

**Title:** SYSTEM AND METHOD FOR USING PRESSURE PULSES FOR FRACTURE STIMULATION PERFORMANCE ENHANCEMENT AND EVALUATION

**Abstract:** A system and method of applying periodic energy pulses to a portion of a wellbore, fracture(s), and/or near wellbore to interrogate and/or stimulate at least a portion of the wellbore, fracture(s), and/or near wellbore. The system includes a downhole device that is configured to deliver periodic energy pulses to a portion of the wellbore. The downhole device may deliver various energy pulses such as pressure waves, seismic waves, and/or acoustic waves. Sensors may determine properties of a portion of the wellbore and/or fracture based on energy pulses detected within the wellbore. The sensors may be connected to the downhole tool, may be positioned within the wellbore, and/or may be positioned at the surface. The magnitude and/or frequency of the periodic energy pulses may be varied to change the stimulation and/or interrogation of the wellbore.

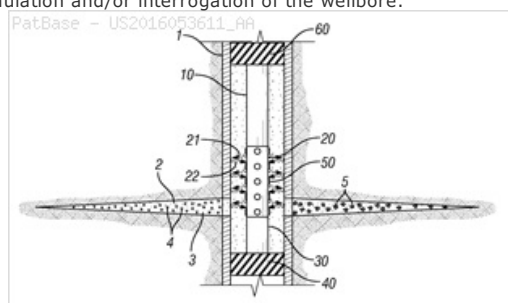
### Classifications:

**International (IPC 8-9):** E21B28/00 E21B41/00 E21B43/25 E21B43/26  
E21B43/263 E21B43/267 E21B47/085 E21B49/00 G01V1/40  
G1V1/40 (Advanced/Invention);

E21B43/26 E21B43/267 G01V1/52 (Advanced/Non-invention)

**CPC:** E21B28/00 E21B43/263 E21B43/267 E21B43/26 E21B43/25

**US:** 166/113 166/244.1 166/250.01 166/250.1 166/308.1 166/63



**Family:**

| Publication number | Publication date | Application number | Application date |
|--------------------|------------------|--------------------|------------------|
| AR101609 AA        | 20161228         | AR2015P102696      | 20150821         |
| CA2958765 AA       | 20170215         | CA20152958765      | 20150819         |
| CO20170002313 A2   | 20170630         | CO20170002313      | 20170308         |
| EP3183420 A1       | 20170628         | EP20150834278      | 20150819         |
| EP3183420 A4       | 20180801         | EP20150834278      | 20150819         |
| IN201717009071 A   | 20170818         | IN201717009071     | 20170316         |
| MX2017001975 A1    | 20170504         | MX20170001975      | 20150819         |
| NO20170279 A       | 20170227         | NO20170000279      | 20170227         |
| US2016053611 AA    | 20160225         | US20150828902      | 20150818         |
| WO16028886 A1      | 20160225         | WO2015US45883      | 20150819         |

**Priority:**

US20140040508P 20140822      US20150828902 20150818      WO2015US45883 20150819

**Probable Assignee:** BAKER HUGHES A GE CO LLC

**Assignee(s):** (std): BAKER HUGHES INC

**Assignee(s):** LIVESCU SILVIU ; MOOS DANIEL ; BAKER HUGHES A GE CO LLC

**Inventor(s):** (std): LIVESCU SILVIU ; MOOS DANIEL ; DANIEL MOOS ; SILVIU LIVESCU

**Agent(s):** SIM AND MCBURNEY; MARKS AND CLERK; CAROLINA MERCEDES DAZA MONTALVO; LAMBACHER MICHAEL; JOHNSON REXFORD ET AL

**Designated states:** AE AG AL AM AO AT AU AZ BA BB BE BF BG BH BJ BN BR BW BY BZ CA CF CG CH CI CL CM CN CO CR CU  
CY CZ DE DK DM DO DZ EC EE EG ES FI FR GA GB GD GE GH GM GN GQ GR GT GW HN HR HU ID IE IL IN  
IR IS IT JP KE KG KM KN KP KR KZ LA LC LI LK LR LS LT LU LV LY MA MC MD ME MG MK ML MN MR MT MW  
MX MY MZ NA NE NG NI NL NO NZ OM PA PE PG PH PL PT QA SA SC SD SE SG SI SK SL SM  
SN ST SV SY SZ TD TG TH TJ TM TN TR TT TZ UA UG US UZ VC VN ZA ZM ZW

**Title:** DETERMINING CHARACTERISTICS OF A FRACTURE

**Abstract:** A system for determining characteristics of a fracture can include electromagnetic sensors and a pressure sensor. The electromagnetic sensors can be positioned in a wellbore having a perforation to determine an amount of flow traversing the perforation into a fracture zone. The electromagnetic sensors can include a first electromagnetic sensor positioned in a first segment of the wellbore that is closer than the perforation to a surface of the wellbore. The electromagnetic sensors can also include a second electromagnetic sensor that is positioned in a second segment of the wellbore that is farther than the perforation from the surface of the wellbore. The pressure sensor can be positioned in the wellbore for detecting a pressure wave generated by the flow. The pressure wave and the amount of the flow traversing the perforation can be used to determine a characteristic of a fracture in the fracture zone.

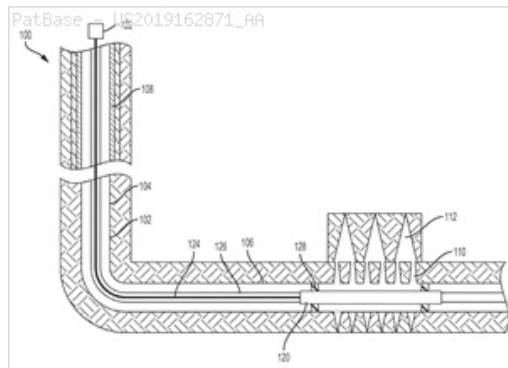
### Classifications:

**International (IPC 8-9):** E21B43/267 E21B47/00 E21B47/06 G01V3/18

G01V3/26 G01V3/30 (Advanced/Invention);

G01V3/28 G01V3/30 (Advanced/Invention),  
E21B47/00 E21B47/06 (Advanced/Non-invention)

**CPC:** G01V3/30 E21B43/267 E21B47/00 E21B47/06 E21B47/122  
G01V3/26



**Family:**

| Publication number | Publication date | Application number | Application date |
|--------------------|------------------|--------------------|------------------|
| CA3030117 AA       | 20190107         | CA20163030117      | 20160930         |
| GB201902047 A0     | 20190403         | GB20190002047      | 20160930         |
| GB2567382 A1       | 20190410         | GB20190002047      | 20160930         |
| NO20190232 A       | 20190214         | NO20190000232      | 20190214         |
| US2019162871 AA    | 20190530         | US20160323129      | 20160930         |
| WO18063328 A1      | 20180405         | WO2016US54786      | 20160930         |

**Priority:**

US20160323129 20160930 WO2016US54786 20160930

**Probable Assignee:** HALLIBURTON CO

**Assignee(s):** (std): HALLIBURTON CO ; HALLIBURTON ENERGY SERVICES INC

**Assignee(s):** SURJAATMADJA JIM BASUKI ; LEWIS BRYAN JOHN ; CHI WEI MING ; DELL DUSTIN MYRON ; EL DEMERDASH AHMED

**Inventor(s):** (std): DEMERDASH AHMED EL ; DUSTIN MYRON DELL ; BRYAN JOHN LEWIS ; AHMED EL DEMERDASH ; WEI MING CHI ; JIM BASUKI SURJAATMADJA ; LEWIS BRYAN JOHN ; SURJAATMADJA JIM BASUKI ; CHI WEI MING ; EL DEMERDASH AHMED ; DELL DUSTIN MYRON

**Agent(s):** PARLEE MCLAWS LLP; RUSSELL DEAN W ET AL

**Designated states:** AE AG AL AM AO AT AU AZ BA BB BE BF BG BH BJ BN BR BW BY BZ CA CF CG CH CI CL CM CN CO CR CU CY CZ DE DJ DK DM DO DZ EC EE EG ES FI FR GA GB GD GE GH GM GN GQ GR GT GW HN HR HU ID IE IL IN IR IS IT JP KE KG KM KN KP KR KW KZ LA LC LK LR LS LT LU LV LY MA MC MD ME MG MK ML MN MR MT MW MX MY MZ NA NE NG NI NL NO NZ OM PA PE PG PH PL PT QA RO RS RU RW SA SC SD SE SG SI SK SL SM SN ST SV SY SZ TD TG TH TJ TM TN TR TT TZ UA UG US UZ VC VN ZA ZM ZW

**3) Family number: 31170137 (US2004226715A)**

© PatBase

**Title:** MAPPING FRACTURE DIMENSIONS

**Abstract:** Hydraulic fracture dimensions and, optionally, fracture closure pressure and time are determined by adding particulate matter that discharges to create an acoustic signal to the proppant, allowing the particulate matter to discharge, and detecting the acoustic signal with geophones or accelerometers. The particulate matter may be spheres or fibers. The discharge may be explosion, implosion, detonation, or rapid combustion or ignition. The discharge may be triggered by fracture closure or by chemical reaction.

**Classifications:**

**International (IPC 8-9):** E21B43/26 E21B43/263 E21B43/267

E21B47/00 (Advanced/Invention);

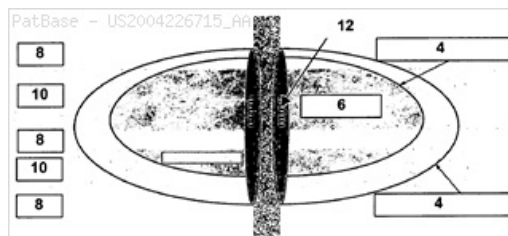
E21B43/25 E21B47/00 (Core/Invention)

**International (IPC 1-7):** E21B43/26 E21B47/00

**CPC:** E21B47/00

**European:** E21B47/00

**US:** 166/250.1 166/250.100P 166/271 166/280.2 166/280.200S 166/299 166/308.1 166/308.100S



**Family:**

| Publication number | Publication date | Application number | Application date |
|--------------------|------------------|--------------------|------------------|
| CA2522679 AA       | 20051017         | CA20042522679      | 20040416         |
| CA2522679 C        | 20091117         | CA20042522679      | 20040416         |
| EA007449 B1        | 20061027         | EA20050001629      | 20040416         |
| EA200501629 A1     | 20060224         | EA20050001629      | 20040416         |
| MXPA05010907 A1    | 20060321         | MX2005PA10907      | 20040416         |
| US2004226715 AA    | 20041118         | US20040824079      | 20040414         |
| US7134492 BB       | 20061114         | US20040824079      | 20040414         |
| WO04092540 A1      | 20041028         | WO2004IB01158      | 20040416         |

**Priority:**

US20030463868P 20030418 US20040824079 20040414 WO2004IB01158 20040416

**Probable Assignee:** SCHLUMBERGER TECHNOLOGY CORP

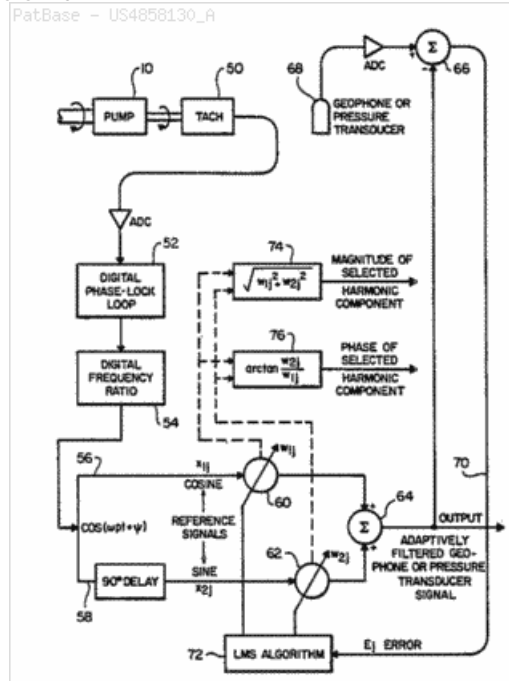
**Assignee(s):** (std): BABOUR KAMAL ; BESSON CHRISTIAN ; DESROCHES JEAN ; GZARA KAIS ; SCHLUMBERGER CA LTD ;

**Assignee(s):** SCHLUMBERGER HOLDINGS LTD ; SERVICES PETROLIERS SCHLUMBERGER ; SOFITECH N V  
**Inventor(s)** (std): BABOUR KAMAL ; BESSON CHRISTIAN ; DESROCHES JEAN ; GZARA KAIS ; WILLBERG DEAN  
**Inventor(s):** CHRISTIAN BESSON  
**Agent(s):** SMART AND BIGGAR; THOMAS O; ROBIN; TIM

**Designated states:** AE AG AL AM AT AU AZ BA BB BE BF BG BJ BR BW BY BZ CA CF CG CH CI CM CN CO CR CU CY CZ DE DK DM DZ EC EE EG ES FI FR GA GB GD GE GH GM GN GQ GR GW HR HU ID IE IL IN IS IT JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MC MD MG MK ML MN MR MW MX NZ NA NE NI NO NZ OM PG PH PL PT RO RU SC SD SE SG SI SK SL SN SY SZ TD TG TJ TM TN TR TT TZ UA UG US UZ VC VN VU YU ZA ZM ZW

**Abstract:** A pump is coupled through a discharge line to a wellbore, which in turn intersects a fracture, the wellbore and fracture being filled with fluid to form a fluid system. Sensors are located in position at the top and, under certain circumstances, at the bottom of the wellbore. The dimensions of the fracture are calculated from data generated by the sensors by analyzing the incident and reflected waves within the fluid system the acoustic waves being generated by pressure pulses from a pump and travel from the pump through the fluid into the fracture. In preferred embodiments of this invention, transfer functions are developed by analysis of the data, so that the data recorded by sensors at the top of the wellbore accurately represent pressure fluctuations at the bottom of the wellbore. Transfer functions relating pressure fluctuations at the top of the wellbore to pressure fluctuations at the bottom of the wellbore, i.e., at the mouth of the fracture, exhibit resonant phenomena in the fracture from which fracture length can be determined. A Fourier transform is generated of transfer functions relating the impulse at the top of the annulus to the impulse response at the fracture entrance and through the fracture, to provide a time domain analysis of the waves in the fracture. This way, travel times of waves in the fracture can be determined, and this data used to estimate the length and height of the fracture, given that the wave speed in the fracture is known.

**US:** 166/250 166/250.09 364/421 702/11 73/151 73/152.39 73/152.58



| Publication number | Publication date | Application number | Application date |
|--------------------|------------------|--------------------|------------------|
| US4858130 A        | 19890815         | US19870083041      | 19870810         |

**Inventor(s):** (std): WIDROW BERNARD

PatBase PDF Export - Page: 3 31/05/2019

underground storage in conjunction with pulsing/fracturing. Alternately, this system could be used to create large pulses downhole for seismic purposes in that they are of such magnitude that they could be readily received in nearby wells or several of uphole locations. The system and method comprises several pulse generating devices longitudinally and axially positioned within an annular drill collar flow channel or PIM such that the PFD medium flows through the annular drill collar flow channel and the PFD medium is guided into one or more sets of selectively reversible flow, upper and lower flow connecting channels, wherein the connecting channels are connected to an inner flow channel and the annular drill collar flow channel, and wherein the annular drill collar flow channel is acted upon by one or more flow throttling devices. In one of the devices listed, the device utilizes one or more turbines residing near and within proximity of a flow diverter that diverts drilling mud into and away from turbine blades such that the force of the PFD medium causes the turbine blades and the turbine to rotationally spin around a coil assembly for power.

#### Classifications:

**International (IPC 8-9):** E21B1/28 E21B28/00 E21B4/14 E21B41/00  
E21B43/26 E21B44/00 E21B44/02 E21B44/06

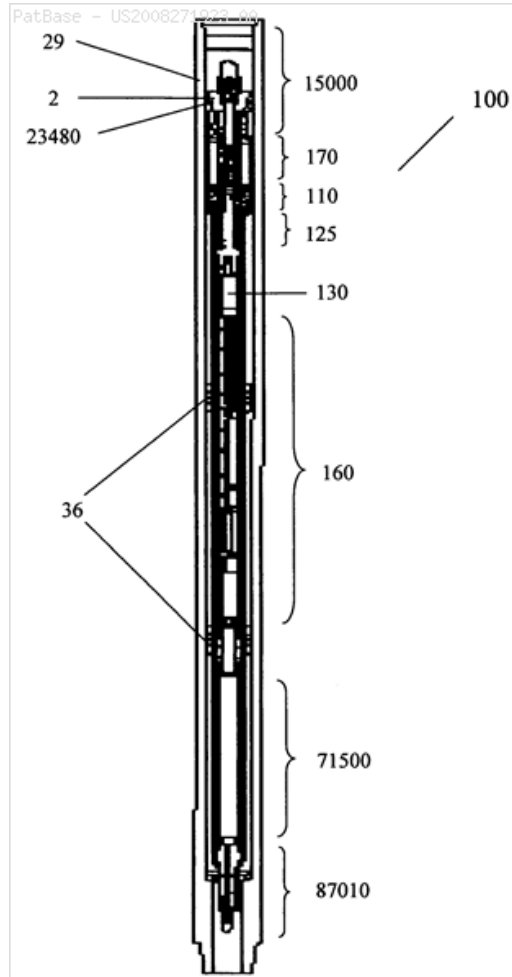
E21B7/24 (Advanced/Invention);

E21B1/00 E21B4/00 E21B44/00 E21B7/00 (Core/Invention)

**CPC:** E21B1/00 E21B21/10 E21B34/10 E21B4/02 E21B7/18 E21B41/0085

**European:** E21B1/00 E21B4/02 E21B41/00R E21B7/18

**US:** 166/177.5 166/249 175/25 175/25P 175/317 175/324



#### Family:

| Publication number | Publication date | Application number | Application date |
|--------------------|------------------|--------------------|------------------|
| CA2686737 AA       | 20081113         | CA20082686737      | 20080226         |
| CA2686737 C        | 20151006         | CA20082686737      | 20080226         |
| CA2710281 AA       | 20090702         | CA20082710281      | 20081217         |
| CA2710281 C        | 20170530         | CA20082710281      | 20081217         |
| EP2148975 A1       | 20100203         | EP20080726053      | 20080226         |
| EP2148975 A4       | 20150506         | EP20080726053      | 20080226         |
| EP2148975 B1       | 20190320         | EP20080726053      | 20080226         |
| EP2235323 A2       | 20101006         | EP20080864254      | 20081217         |
| EP2235323 A4       | 20150506         | EP20080864254      | 20081217         |
| EP2235323 B1       | 20180307         | EP20080864254      | 20081217         |
| MX2009011937 A1    | 20091204         | MX20090011937      | 20080226         |
| MX2010006797 A1    | 20130429         | MX20100006797      | 20081217         |
| MX351601 B         | 20171020         | MX20100006797      | 20081217         |
| RU2009144780 A     | 20110610         | RU20090144780      | 20080226         |
| RU2010130254 A     | 20120127         | RU20100130254      | 20081217         |
| US2008271923 AA    | 20081106         | US20070004121      | 20071220         |
| US2009107723 AA    | 20090430         | US20080316864      | 20081217         |
| US7836948 BB       | 20101123         | US20070004121      | 20071220         |
| US7958952 BB       | 20110614         | US20080316864      | 20081217         |
| WO08136883 A1      | 20081113         | WO2008US02469      | 20080226         |
| WO09082453 A2      | 20090702         | WO2008US13804      | 20081217         |
| WO09082453 A3      | 20091015         | WO2008US13804      | 20081217         |

#### Priority:

US20070927400P 20070503  
US20080316864 20081217

US20070004121 20071220  
WO2008US13804 20081217

WO2008US02469 20080226

**Probable Assignee:** TELEDRIILL INC

**Assignee(s):** (std): KUSKO DAVID JOHN ; LERNER DANIEL MAURICE ; TELEDRIILL INC ; VECSEI GABOR  
**Assignee(s):** KUSKO JAMES ; DAVID JOHN KUSKO  
**Inventor(s):** (std): KUSKO DAVID JOHN ; VECSEI GABOR ; LERNER DANIEL MAURICE  
**Inventor(s):** GABOR VECSEI ; DAVID JOHN KUSKO ; DANIEL MAURICE LERNER  
**Agent(s):** BORDEN LADNER GERVAIS LLP; RUETTIGERS JOACHIM; RACKETTE PATENTANWALTE PARTG MBB; KEHOE LAURA ELLEN; HELLMICH WOLFGANG; GUERRY LEONARD GRUNE; GUERRY L; GRUNE GUERRY L  
**Designated states:** AE AG AL AM AO AT AU AZ BA BB BE BF BG BH BJ BR BW BY BZ CA CF CG CH CI CM CN CO CR CU CY CZ DE DK DM DO DZ EC EE EG ES FI FR GA GB GD GE GH GM GN GQ GR GT GW HN HR HU ID IE IL IN IS IT JP KE KG KM KN KP KR KZ LA LC LI LK LR LS LT LU LV MA MC MD ME MG MK ML MN MR MT MW MX MY MZ NA NE NG NI NL NO NZ OM PG PH PL PT RO RS RU SC SD SE SG SI SK SL SM SN ST SV SY SZ TD TG TJ TM TN TR TT TZ UA UG US UZ VC VN ZA ZM ZW

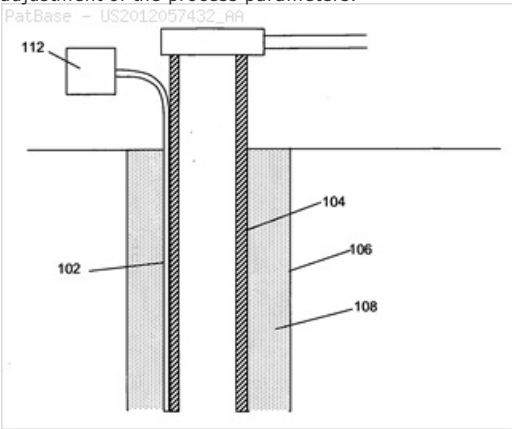
**6) Family number: 43550830 (US2012057432A)** © PatBase

**Title:** WELL MONITORING BY MEANS OF DISTRIBUTED SENSING MEANS

**Abstract:** This application describes methods and apparatus for downhole monitoring in real-time. The method involves interrogating an unmodified optic fibre (102) arranged along the path of a well bore (106) to provide a distributed acoustic sensor and sampling data gathered from a plurality of sensing portions of the fibre. The sampled data is then processed to provide a real-time indication of the acoustic signals detected by the sensing portions of the fibre. The real-time indication provides information to an operator or controller of the downwell process with real-time feedback data regarding what is happening during the down-well process which allows the identification of any problems and adjustment of the process parameters.

**Classifications:**

**International (IPC 8-9):** E21B E21B43/1185 E21B43/26 E21B43/267 E21B47/00 E21B47/10 E21B47/107 E21B47/113 E21B47/12 E21B47/135 E21B47/14 E21B47/16 G01H9/00 G01N29/036 G01S15/00 G01V1/00 G01V1/50 G01V8/02 G01V8/16 H04B10/25 (Advanced/Invention); G01H9/00 (Advanced/Non-invention)  
**CPC:** G01V8/02 E21B43/11857 E21B43/26 E21B47/123 G01H9/004 G01V1/50 G01V2210/1429 G01V2210/646 E21B47/16 E21B47/101 E21B43/267 E21B47/14 G01V8/16 G01N29/036  
**European:** E21B43/1185F E21B43/26 E21B47/10D E21B47/12M2 G01V8/02  
**US:** 166/177.5 166/250.1 166/250.100P 166/308.1 166/308.100S 367/101 367/101S 367/140 367/140S 367/25 367/25S 367/81 367/81P 367/82 367/82P



**Family:**

| Publication number | Publication date | Application number | Application date |
|--------------------|------------------|--------------------|------------------|
| AU2010252797 AA    | 20101202         | AU20100252797      | 20100527         |
| AU2010252797 BB    | 20160303         | AU20100252797      | 20100527         |
| AU2016203552 AA    | 20160616         | AU20160203552      | 20160530         |
| AU2016203552 BB    | 20171214         | AU20160203552      | 20160530         |
| AU2016203553 AA    | 20160616         | AU20160203553      | 20160530         |
| AU2016203553 BB    | 20171214         | AU20160203553      | 20160530         |
| BRPI1012022 A2     | 20160510         | BR2010PI12022      | 20100527         |
| BRPI1012028 A2     | 20160510         | BR2010PI12028      | 20100527         |
| BRPI1012029 A2     | 20160510         | BR2010PI12029      | 20100527         |
| CA2760066 AA       | 20111026         | CA20102760066      | 20100527         |
| CA2760644 AA       | 20111031         | CA20102760644      | 20100527         |
| CA2760644 C        | 20171003         | CA20102760644      | 20100527         |
| CA2760662 AA       | 20101202         | CA20102760662      | 20100527         |
| CA2760662 C        | 20170425         | CA20102760662      | 20100527         |
| CN102292518 A      | 20111221         | CN201080005137     | 20100527         |
| CN102292518 B      | 20170329         | CN201080005137     | 20100527         |
| CN102449263 A      | 20120509         | CN201080023028     | 20100527         |
| CN102449263 B      | 20151125         | CN201080023028     | 20100527         |
| CN102597421 A      | 20120718         | CN201080005244     | 20100527         |
| CN102597421 B      | 20160330         | CN201080005244     | 20100527         |
| CN104295290 A      | 20150121         | CN201410457045     | 20100527         |
| CN104295290 B      | 20170412         | CN201410457045     | 20100527         |
| CN104314552 A      | 20150128         | CN201410457176     | 20100527         |
| CN104314552 B      | 20170926         | CN201410457176     | 20100527         |
| GB200909038 A0     | 20090701         | GB20090009038      | 20090527         |
| GB200919915 A0     | 20091230         | GB20090019915      | 20091113         |
| GB201121106 A0     | 20120118         | GB20110021106      | 20100527         |
| GB201121110 A0     | 20120118         | GB20110021110      | 20100527         |
| GB201121113 A0     | 20120118         | GB20110021113      | 20100527         |
| GB201407427 A0     | 20140611         | GB20140007427      | 20140428         |
| GB201407433 A0     | 20140611         | GB20140007433      | 20100527         |
| GB2482838 A1       | 20120215         | GB20110021106      | 20100527         |

|                 |          |               |          |
|-----------------|----------|---------------|----------|
| GB2482838 B2    | 20131204 | GB20110021106 | 20100527 |
| GB2482839 A1    | 20120215 | GB20110021113 | 20100527 |
| GB2482839 B2    | 20140115 | GB20110021113 | 20100527 |
| GB2483584 A1    | 20120314 | GB20110021110 | 20100527 |
| GB2483584 B2    | 20141231 | GB20110021110 | 20100527 |
| GB2511656 A1    | 20140910 | GB20140007427 | 20140428 |
| GB2511656 B2    | 20141231 | GB20140007427 | 20140428 |
| GB2511657 A1    | 20140910 | GB20140007433 | 20100527 |
| GB2511657 B2    | 20141231 | GB20140007433 | 20100527 |
| IN09162CN2011 A | 20130215 | IN2011CN09162 | 20111208 |
| IN09477DN2011 A | 20130125 | IN2011DN09477 | 20111202 |
| MX2011011897 A1 | 20111208 | MX20110011897 | 20100527 |
| NO20111676 A    | 20111215 | NO20110001676 | 20111206 |
| NO20111678 A    | 20111221 | NO20110001678 | 20111206 |
| NO20111692 A    | 20111221 | NO20110001692 | 20111207 |
| PL228478 B1     | 20180430 | PL20100398045 | 20100527 |
| PL398045 A1     | 20120604 | PL20100398045 | 20100527 |
| RU2011153351 A  | 20130710 | RU20110153351 | 20100527 |
| RU2011153416 A  | 20130710 | RU20110153416 | 20100527 |
| RU2011153423 A  | 20130710 | RU20110153423 | 20100527 |
| RU2014128537 A  | 20160210 | RU20140128537 | 20140711 |
| RU2014128537 A  | 20160210 | RU20140128537 | 20100527 |
| RU2014128551 A  | 20160210 | RU20140128551 | 20140711 |
| RU2015151868 A  | 20190115 | RU20150151868 | 20100527 |
| RU2015151868 A3 | 20190417 | RU20150151868 | 20100527 |
| RU2537419 C2    | 20150110 | RU20110153423 | 20100527 |
| RU2568652 C2    | 20151120 | RU20110153416 | 20100527 |
| RU2648743 C2    | 20180328 | RU20140128537 | 20100527 |
| US2012057432 AA | 20120308 | US20100320884 | 20100527 |
| US2012063267 AA | 20120315 | US20100320877 | 20100527 |
| US2012111560 AA | 20120510 | US20100320882 | 20100527 |
| US2015337653 AA | 20151126 | US20150816456 | 20150803 |
| US8950482 BB    | 20150210 | US20100320882 | 20100527 |
| US9617848 BB    | 20170411 | US20100320884 | 20100527 |
| US9689254 BB    | 20170627 | US20150816456 | 20150803 |
| WO10136764 A2   | 20101202 | WO2010GB01051 | 20100527 |
| WO10136764 A3   | 20110929 | WO2010GB01051 | 20100527 |
| WO10136768 A2   | 20101202 | WO2010GB01056 | 20100527 |
| WO10136768 A3   | 20110203 | WO2010GB01056 | 20100527 |
| WO10136773 A2   | 20101202 | WO2010GB01064 | 20100527 |
| WO10136773 A3   | 20110505 | WO2010GB01064 | 20100527 |
| ZA201108666 A   | 20120926 | ZA20110008666 | 20111124 |

#### Priority:

|                |          |               |          |               |          |
|----------------|----------|---------------|----------|---------------|----------|
| GB20090009038  | 20090527 | GB20090019915 | 20091113 | AU20100252797 | 20100527 |
| CN201080005244 | 20100527 | WO2010GB01064 | 20100527 | WO2010GB01051 | 20100527 |
| WO2010GB01056  | 20100527 | GB20110021110 | 20100527 | RU20150151868 | 20100527 |
| RU20150151868  | 20105227 | US20110320877 | 20111116 | US20150816456 | 20150803 |
| AU20160203552  | 20160530 | AU20160203553 | 20160530 |               |          |

**Probable Assignee:** OPTASENSE HOLDINGS LTD

**Assignee(s):** (std): HILL DAVID JOHN ; MCEWEN KING MAGNUS ; OPTASENS KHOLDINGZ LTD ; OPTASENSE HOLDINGS LTD ; QINETIQ LTD ; TINDELL PATRICK ; TINDEL PATRICK

**Assignee(s):** TINDELL PATRICK PHILLIP ; QINETIQ LIMITED

**Inventor(s):** (std): TINDELL PATRICK ; KHILL DEHVID DZHON ; MAK JUEHN KING MAGNUS ; MAKYUEN KING MAGNUS ; KHILL DEVID DZHON ; TINDELL PATRICK PHILIP ; TIN DELL PATRICK ; PATRICK TINDELL ; MAGNUS MCEWEN KING ; JOHN HILL DAVID ; TINDELL PATRICK PHILLIP ; TINDEL PATRICK ; TINDELL PATRICK ; MCEWEN KING MAGNUS ; HILL DAVID JOHN

**Inventor(s):** DAVID JOHN HILL ; PATRICK PHILIP TINDELL ; HILL DAVID JOHN MC ; EWENKING MAGNUS ; TINDEL PATRICK ; PATRICK TINDEL

**Agent(s):** DAVIES COLLISON CAVE ; DAVIES COLLISON CAVE PTY LTD ; FETHERSTONHAUGH AND CO ; YURIDICHESKAYA GORODISSKIY I PARTNER OOO FA ; OOO YURIDICHESKAYA GORODISSKIY I PARTNER FA ; MCDONNELL BOEHNNEN HULBERT AND BERGHOF LLP ; NORTHWAY DANIEL R

**Designated states:** AE AG AL AM AO AT AU AZ BA BB BE BF BG BH BJ BR BW BY BZ CA CF CG CH CI CL CM CN CO CR CU CZ DE DK DM DO DZ EC EE EG ES FI FR GA GB GD GE GH GM GN GQ GR GT GW HN HR HU ID IE IL IN IS IT JP KE KG KM KN KP KR KZ LA LC LK LR LS LT LU LV LY MA MC MD ME MG MK ML MN MR MT MW MX MY MZ NA NE NG NI NL NO NZ OM PE PG PH PL PT RO RS RU SC SD SE SG SI SK SL SM SN ST SV SY SZ TD TG TH TJ TM TN TR TT TZ UA UG US UZ VC VN ZA ZM ZW

#### 7) Family number: 44046381 (US2009288820A)

PatBase

**Title:** METHOD OF MANUFACTURE AND THE USE OF A FUNCTIONAL PROPPANT FOR DETERMINATION OF SUBTERRANEAN FRACTURE GEOMETRIES

**Abstract:** Proppants having added functional properties are provided, as are methods that use the proppants to track and trace the characteristics of a fracture in a geologic formation. Information obtained by the methods can be used to design a fracturing job, to increase conductivity in the fracture, and to enhance oil and gas recovery from the geologic formation. The functionalized

proppants can be detected by a variety of methods utilizing, for example, an airborne magnetometer survey, ground penetrating radar, a high resolution accelerometer, a geophone, nuclear magnetic resonance, ultra-sound, impedance measurements, piezoelectric activity, radioactivity, and the like. Methods of mapping a subterranean formation are also provided and use the functionalized proppants to detect characteristics of the formation.

**Classifications:**

**International (IPC 8-9):** B01J13/02 B23B19/00 B82Y30/00 C04B35/628 C09K8/60 C09K8/74 C09K8/80 E21B43/00 E21B43/267 E21B43/27 E21B47/00 E21B47/10 E21B47/12 E21B49/00 G01V3/24 (Advanced/Invention); C09K8/60 E21B43/00 E21B43/25 E21B47/00 E21B49/00 (Core/Invention)

**International (IPC 1-7):** E21B43/25 E21B47/00

**CPC:** C09K8/80 B01J13/02 B82Y30/00 C04B35/62807 C04B35/62823 C04B35/62839 C04B35/62842 C04B35/62894 C04B2235/3418 C04B2235/422 C04B2235/5288 C09K8/805 E21B43/00 E21B43/267 E21B47/00 E21B47/12 E21B49/00 G01V3/24 Y10S507/907 Y10S507/924 Y10T428/29 Y10T428/2991 Y10T428/2993

**European:** B01J13/02 B82Y30/00 C04B35/628B10 C04B35/628B2B C04B35/628B2H8 C04B35/628B8R C04B35/628P C09K8/80 C09K8/80B E21B43/00 E21B43/267 E21B47/00 E21B47/12 E21B49/00 M04B235/34D M04B235/42C M04B235/52J2

**US:** 166/249 166/250.1 166/250.100P 166/250.100S 166/251.1 166/251.100S 166/280.2 166/280.200S 428/357 428/403 428/404 507/219 507/219S 507/269 507/269S 507/270 507/270S 507/271 507/907 507/924

**Family:**

| Publication number | Publication date | Application number | Application date |
|--------------------|------------------|--------------------|------------------|
| AR071860 AA        | 20100721         | AR2009P101818      | 20090520         |
| CA2725088 AA       | 20101119         | CA20092725088      | 20090519         |
| CA2725088 C        | 20170328         | CA20092725088      | 20090519         |
| CN102099545 A      | 20110615         | CN200980128414     | 20090519         |
| CN102099545 B      | 20150610         | CN200980128414     | 20090519         |
| EA022413 B1        | 20151230         | EA20100071331      | 20090519         |
| EA201071331 A1     | 20110630         | EA20100071331      | 20090519         |
| EP2307666 A2       | 20110413         | EP20090744812      | 20090519         |
| GC6395 A           | 20171107         | GC2009P013517      | 20090519         |
| MX2010012463 A1    | 20101207         | MX20100012463      | 20090519         |
| US2009288820 AA    | 20091126         | US20090468088      | 20090519         |
| US2012181020 AA    | 20120719         | US20120432015      | 20120328         |
| US8168570 BB       | 20120501         | US20090468088      | 20090519         |
| US9803135 BB       | 20171031         | US20120432015      | 20120328         |
| WO10011402 A2      | 20100128         | WO2009US44425      | 20090519         |
| WO10011402 A3      | 20100910         | WO2009US44425      | 20090519         |

**Priority:**

US20080054515P 20080520 US20080054622P 20080520 US20080120317P 20081205  
US20090468088 20090519 WO2009US44425 20090519 US20120432015 20120328

**Probable Assignee:** HALLIBURTON CO

**Assignee(s):** (std): BARRON ANDREW R ; CHATTERJEE DILIP K ; COKER CHRISTOPHER E ; OXANE MATERIALS INC ; XIE YUMING ; SKALA ROBERT D ; HALLIBURTON ENERGY SERVICES INC ; OXANE MAT INC ; HALLIBURTON CO

**Assignee(s):** COMERICA BANK A TEXAS BANKING ASSOCIATION ; DELTA CENTAURI LLC

**Inventor(s):** (std): YUMING XIE ; SKALA ROBERT D ; XIE YUMING ; CHATTERJEE DILIP K ; COKER CHRISTOPHER E ; BARRON ANDREW R

**Inventor(s):** CHRISTOPHER E COKER ; ROBERT D SKALA ; ANDREW R BARRON ; DILIP K CHATTERJEE

**Agent(s):** DIMOCK STRATTON LLP; NORTON ROSE FULBRIGHT CANADA LLP SENCRL SRL; GRUENECKER KINKELDEY STOCKMAIR AND SCHWANHAUESSER ANWALTSSOZIETAET; SULEIMAN I AL AMMAR LAW OFFICE; KILYK AND BOWERSOX PLLC; CRAIG W; TUMEY LLP; KILYK LUKE A

**Designated states:** AE AG AL AM AO AT AU AZ BA BB BE BF BG BH BJ BR BW BY BZ CA CF CG CH CI CM CN CO CR CU CY CZ DE DK DM DO DZ EC EE EG ES FI FR GA GB GD GE GH GM GN GQ GR GT GW HN HR HU ID IE IL IN IS IT JP KE KG KM KN KP KR KZ LA LC LI LK LR LS LT LU LV LY MA MC MD ME MG MK ML MN MR MT MW MX MY MZ NA NE NG NI NL NO NZ OM PG PH PL PT RO RS RU SC SD SE SG SI SK SL SM SN ST SV SY SZ TD TG TJ TM TN TR TT TZ UA UG US UZ VC VN ZA ZM ZW

**8) Family number: 48165935 (US2011011576A)**

© PatBase

**Title:** ACOUSTIC GENERATOR AND ASSOCIATED METHODS AND WELL SYSTEMS

**Abstract:** A well system and associated method can include an acoustic generator which can be used to excite a formation with acoustic waves transmitted from the acoustic generator. Another well system and associated method can include an acoustic generator which can transmit acoustic waves into cement surrounding a casing. Another well system and associated method can include an acoustic generator which can be used to transmit acoustic waves into an annulus surrounding a well screen during or after a gravel packing operation. Another well system and associated method can include an acoustic generator which can be connected in a drill string in close proximity to a drill bit, with the acoustic generator transmitting acoustic waves into a formation ahead of the bit.

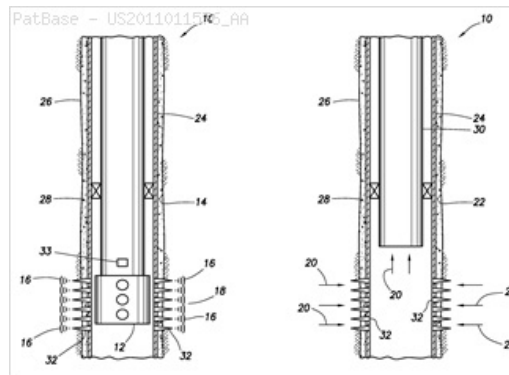
**Classifications:**

**International (IPC 8-9):** E21B27/00 E21B28/00 E21B33/13 E21B43/00 E21B43/04 E21B43/267 E21B47/14 E21B49/00 G01V1/04 G01V1/40 (Advanced/Invention); E21B7/24 (Advanced/Non-invention)

**CPC:** G01V1/40 E21B7/24 E21B28/00 E21B33/13 E21B43/003 E21B43/04 E21B43/267 E21B47/14 E21B49/00

**European:** E21B33/13 E21B43/00C E21B43/04 E21B43/267 E21B47/14 E21B49/00 G01V1/40

**US:** 1/1 166/162 166/177.1 166/177.100P 166/177.4 166/286 181/106 181/106S 367/25 73/152.05 73/152.050S



#### Family:

| Publication number | Publication date | Application number | Application date |
|--------------------|------------------|--------------------|------------------|
| US2011011576 AA    | 20110120         | US20100834971      | 20100713         |
| US2013037259 AA    | 20130214         | US20120647035      | 20121008         |
| US2014313855 AA    | 20141023         | US20140307709      | 20140618         |
| US8813838 BB       | 20140826         | US20120647035      | 20121008         |
| US9410388 BB       | 20160809         | US20140307709      | 20140618         |
| US9567819 BB       | 20170214         | US20100834971      | 20100713         |

#### Priority:

US20090225311P 20090714 US20100834971 20100713 US20120647035 20121008  
US20140307709 20140618

**Probable Assignee:** HALLIBURTON CO

**Assignee(s):** (std): CAVENDER TRAVIS W ; GLEITMAN DANIEL D ; HALLIBURTON CO ; HALLIBURTON ENERGY SERV INC ; HALLIBURTON ENERGY SERVICES INC ; SCHULTZ ROGER L

**Inventor(s):** (std): SCHULTZ ROGER L ; CAVENDER TRAVIS W ; GLEITMAN DANIEL D

**Agent(s):** SMITH IP SERVICES PC; SCHWEGMAN LUNDBERG AND WOESSNER PA; CRAIG W; CHAMBERLAIN HRDLICKA

#### 9) Family number: 49556611 (US2012327742A)

© PatBase

**Title:** BOREHOLE FLOW MODULATOR AND INVERTED SEISMIC SOURCE GENERATING SYSTEM

**Abstract:** The present invention relates to the vertical seismic profiling (VSP) of geological formations in which profiling is used to obtain information for performing precise interpretations of geophysical seismic data and better understanding of geophysical information. The disclosure involves using a sound source for generating primary and secondary seismic pulses within well boreholes. The seismic profiling system obtains information regarding a geological formation traversed by a borehole with controllable downhole seismic pulse generators with drill string tool(s). The tool(s) have contact with and are coupled to the formation. A seismic pulsing device (SPD) is attached to a portion of the drill string and a valve controller is used to control opening and closing the valve causing high amplitude short duration ultra wide band pressure pulses, generating primary seismic waves sent into surrounding geological formations. This generates secondary seismic waves received that can be detected by geophones or similar devices.

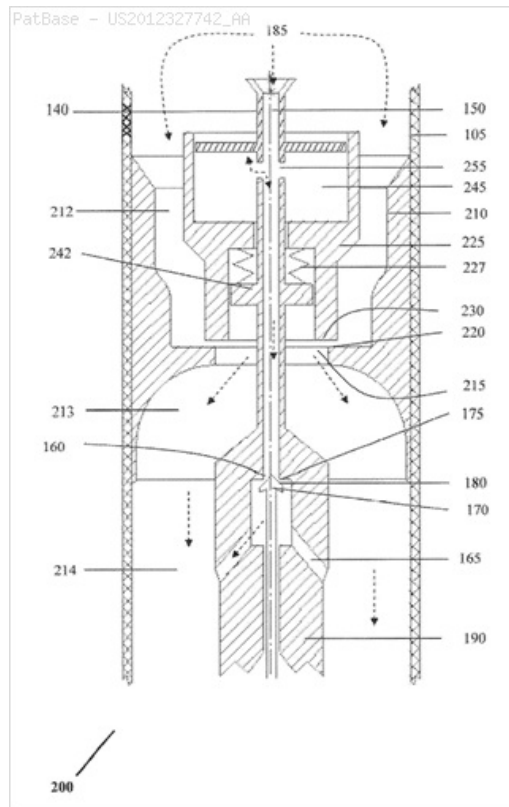
#### Classifications:

**International (IPC 8-9):** E21B47/14 E21B47/18 G01V1/02 G01V1/137 G01V1/40 (Advanced/Invention)

**CPC:** G01V1/137 E21B47/182

**European:** E21B47/18C G01V1/137

**US:** 367/25



#### Family:

| Publication number | Publication date | Application number | Application date |
|--------------------|------------------|--------------------|------------------|
| US2012327742 AA    | 20121227         | US20100582447      | 20100302         |
| US2018329093 AA    | 20181115         | US20180978887      | 20180514         |
| US10001573 BB      | 20180619         | US20100582447      | 20100302         |
| WO11109014 A1      | 20110909         | WO2010US25895      | 20100302         |

#### Priority:

US20100582447 20100302 WO2010US25895 20100302 US20120582447 20120903  
 US20180978887 20180514

**Probable Assignee:** TELEDRIILL INC

**Assignee(s):** (std): KUSKO DAVID JOHN ; LERNER DANIEL MAURICE ; TELEDRIILL INC ; VECSEI GABOR

**Assignee(s):** KUSKO JAMES

**Inventor(s):** (std): VECSEI GABOR ; KUSKO DAVID JOHN ; LERNER DANIEL MAURICE

**Agent(s):** GUERRY L; EPATENTMANAGERCOM; GRUNE GUERRY L

**Designated states:** AE AG AL AM AO AT AU AZ BA BB BE BF BG BH BJ BR BW BY BZ CA CF CG CH CI CL CM CN CO CR CU CY CZ DE DK DM DO DZ EC EE EG ES FI FR GA GB GD GE GH GM GN GQ GR GT GW HN HR HU ID IE IL IN IS IT JP KE KG KM KN KP KR KZ LA LC LK LR LS LT LU LV LY MA MC MD ME MG MK ML MN MR MT MW MX MY MZ NA NE NG NI NL NO NZ OM PE PG PH PL PT RO RS RU SC SD SE SG SI SK SL SM SN ST SV SY SZ TD TG TH TJ TM TN TR TT TZ UA UG US UZ VC VN ZA ZM ZW

#### 10) Family number: 54627473 (US2013220598A)

© PatBase

**Title:** SYSTEM FOR EXTRACTING HYDROCARBONS FROM UNDERGROUND GEOLOGICAL FORMATIONS AND METHODS THEREOF

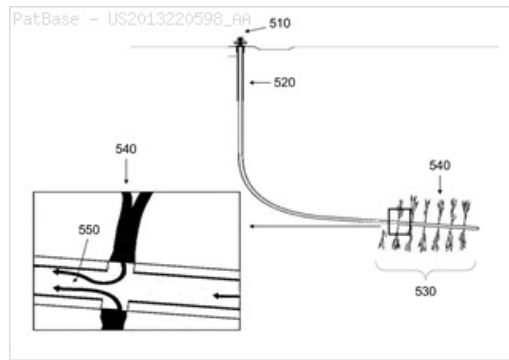
**Abstract:** An ultrasonic fracking system and methods of using the same to extract hydrocarbons from underground geological formations (e.g., oil shale, coal beds, etc.) are disclosed. The system includes piezoelectric devices that are used to produce ultrasonic mechanical vibrations and induce fractures in the geological formations. In one embodiment, a system for extracting underground hydrocarbons comprises a plurality of piezoelectric devices capable of producing mechanical waves sufficient to fracture oil shale and other geological formations, a system of delivery for innocuous proppants to create a path of least resistance for enhanced hydrocarbon flow, and a vacuum pump connected to the fractures created by the piezoelectric devices to assist in removing the hydrocarbons.

#### Classifications:

**International (IPC 8-9):** E21B28/00 E21B43/00 (Advanced/Invention)

**CPC:** E21B28/00 E21B43/26

**US:** 166/177.1 166/249



#### Family:

| Publication number | Publication date | Application number | Application date |
|--------------------|------------------|--------------------|------------------|
| US2013220598 AA    | 20130829         | US20120408898      | 20120229         |

#### Priority:

US20120408898 20120229

**Probable Assignee:** MINDCAKE LLC

**Assignee(s):** (std): BOYD STEPHEN A ; PALUMBO JOHN L

**Assignee(s):** MINDCAKE LLC

**Inventor(s):** (std): PALUMBO JOHN L ; BOYD STEPHEN A

#### 11) Family number: 55003909 (US2013277050A)

© PatBase

**Title:** INTERACTING HYDRAULIC FRACTURING

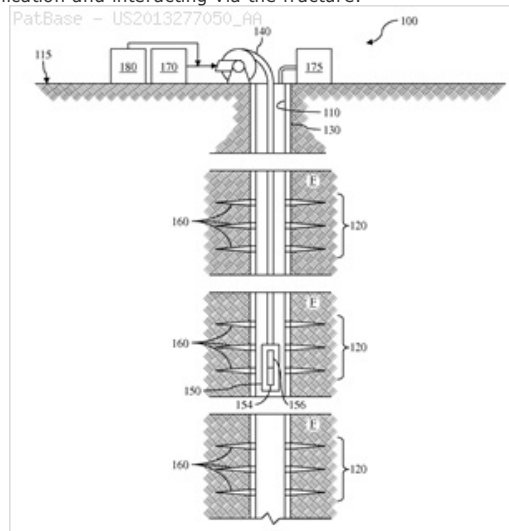
**Abstract:** A fracture extending away from a first subterranean well and toward a second subterranean well may be initiated by pumping fluid into the first subterranean well. The fracture may be propagated further towards the second subterranean well by continuing to pump fluid into the first subterranean well, while monitoring a pressure in the second subterranean well. Proppant may be pumped into the second subterranean well via the first subterranean well and the fracture upon detection of a change in the monitored pressure in the second subterranean well. The change in monitored pressure in the second subterranean well may be sufficient to indicate that the first and second wells are in fluid communication and interacting via the fracture.

#### Classifications:

**International (IPC 8-9):** E21B43/17 E21B43/26 E21B43/267 E21B47/06 (Advanced/Invention)

**CPC:** E21B43/267 E21B47/06 E21B43/17 E21B43/26

**US:** 1/1 166/271 166/50 166/52



#### Family:

| Publication number | Publication date | Application number | Application date |
|--------------------|------------------|--------------------|------------------|
| CA2813878 AA       | 20131024         | CA20132813878      | 20130424         |
| US2013277050 AA    | 20131024         | US20130869482      | 20130424         |
| US2016061026 AA    | 20160303         | US20150937447      | 20151110         |
| US9187992 BB       | 20151117         | US20130869482      | 20130424         |

#### Priority:

US20120637585P 20120424 CA20132813878 20130424 US20130869482 20130424  
US20150937447 20151110

**Probable Assignee:** SCHLUMBERGER TECHNOLOGY CORP

**Assignee(s):** (std): SCHLUMBERGER CA LTD ; SCHLUMBERGER TECHNOLOGY CORP

**Assignee(s):** SCHLUMBERGER CANADA LTD ; CHERIAN BILU VERGHIS ; KRISHNAMURTHY JAYANTH ; PANJAITAN MARADEN

**Inventor(s):** (std): PANJAITAN MARADEN ; KRISHNAMURTHY JAYANTH ; CHERIAN BILU VERGHIS

**Agent(s):** SMART AND BIGGAR; TIM; RACHEL E

**Title:** SYSTEMS AND METHODS FOR INCREASING FRACTURE COMPLEXITY USING ACOUSTIC ENERGY

**Abstract:** A system is configured to fracture a formation surrounding a subterranean wellbore. In one example, the system includes a tool string configured to be deployed in the wellbore, and an acoustic pulse generator connected to the tool string and configured to transmit acoustic pressure pulses into the formation. The acoustic pulse generator is configured to generate acoustic pressure pulses with a magnitude of at least 1000 pounds per square inch.

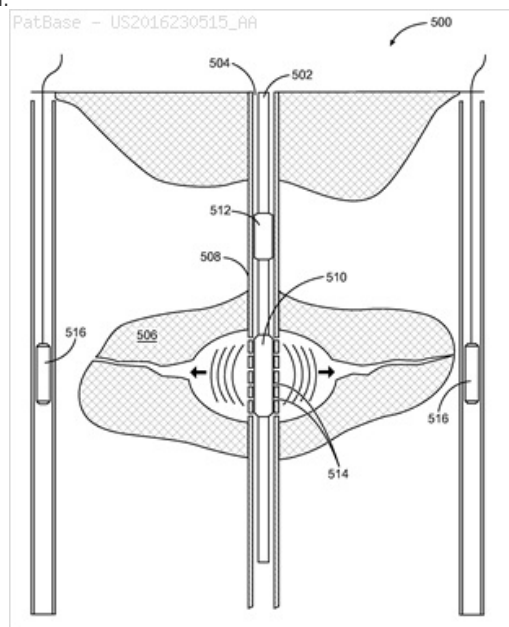
**Classifications:**

**International (IPC 8-9):** E21B43/00 E21B43/17 E21B43/26

E21B49/00 (Advanced/Invention)

**CPC:** E21B28/00 E21B49/00 E21B43/003 E21B43/26

**US:** 166/249



**Family:**

| Publication number | Publication date | Application number | Application date |
|--------------------|------------------|--------------------|------------------|
| US2016230515 AA    | 20160811         | US20130023024      | 20131216         |
| WO15094159 A1      | 20150625         | WO2013US75391      | 20131216         |

**Priority:**

US20130023024 20131216 WO2013US75391 20131216

**Probable Assignee:** HALLIBURTON CO

**Assignee(s):** (std): HALLIBURTON CO ; HALLIBURTON ENERGY SERVICES INC

**Inventor(s):** (std): HUNTER TIMOTHY HOLIMAN ; CAVENDER TRAVIS WAYNE ; PARKER MARK ALLEN

**Agent(s):** MADDEN ROBERT B ET AL

**Designated states:** AE AG AL AM AO AT AU AZ BA BB BE BF BG BH BJ BN BR BW BY BZ CA CF CG CH CI CL CM CN CO CR CU CY CZ DE DK DM DO DZ EC EE EG ES FI FR GA GB GD GE GH GM GN GQ GR GT GW HN HR HU ID IE IL IN IR IS IT JP KE KG KM KN KP KR KZ LA LC LK LR LS LT LU LV LY MA MC MD ME MG MK ML MN MR MT MW MX MY MZ NA NE NG NI NL NO NZ OM PA PE PG PH PL PT QA RO RS RU RW SA SC SD SE SG SI SK SL SM SN ST SV SY SZ TD TG TH TJ TM TN TR TT TZ UA UG US UZ VC VN ZA ZM ZW

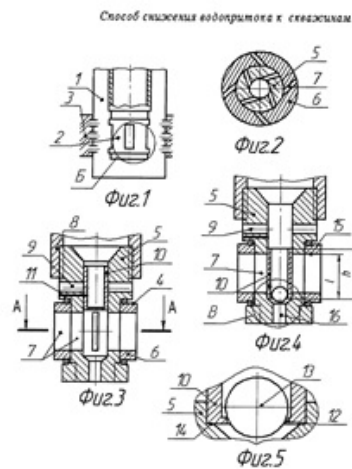
**Title:** WATER INFLOW TO THE WELLS REDUCTION METHOD

**Abstract:** FIELD: oil and gas industry. SUBSTANCE: invention relates to the oil industry, and can be used in the oil deposits development. Method comprises the production well selection, the low-saline water injection into the injection well for at least five days, this well switching into the waste or reservoir water injection with depletion prior to the event performance. Low-saline water injection into the injection well cycles are repeated with increase in the production well watercut by 10–30 percent relative to the watercut after the previous injection cycle. Increasing the low-saline water injection volume in each subsequent cycle. Selecting several production wells located at distances from the injection well of not more than 500 m. Low-saline water injection into the injection well is carried out in the pulsed mode and with operating selected wells. Turning off the fluid into the reservoir pulsed injection device. Switching the injection well into the waste or reservoir water injection. Low-saline water injection into the injection well cycles are repeated with the turned off fluid pulse injection device and with increase in the watercut, at least in one production well, by 10–30 percent relative to the watercut after the previous injection cycle. As the fluid pulsed injection device using the spool type hydraulic vibrator. Vibrator contains the hollow shaft and a spool, which are made with slit slots. For the hydraulic vibrator turning off drilling the radial holes in its shaft above the spool. Holes communicate the shaft and well cavity to each other. In the shaft cavity opposite the radial holes and above the slit slots, installing the hollow rod with fixation against the axial movement. Rod is made with the annular protrusion at the inner wall lower end. Rod overlaps the shaft slotted slits during its movement down underneath the radial holes. Hollow rod is moved by the pressure of waste or reservoir water injected into the formation after the ball dropping into the well. Selecting the ball outer diameter to be less than the hollow rod internal diameter and larger than this rod annular protrusion internal diameter. EFFECT: reduction in watercut and increase in the oil volume production. 1 cl, 5 dwg

**Classifications:**

**International (IPC 8-9):** E21B43/20 E21B43/25

E21B43/32 (Advanced/Invention)



**Family:**

| Publication number | Publication date | Application number | Application date |
|--------------------|------------------|--------------------|------------------|
| RU2678338 C1       | 20190128         | RU20180100959      | 20180110         |

**Priority:**

RU20180100959 20180110

**Probable Assignee:** PUBLICHNOE AKTSIONERNOE OBSHCHESTVO TATNEFT IMENI V D SHASHINA

**Assignee(s):** (std): PUBLICHNOE AKTSIONERNOE OBSHCHESTVO TATNEFT IMENI V D SHASHINA

**Assignee(s):** PUBLICHOE AKTSIONERNOE OBSHCHESTVO TATNEFT IMENI VD SHASHINA ; TATNEFT PUBLIC JOINT STOCK CO NAME IN D SHASHIN

**Inventor(s):** (std): MOROZOV PAVEL GEORGIEVICH ; NURUTDINOV ILSUR ANUROVICH ; PODAVALOV VLADLEN BORISOVICH ; SAETGARAEV RUSTEM KHALITOVICH ; VAFIN ILDUS ZAKEEVICH ; YAKUPOV AJDAR RASHITOVICH

**Agent(s):** TATNEFT IM VD SHASHINA TSENTR TEKHNOLOGICHESKOGO RAZVITIYA OTDEL RAZVITIYA INTELLEKTUALNOJ SOBSTVENN

**14) Family number: 9124623 (US5228508A)**

**Title:** Perforation cleaning tools

**Abstract:** In accordance with illustrative embodiments of the present invention, a well perforation cleaning tool includes a fluidic oscillator that creates pressure pulsations which induce cyclical stresses in the walls of the perforations and causes damaged skins thereon to disintegrate in order to improve the productivity of the well. The output passages of one embodiment of the fluidic oscillator are connected to respective internal storage cavities and each cavity is communicated with the annulus by a pair of outlet passages. In other embodiments, relatively short length external cavities communicate with the output passages to provide means by which the pressure pulsations are conveyed to the well annulus. Cylindrical filter tubes having a plurality of sets of axially spaced slots are adjustably mounted at the upper and lower ends of the tool may, if desired, be used to provide resistances which substantially confine the pressure pulsations to the immediate vicinity of the tool body. Both tubing conveyed and coil tubing conveyed tools are disclosed.

### Classifications:

**International (IPC 8-9):** E21B28/00 E21B37/00 E21B37/08

E21B41/00 (Advanced/Invention);

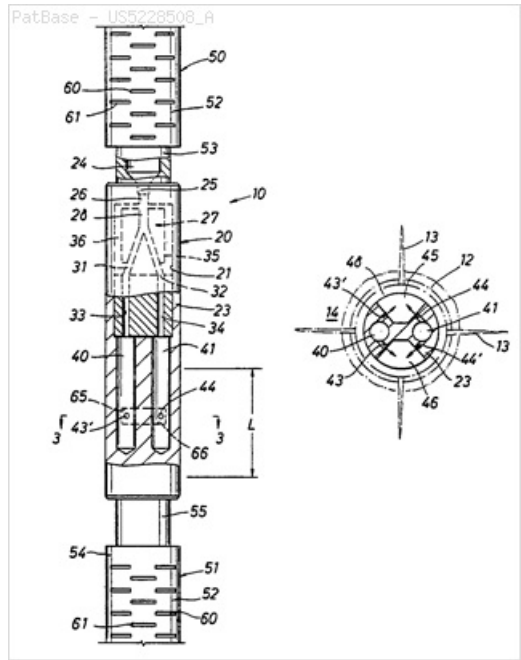
E21B28/00 E21B37/00 E21B41/00 (Core/Invention)

**International (IPC 1-7):** E21B37/00 E21B37/08

**CPC:** E21B28/00 E21B37/08 E21B41/0078

**European:** E21B28/00 E21B37/08 E21B41/00P

**US:** 166/177 166/177.2 166/222 166/312



**Family:**

| Publication number | Publication date | Application number | Application date |
|--------------------|------------------|--------------------|------------------|
| CA2098000 AA       | 19941209         | CA19932098000      | 19930608         |
| US5228508 A        | 19930720         | US19920887846      | 19920526         |

**Priority:**

US19920887846 19920526 CA19932098000 19930608

**Probable Assignee:** ABRADO LLC

**Assignee(s):** (std): FACTEAU DAVID M ; HYMAN MICHAEL D ; COBB TIMOTHY A

**Assignee(s):** DOWNHOLE FLUIDICS INC ; ABRADO LLC ; PERF CLEAN INT ; PERF CLEAN INT INC

**Inventor(s):** (std): COBB TIMOTHY A ; FACTEAU DAVID M ; HYMAN MICHAEL D

**Agent(s):** SMART AND BIGGAR