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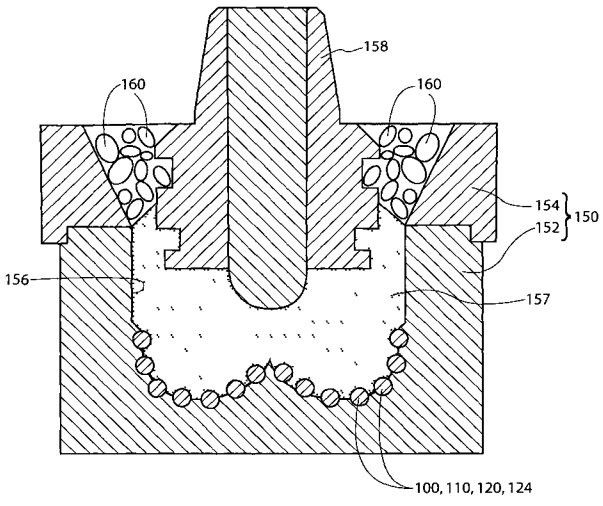
(54) Title: DISPLACEMENT MEMBERS AND METHODS OF USING SUCH DISPLACEMENT MEMBERS TO FORM BIT BODIES OF EARTH BORING ROTARY DRILLS BITS



(57) Abstract: Displacement members (68,100,110,120,124) for use in forming a bit body of an earth-boring rotary drill bit include a body having an exterior surface, at least a portion of which is configured to define at least one surface of the bit body as the bit body is formed around the displacement member. In some embodiments, the body may be hollow and/or porous. Methods for forming eai-th-boring rotary drill, bits include positioning such a displacement member in a mold (62,150) and forming a bit body around the displacement member in the mold. Additional methods include pressing a plurality of particles to form a body, forming at least one recess in the body, positioning such a displacement member in the recess, and sintering the body to form a bit body.

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AMENDED CLAIMS
received by the International Bureau on 28 July 2008 (28.07.08);
claims 1 and 9 amended, remaining claims unchanged.

1. An earth-boring rotary drill bit comprising a bit body attached to a shank, the bit body and the shank having abutting surfaces concentric to an interface axis offset from a longitudinal and rotational axis of the drill bit.

2. The rotary drill bit of claim 1, wherein at least a portion of each of the abutting surfaces has a generally cylindrical shape.

3. The rotary drill bit of claim 1, wherein at least of portion of each of the abutting surfaces has a generally frustoconical shape.

4. The rotary drill bit of any one of claims 1 through 3, wherein the bit body comprises a connection portion attached to the shank, the connection portion of the bit body predominantly comprising a particle-matrix composite material, the particle-matrix composite material comprising a plurality of hard particles dispersed throughout a matrix material, the hard particles comprising a material selected from diamond, boron carbide, boron nitride, aluminum nitride, and carbides or borides of the group consisting of W, Ti, Mo, Nb, V, Hf, Zr, Si, Ta, and Cr, the matrix material selected from the group consisting of iron-based alloys, nickel-based alloys, cobalt-based alloys, titanium-based alloys; aluminum-based alloys, iron and nickel-based alloys, iron and cobalt-based alloys, and nickel and cobalt-based alloys.

5. The rotary drill bit of any one of claims 1 through 4, wherein a shape of one of the abutting surfaces defines at least one protrusion, and wherein a shape of another of the abutting surfaces defines at least one recess, the at least one protrusion disposed at least partially within the at least one recess.

6. The rotary drill bit of claim 5, wherein the at least one protrusion projects into the at least one recess in a generally lateral direction relative to a longitudinal axis of the drill bit.

7. The rotary drill bit of any one of claims 1 through 6, wherein the shank comprises a male connection portion and the bit body comprises a female connection portion configured to receive the male connection portion of the shank at least partially therein, an exterior surface of the male connection portion and an interior surface of the female connection portion defining the abutting surfaces.

8. The rotary drill bit of any one of claims 1 through 6, wherein the bit body comprises a male connection portion and the shank comprises a female connection portion configured to receive the male connection portion of the bit body at least partially therein, an exterior surface of the male connection portion and an interior surface of the female connection portion defining the abutting surfaces.

9. The rotary drill bit of any one of claims 1 through 8, wherein the abutting surfaces are free of threads.

10. The rotary drill bit of any one of claims 1 through 9, wherein the abutting surfaces are substantially smooth.

11. The rotary drill bit of any one of claims 1 through 10, further comprising at least one of a weld and a brazing material at an interface between the bit body and the shank.

12. The rotary drill bit of any one of claims 1 through 11, further comprising at least one cutting element secured to a face of the drill bit.

13. A method of attaching a shank and a bit body of an earth-boring rotary drill bit, the method comprising:

abutting at least one surface of a shank against at least one surface of a bit body of an earth-boring rotary drill bit; and

causing the abutting surfaces to be concentric to an interface axis offset from a longitudinal and rotational axis of the drill bit

14. The method of claim 13, further comprising:
forming at least one protrusion in one of the abutting surfaces;
forming at least one recess in another of the abutting surfaces; and
inserting the at least one protrusion at least partially into the at least one recess.

15. The method of claim 14, wherein forming at least one protrusion in one of the abutting surfaces comprises forming at least one protrusion projecting in a generally lateral direction relative to the longitudinal axis of the drill bit in one of the abutting surfaces.

16. The method of any one of claims 13 through 15, further comprising:
forming a male connection portion on the bit body;
forming a female connection portion on the shank;
inserting the male connection portion of the bit body into the female connection portion of the shank;
causing an exterior surface of the male connection portion to abut against an interior surface of the female connection portion; and
causing the abutting exterior surface of the male connection portion and interior surface of the female connection portion to be concentric to the interface axis.

17. The method of claim 16, further comprising forming at least a portion of each of the exterior surface of the male connection portion and the interior surface of the female connection portion to have a generally frustoconical shape.

18. The method of claim 16, further comprising forming at least a portion of each of the exterior surface of the male connection portion and the interior surface of the female connection portion to have a generally cylindrical shape.

19. The method of any one of claims 13 through 18, further comprising providing at least one of a weld and a brazing material at an interface between the bit body and the shank.

20, The method of any one of claims 13 through 19, further comprising securing at least one cutting element to a face of the rotary drill bit.

STATEMENT UNDER ARTICLE 19 (1)

Applicant has amended independent claims 1 and 9. In particular, claim 1 has been amended to recite that the body of the displacement member "does not form a portion or a component of the earth-boring rotary drill bit," and claim 9 has been amended to recite the action of "removing the body of the at least one displacement member from the bit body of the earth-boring rotary drill bit." The amendments have no impact on the description and the drawings.