(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
6 October 2011 (06.10.2011)

PCT

(10) International Publication Number
WO 2011/123628 A3

(51) International Patent Classification:
B23K 20/12 (2006.01) *E21B 10/26* (2006.01)

(21) International Application Number:
PCT/US2011/030705

(22) International Filing Date:
31 March 2011 (31.03.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/319,850 31 March 2010 (31.03.2010) US
61/393,605 15 October 2010 (15.10.2010) US

(71) Applicant *(for all designated States except US)*: **SMITH INTERNATIONAL, INC.** [US/US]; 1310 Rankin Rd., Houston, Texas 77073 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **DAVIS, Richard** [US/US]; 2314 Summer Breeze Lane, Houston, Texas 77067 (US).

(74) Agent: **NOAH, Wesley, T.**; Smith International, Inc. - Patent Services, 1310 Rankin Rd., Houston, Texas 77073 (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, RO, RS, RU, 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, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, 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).

Published:

— *with international search report (Art. 21(3))*

(88) Date of publication of the international search report:
29 March 2012

(54) Title: ARTICLE OF MANUFACTURE HAVING A SUB-SURFACE FRICTION STIR WELDED CHANNEL

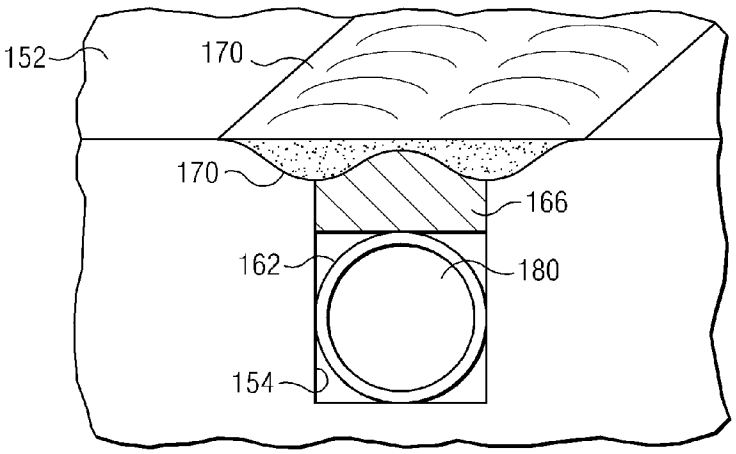

FIG. 3G

(57) Abstract: A method for routing an electrical conductor through a sub-surface channel in substantially any suitable metallic article of manufacture includes friction stir welding a cap in a groove formed in a surface of the article so as to form the sub-surface channel. An electrical conductor is then routed through the channel. The channel may further include a substantially tubular conduit formed therein with the electrical conductor being routed through the conduit. The friction stir weld zone formed during friction stir welding is generally harder and more wear resistant that the article body.

WO 2011/123628 A3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/030705

A. CLASSIFICATION OF SUBJECT MATTER

B23K 20/12(2006.01)i, E21B 10/26(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)
B23K 20/12; E21B 43/01

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) & Keywords: friction, weld, cap, groove, tubular conduit, route

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-2001-0087185 A (HITACHI, LTD.) 15 September 2001 See Abstract; Claim 1 and Figure 6	1-24
A	US 2008-0115971 A1 (KELLEHER JOSEPH PATRICK et al.) 22 May 2008 See Abstract and Figure 1	1-24
A	JP 2004-034140 A (HONDA MOTOR CO. LTD. et al.) 05 February 2004 See Abstract and Figure 1	1-24

☐ 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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 DECEMBER 2011 (27.12.2011)	**27 DECEMBER 2011 (27.12.2011)**

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
Government Complex-Daejeon, 189 Cheongsa-ro,
Seo-gu, Daejeon 302-701, Republic of Korea
Facsimile No. 82-42-472-7140

Authorized officer
Hong, Sung Ui
Telephone No. 82-42-481-5524

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2011/030705

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 10-2001-0087185 A	15.09.2001	AU 2001-18348 A1	13.09.2001
		AU 2001-18348 B2	09.01.2003
		CN 1192846 C0	16.03.2005
		CN 1312141 A0	12.09.2001
		CN 1583344 A	23.02.2005
		CN 1583345 A	23.02.2005
		CN 1583345 C0	21.02.2007
		EP 1132167 A2	12.09.2001
		EP 1132167 A3	05.12.2001
		EP 1132167 B1	28.04.2004
		EP 1293288 A1	19.03.2003
		JP 03-575748 B2	13.10.2004
		JP 2001-321966 A	20.11.2001
		TW 473411 A	21.01.2002
		US 2001-0019073 A1	06.09.2001
		US 2002-0079347 A1	27.06.2002
		US 2002-0079352 A1	27.06.2002
		US 2003-0205608 A1	06.11.2003
		US 6722555 B2	20.04.2004
		US 6786388 B2	07.09.2004
US 2008-0115971 A1	22.05.2008	AU 2005-287856 A1	30.03.2006
		AU 2005-287856 B2	04.03.2010
		BR PI0515492A	29.07.2008
		CA 2580091 A1	30.03.2006
		EP 1792048 A1	06.06.2007
		JP 2008-513630 A	01.05.2008
		KR 10-2007-0060103 A	12.06.2007
		NO20071383A	20.06.2007
		WO 2006-032076 A1	30.03.2006
JP 2004-034140 A	05.02.2004	AU 2003-281364 A8	23.01.2004
		CN 1332781 C0	22.08.2007
		CN 1668412 A	14.09.2005
		CN 1668412 C0	22.08.2007
		GB 2405609 A	09.03.2005
		JP 03-931119 B2	13.06.2007
		KR 10-1032241 B1	02.05.2011
		US 2006-0151576 A1	13.07.2006
		WO 2004-004962 A1	15.01.2004