



(51) International Patent Classification:

E21B 49/00 (2006.01) *G01N 30/86* (2006.01)
G01N 1/22 (2006.01)

(21) International Application Number:

PCT/US2013/077825

(22) International Filing Date:

26 December 2013 (26.12.2013)

(25) Filing Language:

English

(26) Publication Language:

English

(71) Applicant: **LANDMARK GRAPHICS CORPORATION** [US/US]; 2107 City West Blvd., Bldg. 2, Houston, TX 77042 (US).

(72) Inventors: **DURSUN, Serkan**; 4711 Plymouth Way, Missouri City, TX 77459 (US). **UYANIK, Ilyas**; 5440 North Braeswood, Apt 928, Houston, TX 77096 (US). **GERMAIN, Olivier R.**; 5224 Sagecircle, Houston, TX 77056 (US).

(74) Agents: **MACKEY, Cole et al.**; Locke Lord LLP, 600 Travis, Suite 2800, Houston, TX 77002-3095 (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, IR, IS, JP, KE, KG, 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, SA, 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, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

Published:

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

(54) Title: REAL-TIME MONITORING OF HEALTH HAZARDS DURING HYDRAULIC FRACTURING

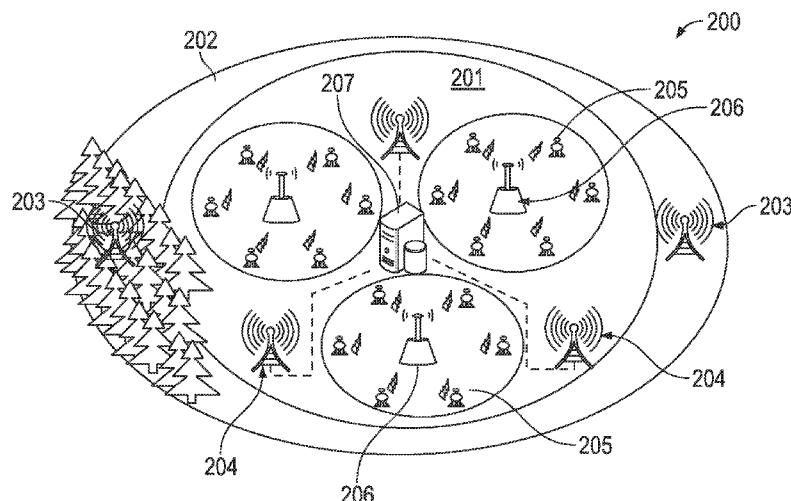


FIG. 2

(57) Abstract: A real-time silica monitoring system can include a plurality of off-site sensors positioned at geographic locations off-site from a hydraulic fracturing well site that detect and measure quantities of airborne silica particles, a plurality of on-site sensors positioned at geographic locations on a hydraulic fracturing well site that detect and measure quantities of air-borne silica particles, and one or more mobile sensors suitable to be carried by individual persons that detect and measure quantities of airborne silica particles. A monitoring system can include a computer system that can aggregate and store airborne silica measurements taken by one or more sensors and communicate data to a user.