

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
5 January 2012 (05.01.2012)

PCT

(10) International Publication Number
WO 2012/003196 A3

- (51) **International Patent Classification:**
E21B 33/13 (2006.01) *E21B 33/138* (2006.01)
- (21) **International Application Number:**
PCT/US201 1/042278
- (22) **International Filing Date:**
29 June 2011 (29.06.2011)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
12/830,039 2 July 2010 (02.07.2010) US
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- (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).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(H))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(Hi))

Published:

- 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))

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

1 March 2012

(54) **Title:** SHAPE MEMORY CEMENT ANNULUS GAS MIGRATION PREVENTION APPARATUS

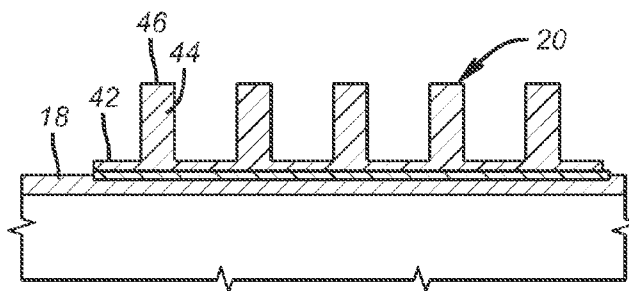


FIG. 5

(57) **Abstract:** The annular space around a tubular string has a shape memory material that is in a low profile configuration for run in. After the desired position is obtained and the annulus has cement delivered to fill the annular space, the shape memory device is triggered to revert to an original shape that spans the annulus to seal the tubular and the wellbore sides of the annular space against gas migration through the cement. The structures can have varying run in shapes and can also have original shapes that when the material is triggered will act to displace cement to enhance its compaction on the tubular or the wellbore wall. Combinations of shape memory alloys and polymers are also contemplated to enhance the seal against gas migration.



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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/042278**A. CLASSIFICATION OF SUBJECT MATTER*****E21B 33/13(2006.01)i, E21B 33/138(2006.01)1***

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 33/13; E21B 33/00; E21B 43/12; E21B 43/04

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:gas migration, span, dimension, shape memory material, shape memory shape, shape memory alloy

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2001-0050169 A1 (PHILIP D. NYUYEN et al.) 13 December 2001 See the whole document.	1-27
A	US 04463807A A (STODDARD; XERXES T. et al.) 07 August 1984 See the whole document.	1-27
A	US 05390742A A (DINES; CHRISTOPHER A. et al.) 21 February 1995 See the whole document.	1-27
A	US 2007-0277979 A1 (HALLIBURTON ENERGY SERVICES) 06 December 2007 See the whole document.	1-27

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

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Date of the actual completion of the international search

06 JANUARY 2012 (06.01.2012)

Date of mailing of the international search report

09 JANUARY 2012 (09.01.2012)

Name and mailing address of the ISA/KR

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Government Complex-Daejeon, 189 Cheongsa-ro,
Seo-gu, Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

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Telephone No. 82-42-481-5520



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US201 1/042278

Patent document cited in search report	Publication date	Patent family member(s)	Publication date		
US 200 1-0050 169 A1	13 . 12 .200 1	AU 1998-89294 B2	13 . 09 . 200 1		
		AU 1998-89295 B2	27 . 09 . 200 1		
		AU 1998-89295 C	06 . 05 . 1999		
		AU 2000-48862 A 1	0 1 . 02 . 200 1		
		AU 200 1- 18407 A 1	13 . 09 . 200 1		
		AU 200 1- 18407 B2	04 . 03 . 2004		
		AU 7389 14 C	11 . 04 . 2002		
		AU 8929598 A	06 . 05 . 1999		
		CA 2250593 A1	16 . 04 . 1999		
		CA 23 14392 A1	27 . 0 1 . 200 1		
		CA 2339531 A1	07 . 09 . 200 1		
		EP 0909874 A2	2 1 . 04 . 1999		
		EP 0909874 A3	27 . 10 . 1999		
		EP 0909875 A2	2 1 . 04 . 1999		
		EP 0909875 A3	27 . 10 . 1999		
		EP 1132571 A 1	12 . 09 . 200 1		
		N0984802A	19 . 04 . 1999		
		N0984802D0	15 . 10 . 1998		
		US 05934376A A	10 . 08 . 1999		
		US 06003600A A	2 1 . 12 . 1999		
		US 2002-0066560 A1	06 . 06 . 2002		
		US 2002-00700 19 A1	13 . 06 . 2002		
		US 2002-0104650 A1	08 . 08 . 2002		
		US 2002-016666 1 A1	14 . 11 . 2002		
		US 2003-00753 15 A1	24 . 04 . 2003		
		US 6427775 B1	06 . 08 . 2002		
		US 6446722 B2	10 . 09 . 2002		
		US 648 1494 B1	19 . 11 . 2002		
		US 6540022 B2	0 1 . 04 . 2003		
		US 6557635 B2	06 . 05 . 2003		
		US 657 1872 B2	03 . 06 . 2003		
		us 6755245 B2	29 . 06 . 2004		
		US 04463807A A	07 . 08 . 1984	us 04437520A A	20 . 03 . 1984
				us 04448252A A	15 . 05 . 1984
us 0446540 1A A	14 . 08 . 1984				
US 05390742A A	2 1 . 02 . 1995	GB 227 113 1 A	06 . 04 . 1994		
		GB 2276648 A	05 . 10 . 1994		
		US 0536 1843A A	08 . 11 . 1994		
US 2007-0277979 A1	06 . 12 . 2007	US 766 1481 B2	16 . 02 . 2010		