



- (51) **International Patent Classification:**  
*E21B 43/26* (2006.01)    *E21B 43/16* (2006.01)
- (21) **International Application Number:**  
PCT/US2013/036176
- (22) **International Filing Date:**  
11 April 2013 (11.04.2013)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**  
61/623,515    12 April 2012 (12.04.2012)    US
- (71) **Applicant:** **BAKER HUGHES INCORPORATED**  
[US/US]; 2929 Allen Parkway, Suite 2100, Houston, TX 77019 (US).
- (72) **Inventors:** **CREWS, James**; 5206 Sunshine Point, Willis, TX 77318 (US). **HUANG, Tianping**; 19827 Lajuana Lane, Spring, TX 77388 (US).
- (74) **Agent:** **JONES, John, Wilson**; 2777 Allen Parkway, Suite 1000, Houston, TX 77019 (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, BN, 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, PA, 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.

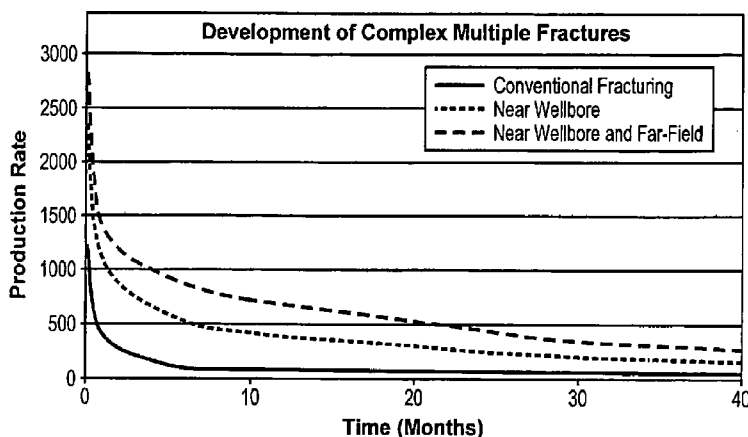
- (84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, 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).

**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:**  
9 January 2014

(54) **Title:** METHOD OF INCREASING THE PERMEABILITY OF A SUBTERRANEAN FORMATION BY CREATING A MULTIPLE FRACTURE NETWORK



**FIG. 2**

(57) **Abstract:** The stimulated rock volume (SRV) of a subterranean formation may be increased by pumping viscous fracturing fluid into the formation in a first stage to create or enlarge a primary fracture, decreasing the pumping in order for the fluid to increase in viscosity within the primary fracture, and then continuing to pump viscous fluid into the formation in a second stage. The fluid pumped into the second stage is diverted away from the primary fracture and a secondary fracture is created. The directional orientation of the secondary fracture is distinct from the directional orientation of the primary fracture. The fluid of the first stage may contain a viscosifying polymer or viscoelastic surfactant or may be slickwater.

WO 2013/155307 A3

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2013/036176

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC(8) - E21B 43/26 (2013.01) USPC - 166/308.1 According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) IPC(8) - C09K 8/60, 8/68; E21B 43/25, 43/26 (2013.01) USPC - 166/280.2, 300, 305.1, 307, 308.1, 308.2; 175/65, 72; 507/211, 219, 244; 523/130 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched CPC - C09K 2208/26, 2208/30 (2013.01) Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PatBase, Google Patents		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,472,050 A (RHOTEN et al) 05 December 1995 (05.12.1995) entire document	1-33
Y	US 2004/0102330 A1 (ZHOU et al) 27 May 2004 (27.05.2004) entire document	1-33
Y	WO 2011/145966 A1 (BARMATOV et al) 24 November 2011 (24.11.2011) entire document	7, 13-15, 19-24, 33
Y	US 2007/0151726 A1 (CREWS et al) 05 July 2007 (05.07.2007) entire document	9-11
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/>		
* 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 another 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 24 October 2013		Date of mailing of the international search report <b>12 NOV 2013</b>
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201		Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774