

**ProFrac Holding Corp. and U.S. Well Services, LLC
v.
Halliburton Energy Services, Inc.**

**PGR2023-00023
U.S. Patent No. 11,373,058**

**EXHIBIT 1052: Petitioners' Demonstrative Exhibits
August 14, 2024**

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Challenged Claims

Claim 1: A computer-implemented method for controlling electrical fracturing equipment for fracturing a well, the method comprising:

generating a sequence of stimuli for application to a well environment, the sequence of stimuli comprising one or more of particulate concentrations, chemical concentrations, or a pump rate control;

receiving formation response data comprising data from one or more downhole sensors or surface sensors;

selecting a representative system model based on the received formation response data and sequence of stimuli; and

controlling an electrical fracturing pump based on the representative system model.

Claim 9: A system for controlling electrical fracturing equipment for fracturing a well, the system comprising:

one or more processors; and

a memory comprising instructions to:

[generate...; receive...; select...; and control....]

Claim 16: A non-transitory computer medium storing instructions that, when executed by one or more processors, cause the processors to:

[generate...; receive...; select...; and control....]

Claim 2: The method of claim 1, wherein the representative system model is retrieved from a data store based the received formation response data.

Dependent claims 10, 17 – same as 2

Claim 3: The method of claim 1, wherein the representative system model is generated based on data created through simulation with uncertainty parameters.

Dependent claims 11, 18 – same as 3

Claim 4: The method of claim 1, wherein selecting the representative system model further comprises:

Dependent claim 12, 19 – same as 4

determining one of a linear or a non-linear relationship between the sequence of stimuli and received formation response data; and

updating the one of the linear or the non-linear relationship based on multiple iterations of the generated sequence of stimuli.

Claim 5: The method of claim 1, wherein the data from the one or more downhole sensors or surface sensors is used to determine changes in flow distribution in response to a diverter drop, the changes in flow distribution used to determine the representative system model.

Dependent claim 13 – same as 5

Claim 6: The method of claim 1, wherein the one or more downhole sensors or surface sensors comprises one or more of a single-point electrical sensors, an optical sensor, or a fiber optic sensor.

Claim 7: The method of claim 1, wherein the formation response data comprises measurements of one or more of pressure, temperature, flow, dynamic strain, static strain, acoustic intensity, resistivity, or electromagnetic signals or frequency, amplitude or phase of any of the electromagnetic signals.

Dependent claim 14 – same as 7

Claim 8: The method of claim 1, wherein the representative system model predicts a proxy value comprising one or more of a cluster efficiency, a complexity factor, or a proximity index, and the predicted proxy value is used to control one or more of a uniform flow across perforation clusters, a formation complexity, or interference in a neighboring well.

Dependent claim 15 – same as 8

Claim 20: The non-transitory computer readable medium of claim 16, wherein the formation response data comprises measurements of one or more of pressure, temperature, flow, dynamic strain, static strain, acoustic intensity, resistivity, or electromagnetic signals or frequency, amplitude or phase of any of the signals,

and the representative system model predicts a proxy value comprising one or more of a cluster efficiency, a complexity factor, or a proximity index, and the predicted proxy value is used to control one or more of a uniform flow across perforation clusters, a formation complexity, or interference in a neighboring well.

[Claims 7/14 and 8/15 combined]

Level of Ordinary Skill

“As of September 17, 2019, a person of ordinary skill in the art (‘POSITA’) would have had a B.S. in Chemical Engineering, Mechanical Engineering, Materials Science, or Metallurgical Engineering or an equivalent field and at least two years of academic or industry experience in the oil and gas industry, including experience with process control systems. Further, a person with additional education but less professional experience, and vice-versa, may qualify.”

Pet. at 23-24; Nikolaou Decl. [EX-1003] at ¶ 4; ID at 5

The Asserted Grounds

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–4, 6–7, 9–12, 14, 16–19	103	Pankaj, Payne
5, 6, 13	103	Pankaj, Payne, Dawson
8, 15, 20	103	Pankaj, Payne, Lecerf
3, 11, 18	103	Pankaj, Payne, Klumpen
1–20	101	Eligibility

Name	Patent Document	Exhibit
Pankaj	U.S. 2018/0230782 A1 (Aug. 16, 2018)	1005
Payne	U.S. 2016/0258267 A1 (Sept. 8, 2016)	1006
Dawson	U.S. 10,378,333 B2 (Aug. 13, 2019)	1024
Lecerf	U.S. 10,087,722 B2 (Oct. 2, 2018)	1027
Klumpen	U.S. 8,352,227 B2 (Jan. 8, 2013)	1019

I.D. (Paper 9) at 3-4; Pet. at 24-25

Ground 5: Invalidity under § 101

Step One: “First, we determine whether the claims at issue are directed to one of those patent-ineligible concepts [laws of nature, natural phenomena, and abstract ideas].”

Step Two: “If so, we then ask, ‘what else is there in the claims before us?’.... To answer that question, we consider the elements of each claim both individually and as an ordered combination to determine whether the additional elements transform the nature of the claim into a patent-eligible application.... We have described step two of this analysis as a search for an ‘inventive concept’ – i.e., an element or combination of elements that is sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the ineligible concept itself.”

Alice Corp. Pty. Ltd. v. CLS Bank Int’l, 573 U.S. 208, 217-18 (2014) (cleaned up)

“The ‘abstract idea’ step of the inquiry calls upon us to look at the **focus of the claimed advance over the prior art** to determine if the claim’s character as a whole is directed to excluded subject matter.” *Affinity Labs of Texas v. DIRECTV*, 838 F.3d 1253, 1257 (Fed. Cir. 2016).

“The ‘abstract idea’ step of the inquiry calls upon us to look at the **focus of the claimed advance over the prior art** to determine if the claim’s character as a whole is directed to excluded subject matter.” *Affinity Labs of Texas v. DIRECTV*, 838 F.3d 1253, 1257 (Fed. Cir. 2016).

“In the oil and gas industry, **electric frac pumps are often controlled** in order to achieve certain downhole environment responses. However, typically **settings are performed manually based on manually appraised information** retrieved from the downhole environment. For example, a **technician may review sensor data and, based on experience, adjust various settings** such as flow rate, pressure values, chemical compositions, etc., on an electric frac pump. In some cases, a **representative system model may be used for determining pump settings based on sensor information**; however, the representative system model is **typically manually selected** by a technician **based on observed sensor data**. Additionally, the representative system model may be a static construct and may not accurately reflect the well to which it has been deployed.” 058 Patent [EX-1001] at 1:11-29 (“Background”).

Pet. Reply at 1; Pet. at 4-5, 83

“The ‘abstract idea’ step of the inquiry calls upon us to look at the **focus of the claimed advance over the prior art** to determine if the claim’s character as a whole is directed to excluded subject matter.” *Affinity Labs of Texas v. DIRECTV*, 838 F.3d 1253, 1257 (Fed. Cir. 2016).

Claim 1: A **computer-implemented method for controlling electrical fracturing equipment for fracturing a well, the method comprising:**

- generating a sequence of stimuli for application to a well environment, the sequence of stimuli comprising one or more of particulate concentrations, chemical concentrations, or a pump rate control;**
- receiving formation response data comprising data from one or more downhole sensors or surface sensors;**
- selecting a representative system model based on the received formation response data and sequence of stimuli; and**
- controlling an electrical fracturing pump based on the representative system model.**

Pet. Reply at 1; Pet. at 86-91

“The focus of the 058 claims is automating fracturing steps.” Pet. Reply at 1.

“The ‘focus of the claimed advance’ is therefore claim 1’s method being ‘computer-implemented.’ This is consistent with the specification explaining that ‘typically’ pump settings were ‘performed manually based on manually appraised information.... [A] technician may review sensor data and ... adjust various settings... [A] representative system model may be used for determining pump settings based on sensor information; however, the ... model is typically manually selected by a technician.’” Pet. Reply at 13.

Pet. Reply at 1, 13

“Claim 1 of the 058 patent covers a ‘computer-implemented method for controlling fracturing equipment’ requiring four steps.... Claim 1 is thus directed to the abstract idea of selecting a plan (‘representative system model’) for a desired result (‘controlling’ a pump) based on information received (‘response data’) in response to one or more inquiries (‘sequence of stimuli’).” Pet. at 87.

“Here, the ‘focus of the claimed advance’ is the automated selection of the system model and controlling the pump based on the system model....” Pet. at 92, n. 6.

“The claims are not directed to any improvements in computers *per se*, but merely to using computers to automate a process that the ’058 patent admits was typically performed manually by technicians.... Thus, as in *IBM*, the 058 patent ‘merely contemplates automation using a computer.’” *IBM v. Zillow Grp.*, 50 F.4th 1371, 1377 (Fed. Cir. 2022). Pet. at 90.

“The purported improvement disclosed in the 058 patent is that in the prior art ‘the representative system model is typically manually selected by a technician based on observed sensor data.’ [1:21-23]. The 058 patent discloses using a computer to do this instead. See claim 1 (requiring a ‘computer-implemented method’ for performing the steps shown in Fig. 4)..... *Alice v. CLS Bank*, 573 US 208, 223 (2014) (‘Stating an abstract idea while adding the words ‘apply it with a computer’ is not enough.); *Data Engine Tech. v. Google*, 906 F.3d 999, 1013 (Fed. Cir. 2018) (‘The mere automation of this [claimed] process does not negate its abstraction.’)” Pet. at 5.

Pet. at 5, 87, 90, 92

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

PROFRAC HOLDING CORPORATION
and
U.S. WELL SERVICES, LLC,
Petitioners,

v.

HALLIBURTON ENERGY SERVICES, INC.,
Patent Owner.

Case PGR2023-00023
Patent No. 11,373,058

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Alexandria, Virginia 22313-1450
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PATENT OWNER'S RESPONSE

UNDER 37 C.F.R. § 42.220

Patent Owner Response

The “Petition’s abstract idea fails to account for the part of the claimed advance involving selecting the representative system model based on the formation response data ... ***and the sequence of stimuli***, which has no counterpart in Petitioner’s alleged abstract idea.” POR at 25 (emphasis in original).

Nothing “in the Background section suggests that it was known to generate a sequence of stimuli for application to a well environment in order to obtain formation response data and then select a representative system model ... based on the received formation response data ***and sequence of stimuli***.” POR at 26 (emphasis in original).

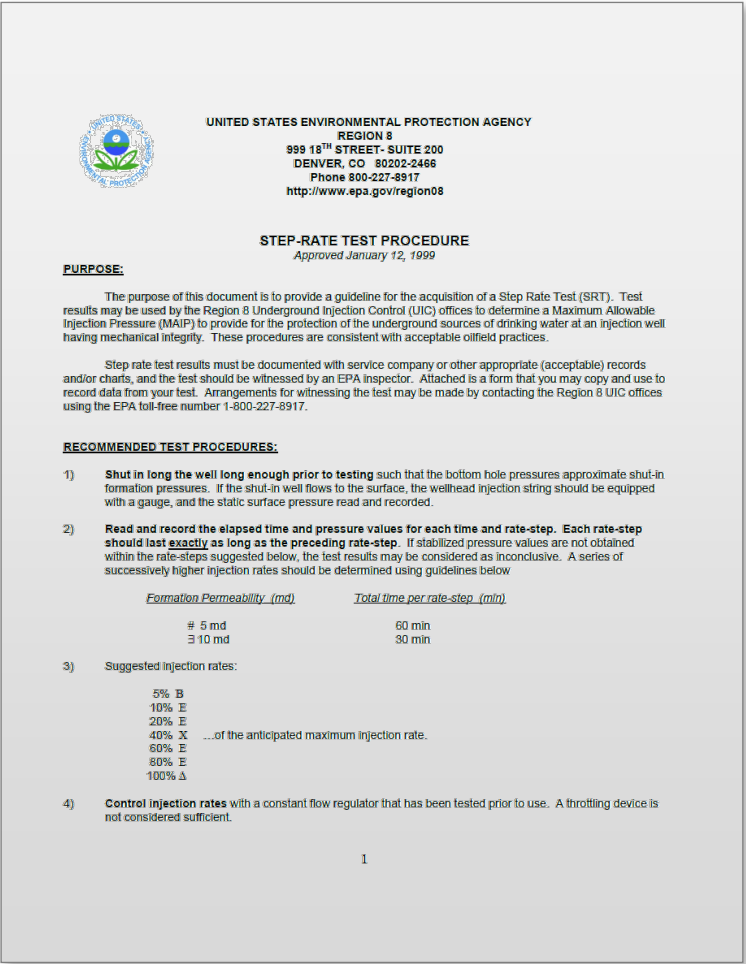
Step-Rate Test Procedure (“sequence of stimuli”)

- “Read and record the elapsed time and pressure values for each time and each rate-step.... A series of successively higher injection rates should be determined.”

Suggested injection rates:

5% B	
10% E	
20% E	
40% X	...of the anticipated maximum injection rate.
60% E	
80% E	
100% Δ	

- “Measure pressures with a down hole pressure bomb.”
- “Record each time step and corresponding pressure.”
- “Once the ISIP [Instantaneous Shut-in Pressure] is obtained, the SRT is concluded.”



EX-1033 (see also EX-1051)

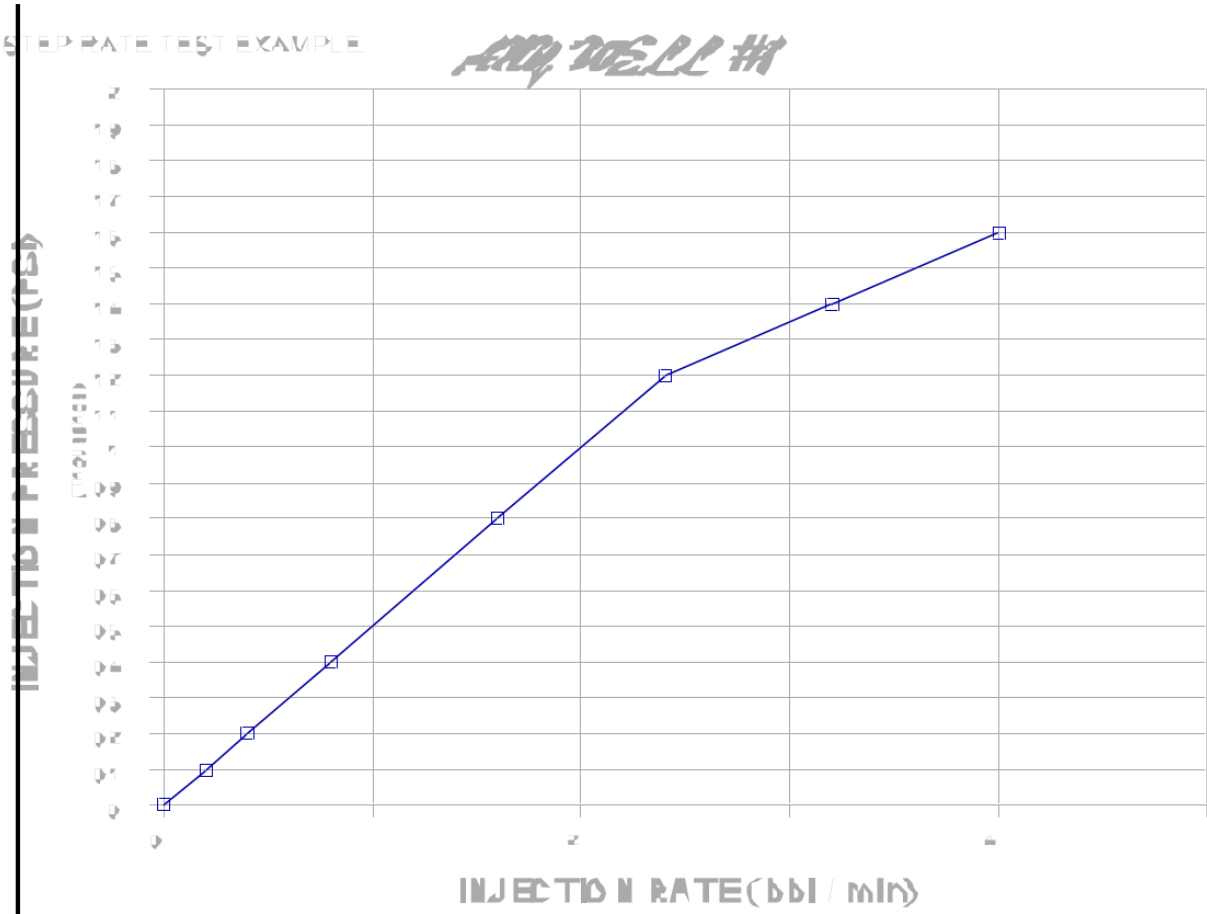
Pet. Reply at 1, 2, 22, 23

Step-Rate Test Procedure (“sequence of stimuli”)

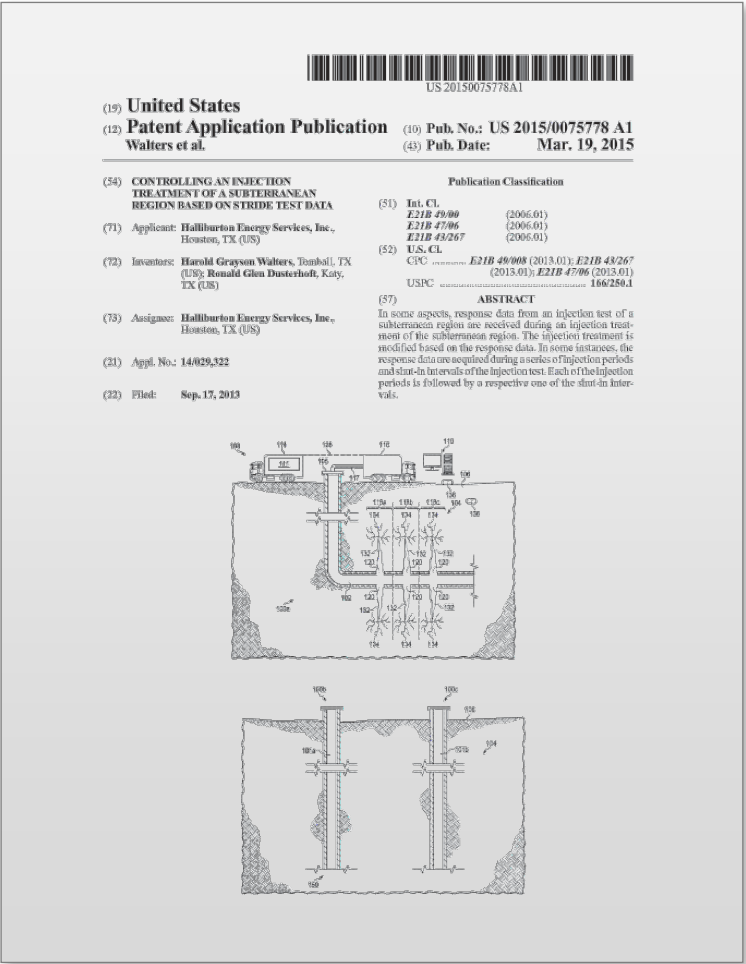
Well: Anywell #1 Date: April 15, 2000 Operator: Lotsa Oil

STEP #1 Test Rate (5% of maximum rate) <u>.2</u> (bbl/min)	
Time (min) :	<u>0</u> <u>5</u> <u>10</u> <u>15</u> <u>20</u> <u>25</u> <u>30</u>
Pressure (psi):	<u>0</u> <u>90</u> <u>95</u> <u>98</u> <u>99</u> <u>100</u> <u>100</u>
STEP #2 Test Rate (10% of maximum rate) <u>.4</u> (bbl/min)	
Time (min) :	<u>0</u> <u>5</u> <u>10</u> <u>15</u> <u>20</u> <u>25</u> <u>30</u>
Pressure (psi):	<u>80</u> <u>170</u> <u>185</u> <u>195</u> <u>199</u> <u>201</u> <u>202</u>
STEP #3 Test Rate (20% of maximum rate) <u>.8</u> (bbl/min)	
Time (min) :	<u>0</u> <u>5</u> <u>10</u> <u>15</u> <u>20</u> <u>25</u> <u>30</u>
Pressure (psi):	<u>190</u> <u>320</u> <u>385</u> <u>392</u> <u>398</u> <u>403</u> <u>404</u>
STEP #4 Test Rate (40% of maximum rate) <u>1.6</u> (bbl/min)	
Time (min) :	<u>0</u> <u>5</u> <u>10</u> <u>15</u> <u>20</u> <u>25</u> <u>30</u>
Pressure (psi):	<u>380</u> <u>700</u> <u>790</u> <u>792</u> <u>798</u> <u>803</u> <u>805</u>
STEP #5 Test Rate (60% of maximum rate) <u>2.4</u> (bbl/min)	
Time (min) :	<u>0</u> <u>5</u> <u>10</u> <u>15</u> <u>20</u> <u>25</u> <u>30</u>
Pressure (psi):	<u>751</u> <u>990</u> <u>1032</u> <u>1093</u> <u>1155</u> <u>1188</u> <u>1202</u>
STEP #6 Test Rate (80% of maximum rate) <u>3.2</u> (bbl/min)	
Time (min) :	<u>0</u> <u>5</u> <u>10</u> <u>15</u> <u>20</u> <u>25</u> <u>30</u>
Pressure (psi):	<u>1133</u> <u>1250</u> <u>1326</u> <u>1370</u> <u>1397</u> <u>1399</u> <u>1403</u>
STEP #7 Test Rate (100% of maximum rate) <u>4.0</u> (bbl/min)	
Time (min) :	<u>0</u> <u>5</u> <u>10</u> <u>15</u> <u>20</u> <u>25</u> <u>30</u>
Pressure (psi):	<u>1350</u> <u>1448</u> <u>1503</u> <u>1530</u> <u>1571</u> <u>1590</u> <u>1600</u>
ISIP : <u>1000</u> (psi)	

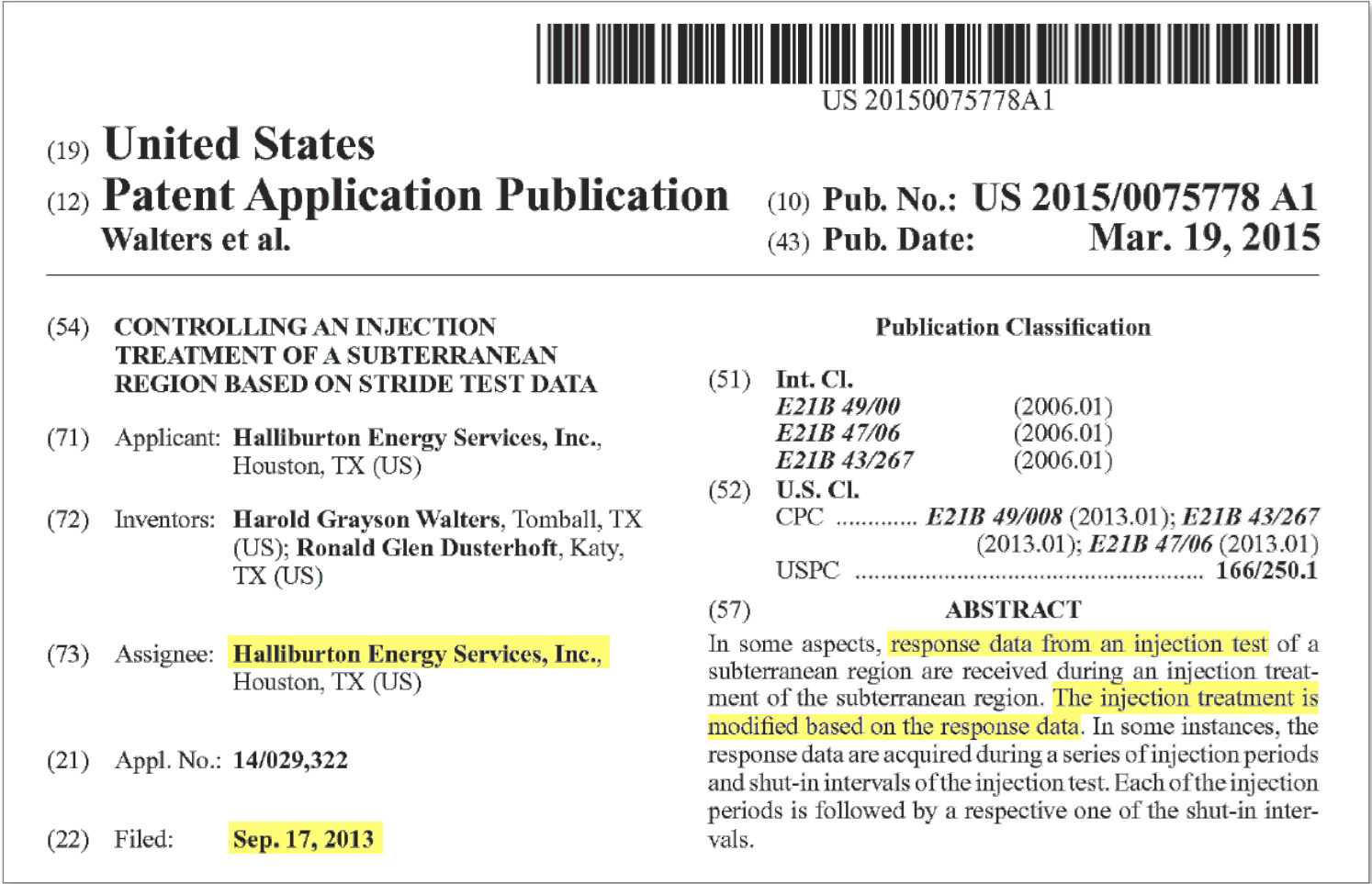
EX-1033 (see also EX-1051)



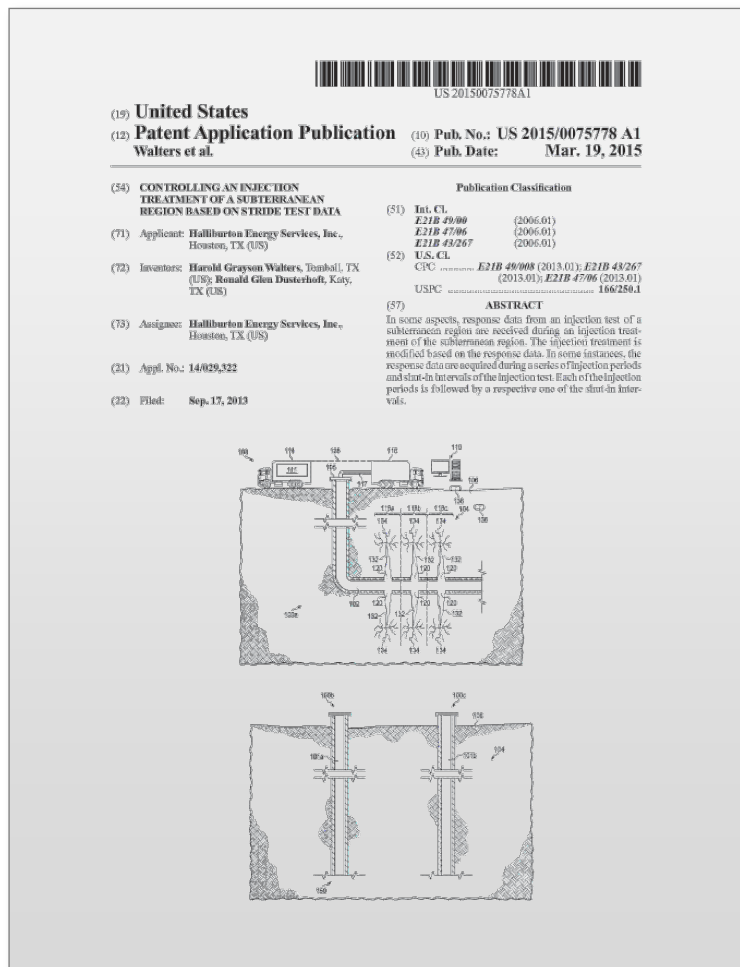
Pet. Reply at 1, 2, 22, 23; Nikolaou Supp. Decl. [EX-1050] at ¶¶ 6-13



EX-1038



Pet. Reply at 4-8, 11; Nikolaou Supp. Decl. [EX-1050] at ¶ 18



EX-1038

“Injection tests are sometimes performed before a fracture treatment. Conventional injection tests include step-rate tests, mini-fracture tests...” [0002]

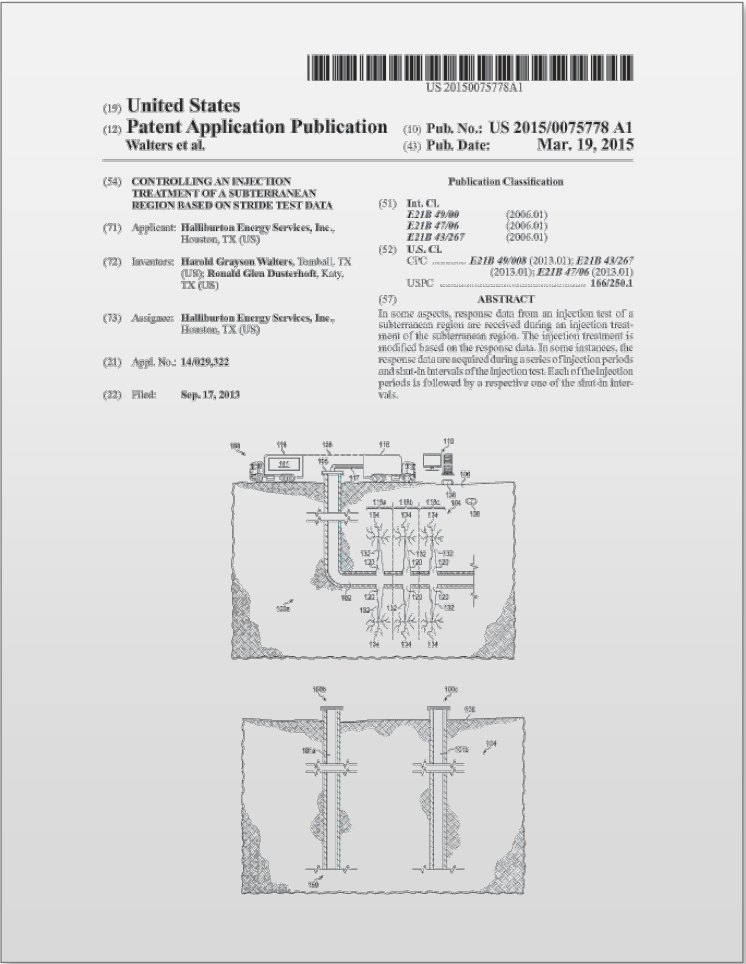
“[A]n injection test includes a controlled injection sequence that is calibrated to induce a measurable response from the subterranean region 104.” [0018]

“The injection test can employ various injection rates and injection materials to test and measure the response of the subterranean region 104 to the varied materials.” [0037]

“[A] measurement system can acquire pressure data from the wellbore 102 during the injection test, and the pressure data can be analyzed to determine ... properties of the subterranean region 104....” [0017]

“Data from the injection test can provide information about the subterranean region, and the information can be used ... to modify or otherwise design an ongoing or future injection treatment.” [0010]

Pet. Reply at 4-8, 11; Nikolaou Supp. Decl. [EX-1050] at ¶ 18



EX-1038

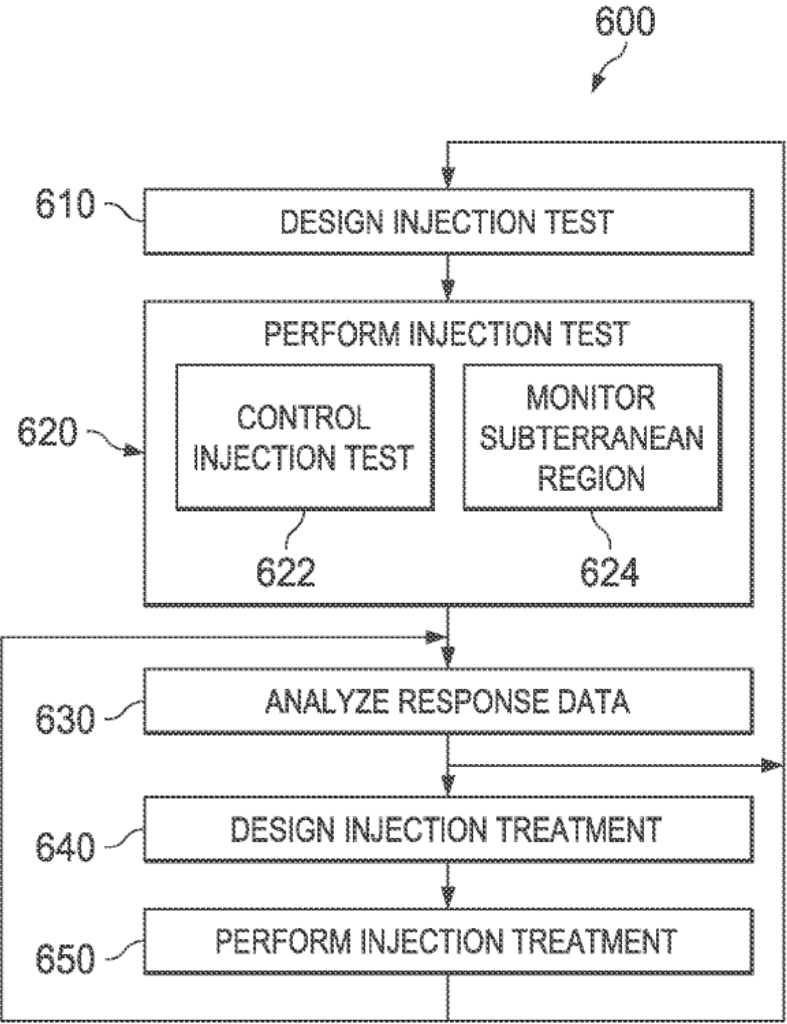


FIG. 6

Pet. Reply at 4-8, 11; Nikolaou Supp. Decl. [EX-1050] at ¶ 18

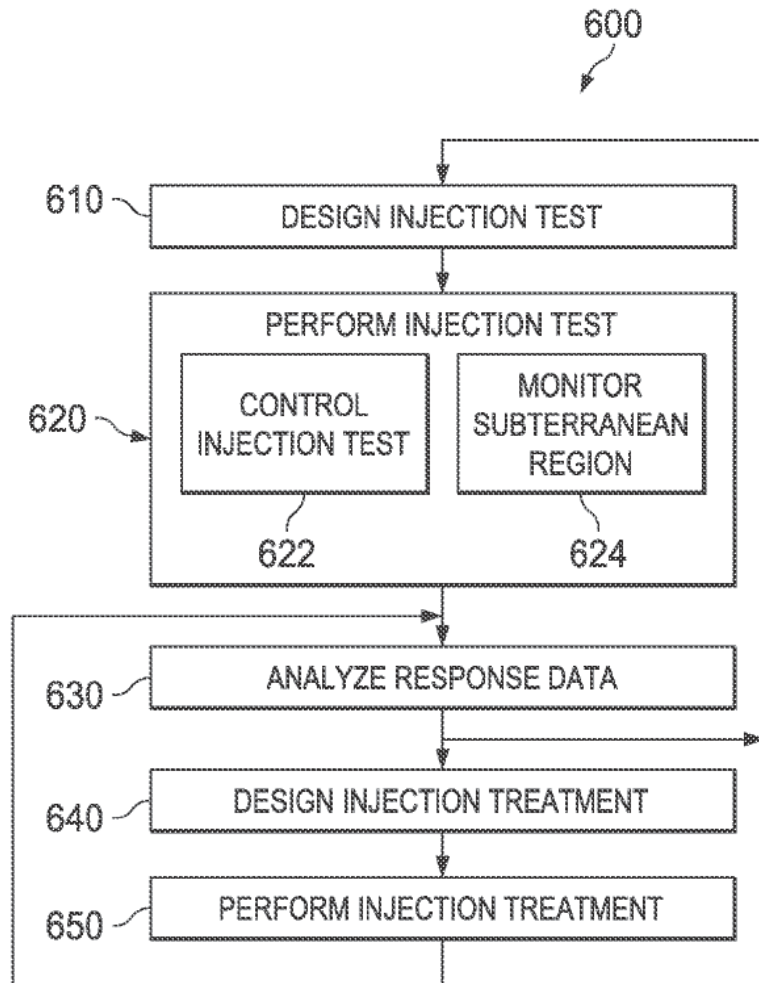


FIG. 6

EX-1038

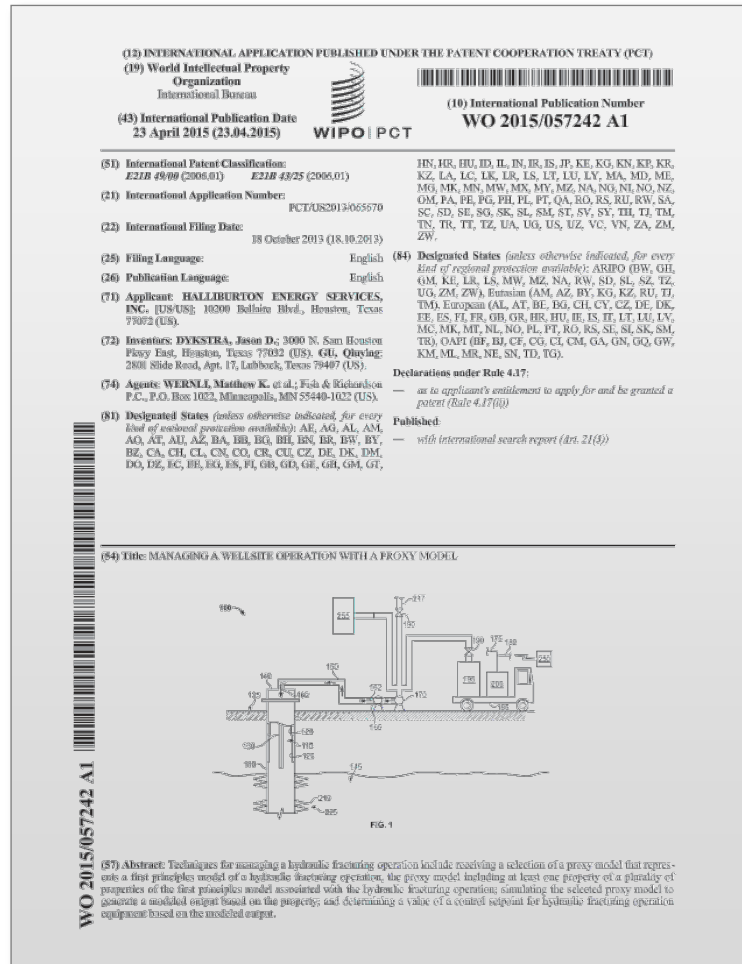
“[T]he data 254 include **injection test data** relating to an injection test.... [T]he injection test data can include pressure data, flow data, seismic data, or a combination of these and other types of response data **acquired during an injection test.**” [0045]

“The injection control subsystem 111 may receive data collected from the subterranean region 104 ... and ... may process the data or otherwise use the data to **select or modify parameters of ... [a] treatment to be applied** to the subterranean region 104.” [0031]

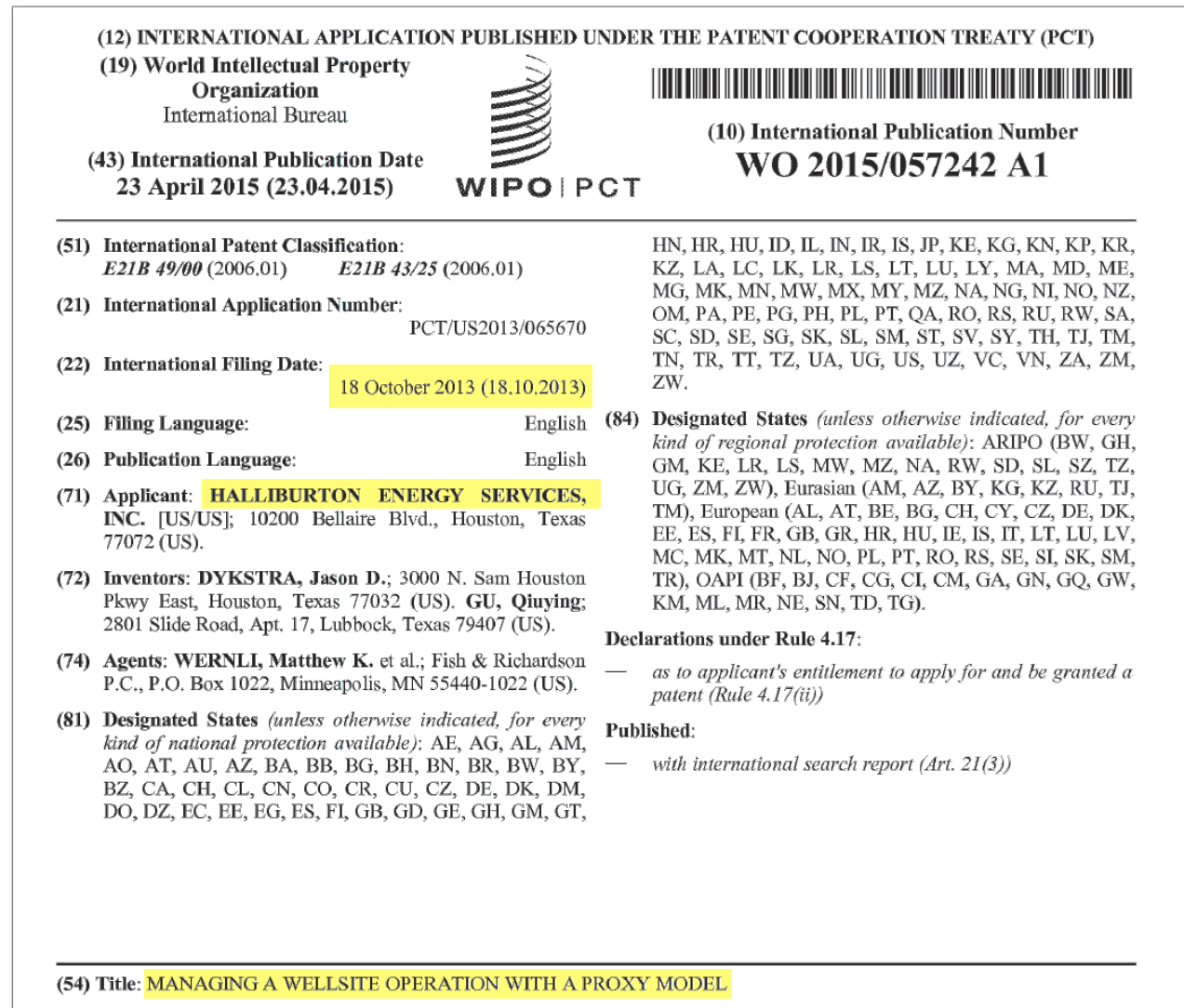
“The analysis and design systems 320,330 can include ... **models** (e.g., fracture models, reservoir models, leak off models, wellbore models, etc.) ... for analyzing the subterranean data and **designing injection tests and treatments.**” [0055]

“At 640, an injection treatment is generated, modified, or otherwise designed.... [T]he injection treatment can be designed **based on the analysis of the response data of the subterranean region to the injection test.**” [0091]

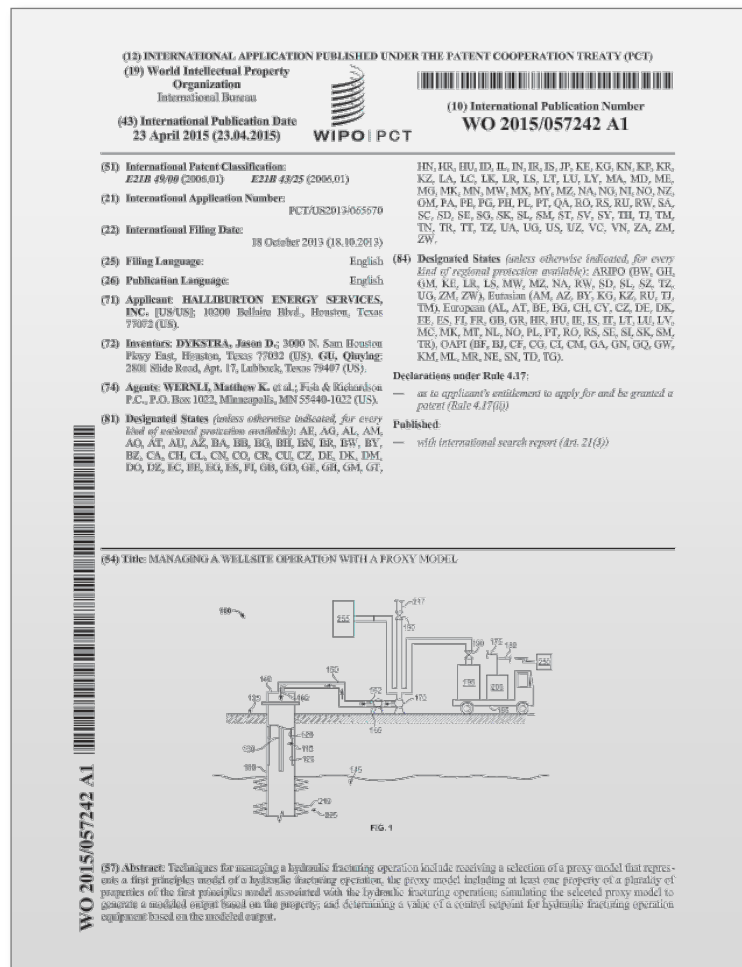
Pet. Reply at 4-8, 11; Nikolaou Supp. Decl. [EX-1050] at ¶¶ 18, 25



EX-1039



Pet. Reply at 7-9, 11; Nikolaou Supp. Decl. [EX-1050] at ¶¶ 26-29



EX-1039

“The present disclosure describes techniques for managing a wellsite operation, such as a hydraulic fracture operation, by using one or more proxy models to determine setpoint controls for operational equipment.” [0029]

“The illustrated system 200 also includes sensors 202 that gather measured or observed data (measurements) 204.” [0046]

“The system 200 also includes a Proxy Model Generator (PMG) 206 that receives, as inputs, the measured properties 204 from the sensors 202. The PMG 206 includes one or more proxy models that can be updated based on the measure[d] properties 204. For example, the PMG 206 may use the measured properties 204 to update parameters within the one or more proxy models of the PMG 206.” [0047]

“[A] model selection algorithm 608 chooses a particular proxy model 610.” [0070].

Pet. Reply at 7-9, 11; Nikolaou Supp. Decl. [EX-1050] at ¶¶ 26-29

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(71) Applicant (for all designated States except US):
STRATAGEN, INC. [US/US]; 575 N. Dairy Ashford, Suite 300, Houston, Texas 77079 (US).

(72) Inventors; and
(75) Inventors/Applicants (for US only): **SHELLEY, Robert** [US/US]; 2131 White Eagle Lane, Katy, Texas 77450 (US). **GULIYEV, Nijat** [AZ/US]; 1950 Eldridge Parkway, Apartment #2210, Houston, Texas 77077 (US). **NEJAD, Amir** [US/US]; 14855 Memorial Drive, Apt. #208, Houston, Texas 77079 (US).

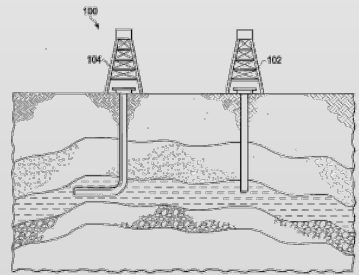
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(54) Title: WELLBORE COMPLETION AND HYDRAULIC FRACTURING OPTIMIZATION METHODS AND ASSOCIATED SYSTEMS



(57) Abstract: Methods and systems for optimizing wellbore completion and, in particular, methods and systems for optimizing hydraulic fracturing parameters are disclosed. In some embodiments, a method of optimizing wellbore completion includes gathering wellbore data, screening and processing the gathered wellbore data, utilizing the screened and processed wellbore data to define an optimized model, and utilizing the optimized model to evaluate combinations of available wellbore completion parameters. In some instances, the optimized model is defined using artificial neural networks, genetic algorithms, and/or boosted regression trees. Further, in some embodiments the combinations of available wellbore completion parameters include hydraulic fracturing parameters, such as number of fractures, fracturing fluid type, proppant type, fracturing volume, and/or other parameters.

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EX-1040

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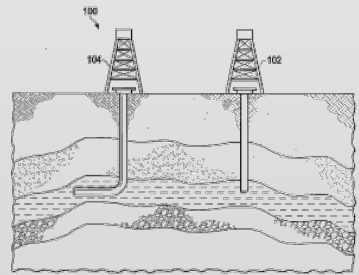
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, 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, 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.

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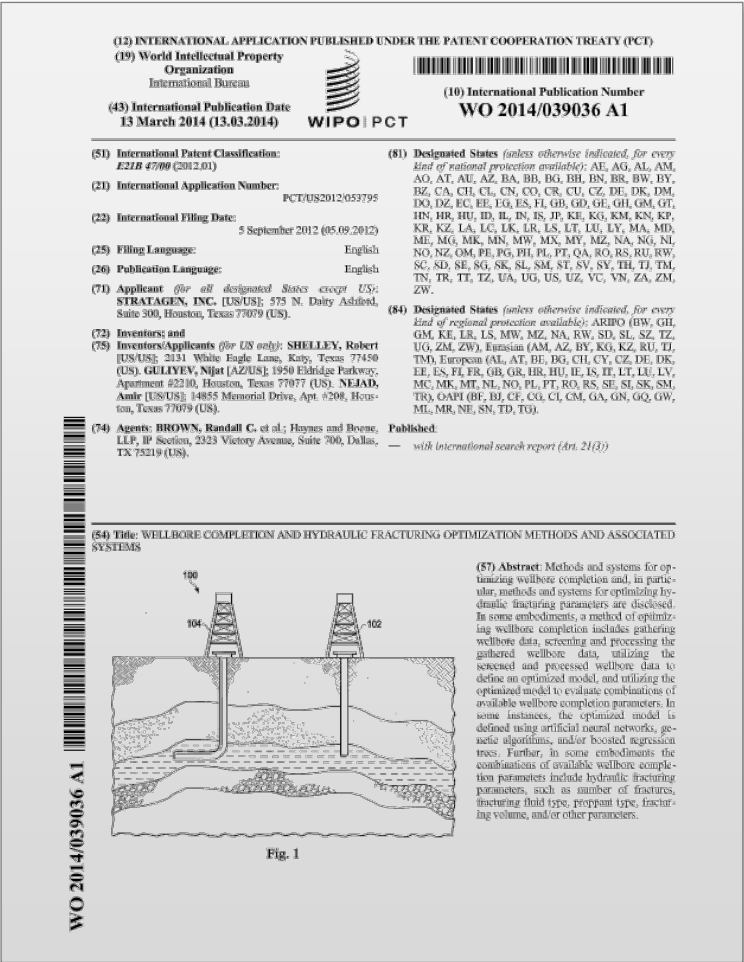
(54) Title: WELLBORE COMPLETION AND HYDRAULIC FRACTURING OPTIMIZATION METHODS AND ASSOCIATED SYSTEMS



(57) Abstract: Methods and systems for optimizing wellbore completion and, in particular, methods and systems for optimizing hydraulic fracturing parameters are disclosed. In some embodiments, a method of optimizing wellbore completion includes gathering wellbore data, screening and processing the gathered wellbore data, utilizing the screened and processed wellbore data to define an optimized model, and utilizing the optimized model to evaluate combinations of available wellbore completion parameters. In some instances, the optimized model is defined using artificial neural networks, genetic algorithms, and/or boosted regression trees. Further, in some embodiments the combinations of available wellbore completion parameters include hydraulic fracturing parameters, such as number of fractures, fracturing fluid type, proppant type, fracturing volume, and/or other parameters.

WO 2014/039036 A1

EX-1040



EX-1040

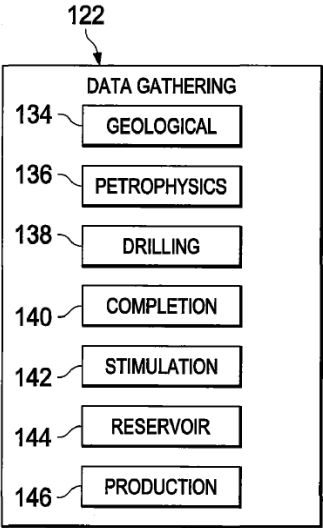


Fig. 4

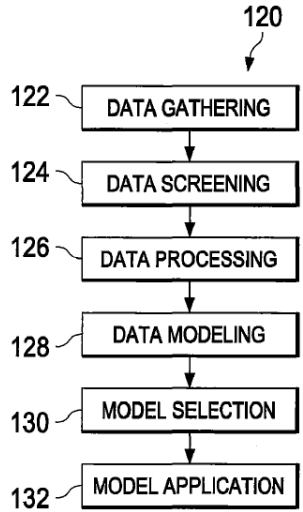


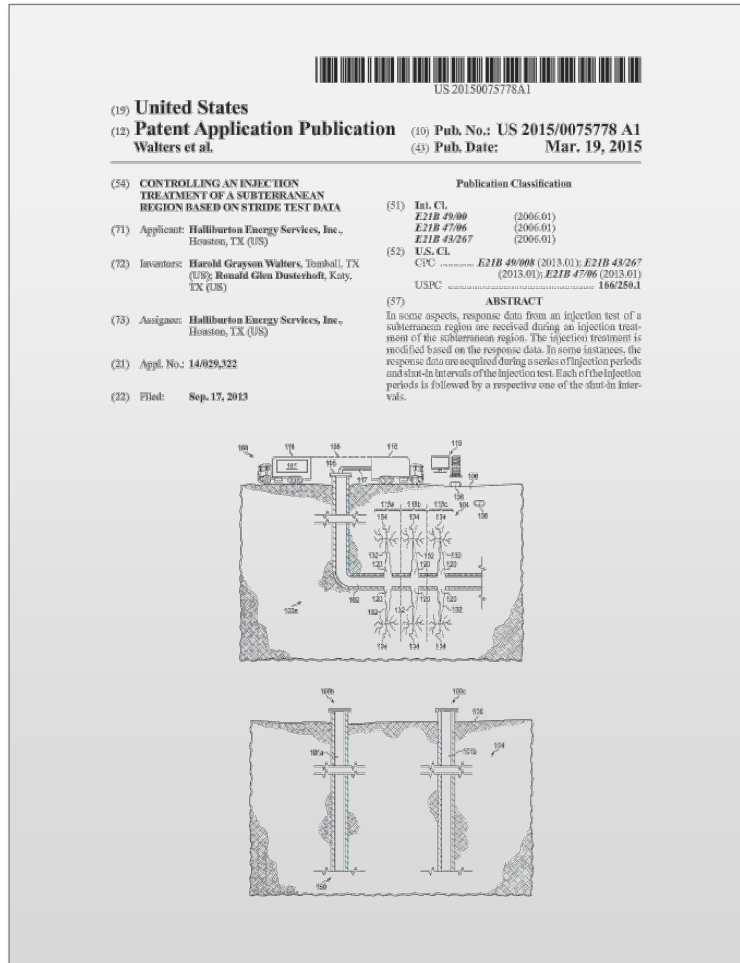
Fig. 3

“[T]he data gathering step 122 includes gathering or obtaining stimulation information 142, such as ... initial and final instantaneous shut-in pressure (ISIP), breakdown pressure, pressure trend, closure pressure, ... and/or other information regarding stimulation.... Accordingly, ... the stimulation information 142 is utilized in a predictive model to estimate the effects of various stimulation options (e.g., hydraulic fracturing parameters) on well production.” [PDF pp. 12-13]

“Referring again to Fig. 3, with the data screened and processed, the method 120 continues to step 128 where data modeling is performed, which leads to model selection at step 130 and then model application at step 132.” [PDF p. 23]

“[T]he methods and systems of the present disclosure can utilize generally any type of model selection to select a best or final model from a plurality of available models.” [PDF p. 26]

Pet. Reply at 9-10 ; Nikolaou Supp. Decl. [EX-1050] at ¶ 30



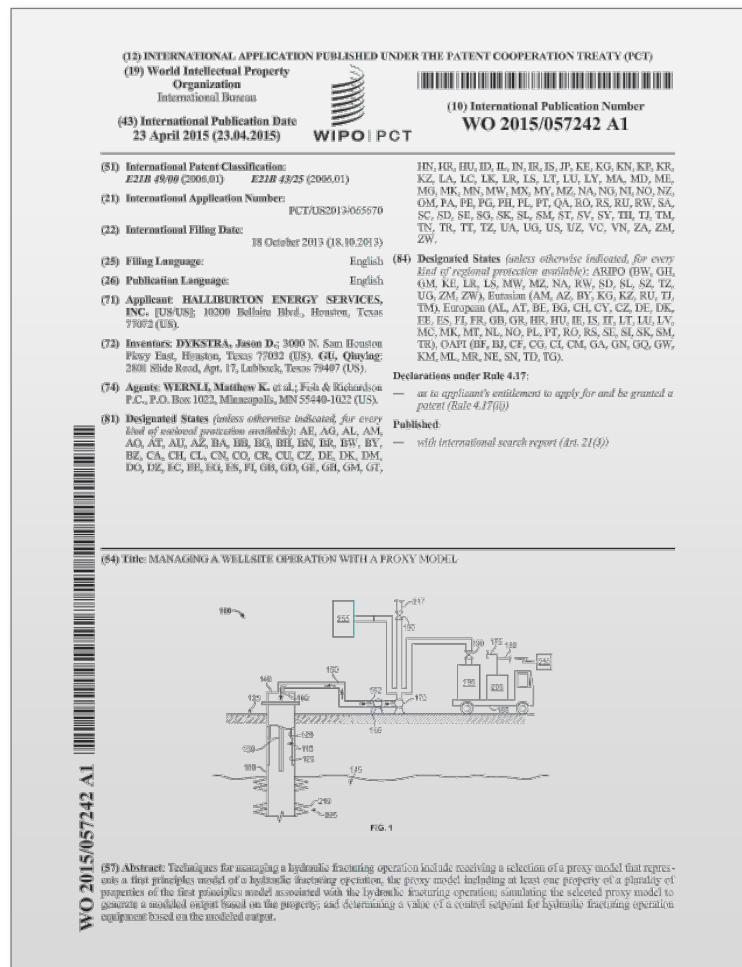
EX-1038

“The injection system 108 may include pump controls or other types of controls for starting, stopping, increasing, decreasing or otherwise controlling pumping as well as controls for selecting or otherwise controlling fluids pumped during the injection treatment. The injection control subsystem 111 may communicate with such equipment to monitor and control the injection treatment.” [0027]

“[T]he injection treatment can be modified, adjusted, or otherwise controlled automatically by an injection control system, manually by a well operator or field engineer, or in a hybrid manner during the treatment.” [0060]

“[T]he injection treatment can be updated or modified in real time or dynamically, for example, based on response data from an injection test during the injection treatment.” [0094]

Pet. Reply at 4-8, 11; Nikolaou Supp. Decl. [EX-1050] at ¶ 33

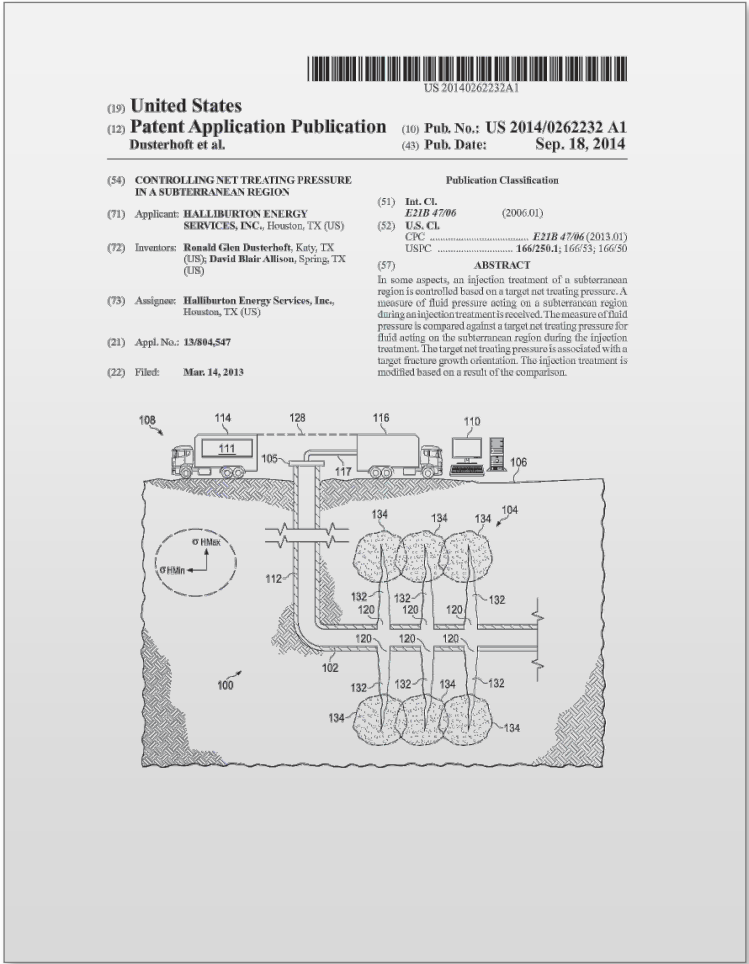


“[A] control system ... may automate a wellsite operation (e.g., a hydraulic fracturing process), thereby reducing cost and/or computational burden.... [O]ne or more proxy models may be used within a control system that controls (e.g., all or partially) the wellsite operation in real time may be generated...” [0027]

“[T]he computing environment 250 may control valves 190 that modulate a flow of the liquid source 217 and/or the gel source 195, as well as control one or more pumps such as pumps 165 and 170.” [0041]

EX-1039

Pet. Reply at 7-9, 11; Nikolaou Supp. Decl. [EX-1050] at ¶ 34



EX-1041

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2014/0262232 A1**

(43) **Pub. Date: Sep. 18, 2014**

(54) **CONTROLLING NET TREATING PRESSURE IN A SUBTERRANEAN REGION**

(71) Applicant: **HALLIBURTON ENERGY SERVICES, INC.**, Houston, TX (US)

(72) Inventors: **Ronald Glen Dusterhoft**, Katy, TX (US); **David Blair Allison**, Spring, TX (US)

(73) Assignee: **Halliburton Energy Services, Inc.**, Houston, TX (US)

(21) Appl. No.: **13/804,547**

(22) Filed: **Mar. 14, 2013**

Publication Classification

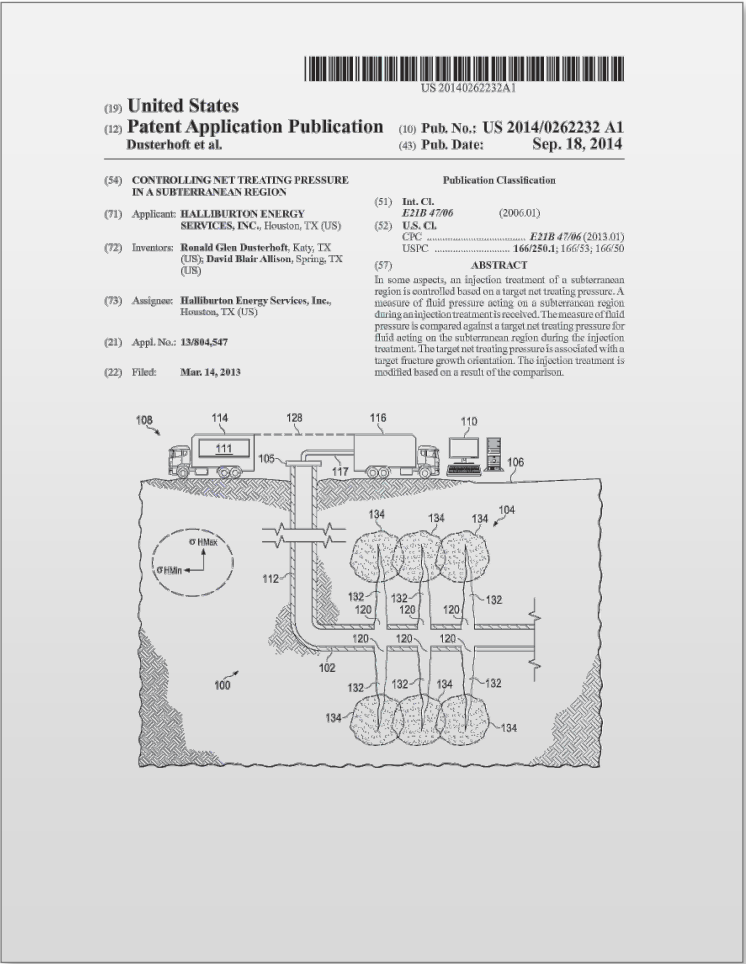
(51) **Int. Cl.**
E21B 47/06 (2006.01)

(52) **U.S. Cl.**
CPC **E21B 47/06** (2013.01)
USPC **166/250.1; 166/53; 166/50**

(57) **ABSTRACT**

In some aspects, an injection treatment of a subterranean region is controlled based on a target net treating pressure. A measure of fluid pressure acting on a subterranean region during an injection treatment is received. The measure of fluid pressure is compared against a target net treating pressure for fluid acting on the subterranean region during the injection treatment. The target net treating pressure is associated with a target fracture growth orientation. The injection treatment is modified based on a result of the comparison.

Pet. Reply at 11-13; Nikolaou Supp. Decl. [EX-1050] at ¶¶ 35-36



EX-1041

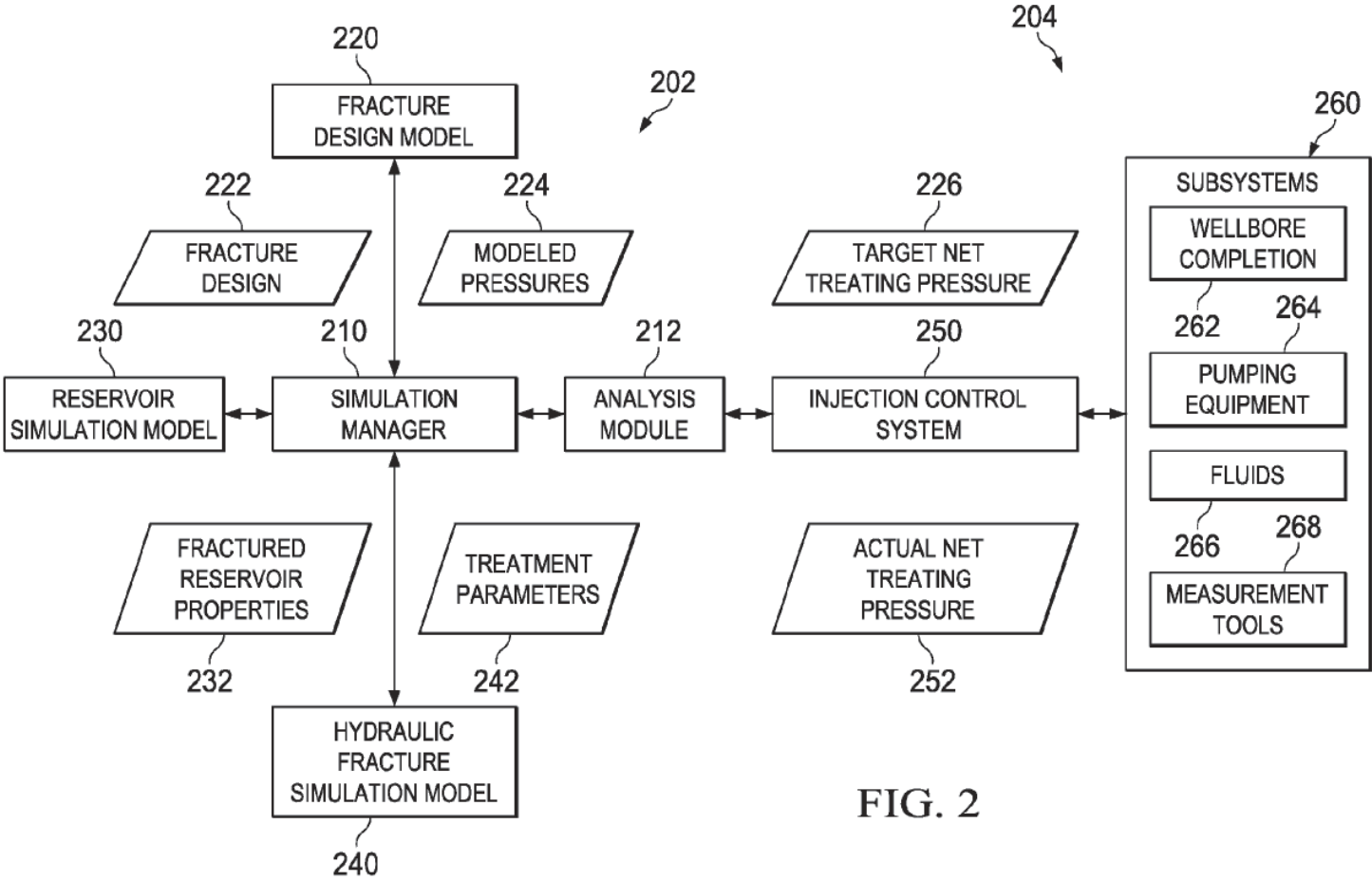


FIG. 2

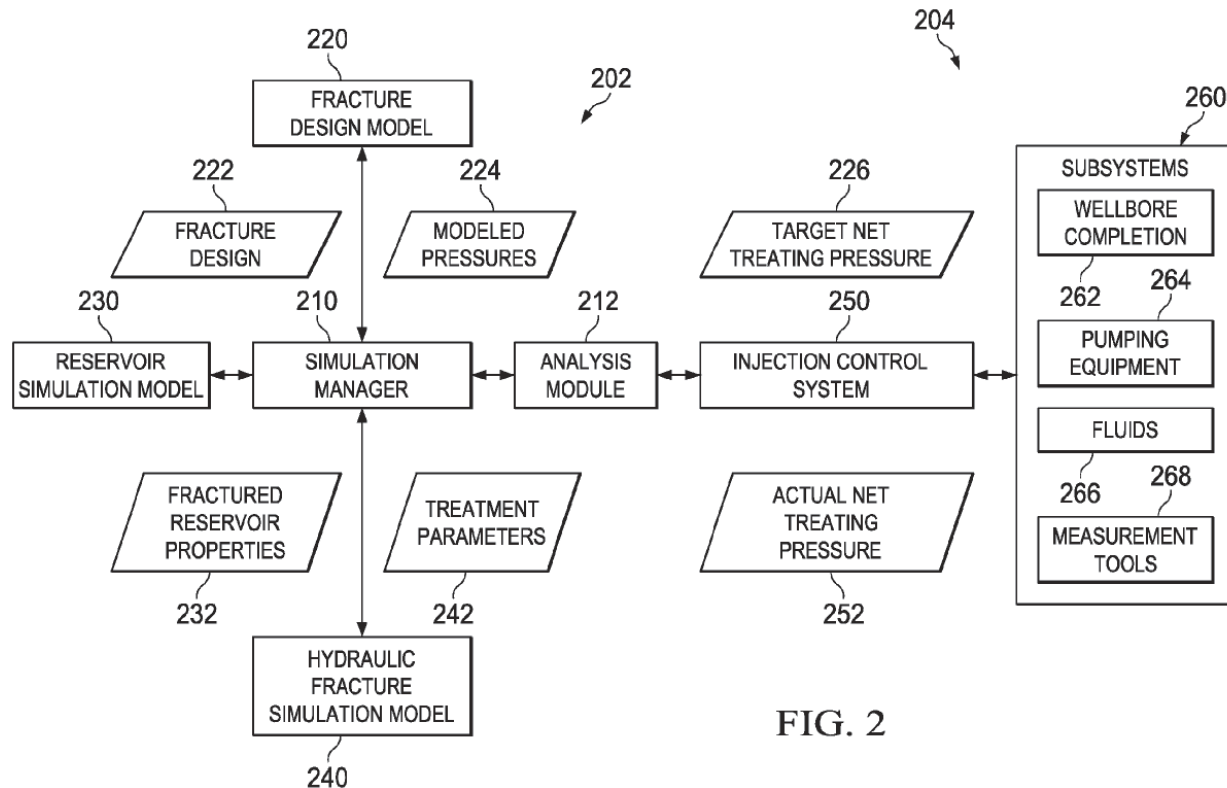


FIG. 2

“The injection treatment control subsystem 111 may receive, generate or modify an injection treatment plan (e.g., a **pumping schedule**) that specifies properties of an **injection treatment to be applied** to the subterranean region 104.” [0030]

“The injection control system 250 can control operations of the subsystems 260. The injection control system 250 may include a user interface that can be operated by a user to access, input, modify, or otherwise manipulate the injection parameters; the injection control system 250 may include **computer-implemented algorithms that can automatically control the subsystems 260**; or injection control system 250 can operate based on a combination of computer-implemented algorithms and user-controlled criteria. The injection control system 250 can include one or more features of the injection treatment control subsystem 111....” [0068]

EX-1041

Pet. Reply at 11-13; Nikolaou Supp. Decl. [EX-1050] at ¶¶ 35-36

“The ‘abstract idea’ step of the inquiry calls upon us to look at the focus of the claimed advance over the prior art to determine if the claim’s character as a whole is directed to excluded subject matter.” *Affinity Labs of Texas v. DIRECTV*, 838 F.3d 1253, 1257 (Fed. Cir. 2016).

Data Engine Tech. v. Google, 906 F.3d 999, 1013 (Fed. Cir. 2018) (“The mere automation of this [claimed] process does not negate its abstraction.”).

“[M]erely limiting the field of use of the abstract idea to a particular existing technological environment does not render the claims any less abstract.” *Chamberlain Grp. v. Techtronic Indus. Co.*, 935 F.3d 1341, 1347 (Fed. Cir. 2019).

“The claims ... are directed to a specific combination of a type of washing unit, information detector, and control unit, configured in a certain way to create technical improvements to systems for washing jet engines.... [H]ere, the system itself is new.” *EcoServices v. Certified Aviation Services*, 830 F. App’x 634, 643, 645 (Fed. Cir. 2020).

Pet. at 5, 85-86, 97; Pet. Reply at 1, 16-17; ID at 21

Automation Middleware Sols. Inc. v. Invensys Sys., 2017 U.S. Dist. LEXIS 233266, *26-26 (E.D. Tex. March 31, 2017), *aff'd*, 737 F. App'x 1005 (Fed. Cir. 2018):

[Claim 1] A method of moving an object in a desired manner using a motion control device from a group of supported motion control devices, comprising the steps of:

- (i) selecting a software driver from a plurality of software drivers, each of the plurality of software drivers comprising driver code to control one or more motion control devices;
- (ii) generating a control command based on an application program and the driver code of the selected software driver; and
- (iii) operating the selected motion control device in accordance with the control command to move the object.

“That Defendants offer varying formulations of the alleged abstract idea is not fatal to their motion because ‘[a]n abstract idea can generally be described at different levels of abstraction.’ *Apple, Inc. v. Ameranth, Inc.*, 842 F.3d 1229, 1240 (Fed. Cir. 2016).” *Id.* at *24.

“Claim 1 ... does not contain an inventive concept.... [T] the claim is directed to the result—that the commands are generated and the object is moved—and not to a particular way of accomplishing it.” *Id.* at *29-30.

Pet. at 5, 85-86, 97; Pet. Reply at 1, 16-17; ID at 21

***Ficep Corp. v. Peddinghaus Corp.*, 2023 U.S. App. LEXIS 21842 (Fed. Cir. Aug. 21, 2023), *cert. denied*, 2024 U.S. LEXIS 1485 (April 1, 2024)**

With prior methods of manufacturing a component from a CAD model, “a human operator typically must program manually the manufacturing machines associated with an assembly line based on the computer-aided design display.” *Id.* at *2.

The patent’s proposed solution to improve efficiency and accuracy, lower cost, and “eliminate the possibility of operator error when providing instructions to automated assembly line equipment” is to remove the human operator from the data transfer equation and instead automatically extract and transfer information from the design model to the manufacturing machine. *Id.* at *3.

Pet. Reply at 16; Pet. at 83

058 Patent

“In the oil and gas industry, electric frac pumps are often controlled in order to achieve certain downhole environment responses. However, typically settings are performed manually based on manually appraised information retrieved from the downhole environment. For example, a technician may review sensor data and, based on experience, adjust various settings such as flow rate, pressure values, chemical compositions, etc., on an electric frac pump. In some cases, a representative system model may be used for determining pump settings based on sensor information; however, the representative system model is typically manually selected by a technician based on observed sensor data. Additionally, the representative system model may be a static construct and may not accurately reflect the well to which it has been deployed.” 058 Patent at 1:11-29 (“Background”).

***Ficep Corp. v. Peddinghaus Corp.*, 2023 U.S. App. LEXIS 21842 (Fed. Cir. Aug. 21, 2023), *cert. denied*, 2024 U.S. LEXIS 1485 (April 1, 2024)**

Claim 7: An apparatus for automatic manufacture of an object, comprising:

a computing device adapted to create a design model of an object...

a programmable logic controller in communication with the computing device and [a] manufacturing machine...

a receiver ... for receiving the design model...

a processor which ... extracts from the design model a plurality of dimensions of components...

a transmitter ... for transmitting the ... dimensions to the ... manufacturing machine...

[the] manufacturing machine manufactures the components based at least in part on the transmitted ... dimensions. *Id.* at *3-4.

Pet. Reply at 16

058 Patent

Claim 1: A computer-implemented method for controlling electrical fracturing equipment for fracturing a well, the method comprising:

generating a sequence of stimuli for application to a well environment, the sequence of stimuli comprising one or more of particulate concentrations, chemical concentrations, or a pump rate control;

receiving formation response data comprising data from one or more downhole sensors or surface sensors;

selecting a representative system model based on the received formation response data and sequence of stimuli; and

controlling an electrical fracturing pump based on the representative system model.

***Ficep Corp. v. Peddinghaus Corp.*, 2023 U.S. App. LEXIS 21842 (Fed. Cir. Aug. 21, 2023), *cert. denied*, 2024 U.S. LEXIS 1485 (April 1, 2024)**

“We agree with the district court that claim 7 is directed to the patent-ineligible abstract idea of extracting and transferring information from a design file to a manufacturing machine.” *Id.* at *6.

“Here, the focus of the claimed advance, as the patent specification indicates, is automating a previously manual process of transferring information from a CAD design model to a manufacturing machine.” *Id.* at *7.

Pet. Reply at 1, 16; Pet. at 87, 92

Petitioners

“Claim 1 of the 058 patent covers a ‘computer-implemented method for controlling fracturing equipment’ requiring four steps.... Claim 1 is thus directed to the abstract idea of selecting a plan (‘representative system model’) for a desired result (‘controlling’ a pump) based on information received (‘response data’) in response to one or more inquiries (‘sequence of stimuli’).” Pet. at 87.

“Here, the ‘focus of the claimed advance’ is the automated selection of the system model and controlling the pump based on the system model...” Pet. at 92, n. 6.

“The focus of the 058 claims is automating fracturing steps.” Pet. Reply at 1.

***Ficep Corp. v. Peddinghaus Corp.*, 2023 U.S. App. LEXIS 21842 (Fed. Cir. Aug. 21, 2023), cert. denied, 2024 U.S. LEXIS 1485 (April 1, 2024)**

“Here, the focus of the claimed advance, as the patent specification indicates, is automating a previously manual process of transferring information from a CAD design model to a manufacturing machine. The manual activity required a human to identify and extract information from a design model and transfer the information to a manufacturing machine.... The '719 patent is a quintessential 'do it on a computer' patent....” *Id.* at *7-8.

“[W]hen focusing on the relevant aspect of the claims—automatically providing information to a manufacturing machine—we do not see any difference between the manual process and the automated process, other than performance of the step by a computer.” *Id.* at *10-11.

“Ficep also analogizes its claims to those in *Diamond v. Diehr*, 450 U.S. 175 [] (1981) and other inventions directed to ‘real world’ systems.... But the claims in these cases were patent eligible because ... they recited specific means for technological improvements.... In contrast, the claims of the '719 patent do not recite any means of technical improvements to an existing process. While the '719 patent eliminates human error by automating the data transfer step, this type of improvement does not make the claims patent eligible.... [M]ere automation of manual processes using generic computers does not constitute a patentable improvement in computer technology.” *Id.* at *13-14.

Pet. Reply at 16

The “inquiry is not whether the claimed invention as a whole is unconventional or non-routine,” but “whether the claim limitations other than the invention’s use of the ineligible concept to which it was directed were well-understood, routine and conventional.” *BSG Tech LLC v. Buyseasons, Inc.*, 899 F.3d 1281, 1290 (Fed. Cir. 2018).

The claims “amount to nothing more than applying the ... abstract idea using techniques that are, whether considered individually or as an ordered combination, well-understood, routine, and conventional.” *cxLoyalty Inc. v. Maritz Holdings Inc.*, 986 F.3d 1367, 1377 (Fed. Cir. 2021).

Pet. at 5, 85-86, 97; Pet. Reply at 1, 16-17

Claim 2: The method of claim 1, wherein the representative system model is retrieved from a data store based the received formation response data.

058 Patent

“Treatment optimization system may retrieve system models from model store 304 and store updated system models in model store 304, which may be a local data store, such as a local memory, or a remote data store, such as networked memory or storage.”
[7:17-21]

Alice Corp. Pty. Ltd. v. CLS Bank, 573 U.S. 208, 226 (2014) (holding that a “data storage unit” is “purely functional and generic” and does not offer a “meaningful limitation beyond generally linking” the use of the method to “implementation via computers”).

“[A] POSITA would immediately understand that in computer-controlled systems like those described in the prior art, the system models would be stored in computer memory.” Nikolaou Supp. Decl. [EX-1050] at ¶¶ 41-43; Nikolaou Decl. [EX-1003] at ¶¶ 192-193.

Pet. at 99; Pet. Reply at 19

Claim 2: The method of claim 1, wherein the representative system model is retrieved from a data store based the received formation response data.

058 Patent

“Treatment optimization system may retrieve system models from model store 304 and store updated system models in model store 304, which may be a local data store, such as a local memory, or a remote data store, such as networked memory or storage.”
[7:17-21]

“[T]he injection control subsystem 111 may process the [injection test] data or otherwise **use the data to select or modify ... treatment** to be applied to the subterranean region 104.” EX-1038, [0031].

“The **memory 250** ... includes data 254 and applications 258.... The applications 258 can include a **fracture design model**, a reservoir simulation tool, a **fracture simulation model**, or any other appropriate applications.” *Id.* at [0043].

The method includes “**model selection at step 130** and then model application at step 132.” EX-1040.0023; *see* .0026 (“[I]t is understood that the methods and systems of the present disclosure can utilize generally any type of model selection to select a best or final model from a plurality of available models.”).

EX-1039 at [0046], [0047]; EX-1018, Fig. 6, [0067]

Pet. at 99; Pet. Reply at 19; Nikolaou Supp. Decl. [EX-1050] at ¶¶ 39-43

Claim 4: The method of claim 1, wherein selecting the representative system model further comprises: determining one of a linear or a non-linear relationship between the sequence of stimuli and received formation response data; and updating the one of the linear or the non-linear relationship based on multiple iterations of the generated sequence of stimuli.

058 Patent

“The generated representative system model may be based on a determined linear or non-linear relationship between system model inputs (e.g., stimuli) and representative system model outputs (e.g., response variables), where a control algorithm is updated (e.g., via curve fitting, etc.) to achieve certain formation responses.” [3:56-61]

“[E]very element of claims [4, 12, 19] was a known, conventional element that was previously used in fracturing operations before September 17, 2019.” Nikolaou Decl. [EX-1003] at ¶¶ 192-193; EX-1013, Abstract, ¶ 43.

“A POSITA would have understood that SRTs and mini-frac tests both (1) determine a linear or non-linear relationship between the sequence of stimuli and response data and (2) update the linear or non-linear relationship based on multiple iterations of the sequence of stimuli.” Nikolaou Supp. Decl. [EX-1050] at ¶45.

Pet. at 101-102; Pet. Reply at 20-23; Nikolaou Supp. Decl. [EX-1050] at ¶¶ 44-48

Claim 4: The method of claim 1, wherein selecting the representative system model further comprises: determining one of a linear or a non-linear relationship between the sequence of stimuli and received formation response data; and updating the one of the linear or the non-linear relationship based on multiple iterations of the generated sequence of stimuli.

058 Patent

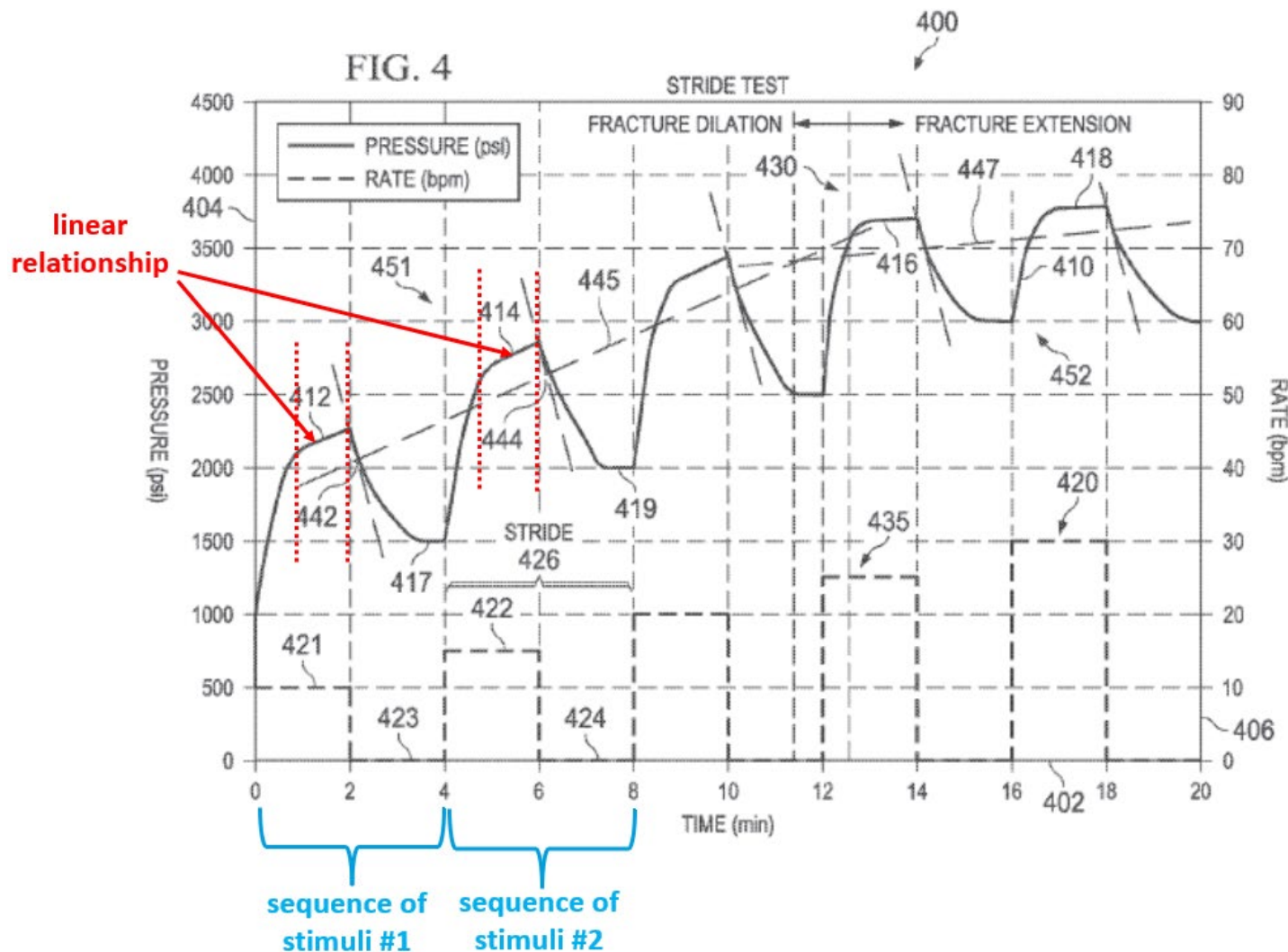
“The generated representative system model may be based on a determined linear or non-linear relationship between system model inputs (e.g., stimuli) and representative system model outputs (e.g., response variables), where a control algorithm is updated (e.g., via curve fitting, etc.) to achieve certain formation responses.” [3:56-61]

“EX-1038 confirms that such injection tests plot the relationship between, e.g., the pump rate(s) and the measured pressure, and repeatedly update the relationship based on multiple changes (‘iterations’) of the pump rate.” Nikolaou Supp. Decl. at ¶ 45.

“[R]esponse data from an injection test of a subterranean region are received.... [T]he response data are acquired during a series of injection periods and shut-in intervals of the injection test.” EX-1038 [Abstract].

“[T]he control subsystem 312 can interact with the monitoring subsystem 314 to control the injection test based on the formation response obtained from the monitoring subsystem 314.” *Id.* at [0053].

Pet. at 101-102; Pet. Reply at 20-23; Nikolaou Supp. Decl. [EX-1050] at ¶¶ 44-48



EX-1038

Pet. at 101-102; Pet. Reply at 20-23; Nikolaou Supp. Decl. [EX-1050] at ¶¶ 44-48

“The example injection test shown in FIG. 4 includes a **succession of injection periods** (e.g., injection periods 421 and 422) and shut-in intervals (e.g., shut-in intervals 423 and 424).” EX-1038 [0064]

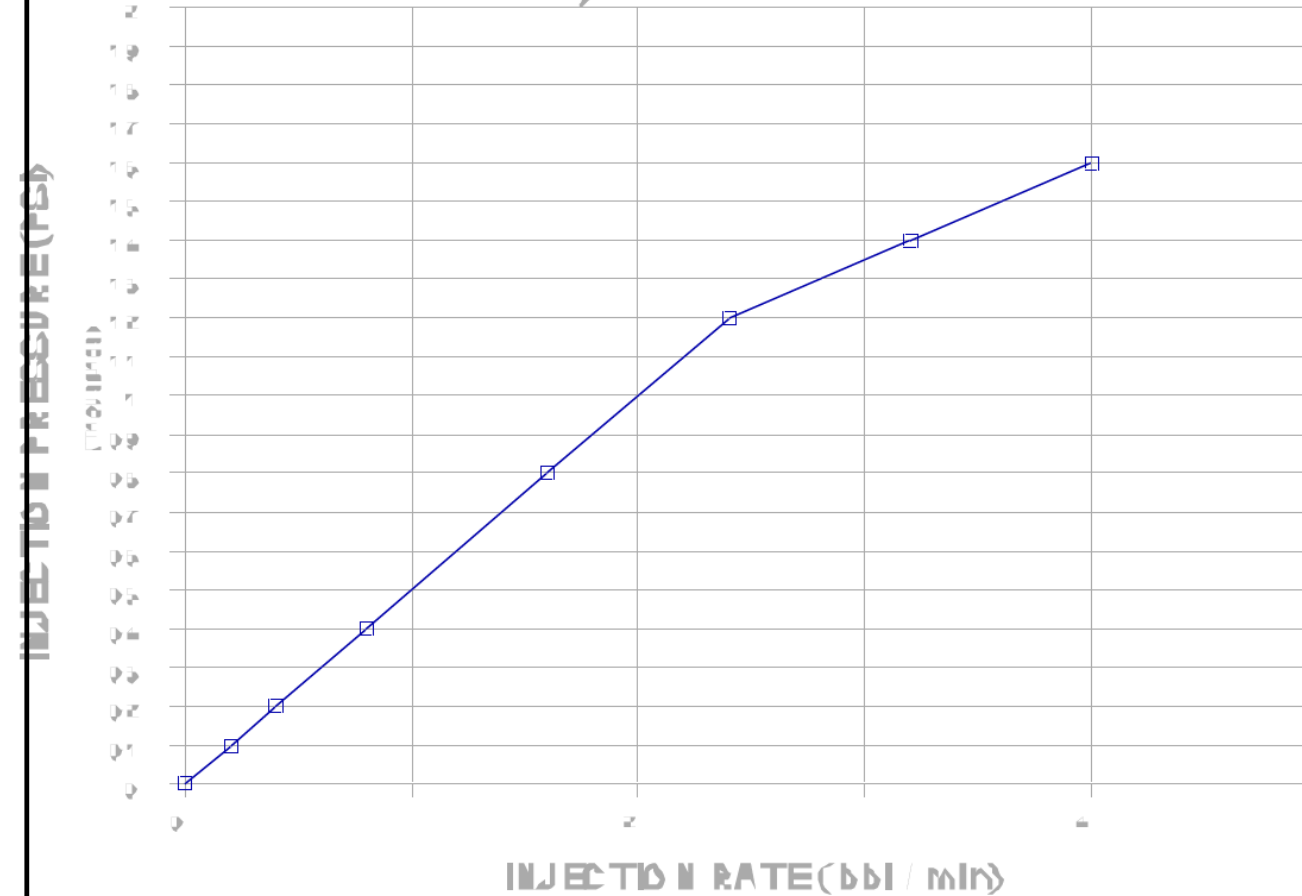
“[E]ach injection period may last at least to a point **where the pressure curve 410 reaches a steady slope** such as the constant slope at 412 and 414.” *Id.* [0067]

“The shape, the decline rate, or other information of the pressure curve 410 can be analyzed to derive formation properties.” *Id.* [0073]

“[T]he injection rate and the duration of each injection period **can be controlled** such that the **pressure reaches a stabilized slope** such as the constant slopes 412 and 414.” *Id.* [0088]

STEP RATE TEST EXAMPLE

ANY WELL #



EX-1033

Pet. at 101-102; Pet. Reply at 20-23; Nikolaou Supp. Decl. [EX-1050] at ¶¶ 44-48

“Plot the injection rates and the corresponding stabilized pressure values. These are graphically represented as a constant slope straight line to a point at which the formation fracture, or breakdown pressure is exceeded. The slope of this subsequent straight line should be less than that of the before-fracture straight line (see example).” EX-1033 at 2.

See also Nikolaou Supp. Decl. [EX-1050] at ¶¶ 47-48 (“[T]hese claims are also directed to well-understood, routine, and conventional technology.”).

Claim 5: The method of claim 1, wherein the data from the one or more downhole sensors or surface sensors is used to determine changes in flow distribution in response to a diverter drop, the changes in flow distribution used to determine the representative system model.

“[U]sing diverters to change flow distribution is using diverters in their conventional manner.” Nikolaou Supp. Decl. [EX-1050] at ¶ 50; Nikolaou Decl. [EX-1003] at ¶¶ 192-193.

“Diverters are used to divert the flow of well treatment fluids (e.g., injection fluids) from perforations taking more fluid to perforations taking less fluid.” EX-1024 [Abstract].

“The diversion process is used to help ensure that stimulation fluids are distributed across the entire interval to be treated.... To accomplish complete coverage, some placement aid may be used to divert the treating fluid from one zone to another.” EX-1046.001.

Pet. at 102-103; Pet. Reply at 23-26

Claim 5: The method of claim 1, wherein the data from the one or more downhole sensors or surface sensors is used to determine changes in flow distribution in response to a diverter drop, the changes in flow distribution used to determine the representative system model.

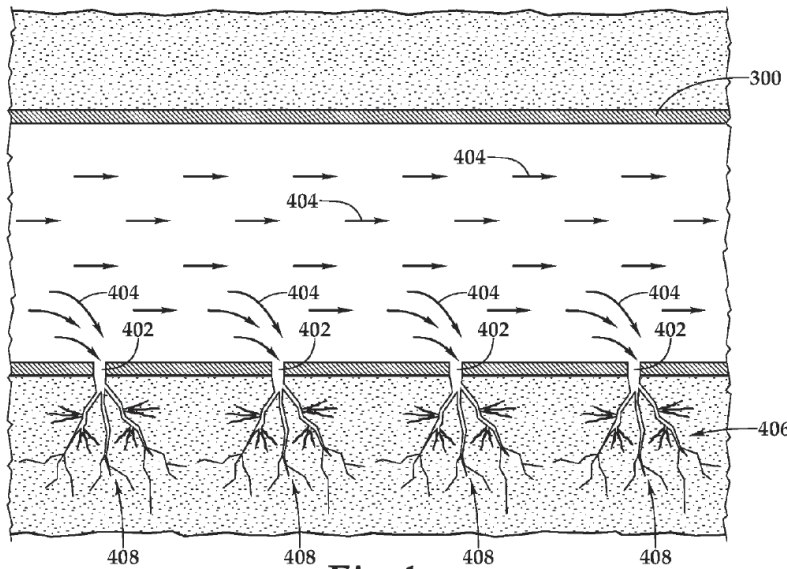


Fig. 4

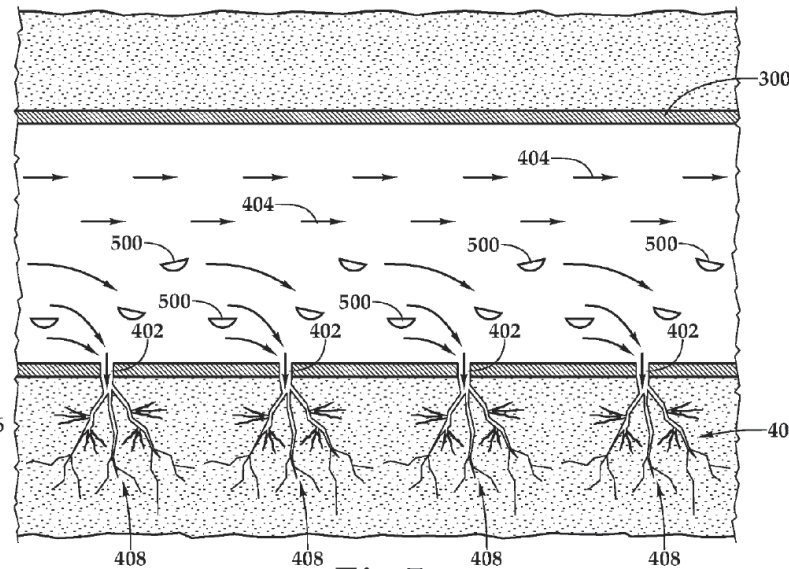


Fig. 5

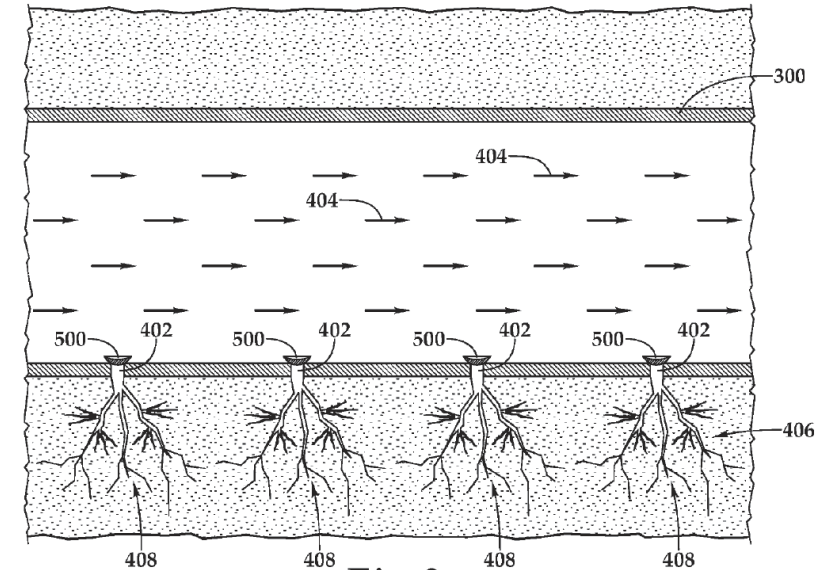


Fig. 6

Nikolaou Supp. Decl. [EX-1050] at ¶¶ 50-51

EX-1045

Pet. at 102-103; Pet. Reply at 23-26

Claim 5: The method of claim 1, wherein the data from the one or more downhole sensors or surface sensors is used to determine changes in flow distribution in response to a diverter drop, the changes in flow distribution used to determine the representative system model.

“It was also common knowledge and conventional to use sensors to measure the well response to diverters.” Nikolaou Supp. Decl. [EX-1050] at ¶ 52.

“[M]onitoring of the treatment is critical for real-time optimization of the diversion process.... [T]he ... most common way to monitor diversion effectiveness is to evaluate the pressure responses during pumping and changes in fracture gradients throughout the stimulation treatment.” EX-1046.016.

“A pressure signal ... may be assessed using a pressure sensor.... The slope in the pressure signal before and after the diverter are provided into the stimulation wellbore may be assessed to determine the effectiveness of the diverter.” EX-1024, Abstract.

Pet. at 102-103; Pet. Reply at 23-26

Claim 5: The method of claim 1, wherein the data from the one or more downhole sensors or surface sensors is used to determine changes in flow distribution in response to a diverter drop, the changes in flow distribution used to determine the representative system model.

“[I]t was also conventional to user diverters as part of injection tests and ... use the measured response from the injection tests (including with diverters) as part of selecting a system model.” Nikolaou Supp. Decl. [EX-1050] at ¶ 53.

“During each injection period, ... diverters can be used to test and determine the subterranean response....” EX-1038 [0067].

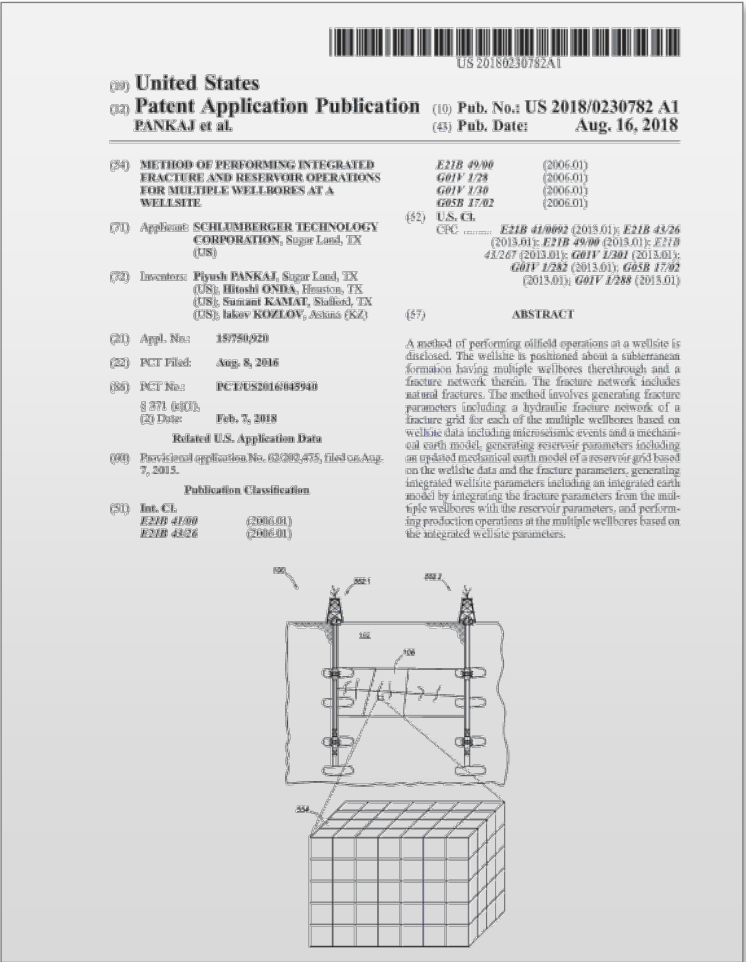
“The analysis and design systems 320, 330 can include various tools (e.g., injection test or treatment design tools), models (e.g., fracture models, reservoir models, leak off models, wellbore models, etc.), simulation tools, or other modules for analyzing the subterranean data and designing injection tests and treatments.” *Id.* at [0055].

“The analysis system 320 can analyze the response data [And] can output the analysis results to the design system 330 for modifying or otherwise designing an injection test or treatment.” *Id.* at [0056].

“[D]esigning an injection treatment can include designing a pumping sequence, a treatment plan, or other aspects of the injection treatment. For example, a respective injection rate, injection material, and duration for each pumping stage of the pumping stage sequence can be selected or otherwise designed.... The design of the pumping sequence can depend on the properties of the subterranean region analyzed based on the test data....” *Id.* at [0091].

Pet. at 102-103; Pet. Reply at 23-26; Nikolaou Supp. Decl. [EX-1050] at ¶¶ 49-53

Grounds 1-4: Invalidity under § 103



EX-1005

(19) **United States**

(12) **Patent Application Publication**
PANKAJ et al.

(10) Pub. No.: **US 2018/0230782 A1**
 (43) Pub. Date: **Aug. 16, 2018**

(54) **METHOD OF PERFORMING INTEGRATED FRACTURE AND RESERVOIR OPERATIONS FOR MULTIPLE WELLBORES AT A WELLSITE**

E21B 49/00 (2006.01)
G01V 1/28 (2006.01)
G01V 1/30 (2006.01)
G05B 17/02 (2006.01)

(71) Applicant: **SCHLUMBERGER TECHNOLOGY CORPORATION**, Sugar Land, TX (US)

(52) **U.S. Cl.**
 CPC *E21B 41/0092* (2013.01); *E21B 43/26* (2013.01); *E21B 49/00* (2013.01); *E21B 43/267* (2013.01); *G01V 1/301* (2013.01); *G01V 1/282* (2013.01); *G05B 17/02* (2013.01); *G01V 1/288* (2013.01)

(72) Inventors: **Piyush PANKAJ**, Sugar Land, TX (US); **Hitoshi ONDA**, Houston, TX (US); **Sumant KAMAT**, Stafford, TX (US); **Iakov KOZLOV**, Astana (KZ)

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Publication Classification

(51) **Int. Cl.**
E21B 41/00 (2006.01)
E21B 43/26 (2006.01)

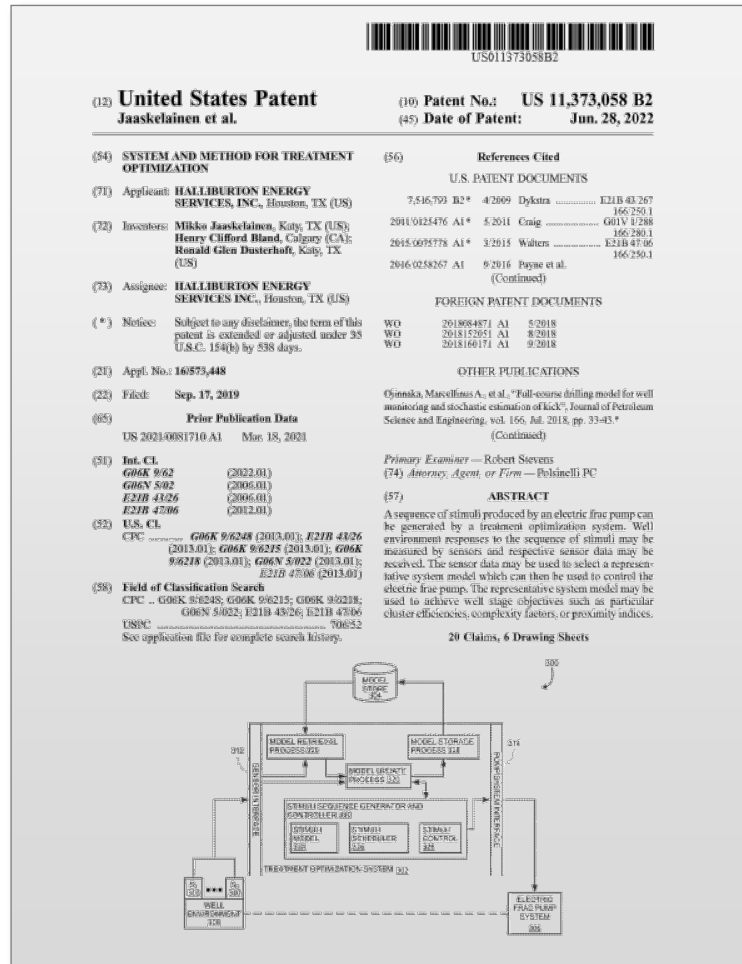
(57) **ABSTRACT**

A method of performing oilfield operations at a wellsite is disclosed. The wellsite is positioned about a subterranean formation having multiple wellbores therethrough and a fracture network therein. The fracture network includes natural fractures. The method involves generating fracture parameters including a hydraulic fracture network of a fracture grid for each of the multiple wellbores based on wellsite data including microseismic events and a mechanical earth model, generating reservoir parameters including an updated mechanical earth model of a reservoir grid based on the wellsite data and the fracture parameters, generating integrated wellsite parameters including an integrated earth model by integrating the fracture parameters from the multiple wellbores with the reservoir parameters, and performing production operations at the multiple wellbores based on the integrated wellsite parameters.

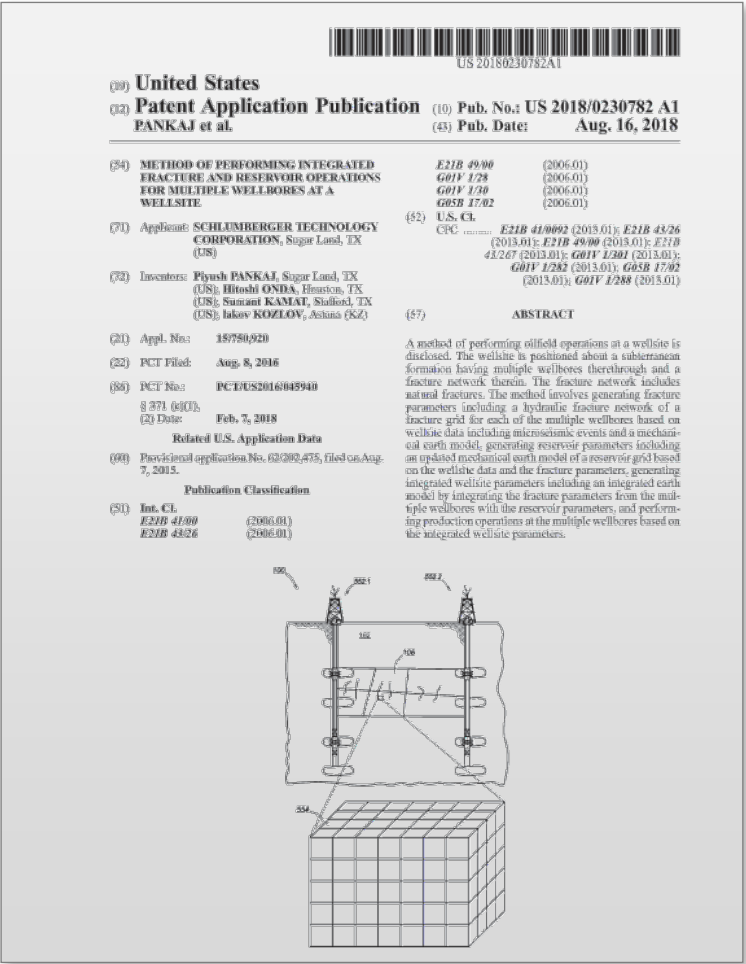


DEMONSTRATIVE EXHIBIT 1052 – NOT EVIDENCE

controlling an electrical fracturing pump based on the representative system model.



EX-1001



EX-1005

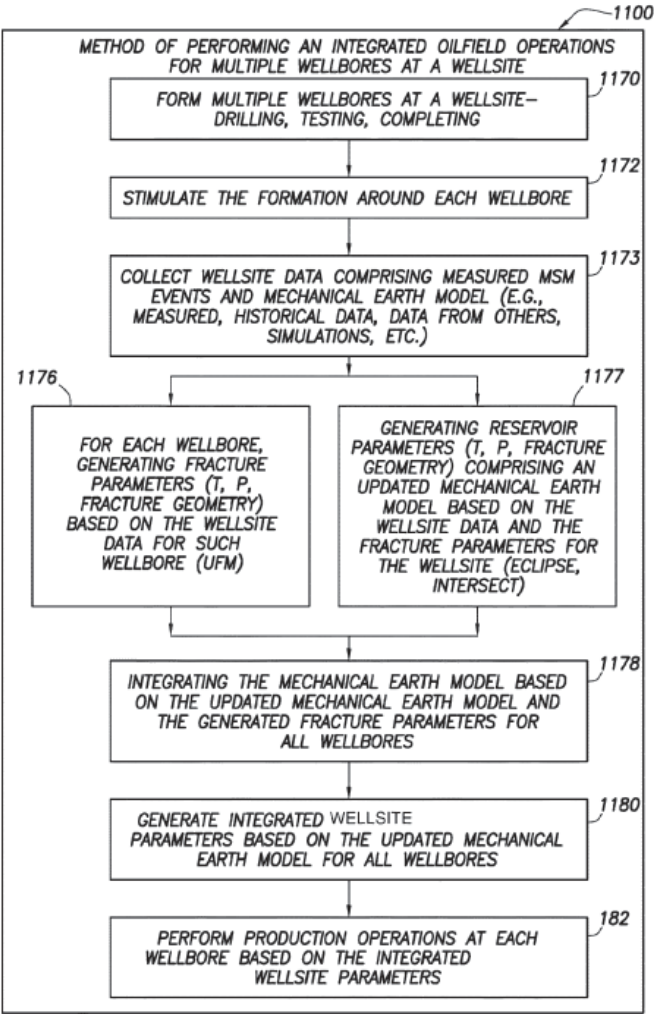


FIG.11

“FIG. 11 is a flow chart depicting a method 1100 for performing integrated oilfield operation at a wellsite.” EX-1005 [0097]

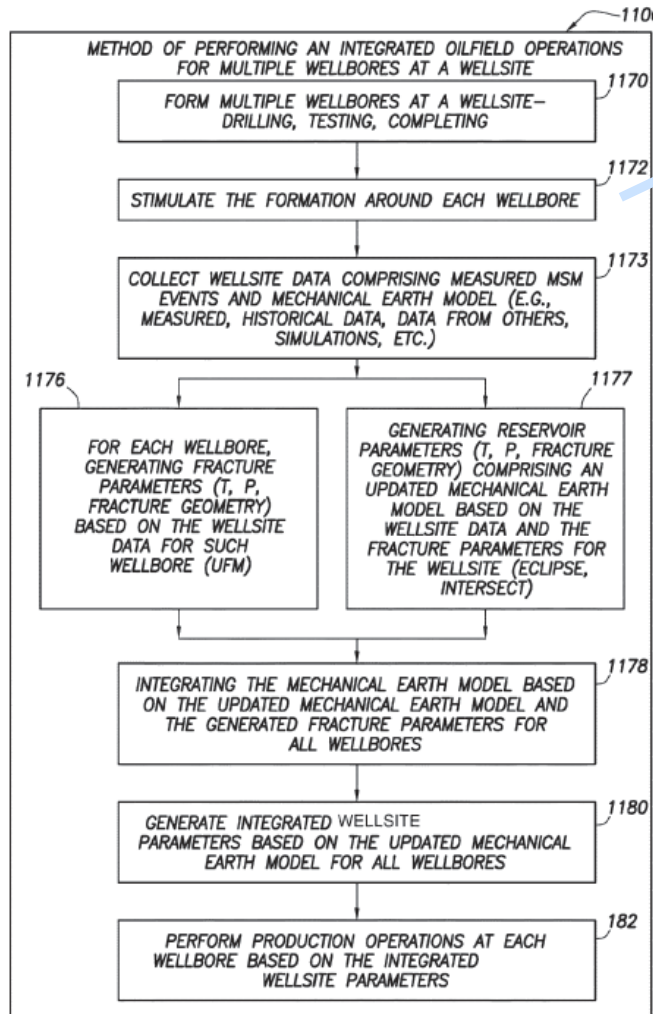


FIG. 11

EX-1005

STIMULATE THE FORMATION AROUND EACH WELLBORE

“The method involves ... 1172 stimulating the formation around each wellbore (e.g., perforating, injecting).” EX-1005 [0097]

“Various fluids, such as conventional stimulation fluids with proppants (slurry), may be pumped into the formation through perforations along the wellbore to create fractures.” *Id.* [0059]

“In particular, injection may be manipulated by adjusting the material being injected and/or the way it is injected to achieve the fractures....” *Id.* [0061]

“FIG. 6.2 is a plot of a fracture model ... generated ... by injection of injection fluid into the formation (i.e., stimulation).” *Id.* [0086]

“[The] fracture wellsite parameters may comprise fracture parameters, such as pump rate, volume (e.g., pad fluid and slurry), fracture geometry (e.g., propped fracture length), concentration of the proppant etc.” *Id.* [0100]

Pet. at 27-30, 40-42

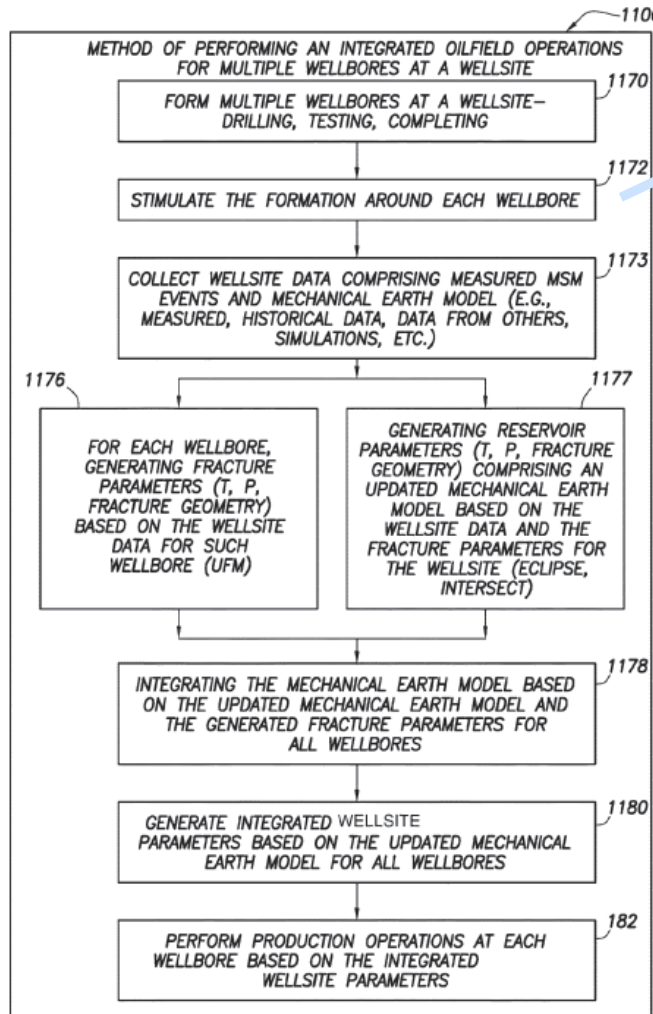
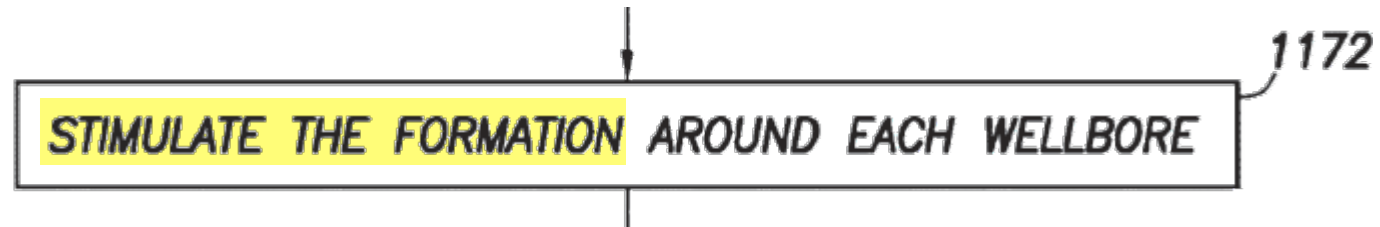


FIG. 11

EX-1005



“Pankaj discloses or at a minimum renders this limitation obvious.” Nikolaou Decl. [EX-1003] at ¶ 82.

“A POSITA would understand ‘perforating’ and ‘injecting’ refer to fracturing treatment processes.” *Id.* at ¶ 83.

“[A POSITA] would have understood [] these teachings in Pankaj to disclose applying a sequence of stimuli to the well (‘stimulate the formation’) by adjusting one or more properties of the fracturing fluid such as the volume of fluid and/or concentration of proppant (‘adjusting the material being injected’) or its pumping rate (‘the way it is injected’). A POSITA would have thus understood these teachings in Pankaj to disclose (or render obvious) [step 1].” *Id.*

Pet. at 27-30, 40-42

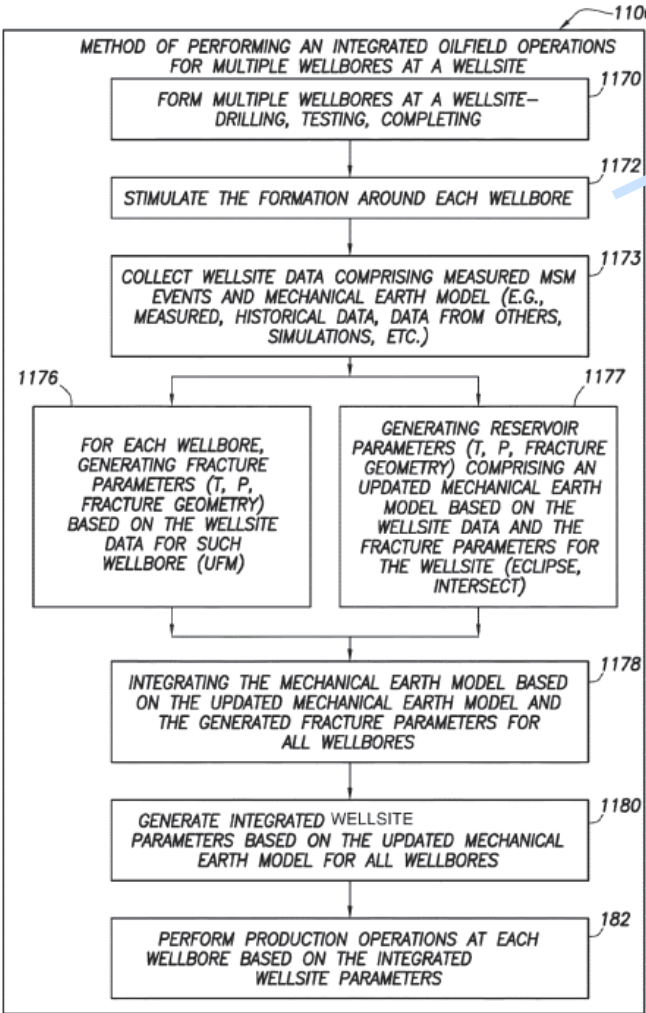
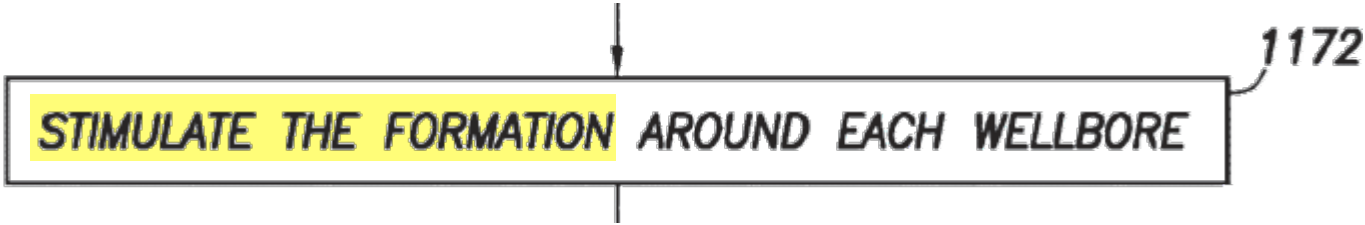


FIG. 11

EX-1005



“The **sequence of increasing the proppant concentration** on the surface is also a parameter that may be recorded while pumping. The **proppant concentration increment** causes increase in the hydraulic fracture conductivity as proppants fill up the fractured volume.” EX-1005 [0104]

TABLE I

Pump rate (bbl/min)/ (kL/min)	Fluid name	Fluid volume (gal)/(kL)	Proppant	Proppant concentration (PPA)
90/(14.3)	Fracturing fluid	20000 (75.7)	None	0
90/(14.3)	Fracturing fluid	15000 (56.8)	Proppant type 1	0.5
90/(14.3)	Fracturing fluid	15000 (56.8)	Proppant type 1	1
90/(14.3)	Fracturing fluid	15000 (56.8)	Proppant type 2	1.5
90/(14.3)	Fracturing fluid	15000 (56.8)	Proppant type 3	2
90/(14.3)	Fracturing fluid	15000 (56.8)	Proppant type 4	2.5
90/(14.3)	Fracturing fluid	10000 (37.9)	Proppant type 5	3
90/(14.3)	Fracturing fluid	10000 (37.9)	Proppant type 6	3.5
90/(14.3)	Fracturing fluid	5000 (18.9)	Proppant type 7	4

“A POSITA would have understood that Table 1 shows a ‘predetermined’ pumping schedule that meets claim 1’s ‘sequence of stimuli’ limitation even if [PO’s] construction of the limitation (a predetermined schedule determined in advance of application to the well environment) were accepted.” Nikolaou Supp. Decl. [EX-1050] at ¶ 62.

Pet. at 27-30, 40-42; Pet. Reply at 28-30

STIMULATE THE FORMATION AROUND EACH WELLBORE

1172

TABLE I

Pump rate (bbl/min)/ (kL/min)	Fluid name	Fluid volume (gal)/(kL)	Proppant	Proppant concentration (PPA)
90/(14.3)	Fracturing fluid	20000 (75.7)	None	0
90/(14.3)	Fracturing fluid	15000 (56.8)	Proppant type 1	0.5
90/(14.3)	Fracturing fluid	15000 (56.8)	Proppant type 1	1
90/(14.3)	Fracturing fluid	15000 (56.8)	Proppant type 2	1.5
90/(14.3)	Fracturing fluid	15000 (56.8)	Proppant type 3	2
90/(14.3)	Fracturing fluid	15000 (56.8)	Proppant type 4	2.5
90/(14.3)	Fracturing fluid	10000 (37.9)	Proppant type 5	3
90/(14.3)	Fracturing fluid	10000 (37.9)	Proppant type 6	3.5
90/(14.3)	Fracturing fluid	5000 (18.9)	Proppant type 7	4

EX-1005

“A POSITA would have understood that Table 1 shows a ‘predetermined’ pumping schedule that meets claim 1’s ‘sequence of stimuli’ limitation even if [PO’s] construction of the limitation (a predetermined schedule determined in advance of application to the well environment) were accepted.” Nikolaou Supp. Decl. [EX-1050] at ¶ 62.

“The proppant concentration, which reads on a sequence of stimuli comprising a ‘particulate concentration,’ is varied over time in the Table I schedule.” *Id.*

“Table I refers to an “input for the simulator,” but a POSITA would have understood that Table I would also be used to apply to the well environment. As explained above, step-rate tests and mini-frac tests were commonplace in the industry and were applied to wells, and a POSITA would understand that Table I is an example of such a test. Therefore, in my opinion Pankaj also discloses the sequence of stimuli limitation under [PO’s] interpretation of the limitation.” *Id.* at ¶ 63.

Pet. at 27-30, 40-42; Pet. Reply at 28-30

controlling an electrical fracturing pump based on the representative system model.



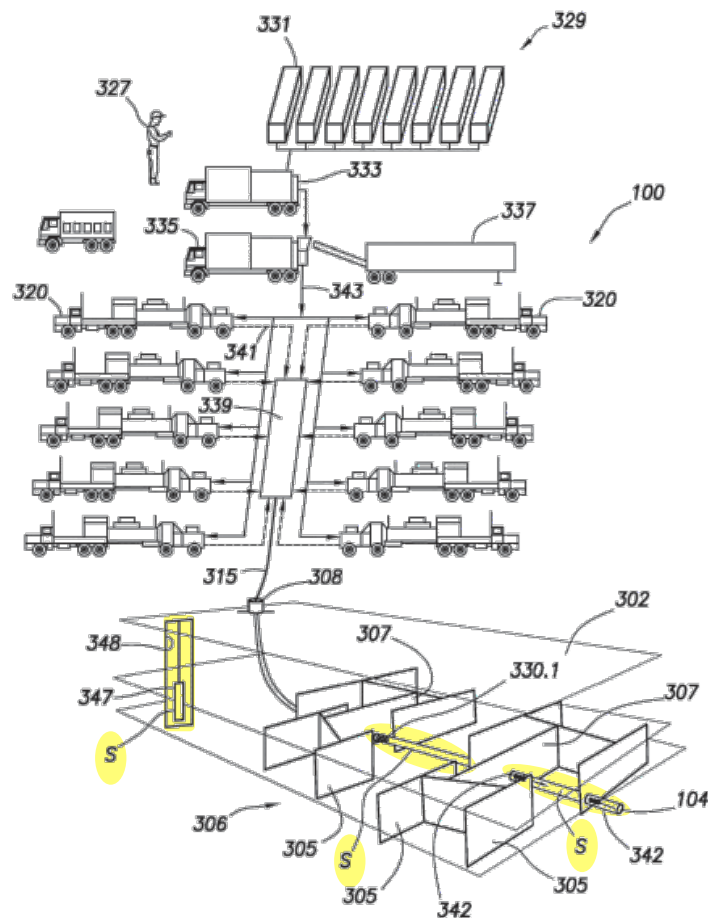


FIG. 3.1

EX-1005

“FIGS. 3.1 and 3.2 show example fracture operations that may be performed about the wellsite 100.” EX-1005 [0054]

“As also shown in FIG. 3.1 ...the wellsite 100 may be provided with sensors (S) to measure wellsite parameters, such as formation parameters ..., fracture parameters (e.g., pump rate, volume (e.g., pad fluid and slurry), fracture geometry (e.g., propped fracture length), concentration of the proppant etc.), fluid parameters (e.g., viscosity, composition, proppant, temperature, density, etc.), reservoir parameters (e.g., pressure, temperature, viscosity), ... and/or other parameters as desired. The sensors (S) may be gauges or other devices positioned about the oilfield to collect data relating to the various operations. Various sensors (S) may be located at various positions along the wellbore ... to collect and/or monitor the desired data.” *Id.* [0062]

See Nikolaou Decl. [EX-1003] at ¶¶ 63, 85, 87.

Pet. at 25-30, 43-45

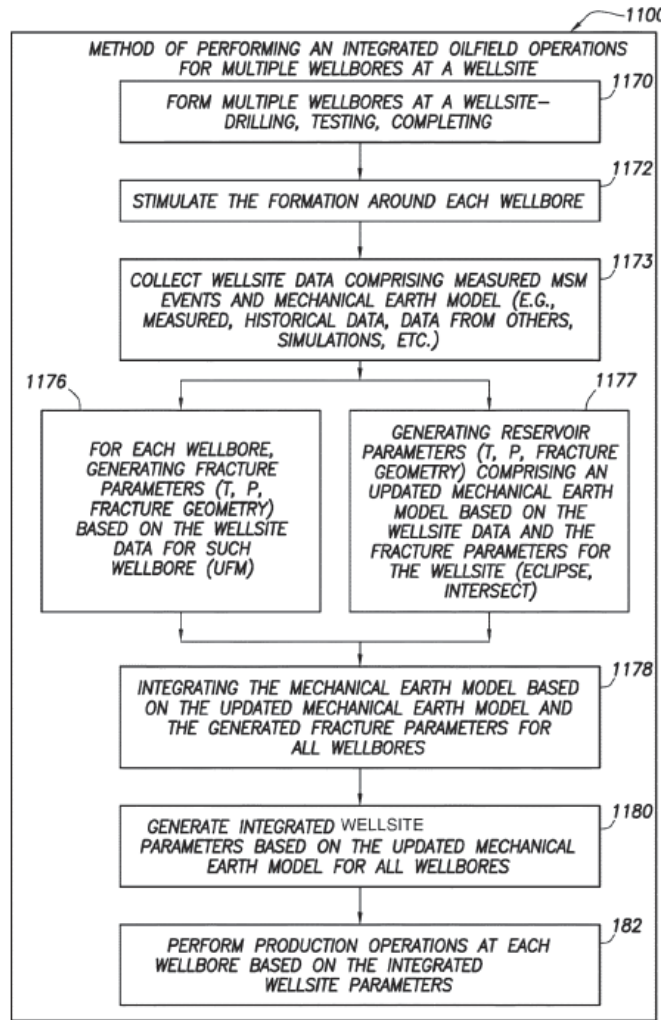
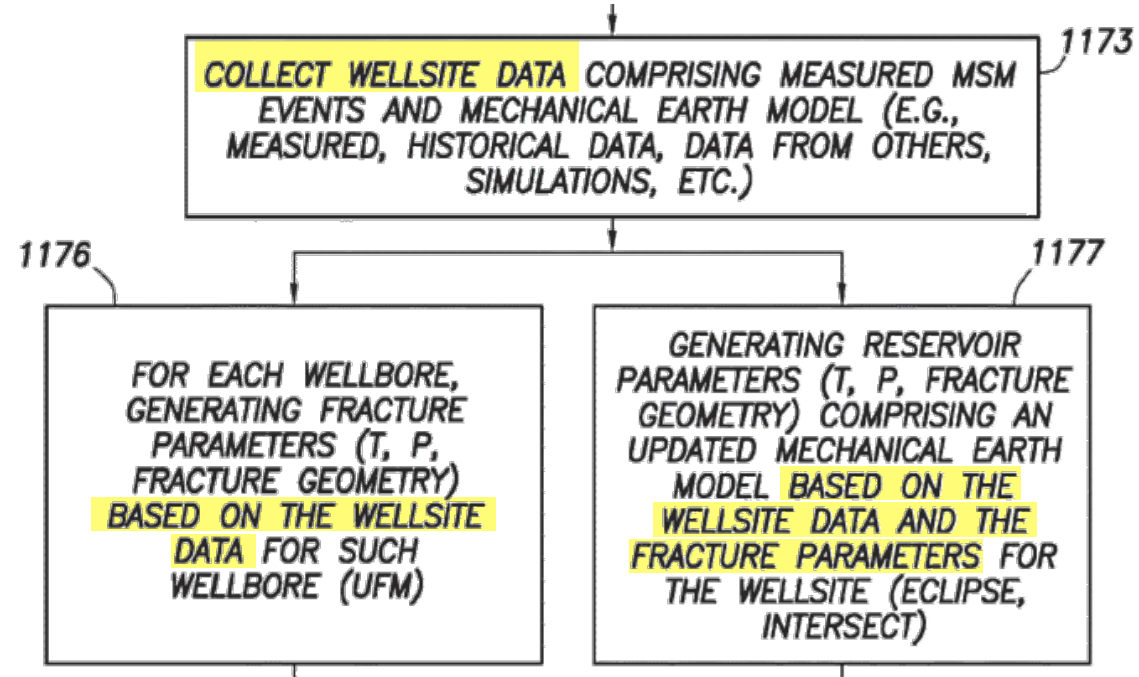


FIG. 11

EX-1005



“Figure 11 of Pankaj discloses steps of generating both the ‘fracture parameters’ 1176 and ‘reservoir parameters’ 1177 using wellsite data from wellbore sensors (‘formation response data’).” See Nikolaou Decl. [EX-1003] at ¶¶ 85-89.

Pet. at 27-30, 43-45

controlling an electrical fracturing pump based on the representative system model.



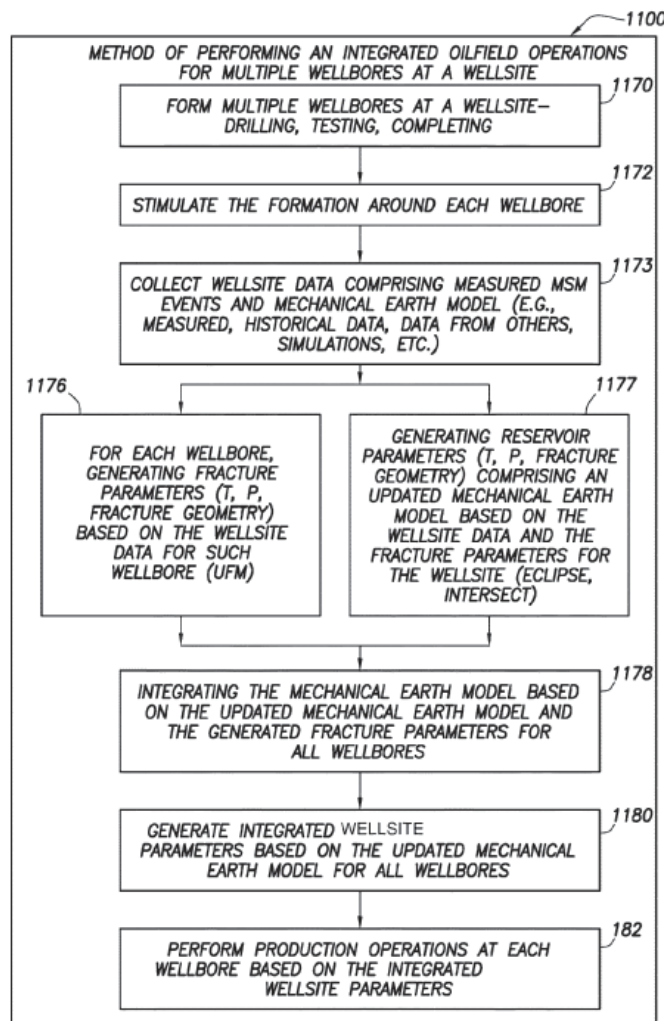
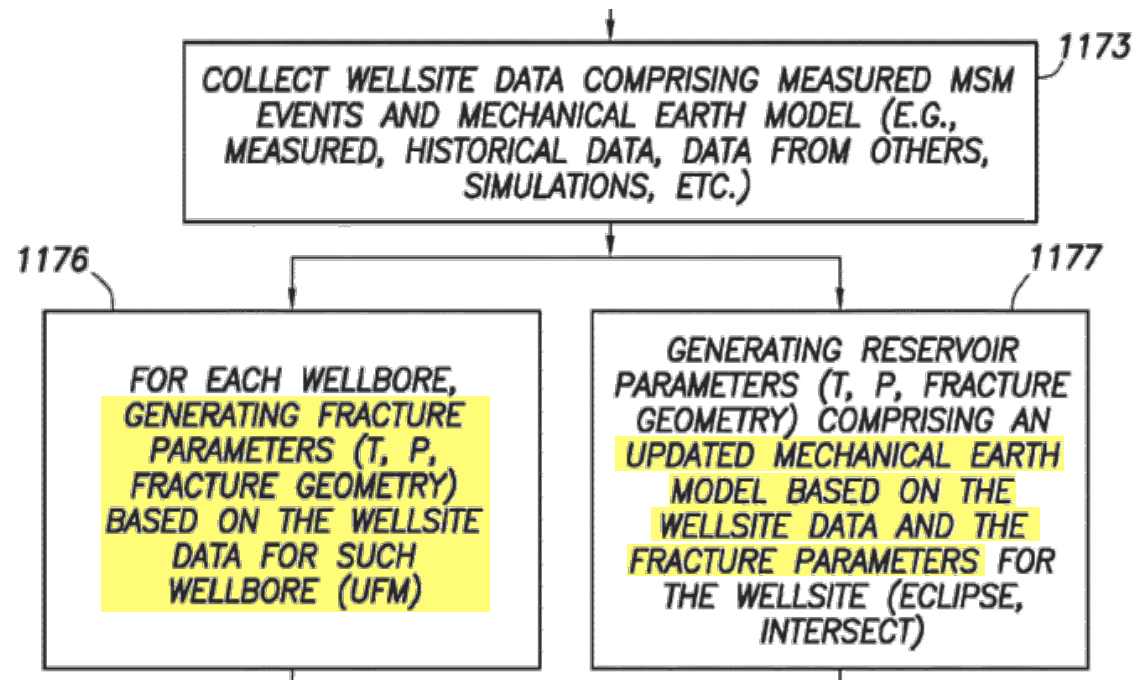


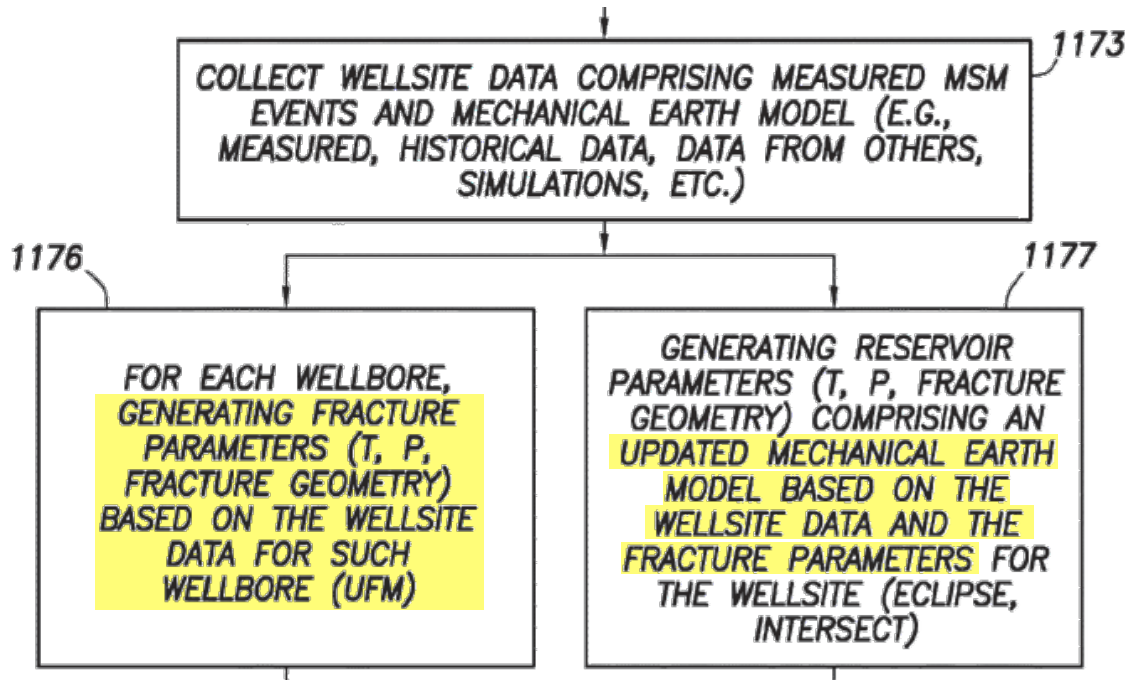
FIG. 11

EX-1005



“In Pankaj, fracture parameters are modeled using wellsite data and the stimulation step. Fig. 11, [0102], [0105]. Using the received parameters, step 1176 also involves simulation techniques, such as an **Unconventional Fracture Model**, that ‘help predict the equivalent behavior of rock deformation causing the hydraulic fracture propagation.’ *Id.*, [0103].” Nikolaou Decl. [EX-1003] at ¶ 91.

Pet. at 45-48, Pet. Reply at 30-32



EX-1005

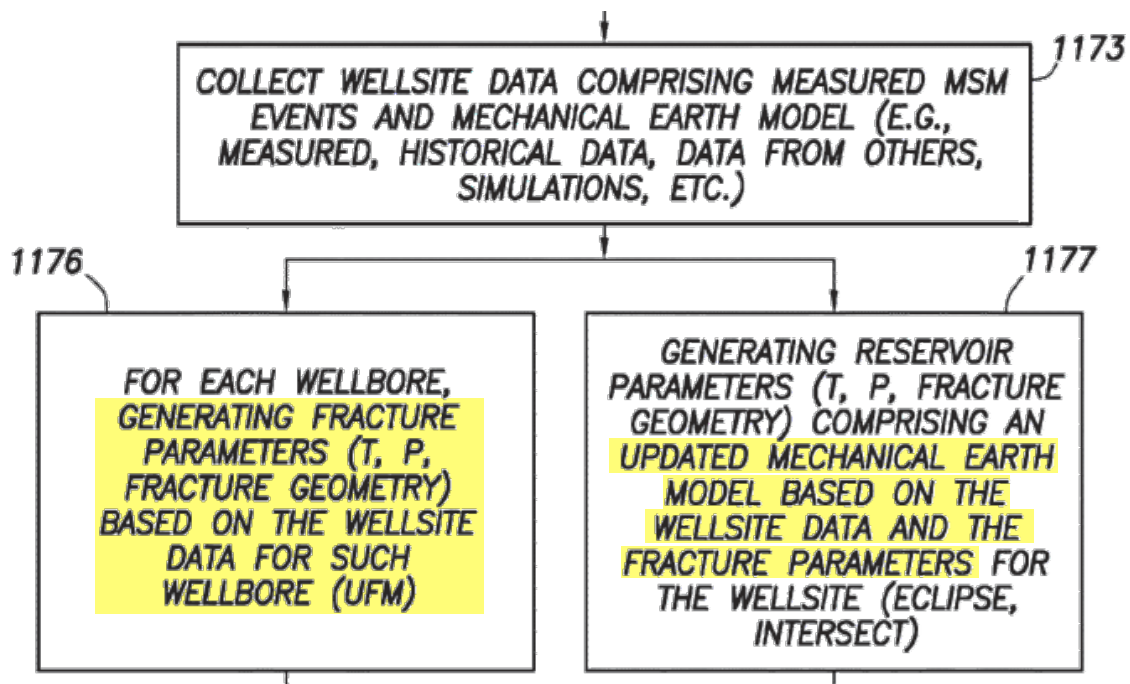
“Using wellsite data (‘received formation response data’), existing models are selected which best represents the subsurface fracture networks (‘selecting a representative system model’):

‘[Unconventional hydraulic Fracture Models (‘UFMs’)] have been developed to understand subsurface fracture networks. Existing models may be used to simulate the governing equations for cases involving smooth fractures.’

Id., [0112]; *see id.*, at [0103] (‘The generating 1176 may involve modeling fracture parameters.... Simulation techniques, such as the Unconventional Fracture Model (UFM using UFM™ or other simulator), may be applied to these input parameters from the wellsite....’).”

Nikolaou Decl. [EX-1003] at ¶ 91 [citing and quoting EX-1005].

Pet. at 45-48, Pet. Reply at 30-32



EX-1005

“[R]eservoir simulations also use models determined from generated fracture parameters (‘sequence of stimuli’) and wellsite data (‘the received formation response data’). *Id.*, [0119] (‘The reservoir parameters (e.g., pressure, flow rate, permeability, viscosity etc.) may be determined based on the wellsite data and the generated fracture parameters 1176.’).... These fracture parameters and reservoir parameters values are then integrated into an updated mechanical earth model. *Id.*, Fig. 11, step 1178, [0126] (‘The method continues with 1178—integrating the updated mechanical earth model by integrating the fracture parameters for all of the wellbores into the updated earth model of the reservoir simulator.’).... Based on these disclosures, a POSITA would have understood that the updated mechanical earth model is selected (‘selecting a representative system model’) based on both the wellsite data (‘the received formation response data’) and fracture parameters/stimulating step (‘sequence of stimuli’).”

Nikolaou Decl. [EX-1003] at ¶ 93 (citing and quoting EX-1005).

Pet. at 45-48, Pet. Reply at 30-32

controlling an electrical fracturing pump based on the representative system model.



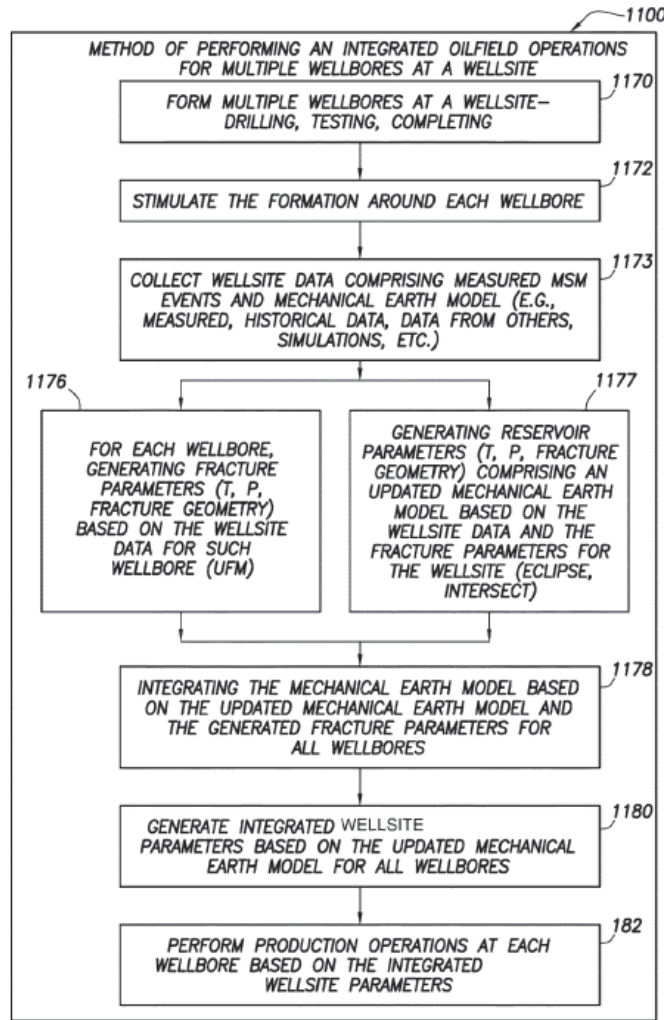
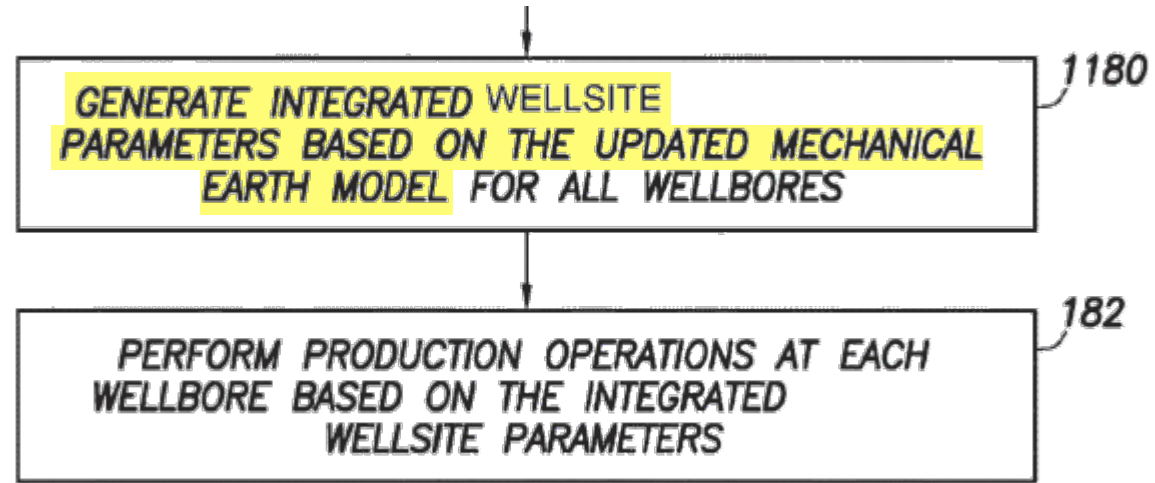


FIG. 11

EX-1005



“The method 1100 may also involve additional applications, such as generating integrated wellsite parameters 1180 for the multi-wellbore wellsite, and performing fracture and/or production operations 1182. The integrated dynamic wellsite parameters may then be generated 1180 from the updated MEM...” EX-1005 [0140].

“The method performing 1182 may involve performing fracture and/or production operations at one or more of the wellbores of the wellsite based on the integrated wellsite parameters.... The fracturing treatment parameters may be optimized to achieve the desired stimulation objectives to maximize well production.” *Id.* [0141].

Pet. at 49-51; Pet. Reply at 32; Nikolaou Decl. [EX-1003] at ¶¶ 95-99

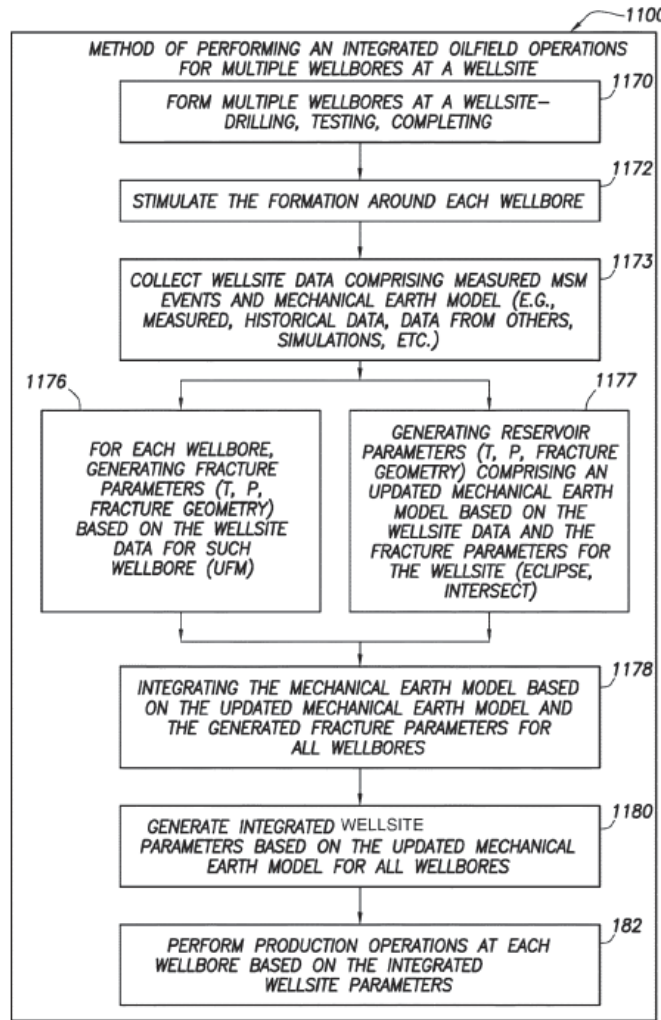
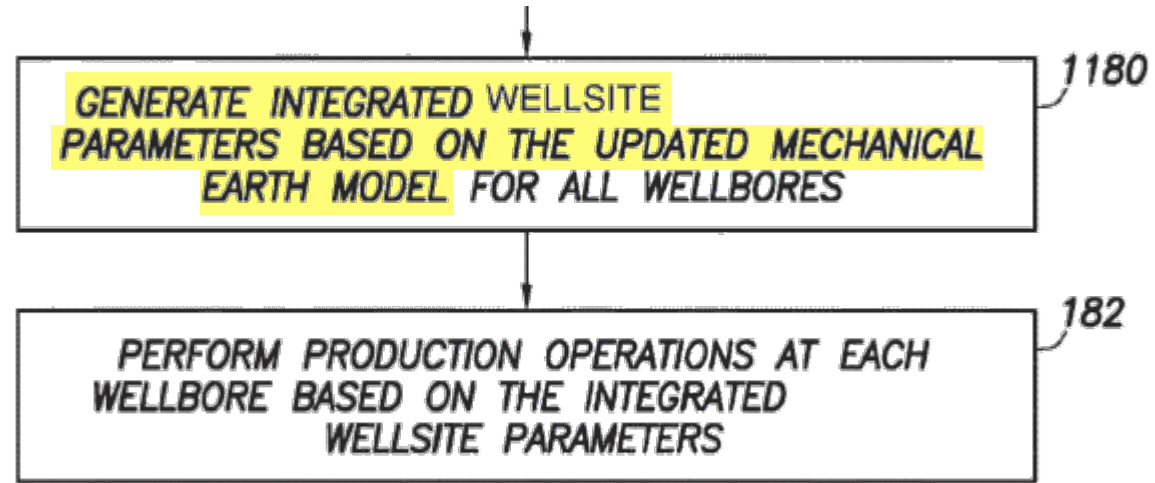


FIG. 11

EX-1005



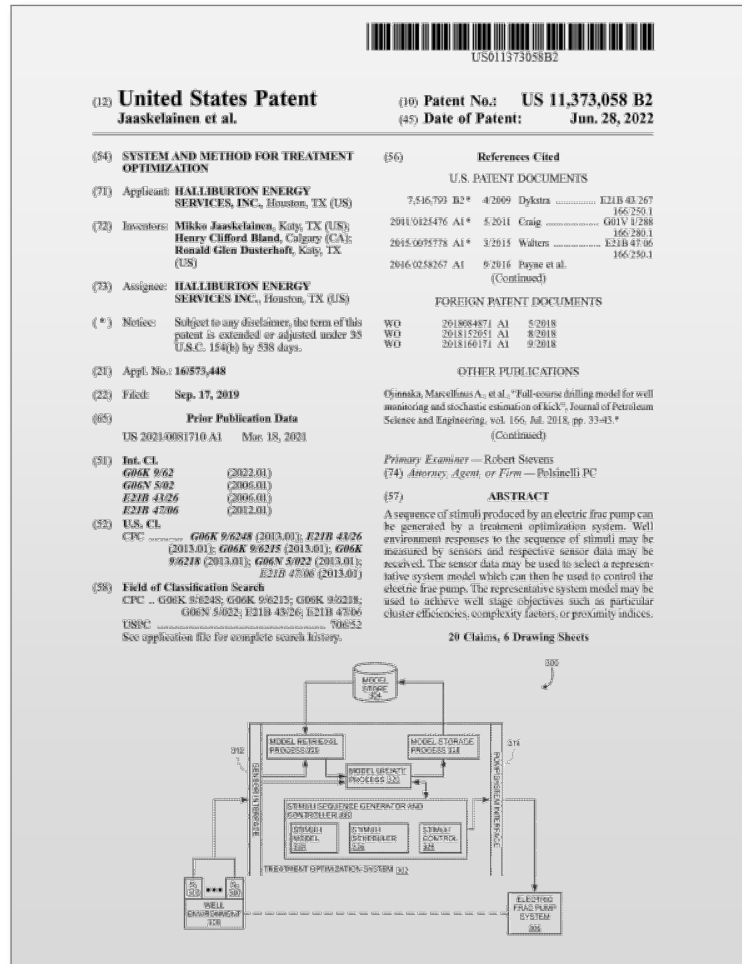
“Fracturing is performed by pumping fluid into the formation using a pump system 329.” EX-1005 [0055].

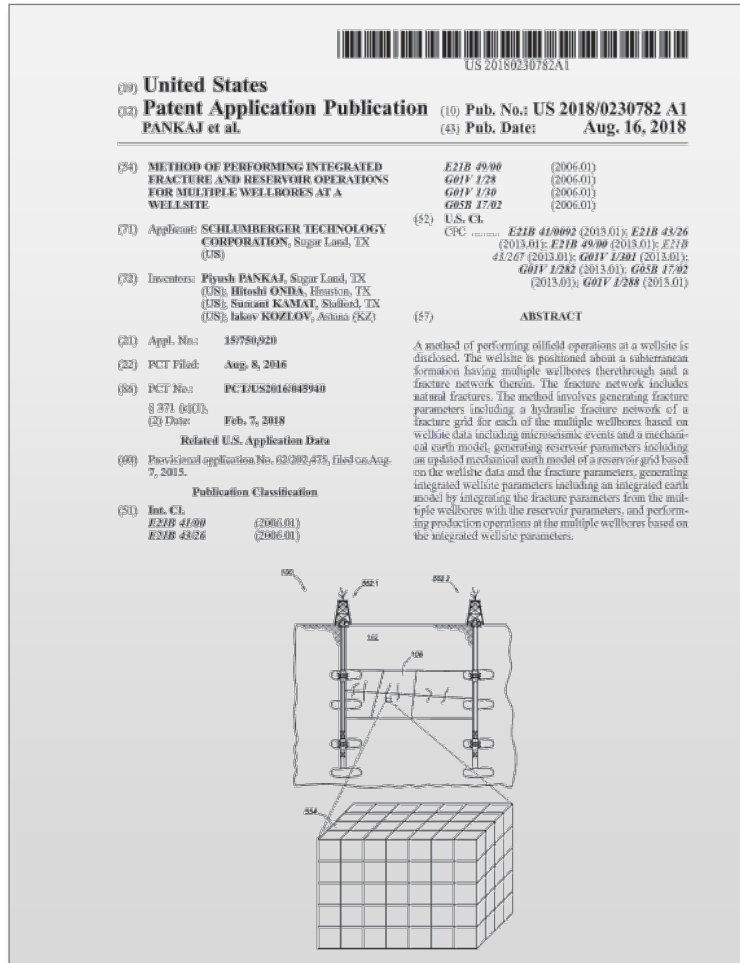
“A computerized control system may be employed to direct the entire pump system 329 during the fracturing operation.” *Id.* [0058].

“[A] POSITA would have understood [this] to mean encompass[ing] using the computer system to control the pumps, e.g. without human intervention.” Nikolaou Supp. Decl. [EX-1050] at ¶ 60.

Pet. at 49-51; Pet. Reply at 32; Nikolaou Reply Decl. [EX-1050] at ¶¶ 54-60

Claim 5: The method of claim 1, wherein the data from the one or more downhole sensors or surface sensors is used to determine changes in flow distribution in response to a diverter drop, the changes in flow distribution used to determine the representative system model. [also claim 13]





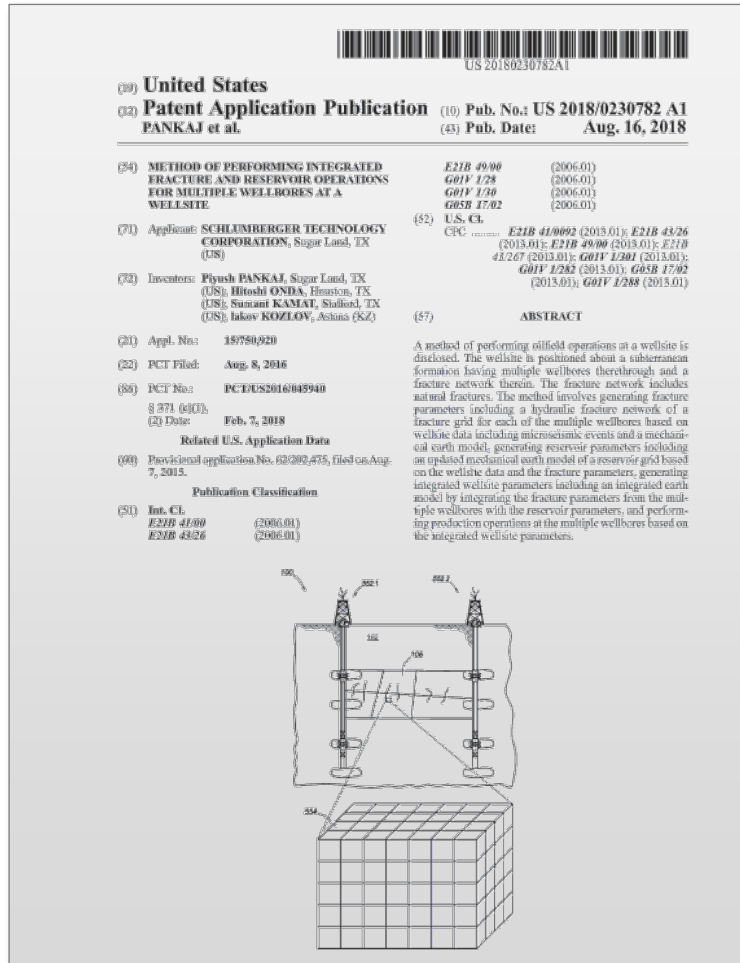
EX-1005

“Simulators (e.g., MANGROVE™) may have built-in unconventional hydraulic fracture models like UFM™ (or other unconventional fracture models)....” EX-1005 [0075]

“UFMs have been developed to understand subsurface fracture networks. Existing models may be used to simulated the governing equations for cases involving smooth fractures.” *Id.* [0112]

“[A] POSITA would have understood that Pankaj discloses that its UFM (a ‘representative system model’) is selected from a group of pre-existing UFMs based on which model best represents wellsite data (‘retrieved from a data store based the received formation response data.’).” Nikolaou Decl. [EX-1003] at ¶ 101.

Pet. at 53-54; Pet. Reply at 33



EX-1005

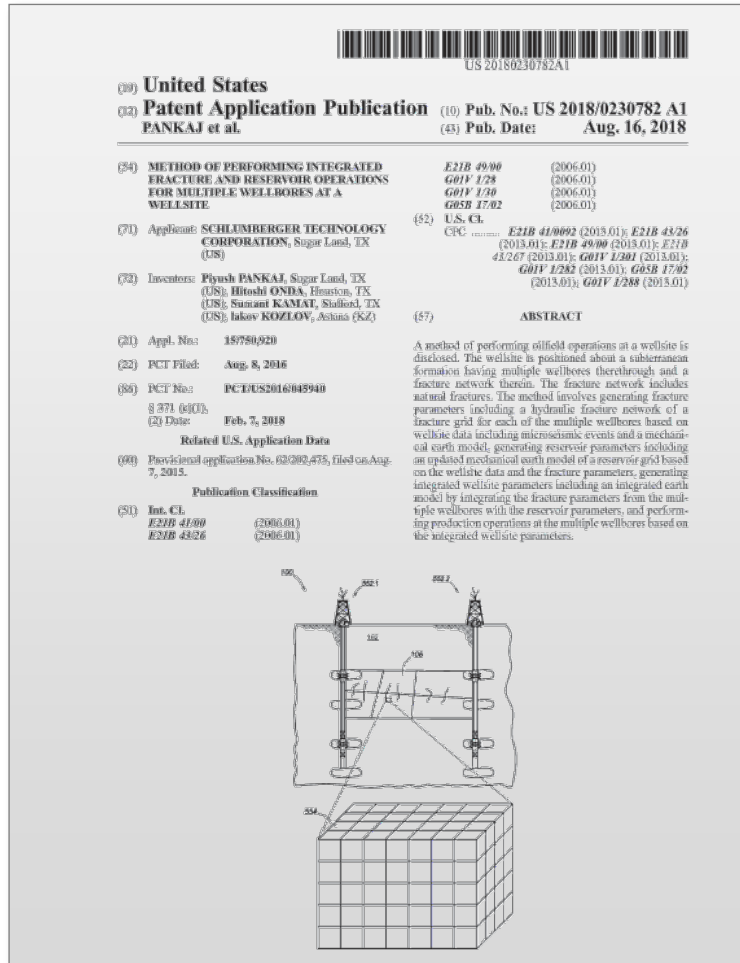
“The wellsite may also include a mechanical earth model (MEM). The MEM may be a model that is provided, or may be calculated from the other wellsite data.” EX-1005 [0099]

“[A]s explained above, a POSITA would have understood that Pankaj’s updated mechanical earth model is selected based on both the wellsite data and generated fracture parameters.” Nikolaou Decl. [EX-1003] at ¶ 102.

“A surface unit 134 may be used to communicate with the drilling tools and/or offsite operations.... The surface unit may be provided with computer facilities for receiving, storing, processing, and/or analyzing data from the operation.” EX-1005 [0037]

See Nikolaou Supp. Decl. [EX-1050] at ¶¶ 40-43 (explaining that a POSITA would have understood models to be stored in computer memory).

Pet. at 53-54; Pet. Reply at 33



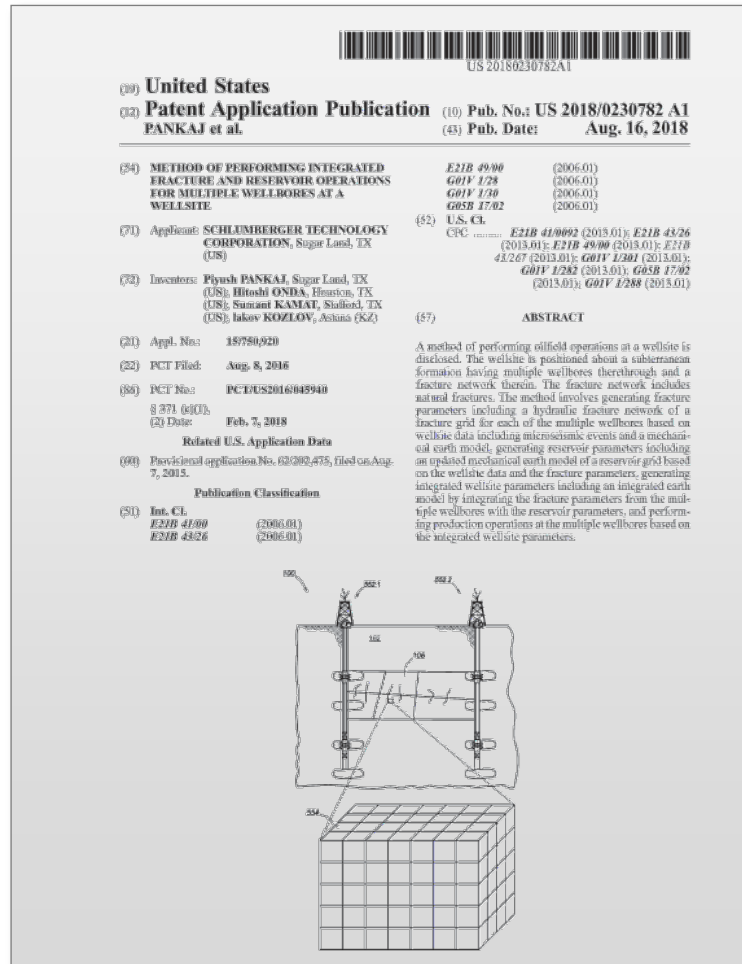
EX-1005

“The generating 1176 may involve modeling the smooth fracture behavior to solve the governing equations and determine the smooth fracture parameters.... Existing models may be used to simulate the governing equations for cases involving smooth fractures.” EX-1005 [0112].

“Pankaj also mentions several governing equations used by these UFM’s, such as equations 1-5. *See Id.*, [0106]–[110] (describing multiple linear equations).” Nikolaou Decl. [EX-1003] at ¶ 110.

“In addition, Pankaj explains that ‘nonlinear system of equations’ may be used by ‘[c]ombining these equations and discretizing the fracture network into small elements.’ *Id.*, [0111] [(‘Combining these equations [in [0106]-0110]] and discretizing the fracture network into small elements may lead to a nonlinear system of equations....’)].” Nikolaou Decl. [EX-1003] at ¶ 111.

Pet. at 57-59; Pet. Reply at 33-36



EX-1005

“Using the updated models, Pankaj discloses that ‘integrated dynamic wellsite parameters may then be generated 1180’. [EX-1005] [0140].” Nikolaou Decl. [EX-1003] at ¶ 114.

“Once the treatment is executed on the wellsite, the treatment data (e.g., treatment pressure, proppant concentration, pumping rates and microseismic hydraulic fracture monitoring data) can be used to re-calibrate the stimulation design model by matching the observed parameters against the predicted parameters from the simulation run. The matching exercise may require changing the reservoir properties in the geological model and/or changing the fracture design parameters and fluid properties.” EX-1005 [0076].

“A POSITA would have understood that this means the updated parameters are both (i) used for fracture and/or production operation and (ii) factored into the linear (or nonlinear) mathematical relationship mentioned above for future models.” Nikolaou Decl. [EX-1003] at ¶ 114.

Pet. at 57-59; Pet. Reply at 33-36

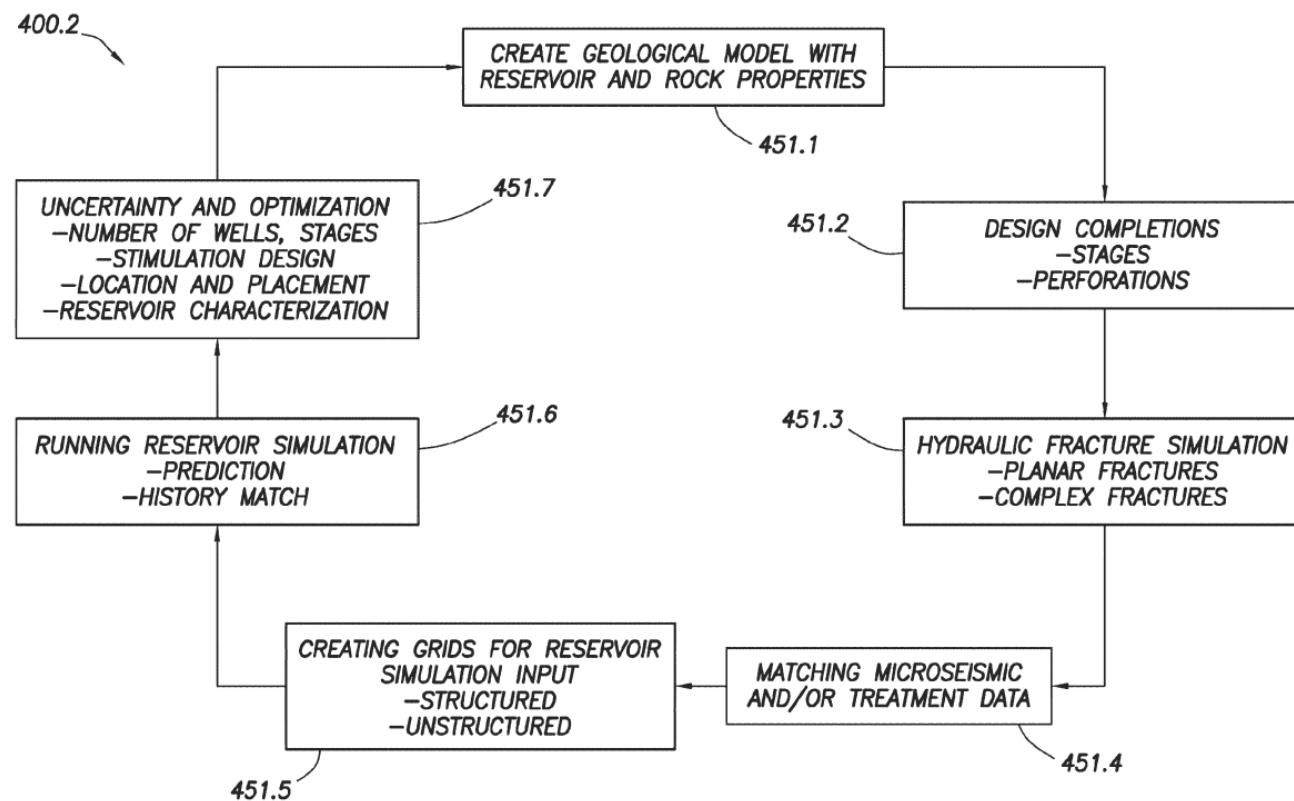


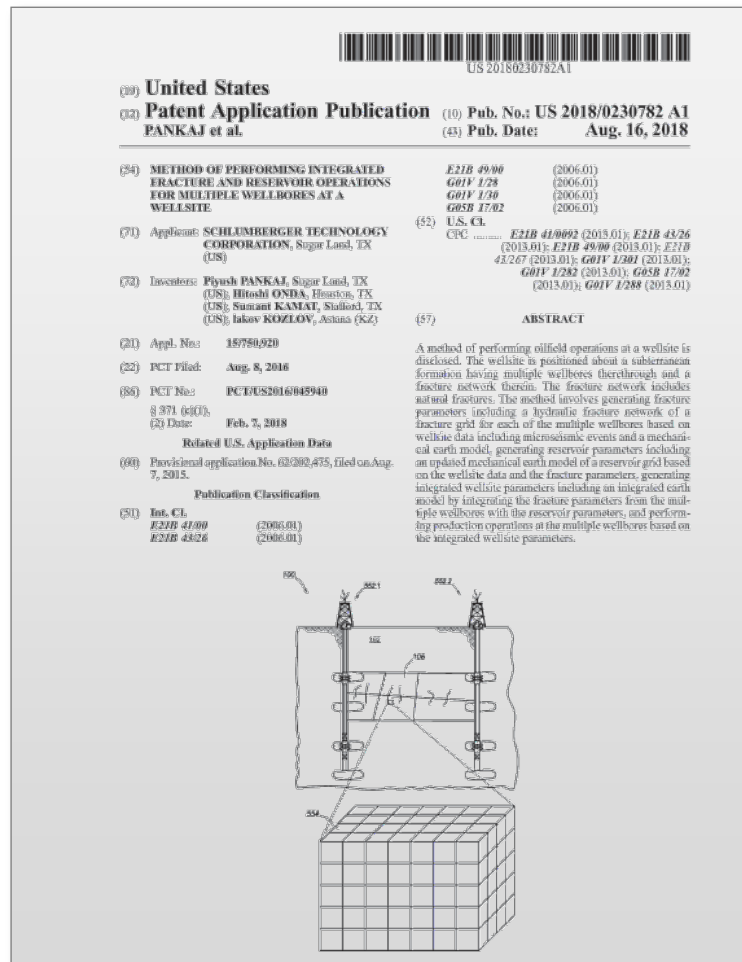
FIG.4.2

EX-1005

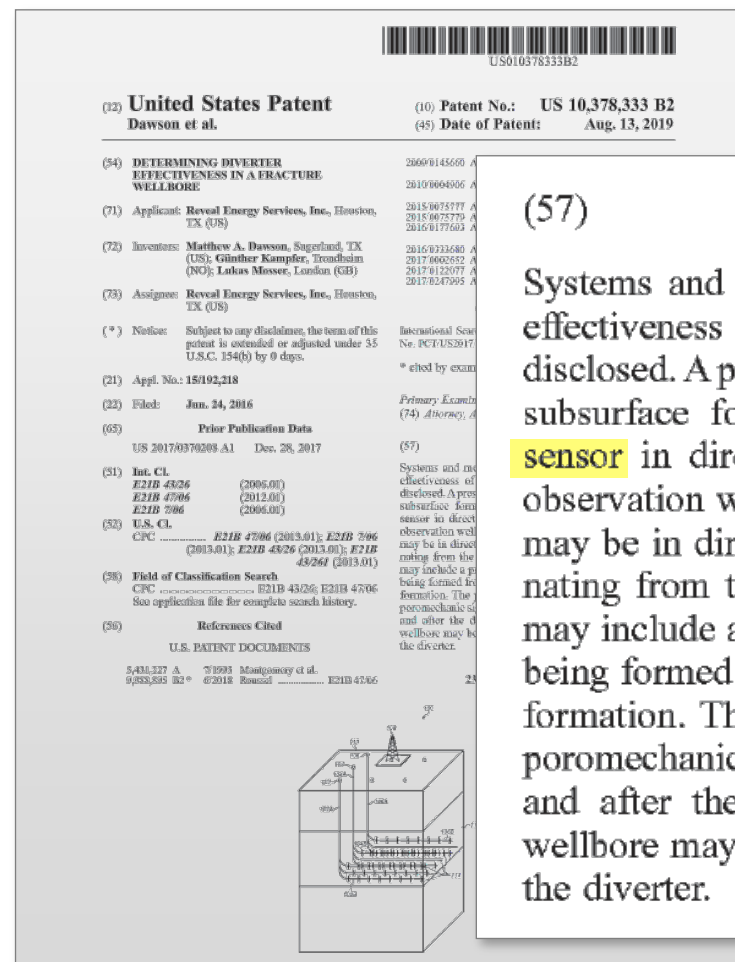
Fig. 4.2 shows loop (“multiple iterations”) with matching exercise to change reservoir properties, fracture design parameters, and fluid properties. See Nikolaou Decl. [EX-1003] at ¶ 114.

“The same treatment design may be applied to a number of wells in a field or part of the field, and the treatment revised to achieve an optimum design that provides the maximum net present value. The fracture parameters for single stage or multiple stage and single well or multiple wells are then optimized. Examples of such fracture parameters may be volume of fracturing fluid, fracturing proppants, number of stages that are to be hydraulically fractured, location and placement of the wellbore, etc.” EX-1005 [0078]

Pet. at 57-59; Pet. Reply at 33-36



EX-1005



EX-1024

(57)

ABSTRACT

Systems and methods for using pressure signals to assess effectiveness of a diverter in a stimulation wellbore are disclosed. A pressure signal in an observation wellbore in the subsurface formation may be assessed using a pressure sensor in direct fluid communication with a fluid in the observation wellbore. The fluid in the observation wellbore may be in direct fluid communication with a fracture emanating from the observation wellbore. The pressure signal may include a pressure change that is induced by a fracture being formed from a stimulation wellbore in the subsurface formation. The pressure signal may be a pressure-induced poromechanic signal. The slope in the pressure signal before and after the diverter are provided into the stimulation wellbore may be assessed to determine the effectiveness of the diverter.

Pet. at 64-68; Pet. Reply at 36-37; Nikolaou Decl. [EX-1003] at ¶¶ 145-156

Questions?