



- (51) **International Patent Classification:**  
*E21B 17/04* (2006.01)    *E21B 10/46* (2006.01)  
*E21B 17/02* (2006.01)
- (21) **International Application Number:**  
PCT/US2012/035388
- (22) **International Filing Date:**  
27 April 2012 (27.04.2012)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**  
13/098,158    29 April 2011 (29.04.2011)    US
- (71) **Applicant (for all designated States except US):** **BAKER HUGHES INCORPORATED** [US/US]; P.O. Box 4740, Houston, TX 77210-4740 (US).
- (72) **Inventors; and**
- (75) **Inventors/Applicants (for US only):** **LIN, Chih** [—/US]; 2206 Pincher Creek Drive, Spring, TX 77386 (US). **SCOTT, Danny, E.** [US/US]; 3015 Poe Drive, Montgomery, TX 77356 (US).
- (74) **Agents:** **WELBORN, Brian, S.** et al.; Intellectual Property Counsel, Baker Hughes Incorporated, P.O. Box 4740, Houston, TX 77210-4740 (US).

(81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States (unless otherwise indicated, for every kind of regional protection available):** ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Declarations under Rule 4.17:**

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

[Continued on next page]

(54) **Title:** DOWNHOLE TOOLS HAVING MECHANICAL JOINTS WITH ENHANCED SURFACES, AND RELATED METHODS

(57) **Abstract:** A downhole tool may comprise a mechanical joint and a diamond-like coating over at least a portion of a surface of at least one component of the mechanical joint, the diamond-like coating having a thickness greater than 10 micrometers. Methods of manufacturing a mechanical joint of a downhole tool may comprise disposing a diamond-like coating on at least a portion of a surface of a component of the mechanical joint of the downhole tool to a thickness of at least 10 microns and at a temperature less than about 200°C.

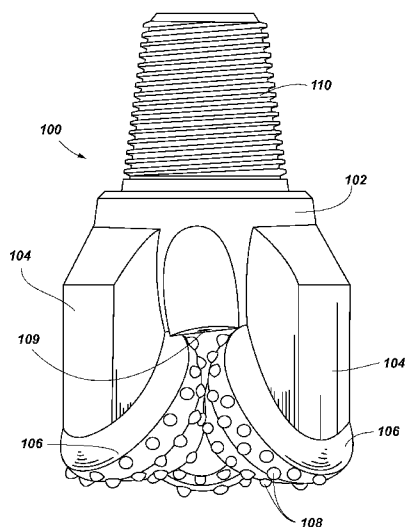


FIG. 1



**Published:**

**(88) Date of publication of the international search report:**

27 December 2012

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

**A. CLASSIFICATION OF SUBJECT MATTER***E21B 17/04(2006.01)i, E21B 17/02(2006.01)i, E21B 10/46(2006.01)i*

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

E21B 17/04; F16J 15/34; E21B 10/08; E21B 10/00; E21B 10/25; F16J 15/16; B23K 31/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) &amp; Keywords: bit, diamond, coating

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009-0321146 A1 (DICK AARON J. et al.) 31 December 2009 See abstract and paragraphs 27,28,33-35,37,39	1,2,4-19
A	See abstract and figure 1	3,20
A	US 2004-0031624 A1 (DANNY E. SCOTT et al.) 19 February 2004 See abstract and paragraphs 18,23 and figure 2	1-20
A	US 2011-0048810 A1 (LIN CHIH et al.) 03 March 2011 See abstract and claim 1	1-20
A	US 06045029A A (SCOTT; DANNY EUGENE) 04 April 2000 See abstract and column 5	1-20

 Further documents are listed in the continuation of Box C. See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

25 OCTOBER 2012 (25.10.2012)

Date of mailing of the international search report

**29 OCTOBER 2012 (29.10.2012)**

Name and mailing address of the ISA/KR

Korean Intellectual Property Office  
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan  
City, 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

LEE, Won Jae

Telephone No. 82-42-481-5512



**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2012/035388**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009-0321146 A1	31.12.2009	EP 2176498 A2	21.04.2010
		EP 2271816 A1	12.01.2011
		EP 2475836 A2	18.07.2012
		US 2009-0014217 A1	15.01.2009
		US 2009-0194339 A1	06.08.2009
		US 8196682 B2	12.06.2012
		WO 2009-012196 A2	22.01.2009
		WO 2009-012196 A3	22.01.2009
		WO 2009-012196 A4	22.01.2009
		WO 2009-124172 A1	08.10.2009
		WO 2011-031636 A2	17.03.2011
		WO 2011-031636 A3	17.03.2011
		WO 2011-031636 A3	09.06.2011
		US 2004-0031624 A1	19.02.2004
GB 2392181 A	25.02.2004		
GB 2392181 B	30.08.2006		
IT T020030642A1	20.02.2004		
US 2004-0031625 A1	19.02.2004		
US 7234541 B2	26.06.2007		
US 2011-0048810 A1	03.03.2011	CA 2771227 A1	10.03.2011
		EP 2470743 A2	04.07.2012
		WO 2011-028427 A2	10.03.2011
		WO 2011-028427 A3	10.03.2011
		WO 2011-028427 A3	26.05.2011
US 06045029A A	04.04.2000	GB 2278865 A	14.12.1994
		GB 2328962 A	10.03.1999
		US 06045029A A	04.04.2000
		US 06068070A A	30.05.2000
		US 6209185 B1	03.04.2001