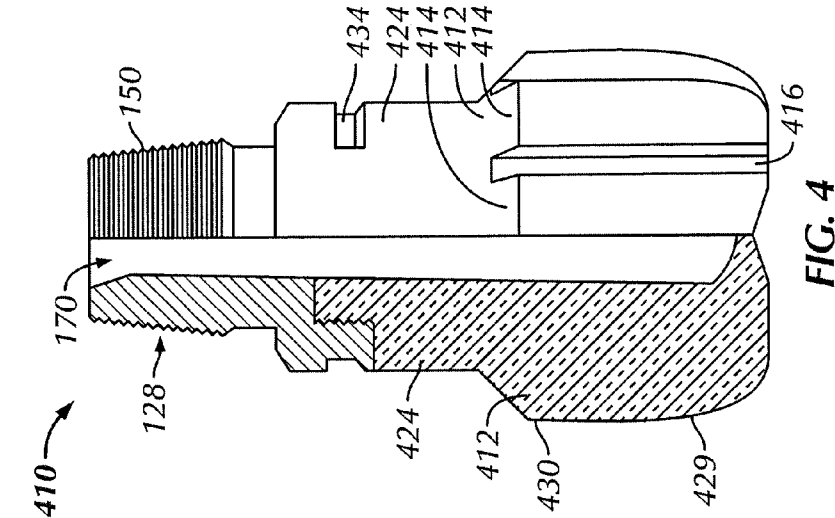
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HOUSTON, TX 77010 (US)(57) **ABSTRACT**

A drill bit including a bit body and an upper portion, wherein the bit body and the upper portion are comprised of a matrix material, and wherein the upper portion includes a threaded connection comprised of a machineable matrix material is disclosed.

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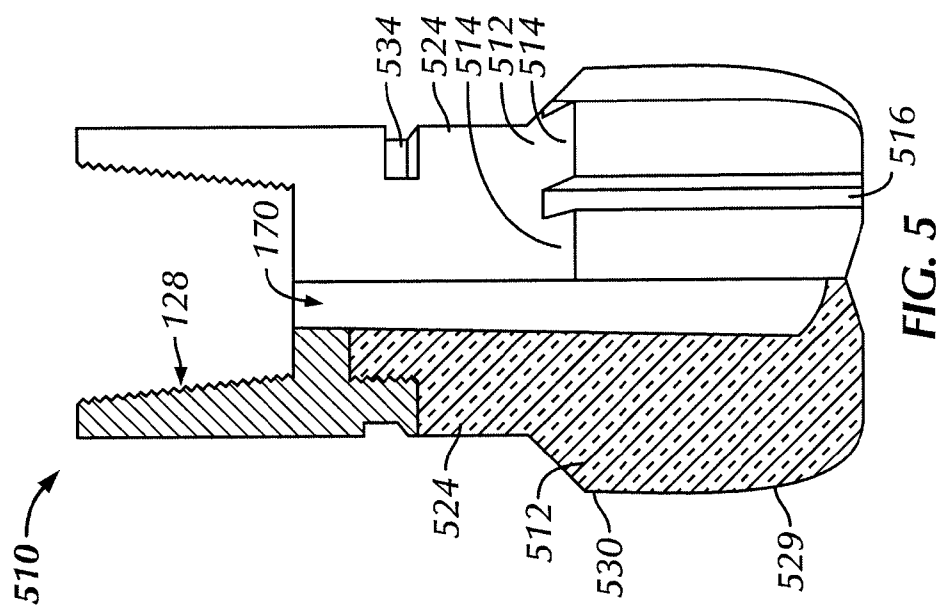


FIG. 5

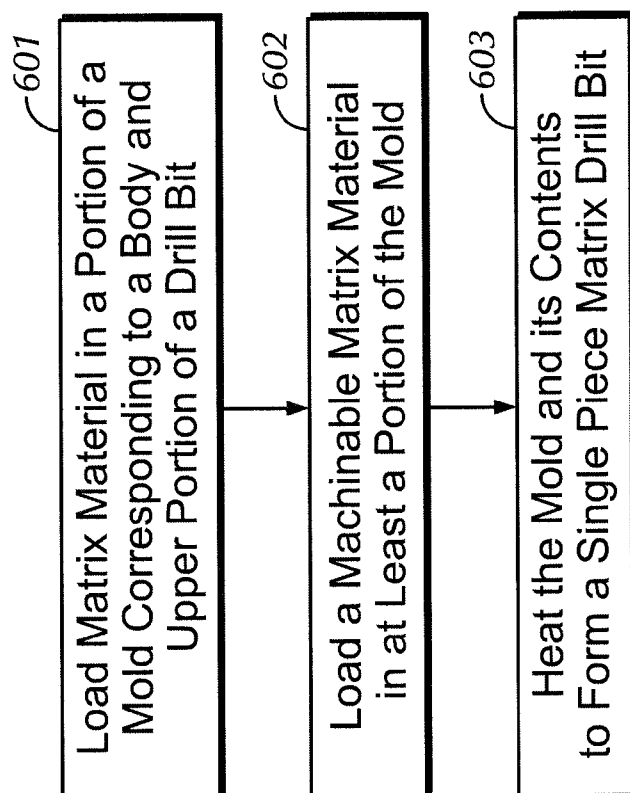
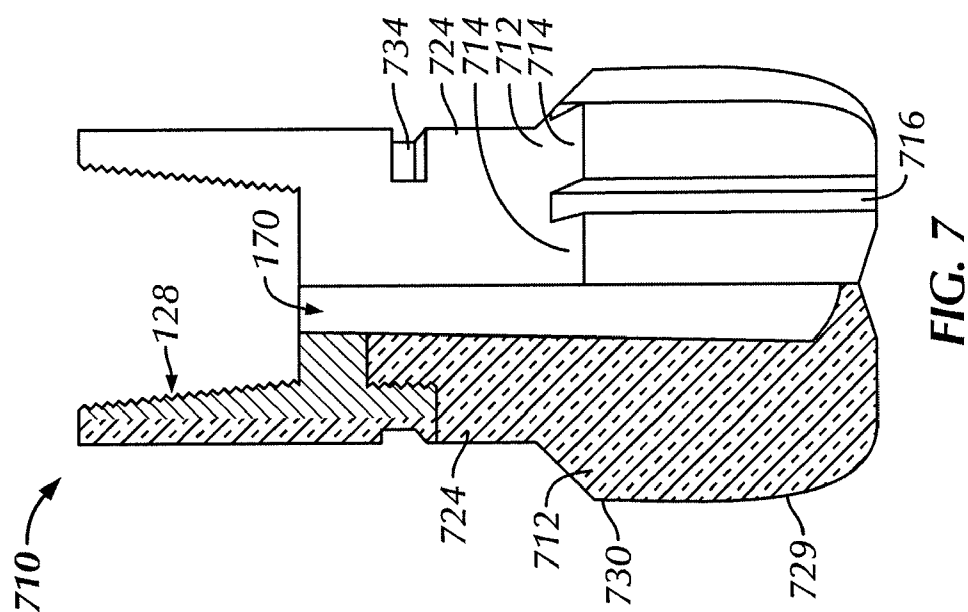
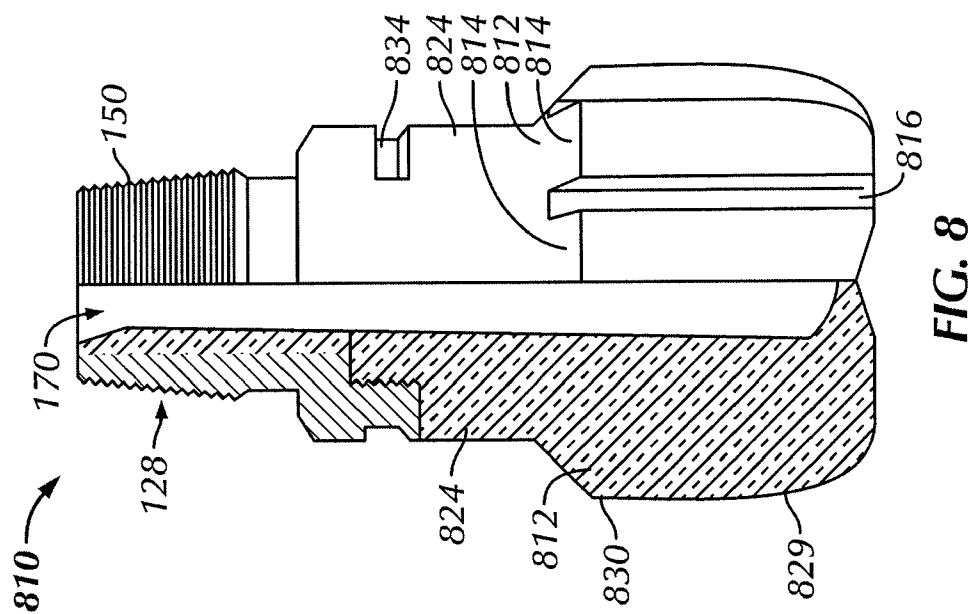


FIG. 6



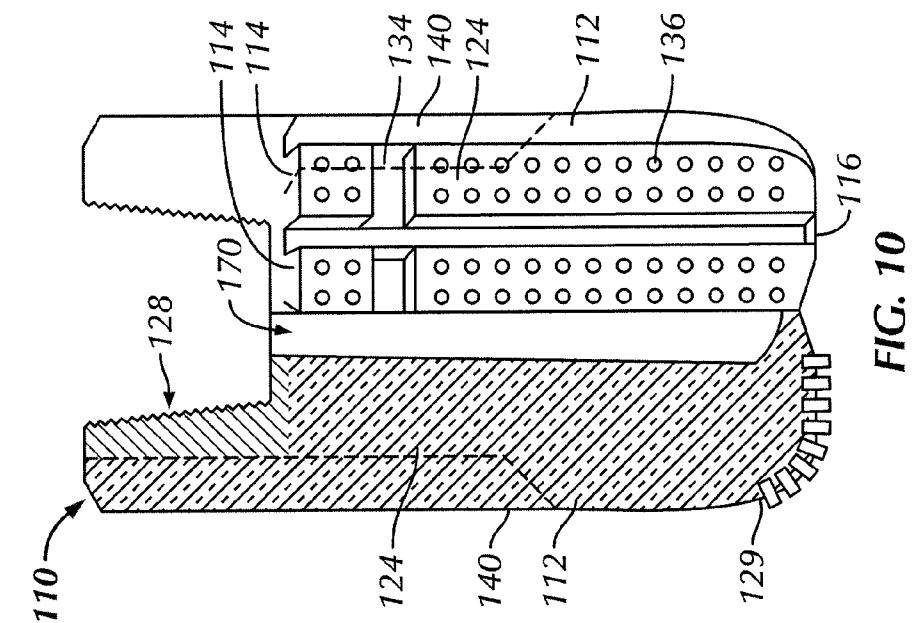


FIG. 10

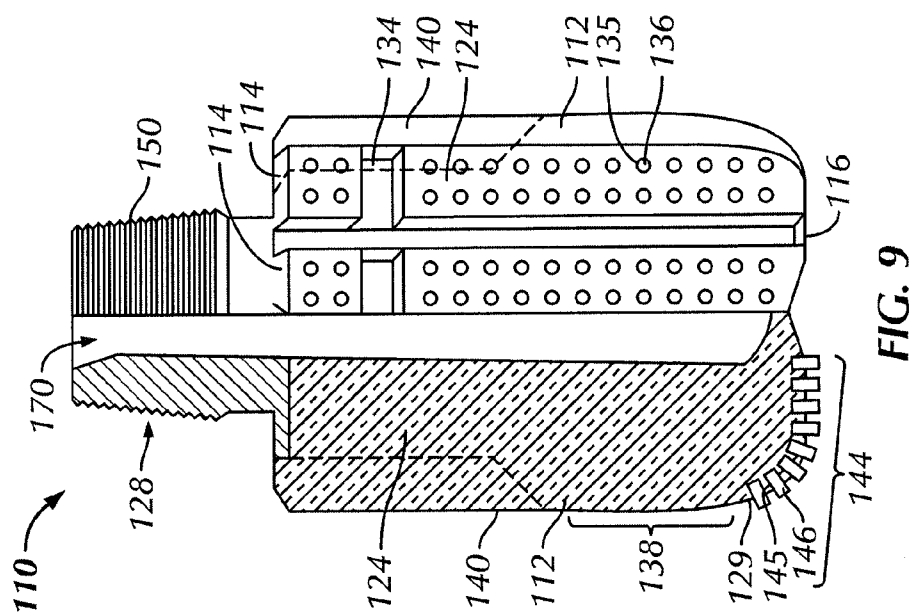


FIG. 9

INTEGRATED CAST MATRIX SLEEVE API CONNECTION BIT BODY AND METHOD OF USING AND MANUFACTURING THE SAME

BACKGROUND OF INVENTION

[0001] 1. Field of the Invention

[0002] Embodiments disclosed herein relate generally to matrix body drill bits and the methods for the manufacture of such drill bits.

[0003] 2. Background Art

[0004] An earth-boring drill bit is typically mounted on the lower end of a drill string and is rotated by rotating the drill string at the surface or by actuation of downhole motors or turbines, or by both methods. When weight is applied to the drill string, the rotating drill bit engages the earth formation and proceeds to form a borehole along a predetermined path toward a target zone.

[0005] Different types of bits work more efficiently against different formation hardnesses. For example, bits containing cutters that are designed to shear the formation frequently drill formations that range from soft to medium to hard. These cutters often have polycrystalline diamond compacts (PDCs) as their cutting faces, and are then called PDC bits.

[0006] Roller cone bits are efficient and effective for drilling through formation materials that are of medium to hard hardness. The mechanism for drilling with a roller cone bit is primarily a crushing and gouging action, in which the inserts of the rotating cones are impacted against the formation material. This action compresses the material beyond its compressive strength and allows the bit to cut through the formation.

[0007] For still harder materials, the mechanism for drilling changes from shearing to abrasion. For abrasive drilling, bits that have fixed, abrasive elements are preferred. While bits that have abrasive polycrystalline diamond cutting elements are known to be effective in some formations, they have been found to be less effective for hard, very abrasive formations such as sandstone. For these hard formations, cutting structures that comprise particulate diamond, or diamond grit, impregnated in a supporting matrix are effective. In the discussion that follows, components of this type are referred to as "diamond impregnated."

[0008] Diamond impregnated drill bits are commonly used for boring holes in very hard or abrasive rock formations. The cutting face of such bits contains natural or synthetic diamonds distributed within a supporting material to form an abrasive layer. During operation of the drill bit, diamonds within the abrasive layer are gradually exposed as the supporting material is worn away. The continuous exposure of new diamonds by wear of the supporting material on the cutting face is the fundamental functional principle for impregnated drill bits.

[0009] The construction of the abrasive layer is of critical importance to the performance of diamond impregnated drill bits. The abrasive layer typically contains diamonds and/or other superhard materials distributed within a suitable supporting material. The supporting material must have specifically controlled physical and mechanical properties in order to expose diamonds at the proper rate.

[0010] Metal-matrix composites are commonly used for the supporting material for both diamond impregnated bits and PDC bits because the specific properties can be controlled by modifying the processing or components. The metal-matrix usually combines a hard particulate phase with a ductile metallic phase. The hard phase often consists of

tungsten carbide and other refractory or ceramic compounds. Copper or other nonferrous alloys are typically used for the metallic binder phase. Common powder metallurgical methods, such as hot-pressing, sintering, and infiltration are used to form the components of the supporting material into a metal-matrix composite. Specific changes in the quantities of the components and the subsequent processing allow control of the hardness, toughness, erosion and abrasion resistance, and other properties of the matrix.

[0011] Proper movement of fluid used to remove the rock cuttings and cool the exposed diamonds is important for the proper function and performance of diamond impregnated bits. The cutting face of a diamond impregnated bit typically includes an arrangement of recessed fluid paths intended to promote uniform flow from a central plenum to the periphery of the bit. The fluid paths usually divide the abrasive layer into distinct raised ribs with diamonds exposed on the tops of the ribs. The fluid provides cooling for the exposed diamonds and forms a slurry with the rock cuttings. The slurry must travel across the top of the rib before reentering the fluid paths, which contributes to wear of the supporting material.

[0012] An example of a prior art diamond impregnated drill bit ("impreg bit") is shown in FIG. 1. The bit 10 includes a bit body 12 and a plurality of ribs 14 that are formed in the bit body 12. The ribs 14 are separated by channels 16 that enable drilling fluid to flow between and both clean and cool the ribs 14. The ribs 14 are typically arranged in groups 20 where a gap 18 between groups 20 is typically formed by removing or omitting at least a portion of a rib 14. The gaps 18, which may be referred to as "fluid courses," are positioned to provide additional flow channels for drilling fluid and to provide a passage for formation cuttings to travel past the drill bit 10 toward the surface of a wellbore (not shown).

[0013] Further examples of prior art impreg bits are shown in FIGS. 2 and 3. The drill bit 10 comprises a shank 24 and a bit body 12. Shank 24 is typically formed of steel, has a smaller diameter than that of the gage of the bit body 12, and includes breaker slots 34 and a threaded pin 28 for attachment to such drill string (not shown). Breaker slots 34 are typically formed on opposing lateral sides of the bit shank 24 and permit engagement and disengagement of the drill bit 10 with the drill string (not shown). Bit body 12 has a cutting face 29 and outer side surface 30. According to one embodiment, the bit body 12 is formed by infiltrating a mass of tungsten-carbide powder impregnated with synthetic or natural diamond. The bit body 12 may include various surface features, such as raised ridges or ribs 14 and recessed grooves or channels 16.

[0014] Impreg bits are typically made from a solid body of matrix material formed by any one of a number of powder metallurgy processes known in the art. During the powder metallurgy process, abrasive particles and a matrix powder are infiltrated with a molten binder material. Upon cooling, the bit body includes the binder material, matrix material, and the abrasive particles suspended both near and on the surface of the drill bit. The abrasive particles typically include small particles of natural or synthetic diamond. Synthetic diamond used in diamond impregnated drill bits is typically in the form of single crystals. However, thermally stable polycrystalline diamond (TSP) particles may also be used.

[0015] The impreg bit formation process typically includes packing a graphite mold with a matrix material in predefined locations of the mold. Once the matrix material has been positioned in the mold, other internal components, including

the shank of the bit, may be positioned in the mold. Specifically, the steel shank of the bit is supported in its proper position in the mold cavity along with any other necessary formers, e.g., those used to form holes to receive fluid nozzles. The remainder of the mold cavity is filled with a charge of tungsten carbide powder. Finally, a binder material, and more specifically, an infiltrant, is placed over the charge of powder. The mold and components therein are then heated in a furnace to sufficiently melt the infiltrant and held at an elevated temperature for a sufficient period to allow the infiltrant to flow into and bind the matrix powder or matrix and segments. The infiltration process that occurs during sintering (heating) bonds the grains of matrix material to each other and to the other components to form a solid bit body that is relatively homogenous throughout. The sintering process also causes the matrix material to bond to other structures that it contacts, such as the steel shank suspended within the mold, thus forming a bit body with a section of steel shank protruding therefrom.

[0016] After formation of the bit body, a separate steel component may be welded to the protruding section of the steel shank to facilitate connection of the bit body to the drill string. As shown in FIGS. 2 and 3, the bit body 12 is formed with steel shank 24 protruding therefrom, as described above and including breaker slots 34, and a threaded pin 28 is welded to steel shank 24 for attachment of the bit 10 to a drill string (not shown). Generally, the threaded pin is made of steel so that threads may be machined onto the surface. It is necessary that the threaded pin be made of steel because although the matrix material used to form the bit body has higher wear and erosion resistance as compare to steel, it is relatively hard and not easily machined. Thus, the threaded pin must be welded to the bit body and steel shank protruding therefrom in order to form a drill bit capable of being connected to a drill string.

[0017] An additional component (not shown), e.g., a stabilizer sleeve, may optionally be welded to the bit body and steel shank prior to connection of the bit to a drill string. The stabilizer sleeve is ordinarily made of steel and/or a matrix material and typically has a diameter equal to the diameter of the bit body gage. Similar to the bit body and steel shank, the stabilizer sleeve may include various surface features, such as raised ridges or blades, recessed grooves or channels, and breaker slots. Generally, the transition between the bit body (and steel shank) and the threaded pin is discontinuous due to their being made of different compositions. Similarly, if a stabilizer sleeve is included, the transition between the bit body and the stabilizer sleeve is discontinuous. Although it is well known in the art to weld a threaded pin, and optionally a stabilizer sleeve, to the bit body and steel shank in order to facilitate connection of the drill bit to the drill string, a discontinuous transition may result in premature bit failure due to internal stresses due to material mismatch which can lead to internal cracking and/or cracking when high loading is applied.

[0018] Accordingly, there exists a need for a drill bit and method for manufacturing a drill bit which has a continuous transition between the bit body and upper portion and, optionally, the stabilizer sleeve.

SUMMARY OF INVENTION

[0019] In one aspect, embodiments disclosed herein relate to a drill bit that includes a bit body and an upper portion, wherein the bit body and the upper portion are comprised of

a matrix material, and wherein the upper portion includes a threaded connection comprised of a machineable matrix material.

[0020] In another aspect, embodiments disclosed herein relate to a drill bit that includes a bit body, an upper portion, and an extra extended gage, wherein the bit body, the upper portion, and the extra extended gage are comprised of a matrix material, and wherein the upper portion includes a threaded connection comprised of a machineable matrix material.

[0021] In another aspect, embodiments disclosed herein relate to a drill bit that includes a bit body and an upper portion, wherein the bit body and the upper portion are comprised of a matrix material, wherein the upper portion includes a threaded connection comprised of a machineable matrix material, and wherein there is an uninterrupted transition between the bit body and the upper portion.

[0022] In another aspect, embodiments disclosed herein relate to a method of manufacturing a single piece matrix drill bit having a body and an upper portion, wherein the method includes loading a matrix material in at least a portion of a mold cavity corresponding to a body portion and an upper portion; loading a machineable matrix material in at least a portion of the mold cavity corresponding to a threaded connection; and heating the mold contents to form a single piece matrix drill bit.

[0023] Other aspects and advantages of the invention will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

[0024] FIG. 1 shows a prior art diamond impregnated drill bit.

[0025] FIG. 2 shows a perspective view of a prior art diamond impregnated drill bit.

[0026] FIG. 3 shows a partial cross-sectional view of a prior art diamond impregnated drill bit.

[0027] FIG. 4 shows a partial cross-sectional view of a drill bit according to an embodiment of the present disclosure.

[0028] FIG. 5 shows a partial cross-sectional view of a drill bit according to an alternative embodiment of the present disclosure.

[0029] FIG. 6 shows a method of forming a drill bit according to an embodiment of the present disclosure.

[0030] FIG. 7 shows a partial cross-sectional view of a drill bit according to an alternative embodiment of the present disclosure.

[0031] FIG. 8 shows a partial cross-sectional view of a drill bit according to an alternative embodiment of the present disclosure.

[0032] FIG. 9 shows a partial cross-sectional view of a drill bit according to an alternative embodiment of the present disclosure.

[0033] FIG. 10 shows a partial cross-sectional view of a drill bit according to an alternative embodiment of the present disclosure.

DETAILED DESCRIPTION

[0034] In one aspect, embodiments disclosed herein relate generally to matrix drill bits and the methods of manufacturing and using the same. More particularly, embodiments disclosed herein relate to single piece drill bits formed of a matrix material, allowing for extension of their use downhole.

Specifically, embodiments disclosed herein relate to a drill bit having a bit body and an upper portion, wherein both the bit body and the upper portion are integrally formed of a matrix material, and wherein the upper portion includes a threaded connection comprised of a machineable matrix material for connection of the drill bit to a drill string.

[0035] As used herein, the term “matrix drill bit” or “matrix bit” is used to refer to bits having a bit body formed of a matrix material, as compared to a steel bit body, wherein the term “matrix material” is used herein to refer to a composition of hard particles dispersed in a matrix of a metal binder, e.g., carburized tungsten carbide, cast tungsten carbide, cemented tungsten carbide (also known as sintered tungsten carbide), and other metal carbides as are known in the art. Such bits may include diamond impregnated drill bits (“impreg bits”) as well as bits having polycrystalline diamond compact (“PDC”) cutters mounted on the exterior face of the bit (“PDC bits”). The term “upper portion” is used herein to refer to the portion of a drill bit that is located axially above the cutting face of a drill bit and which has a smaller diameter than the gage of the drill bit and serves to provide an attachment mechanism for the bit cutting structure to a drill string. While the upper portion is conventionally made of steel, the upper portion may also be formed from a matrix material.

[0036] In a conventional matrix bit, a bit body comprised of a matrix material mixture is first formed with a steel shaft protruding therefrom; a steel threaded pin is then welded to the bit body and steel shaft to form the drill bit. The steel pieces used to form the threaded pin and the shank are typically tougher than the wear resistant matrix material used to form the bit body, resulting in a large amount of residual stresses to be present at the interface between the steel and matrix material, which leads to cracking during manufacturing of the bit as well as cracking or weakening in areas of high applied loading, e.g., the breaker slot areas, during drilling operations.

[0037] Advantageously, embodiments of the present disclosure may include using a matrix material to form both the bit body and the shank (the “upper portion”) of the drill bit so that the bit body and upper portion are formed integrally (as a single piece) of the same matrix material, thereby eliminating the material property mismatch that causes the cracking or weakening of the bit, as described above. Because the bits of the present disclosure are formed integrally, the conventional transition from a bit body to upper portion may not be as readily apparent; however, what will be readily apparent is the use of a matrix material to integrally form the two pieces.

[0038] For example, as shown in FIG. 4, a matrix drill bit 410 includes a bit body 412 and an upper portion 424, wherein the upper portion 424 includes a threaded connection 128 for connection of the bit 410 to a drill string (not shown) and breaker slots 434 for engaging and disengaging the bit from the drill string. Bit body 412 and upper portion 424 are formed integrally using methods disclosed herein and are comprised of a matrix material. Upper portion 424 includes a threaded connection 128 and breaker slots 434. Breaker slots 434 may be formed of a machineable matrix material (which is not steel) that is different from the matrix material used to form the bit body 412 and upper portion 424. Bit body 412 may include a cutting face 429 and outer side surface 430, as well as various surface features, such as raised ridges or ribs 414 and recessed grooves or channels 416.

[0039] Additionally, embodiments of the present disclosure may have various hydraulic arrangements to direct drill-

ing fluid from the drill string to the outside of the bit. Specifically, referring to FIG. 4, drilling fluid is directed within the hollow pin end 150 of the bit 410 to an interior plenum chamber 170 formed in the bit body 412. The fluid is then directed through a hydraulic fluid passageway (not shown) out of the bit through the one or more nozzles (not shown) on bit 410. In some embodiments, nozzles may be individually oriented based the desired hydraulic function: cutting structure, bottom hole cleaning, and/or cuttings evacuation.

[0040] According to one embodiment, the bit body and the upper portion may be comprised of a tungsten-carbide matrix material. In a preferred embodiment, the bit body and at least a portion of the upper portion may be comprised of a tungsten-carbide matrix material that has been impregnated with superabrasive particles. In another embodiment, the superabrasive particles may be impregnated only into a selected region of the bit, e.g., the blades of the bit body and upper portion. In yet another embodiment, the bit body and the upper portion may also be infiltrated with an infiltration binder. The use of a matrix material to form at least a portion of the body or other part of an earth boring bit, e.g., PDC bits, diamond impregnated bits, etc., is known in the art and is disclosed in U.S. Pat. Nos. 7,250,069 and 6,287,360, U.S. Pat. App. Pub. Nos. 2007/0175669 and 2007/0240910, and U.S. patent application Ser. No. 12/121,504, which are assigned to the assignee of the present invention. These patents are hereby incorporated by reference; however, it should be understood that embodiments of the present disclosure are not limited to such matrix materials. In a preferred embodiment, the bit body and the upper portion may be formed integrally using a method, as shown in FIG. 6, that includes loading a matrix material in at least a portion of a mold cavity corresponding to a body portion and an upper portion of a drill bit 601, loading a machineable matrix material in at least a portion of the mold cavity 602 that corresponds to the eventual threaded connection, and heating the mold contents to form a single piece matrix drill bit 603. Additionally, the matrix material may be formable or moldable, which may allow for the material to be shaped to have the desired thickness, shape, contour, etc., when placed or positioned in the mold. Methods of making matrix bit bodies are known in the art and are disclosed, for example, in U.S. Pat. No. 6,287,360 and U.S. patent application Ser. No. 12/121,504, which are assigned to the assignee of the present invention and incorporated by reference herein; however, it should be understood that embodiments of the present disclosure are not limited to such methods.

[0041] Once the drill bit is formed, the machineable matrix material may be machined to form a threaded connection on the upper portion of the drill bit in order to connect the drill bit to a drill string. As shown in FIGS. 4-5 and 7-8, the threaded connection 128 may be formed on the exterior surface of the upper portion, as shown in FIGS. 4 and 8, or may be formed on the interior surface of the upper portion, as shown in FIGS. 5 and 7. Further, the machineable matrix material used to form the threaded connection may comprise an entire thickness of the upper portion to be machined, as shown in FIGS. 4 and 5, or may comprise only a surface of the upper portion to be machined, as shown in FIGS. 7 and 8. In a preferred embodiment, the machineable matrix material is tungsten powder.

[0042] As shown in FIGS. 9 and 10, a drill bit 110 according to the present disclosure may further include an extra extended gage 140 comprised of a matrix material and formed

integrally with the bit body 112 and upper portion 124 of the bit to form a single piece drill bit 110. The extra extended gage may be functionally equivalent to a sleeve, as conventionally referred to in the art, but differs from the sleeve because it is integral with the bit, with a seamless transition therebetween such that there is no distinction as to where a bit body ends and a sleeve begins. Thus, for the purposes of this application, an extended gage is present when the bit body is continuously extended with a matrix material structure (at substantially the same diameter as the bit body) such that breaker slots are formed therein. The extra extended gage 140 may have a diameter equal to that of the bit body 112 and may include breaker slots 134 and threaded connection 128. Threaded connection 128 may be formed of a machineable matrix material that is different than the matrix material used to form bit body 112, upper portion 124, and extra extended gage 140. The extra extended gage 140 may serve to further stabilize the bit in the wellbore during drilling as well as maintain the selected drilling trajectory. Similar to the bit body 112, the extra extended gage 140 may include various surface features, such as raised ribs or blades 114 and recessed grooves or channels 116, as is known in the art. Grooves 116 may be included to provide pathways for drilling fluid circulation. In one embodiment, blades 114 are present on both the bit body 112 and the extra extended gage 140. In a preferred embodiment, blades 114 are continuous and uninterrupted from cutting face 129 to threaded connection 128.

[0043] Additionally, as is also shown in FIG. 9, the nose region 144 of bit body 112 may include sockets 145 in which preformed impregnated inserts 146 may be affixed. Such inserts 146 may extend along the nose region 144 and into the gage region 138 of the bit body 112. Preformed inserts 146 may include a consolidated or hot pressed insert, such as the type described in U.S. Pat. No. 6,394,202, which is assigned to the present assignee and herein incorporated by reference in its entirety. Similar to other embodiments of impregnated ribs, such preformed inserts may include super abrasive particles dispersed within a continuous matrix material, such as the materials described below in detail. Further, such preformed inserts may be formed from encapsulated particles, as described in U.S. Patent Publication No. 2006/0081402 and U.S. application Ser. Nos. 11/779,083, 11/779,104, and 11/937,969.

[0044] Further, as is also shown in FIG. 9, blades 114 (on both the gage region 138 of the bit body 112 and the extra extended gage 140) may include sockets 135 in which superabrasive wafer elements 136, such as polycrystalline diamond ("PCD") or thermally stable polycrystalline diamond ("TSP"), may be affixed to increase the hardness of such exterior portion of the bit 110. Use of such features (preformed inserts or cutting elements) affixed to the gage region is known in the art, thus, it is within the scope of the present disclosure that such features (or any other features) known in the art of diamond impregnated bits may be used in conjunction with the embodiments of the present disclosure.

[0045] In one embodiment, the bit body, upper portion, and extra extended gage are formed integrally and are comprised of a tungsten-carbide matrix material. In a preferred embodiment, the bit body, upper portion, and extra extended gage may be comprised of a tungsten-carbide matrix material that has been impregnated with superabrasive particles. In another embodiment, the superabrasive particles may be impregnated only into a selected region of the bit, e.g., the blades of the bit body and extra extended gage. In yet another embodiment,

the bit body, upper portion, and extra extended gage may be infiltrated with an infiltration binder.

[0046] Once the drill bit is formed, the machineable matrix material may be machined to form a threaded connection in order to connect the drill bit to a drill string. As shown in FIG. 9, the threaded connection 128 may be formed on the exterior surface of the upper portion 124. Alternatively, as shown in FIG. 10, the threaded connection 128 may be formed on the interior surface of the extra extended gage 140. The machineable matrix material used to form the threaded connection may comprise up to the entire thickness of the part of the bit to be machined. In a preferred embodiment, the machineable matrix material is tungsten.

[0047] The matrix material used to form the bit body and upper portion, and the optional extra extended gage, is preferably formed of a powdered material, for example, a carbide such as tungsten carbide, titanium carbide, or tantalum carbide, which may comprise a somewhat porous matrix. The binder or infiltration material of the present disclosure may comprise a metal or metal alloy, such as cobalt, iron or manganese, or alloys thereof.

[0048] Additionally, the matrix material of the bit body and upper portion, and optionally the extra extended gage, may include a plurality of superabrasive particles impregnated therein, for example, synthetic diamond, natural diamond, boron nitride, or other superhard material. The superabrasive particles may provide greater durability and wear resistance to the matrix material because they may be less likely to be sheared off of the drill bit during drilling. Even as the bit wears during drilling, new superabrasive particles may be continually exposed due to their impregnation throughout the matrix material of the bit, thus prolonging the life of the drill bit.

[0049] Manufacturing of a bit in accordance with the present disclosure may begin with the fabrication of a mold, having the desired body shape and component configuration. Matrix material may be loaded into the mold in the desired locations, i.e., the body and upper portion, and the matrix material may be infiltrated with an infiltration binder. The matrix material of the bit body and upper portion may be further comprised of a plurality of abrasive particles, for example, synthetic diamond, natural diamond, boron nitride, or other superhard material. Additionally, the mold may be fabricated to have a desired body shape that includes an extra extended gage portion wherein the matrix material may be loaded into the body, upper and extra extended gage portions of the mold to integrally form a single piece drill bit in accordance with the present disclosure. In one embodiment, a method of manufacturing a single piece drill bit having a body, an upper portion, and an extra extended gage, includes: loading a matrix material in at least a portion of a mold cavity corresponding to a body portion, an upper portion, and an extra extended gage portion; loading a machineable matrix material in at least a portion of the mold cavity corresponding to the threaded connection; and heating the mold contents to form a single piece matrix drill bit. Once the bit is formed, the machineable matrix material may be machined to form a threaded connection capable of connecting the drill bit to a drill string.

[0050] Additionally, while only a single matrix composition is shown in these embodiments, it is also within the scope of the present disclosure that multiple gradient layers of matrix materials may be used. Thus, the matrix composition may be divided into two or more matrix regions to transition

from harder to tougher materials to minimize issues concerning strength and integrity as well as formation of stresses within the bit. For example, in a particular embodiment, a base or inner region of a bit may be formed of a less hard or tougher matrix material than an outer region so as to provide greater support and durability to the bit, and reduce or prevent the incidents of bit breakage, while also achieving necessary wear resistance to the exterior surfaces. An example of such a bit is described in U.S. patent application Ser. No. 12/121,575, which is assigned to the present assignee and herein incorporated by reference in its entirety.

[0051] Advantageously, embodiments of the present disclosure may provide at least one of the following. The use of a single piece drill bit formed entirely of matrix material may allow for greater wear resistance as well as fracture resistance by minimizing stresses in the matrix material, thus yielding a tougher bit. Specifically, the use of a single piece drill bit formed entirely of impregnated matrix material such that the abrasive particles are present throughout the entire bit may provide a bit suitable for drilling very hard or abrasive formations as well as capable of tolerating high rotational speeds. Additionally, by manufacturing a matrix drill bit as a single piece, the stepwise manufacturing process is eliminated. That is, it is no longer necessary to first produce a bit body with a steel shank protruding therefrom, nor is it necessary to later weld the steel upper portion and optional sleeve portion to the bit body. Notably, the need to use steel is completely eliminated, resulting in a drill bit formed from a one-step manufacturing process and having continuous composition and uninterrupted transition from the bit body to the upper portion or extra extended gage. These advantages may lead to improved drill bits in terms of longer bit life as well as presenting fewer manufacturing concerns (welding steps and potential for cracking during manufacture).

[0052] While the invention has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments can be devised which do not depart from the scope of the invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the attached claims.

What is claimed:

1. A drill bit, comprising:
a bit body and an upper portion;
wherein the bit body and the upper portion are comprised of a matrix material; and
wherein the upper portion includes a threaded connection comprised of a machineable matrix material.
2. The drill bit of claim 1, wherein the bit body and upper portion are further comprised of a plurality of abrasive particles.
3. The drill bit of claim 2, wherein the abrasive particles comprise at least one of synthetic diamond, natural diamond, or boron nitride.
4. The drill bit of claim 1, further comprising:
an extra extended gage, wherein the extra extended gage is comprised of a matrix material.
5. The drill bit of claim 4, wherein the extra extended gage is further comprised of a plurality of abrasive particles.
6. The drill bit of claim 4, wherein the extra extended gage further comprises a plurality of gage protection inserts.
7. The drill bit of claim 6, wherein the inserts comprise at least one of synthetic diamond, natural diamond, or boron nitride.

8. The drill bit of claim 1, wherein the matrix material is tungsten carbide.

9. The drill bit of claim 1, wherein the machineable matrix material is tungsten.

10. A drill bit, comprising:

a bit body, an upper portion, and an extra extended gage;
wherein the bit body, the upper portion, and the extra extended gage are comprised of a matrix material; and
wherein the upper portion includes a threaded connection comprised of a machineable matrix material.

11. The drill bit of claim 10, wherein the bit body, the upper portion, and the extra extended gage are further comprised of a plurality of abrasive particles.

12. The drill bit of claim 11, wherein the abrasive particles comprise at least one of synthetic diamond, natural diamond, or boron nitride.

13. The drill bit of claim 10, wherein the extra extended gage further comprises a plurality of gage protection inserts.

14. The drill bit of claim 13, wherein the inserts comprise at least one of synthetic diamond, natural diamond, or boron nitride.

15. The drill bit of claim 10, wherein the matrix material is tungsten carbide.

16. The drill bit of claim 10, wherein the machineable matrix material is tungsten.

17. A drill bit, comprising:

a bit body and an upper portion;
wherein the bit body and the upper portion are comprised of a matrix material;
wherein the upper portion includes a threaded connection comprised of a machineable matrix material; and
wherein there is an uninterrupted transition between the bit body and the upper portion.

18. The drill bit of claim 17, wherein the bit body and upper portion are further comprised of a plurality of abrasive particles.

19. The drill bit of claim 18, wherein the abrasive particles comprise at least one of synthetic diamond, natural diamond, or boron nitride.

20. The drill bit of claim 17, further comprising:

an extra extended gage, wherein the extra extended gage is comprised of a matrix material.

21. The drill bit of claim 20, wherein the extra extended gage is further comprised of a plurality of abrasive particles.

22. The drill bit of claim 20, wherein the extra extended gage further comprises a plurality of gage protection inserts.

23. The drill bit of claim 22, wherein the inserts comprise at least one of synthetic diamond, natural diamond, or boron nitride.

24. The drill bit of claim 20, wherein there is an uninterrupted transition between the bit body and the extra extended gage.

25. The drill bit of claim 17, wherein the matrix material is tungsten carbide.

26. The drill bit of claim 17, wherein the machineable matrix material is tungsten.

27. A method of manufacturing a single piece matrix drill bit having a body and an upper portion, comprising:

loading a matrix material in at least a portion of a mold cavity corresponding to a body portion and an upper portion;

loading a machineable matrix material in at least a portion of the mold cavity corresponding to a threaded connection; and heating the mold contents to form a single piece matrix drill bit.

28. The method of claim **27**, further comprising: machining the machineable matrix material to form a threaded connection for connecting the single piece matrix drill bit to a drill string.

29. The method of claim **27**, further comprising: loading a plurality of abrasive particles in at least a portion of the mold cavity.

30. The method of claim **27**, further comprising: infiltrating the mold contents with an infiltrating binder prior to heating the mold contents.

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