

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LIBERTY ENERGY INC. AND LIBERTY OILFIELD SERVICES LLC
Petitioners

v.

U.S. WELL SERVICES, LLC
Patent Owner

Case No. IPR2025-00066
Patent 10,598,258

PETITION FOR *INTER PARTES* REVIEW OF CLAIMS 1-20 OF
U.S. PATENT NO. 10,598,258

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LIST OF EXHIBITS

Ex. No. ¹	Description
1001	U.S. Patent No. 10,598,258 to Oehring <i>et al.</i> entitled “Multi-plunger Pumps and Associated Drive Systems” (the “258 Patent”)
1002	File History for U.S. Patent No. 10,598,258
1003	Declaration of Dr. Robert Durham
1004	U.S. Patent Publication No. 2020/0256429 to Buckley, “Electric Drive Pump for Well Stimulation,” (“ <i>Buckley</i> ”) filed September 25, 2018 and published August 13, 2020.
1005	U.S. Provisional Application No. 62/562,943 to Buckley <i>et al.</i> , “Electric Drive Pump for Well Stimulation,” (“ <i>Buckley Provisional</i> ”) filed September 25, 2017.
1006	U.S. Patent Publication No. 2015/0361736 to Bergan <i>et al.</i> , “Heave Compensation Winches,” (“ <i>Bergan</i> ”), filed June 13, 2014 and published December 17, 2015.
1007	United States Patent No. 4,100,822 to Rosman, “Drive System for a Moving Mechanism,” (“ <i>Rosman</i> ”) filed April 19, 1976 and granted July 18, 1978.
1008	U.S. Patent Publication No. 2016/0258267 to Payne <i>et al.</i> , “Well Fracturing Systems with Electrical Motors and Methods of Use” (“ <i>Payne</i> ”), filed March 3, 2016 and published September 8, 2016.
1009	Chinese Publication No. CN103742382A to Yi, “Fracturing Pump Transmission System and Fracturing Truck,” (“ <i>Yi</i> ”), filed December 30, 2013 and published April 23, 2014.
1010	Certified English Translation of <i>Yi</i> and Translator’s Declaration
1011	Merriam-Webster Online Dictionary, “Pinion,” captured by the Internet Archive on August 17, 2017, available at < https://web.archive.org/web/20170817030125/https://www.merriam-webster.com/dictionary/pinion >.

¹ Citations to patents are made by column and line cite; citations to patent publications are made by paragraph number; citations to Exhibit 1002 are made with reference to the Bates-stamped pagination; citations to other exhibits are made to the page number of the document itself.

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1014	Nesbitt, B., “Handbook of Pumps and Pumping: Pumping Manual International,” Elsevier, 2006.
1015	Camara, John A., “Electrical Engineering Reference Manual for the Electrical and Computer PE Exam,” 6 th ed. (Professional Publications, Inc. 2002), ISBN: 1-888577-56-8.
1016	Gardner Denver GD-2500 Quintuplex Well Servicing Pump Operating and Service Manual, captured by the Internet Archive on Sept. 17, 2005, available at https://web.archive.org/web/20120917102614/http://www.quincieoilfield.com/pdf/3.0%20Gardner%20Denver/2500/GD2500Q%20Op%20&%20Service%20Manual.pdf .
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1018	Merriam-Webster Online Dictionary, “Quintuple,” captured by the Internet Archive on February 2, 2017, available at https://web.archive.org/web/20170202121725/https://www.merriam-webster.com/dictionary/quintuple .
1019	Mark’s Standard Handbook for Mechanical Engineers, Eleventh Edition, McGraw-Hill Companies, New York, 2007.
1020	Langewis, Jr., C. and Gleeson, C. W., “Practical Hydraulics of Positive Displacement Pumps for High-Pressure Waterflood Installations,” Society of Petroleum Engineers, February 1971.
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1024	Fink, Donald G., STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS, 13 th ed. (McGraw-Hill, New York: 1993), ISBN: 0-07-020984-7.
1025	U.S. Patent Publication No. 2011/0241590 to Horikoshi et al., entitled “Motor Driving Apparatus Having Fault Diagnostic Function” (filed Feb. 11, 2011 and published Oct. 6, 2011).

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1026	Roethemeyer, Dale E., Yankaskas, David R., “Evolution of Motor and Variable Frequency Drive Technology,” in <i>ACEEE Summer Study Proceedings on Energy Efficiency in Industry</i> , 1995, pp. 541-552.
1027	U.S. Patent No. 3,186,222 to Martin, “Well Signaling System,” filed July 28, 1960 and issued June 1, 1965.
1028	U.S. Patent No. 3,075,136 to Jones, “Variable Pulse Width Parallel Inverters,” filed August 31, 1961 and issued January 22, 1963.
1029	U.S. Patent No. 3,262,036 to Clarke et al, “Means for Smoothly Varying the Speed of a Star-Connected Polyphase Induction Motor,” filed September 19, 1962 and issued July 19, 1966.
1030	Shepherd, William and Stanway, Jack, “Unbalanced Voltage Control of 3-Phase Loads by the Triggering of Silicon Controlled Rectifiers,” <i>IEEE Transactions on Industry and General Applications</i> , no. 3, pp. 206-216, 1965.
1031	Hickok, H. N., "Adjustable Speed—A Tool for Saving Energy Losses in Pumps, Fans, Blowers, and Compressors," <i>IEEE Transactions on Industry Applications</i> , no. 1, pp. 124-136, 1985.
1032	DeWinter, Frank A. and Kedrosky, Brian J., “The Application of a 3500-hp Variable Frequency Drive for Pipeline Pump Control,” in <i>IEEE Transactions on Industry Applications</i> , Vol. 25, No. 6, 1019-1024 1989.
1033	Perrin, M., Kohn, G., Mugford, S., Seggewiss, G., “Induction Motors, Reciprocating Compressors and Variable Frequency Drives,” <i>Record of Conference Papers. IEEE Industry Applications Society 44th Annual Petroleum and Chemical Industry Conference</i> , 15-17 Sept. 1997 1997, pp. 1-9, doi: 10.1109/PCICON.1997.648162.
1034	Lockley, B., Wood, B., Paes, R., DeWinter, F., “IEEE Std 1566 - The Need for a Large Adjustable Speed Drive Standard,” in <i>2006 Record of Conference Papers - IEEE Industry Applications Society 53rd Annual Petroleum and Chemical Industry Conference</i> , 11-15 Sept. 2006, pp. 1-10, doi: 10.1109/PCICON.2006.359687.
1035	Manz, L. B., "The motor designer's viewpoint of an adjustable speed drive specification," <i>IEEE Industry Applications Magazine</i> , vol. 1, no. 1, pp. 16-21, 1995.
1036	Baseer, M., “Electric Machines and Adjustable Speed Drives,” in <i>University of Bradford Electric and Telecommunications Research Seminar Series, 8th Workshop Proceedings</i> , April 1, 2009, 131-134.
1037	Declaration of Sylvia Hall-Ellis, Ph.D.

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1038	Plaintiff’s Motion for Leave to File the Second Amended Complaint, <i>U.S. Well Services, LLC et al. v. Liberty Energy, Inc. et al.</i> , No. 4:24-cv-00839 (S.D. Tex. September 19, 2024)
1039	Claim Listing for Claims of ’258 Patent
1040	<i>Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation</i> (June 21, 2022)
1041	Federal Court Management Statistics (June 30, 2024), <i>available at</i> < https://www.uscourts.gov/sites/default/files/data_tables/fcms_na_appprofile0630.2024.pdf >
1042	File History for U.S. Patent No. 11,959,533
1043	Wells, B.A., Wells, K.L, “Shooters – A “Fracking” History,” American Oil & Gas Historical Society, https://aoghs.org/technology/hydraulic-fracturing , last updated March 7, 2024.
1044	Montgomery, Carl T., Smith, Michael B., “Hydraulic Fracturing, a History of an Enduring Technology,” <i>Journal of Petroleum Technology</i> 62 (12), December 2010.
1045	Bourgoyne, Adam T. Jr., et al., “Applied Drilling Engineering,” <i>Society of Petroleum Engineering Textbook Series</i> , Volume 2, 1986.
1046	Vasilliou, Marius S., “Historical Dictionary of the Petroleum Industry,” Second Edition, Rowman & Littlefield, 2018.
1047	U.S. Patent Publication No. 2013/0306322 to Sanborn et al., entitled “System and Process for Extracing Oil and Gas by Hydraulic Fracturing” (filed Dec. 7, 2012 and published Nov. 21, 2013).
1048	U.S. Patent Publication No. 2012/0255734 to Coli et al., entitled “Mobile, Modular, Electrically Powered System for Use in Fracturing Underground Formations” (filed April 6, 2012 and published Oct. 11, 2012).
1049	U.S. Patent No. 9,410,410 to Broussard et al., entitled “System for Pumping Hydraulic Fracturing Fluid using Electric Pumps” (filed Nov. 16, 2012 and issued Aug. 9, 2016)
1050	Johns, Cort MacLean, “Industrial Revolutions: From Ctesibius to Mars,” ABC Book Center, 2021.

I. MANDATORY NOTICES

Real Party in Interest: Liberty Energy Inc., Liberty Oilfield Services LLC (collectively, “Liberty” or “Petitioners”), and Liberty Advanced Equipment Technologies LLC are the real parties in interest.

Related Matters: The ’258 Patent is involved in a pending lawsuit between Petitioners and U.S. Well Services, LLC (“Patent Owner,” or “PO”) entitled *U.S. Well Services, LLC, et al v. Liberty Energy, Inc. et al*, 4:24-cv-00839-KPE (S.D. Tex.) (“Liberty Litigation”), filed March 6, 2024.

Lead Counsel and Back-Up Counsel: Petitioners designates lead and back-up counsel as noted below. A Power of Attorney is filed concurrently herewith under 37 C.F.R. §42.10(b).

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Service Information: Correspondence to lead and back-up counsel can be provided at the postal and electronic addresses above. Petitioners also consent to

service by electronic mail at chad.walters@bakerbotts.com, andrew.grado@bakerbotts.com, and jacob.mcdonald@bakerbotts.com.

II. STANDING AND FEES

Standing: Petitioners certify under 37 C.F.R. §42.104(a) that the '258 Patent is eligible for *inter partes* review and that Petitioners are not barred or estopped from requesting *inter partes* review on the grounds set forth herein.

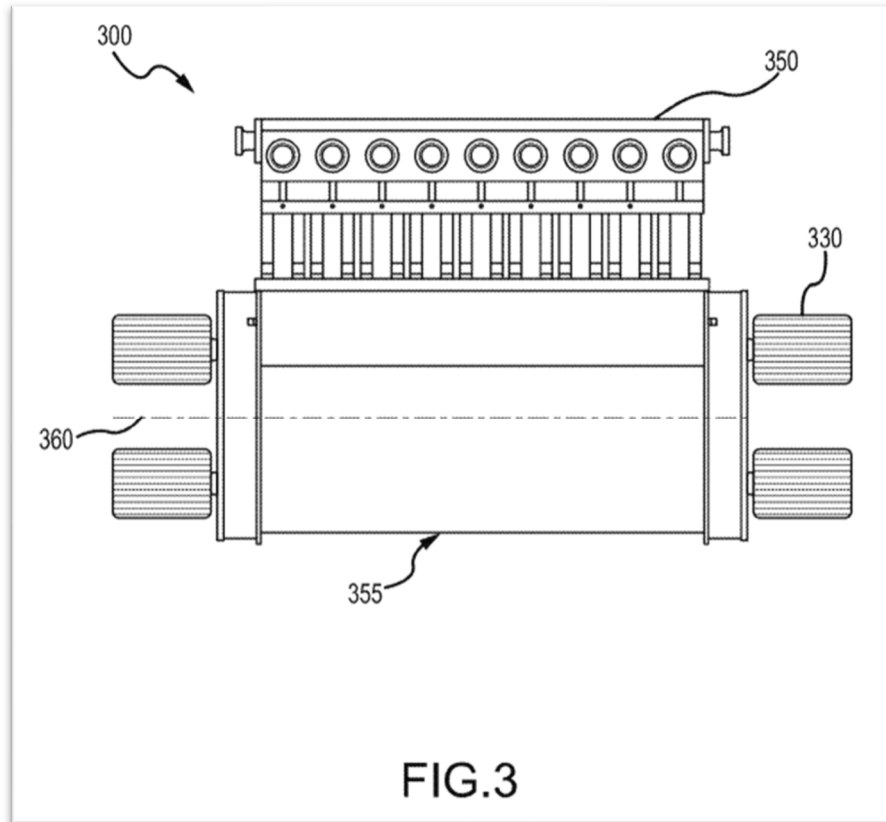
Fees: The Office is authorized to charge the fee set forth in 37 C.F.R. §42.15(a) to Deposit Account No. 02-0384 as well as any additional fees that might be due in connection with this Petition.

III. OVERVIEW OF THE '258 PATENT

A. Subject Matter of the '258 Patent

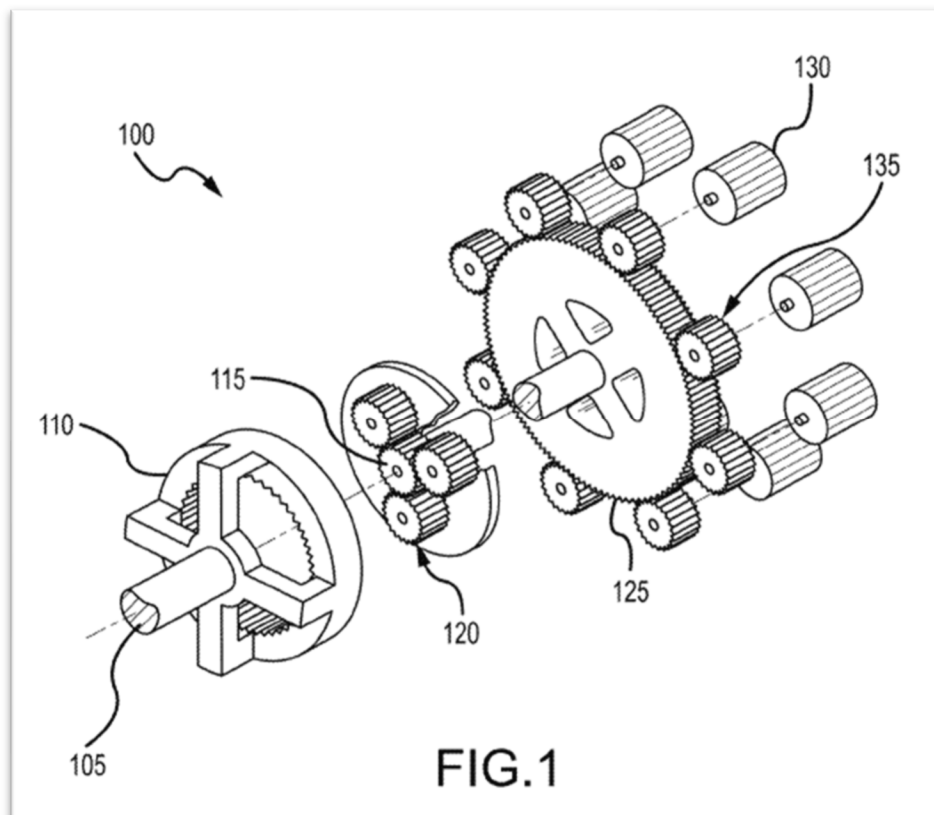
The '258 Patent generally relates to “drive systems for reciprocating plunger-style pumps used in hydraulic fracturing operations, and more particularly to multi-plunger hydraulic fracturing pumps and associated drive systems.” EX1001, 1:16-19.

The system taught by the '258 Patent includes a “multi-plunger hydraulic pump” that is powered by a “plurality of motors,” which may be electric motors or hydraulic motors. *Id.*, 2:46-67. Figure 3 of the '258 Patent depicts this configuration:



Id., Fig. 3 (showing pump 300, multi-plunger fluid end 350, motors 330, and crankshaft centerline 360, *id.*, 8:33-46).

The system further includes a “planetary gear train having a plurality of input pinion gears in rotational contact with each of the plurality of motors,” depicted below. *Id.*, 2:53-57.



Id., Fig. 1.

The system may further include “a plurality of speed reduction gearboxes positioned between the plurality of input pinion gears and the plurality of motors.”

Id., 2:61-63. Further, the electric motors may be connected to a “variable frequency drive (VFD)” that “control[s] the speed of the plurality of motors” and may “be configured to automatically shut off in the event of an overpressure event.” *Id.*, 3:16-27.

B. Priority Date and Prosecution History of the '258 Patent

The application leading to the '258 Patent was filed on December 5, 2018 as Application 16/210,807 and claimed priority to provisional application No.

62/594,912, which was filed on December 5, 2017. EX1001, items (21), (22), (60). For purposes of this petition, Petitioner assumes without conceding that under AIA §102(a), the effective filing date of the '258 Patent is December 5, 2017.

The Patent Office issued a first Non-Final Office Action on July 3, 2019, rejecting Claims 1-20 as being obvious over various combinations of U.S. Patent Publication 2017/0051732 (“*Hernandez*”), U.S. Patent No. 4,100,822 (“*Rosman*”), U.S. Patent No. 8,851,860 (“*Mail*”), and U.S. Patent Publication 2016/0258267 (“*Payne*”). EX1002, 115-127. In response, the Applicant amended independent Claims 1, 11, and 15 to recite that the claimed “plurality of motors [are] positioned to simultaneously power the multi-plunger pump.” *Id.*, 99-102.

Following these amendments, the Patent Office issued a notice of allowance on November 21, 2021. *Id.*, 62.

IV. SUMMARY OF PRIOR ART

A. Buckley (EX1004)

Buckley is a U.S. Patent Application Publication filed September 25, 2018, as PCT No. PCT/US2019/052755 and published August 13, 2020. EX1004. *Buckley* claims priority to U.S. Provisional Application No. 62/562,943 (EX1005, “*Buckley Provisional*”) filed on September 25, 2017. *Buckley* properly claimed benefit to (EX1004, item (60)), was filed copending with (*id.*, item (22)), and shared a common inventor with (*id.*, item (72)) *Buckley Provisional*. See AIA 35 U.S.C. §102(d);

MPEP §2154.01(b). Also, the subject matter relied upon in *Buckley* is disclosed in *Buckley Provisional*. See MPEP §2154.01(b).

Dynamic Drinkware does not apply. See *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1379-80 (Fed. Cir. 2015). The Board has determined that, “for prior-art determinations under AIA §102, ‘there is no need to evaluate whether any claim of [a reference] patent document is *actually entitled to priority* or benefit under 35 U.S.C. 119, 120.’” See, e.g., *Penumbra, Inc. v. RapidPulse, Inc.*, IPR2021-01466, Paper 34 (P.T.A.B. March 20, 2023) (precedential), at 32 (emphasis original; citing MPEP §2154.01(b); holding that the requirement in *Dynamic Drinkware* (that under pre-AIA 35 U.S.C. §102(e), a reference patent’s claims must have written description support in its provisional application to be entitled to the filing date of the provisional application) does not apply to AIA 35 U.S.C. §102(d)); see also *Apple Inc. v. Telefonaktiebolaget LM Ericsson*, IPR2022-00341, Paper 10 (P.T.A.B. Sept. 14, 2022), at 19.

Thus, for prior art purposes, *Buckley* was effectively filed on September 25, 2017, and qualifies as prior art under AIA §102(a)(2). Like the '258 Patent, *Buckley* describes a pumping system that “relates generally to hydraulic fracturing in oil and gas wells, and in particular to an electric drive pump used to drive a fluid end for the pumping of a fracturing fluid into a well.” EX1004, [0001]; EX1005, 2. Thus,

Buckley is from the same field of art as the '258 Patent and describes a fracturing pump that is similar to the pump described in the '258 Patent. EX1003, ¶124.

B. Bergan (EX1006)

Bergan is a U.S. Patent Publication filed on June 13, 2014, and published on December 17, 2015. *Bergan* is prior art at least under 35 U.S.C. §§102(a)(1) and 102(a)(2).

Bergan discloses a hoisting system for use in oil and gas drilling that is driven by multiple electric motors. EX1006, Abstract, [0030]. *Bergan* further describes a “planetary gear system” that is used to couple the multiple electric motors to the load so the motors can drive the rotation of the load. *Id.*, [0032], Figs. 5, 6.

Thus, *Bergan* is in a field of art—using multiple motors and a planetary gear system for driving a load in oil and gas drilling—that is highly relevant to the '258 Patent, which describes a similar configuration for driving a fracturing pump, and a POSITA would understand that *Bergan* addresses the potential problem of connecting multiple electric motors to a load. EX1003, ¶127.

C. Rosman (EX1007)

Rosman is a U.S. Patent issued on July 18, 1978. *Rosman* is prior art at least under 35 U.S.C. §§102(a)(1) and 102(a)(2). *Rosman* teaches the use of multiple smaller motors which combine power outputs through gearing to drive a larger, higher torque load. *See, e.g.*, EX1007, 2:15-24, 4:54-62, Figs. 1-4. Thus, *Rosman*

is highly relevant to the '258 Patent, as it describes a gearing configuration for using multiple electric motors to drive a load, as is taught by the '258 Patent. EX1003, ¶129.

D. Payne (EX1008)

Payne is a U.S. Patent Application Publication published on filed on March 3, 2016 and published on September 8, 2016. *Payne* is prior art at least under 35 U.S.C. §§102(a)(1) and 102(a)(2). *Payne* describes a hydraulic fracturing system that uses electrical motors, which are controlled by a variable frequency drive, to drive a fracturing pump. EX1008, Abstract. Thus, *Payne* is in a field of art—VFD-controlled electric motors for use with fracturing pumps—that is highly relevant to the '258 Patent, which describes VFD-controlled, electric motor-driven fracturing pumps. EX1003, ¶131.

E. Yi (EX1009)

Yi is a Chinese Publication published April 23, 2014. *Yi* is prior art at least under 35 U.S.C. §102(a)(1). Petitioner provides an English translation of *Yi* and a supporting translator affidavit. EX1009, EX1010.

Yi discloses a “fracturing pump transmission system” wherein “multiple motors are used to drive the fracturing pump.” EX1010, Abstract. A POSITA would understand that *Yi*’s fracturing pump is similar to the pump described in the '258 Patent. EX1003, ¶133.

F. Jelaska (EX1012)

Jelaska is a selection from the book titled *Gears and Gear Drives* by Damir *Jelaska*. *Jelaska* was publicly available no later than May 16, 2013, and is prior art at least under 35 U.S.C. §102(a)(1). See EX1037, ¶¶34-40, 55. *Jelaska* describes various gearing systems, their underlying mathematical principles, and their applications. See generally EX1012.

G. Tutterow (EX1013)

Tutterow is a book titled *Variable Speed Pumping: A Guide to Successful Applications* prepared at the Europump and Hydraulic Institute. *Tutterow* was publicly available no later than August 24, 2004, and is prior art at least under 35 U.S.C. §102(a)(1). See EX1037, ¶¶41-47, 55. *Tutterow* describes fundamental pumping principles, types of pumps, and techniques for controlling the speed of those pumps. See generally EX1013.

H. Nesbitt (EX1014)

Nesbitt is a book titled *Handbook of Pumps and Pumping* edited by Brian Nesbitt. *Nesbitt* was publicly available no later than November 14, 2008, and is prior art at least under 35 U.S.C. §102(a)(1). See EX1037, ¶¶48-55. *Nesbitt* is a textbook that describes fundamental pump and pumping principles. See generally EX1014.

I. Summary of Grounds

Ground	Claims	Basis (35 U.S.C. §)	Prior Art
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1A	1, 3, 6	103	<i>Buckley, Bergan, the Knowledge of a POSITA and, in the alternative, Jelaska</i>
1B	1, 3, 6	103	<i>Yi, Bergan, the Knowledge of a POSITA and, in the alternative, Jelaska</i>
2A	4, 5	103	<i>Buckley, Bergan, the Knowledge of a POSITA and, in the alternative, Jelaska and Tutterow</i>
2B	4, 5	103	<i>Yi, Bergan, the Knowledge of a POSITA and, in the alternative, Jelaska and Tutterow</i>
3A	7, 15, 17	103	<i>Buckley, Bergan, the Knowledge of a POSITA and, in the alternative, Jelaska and Nesbitt</i>
3B	7, 15, 17	103	<i>Yi, Bergan, the Knowledge of a POSITA and, in the alternative, Jelaska and Nesbitt</i>
4A	2, 16	103	<i>Buckley, Bergan, Rosman, the Knowledge of a POSITA and, in the alternative, Jelaska and Nesbitt</i>
4B	2, 16	103	<i>Yi, Bergan, Rosman, the Knowledge of a POSITA and, in the alternative, Jelaska and Nesbitt</i>
5A	8-11, 13	103	<i>Buckley, Bergan, Payne, the Knowledge of a POSITA and, in the alternative, Jelaska</i>
5B	8-11, 13	103	<i>Yi, Bergan, Payne, the Knowledge of a POSITA and, in the alternative, Jelaska</i>
6A	12	103	<i>Buckley, Bergan, Payne, Rosman, the Knowledge of a POSITA and, in the alternative, Jelaska and Nesbitt</i>
6B	12	103	<i>Yi, Bergan, Payne, Rosman, the Knowledge of a POSITA and, in</i>

			<i>the alternative, Jelaska and Nesbitt</i>
7A	14	103	<i>Buckley, Bergan, Payne, the Knowledge of a POSITA and, in the alternative, Jelaska and Tutterow</i>
7B	14	103	<i>Yi, Bergan, Payne, the Knowledge of a POSITA and, in the alternative, Jelaska and Tutterow</i>
8A	18	103	<i>Buckley, Bergan, the Knowledge of a POSITA and, in the alternative, Jelaska, Tutterow, and Nesbitt</i>
8B	18	103	<i>Yi, Bergan, the Knowledge of a POSITA and, in the alternative, Jelaska, Tutterow, and Nesbitt</i>
9A	19, 20	103	<i>Buckley, Bergan, Payne, the Knowledge of a POSITA and, in the alternative, Jelaska and Nesbitt</i>
9B	19, 20	103	<i>Yi, Bergan, Payne, the Knowledge of a POSITA and, in the alternative, Jelaska and Nesbitt</i>

EX1003, ¶19; EX1039 (listing challenged claim elements).

V. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art would have either (1) a Bachelor of Science in Mechanical Engineering, Electrical Engineering, Petroleum Engineering or an equivalent field, as well as at least 2 years of academic or industry experience in the oil and gas industry, including well drilling, completion, or production, or (2)

at least four years of industry experience in the oil and gas industry including well drilling, completion, or production. EX1003, ¶48.

VI. CLAIM CONSTRUCTION

Claim terms in IPR are construed according to their “ordinary and customary meaning” to those of skill in the art. *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (*en banc*); 37 C.F.R. §42.100(b). Constructions are proposed “only to the extent necessary.” *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017). For the purposes of this proceeding and the grounds presented herein, Petitioners do not present any constructions. EX1003, ¶49.

VII. INSTITUTION IS PROPER

A. The Fintiv Factors Favor Institution under §314(a)

The factors described in *Apple, Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (P.T.A.B. May 13, 2020) (Precedential) (“*Fintiv-I*”) favor institution. Notably, the merits of this Petition are particularly strong, with compelling art and arguments.

The Liberty Litigation is just beginning. Only 6 weeks ago, plaintiffs sought to amend the complaint and in doing so described the case as “in its infancy” with “ample time” for “Defendants to request a continuance.” EX1038, 6. Thus, the *Fintiv* factors favor institution. EX1040, pp.3, 8-9; EX1041, p.36 (showing a median 30-month time-to-trial); *Samsung Elecs. Co. v. Staton Techiya, LLC*, IPR2022-00324, Paper 13, at 12 (P.T.A.B. July 11, 2022) (applying the median).

A stay motion has not yet been filed in the Liberty Litigation, but Petitioners may file one in the event of IPR institution. The Board has treated related factors as neutral after declining to speculate on the outcome of a stay motion. *See, e.g., HP Inc. v. Slingshot Printing LLC*, IPR2020-01084, Paper 13 at 9 (P.T.A.B. Jan. 14, 2021).

“[I]t is often reasonable for a petitioner to wait to file its petition until it learns which claims are being asserted against it in the parallel proceeding.” *Fintiv-I* at 11. Here, Petitioners promptly filed this Petition against all claims of the ’258 Patent just over 3 months from receiving infringement contentions. The “diligent” filing favors institution. *See, e.g., Corning v. Dali Wireless*, IPR2021-00762, Paper 8 at 9-10 (P.T.A.B. October 31, 2021) (crediting petitioner’s diligent filing of the petition approximately four months after receiving infringement contentions). Due to Petitioners’ diligence, it would be premature at the time of this Petition to argue regarding the timing of respective milestones in this proceeding versus the Liberty Litigation. If PO raises 314(a) arguments in a Preliminary Response, Petitioners respectfully request the opportunity to reply prior to institution to address expected schedules and whether a prior art stipulation would be appropriate.

B. Institution is Proper under §325(d)

Although *Rosman* and *Payne* were relied upon by the examiner during prosecution of the ’258 Patent, each of the Grounds herein rely upon *Bergan* and

either *Buckley* (Grounds 1-9A) or *Yi* (Grounds 1-9B), none of which was before the Patent Office during examination. Further, *Buckley* and *Yi* disclose those limitations of the '258 Patent that were added to achieve allowance. EX1002, 62, 99-102. The Board has found that the *Becton* factors favor institution in situations where even a single noncumulative secondary reference distinguished the prior-art ground regardless of other overlapping references. *Oticon Medical AB et al. v. Cochlear Limited*, IPR2019-00975, Paper 15 at 9-20 (P.T.A.B. Oct. 16, 2019) (precedential).

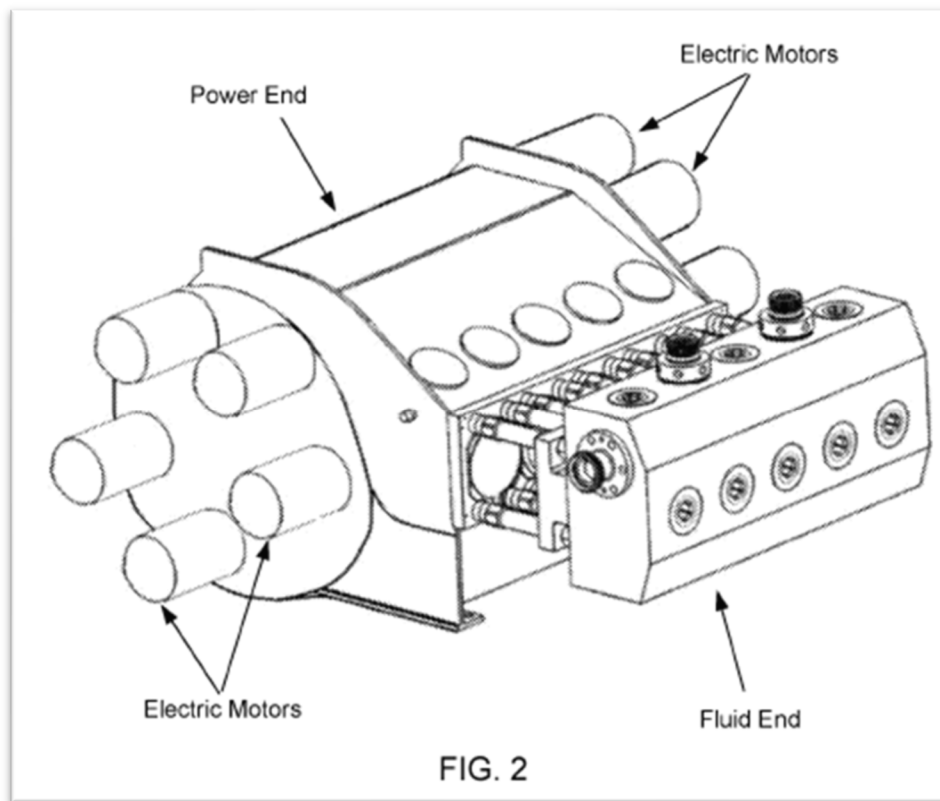
VIII. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Ground 1A: The combination of Buckley and Bergan renders obvious Claims 1, 3 and 6 in view of the knowledge of a POSITA and, in the alternative, Jelaska

1. Motivation to Combine

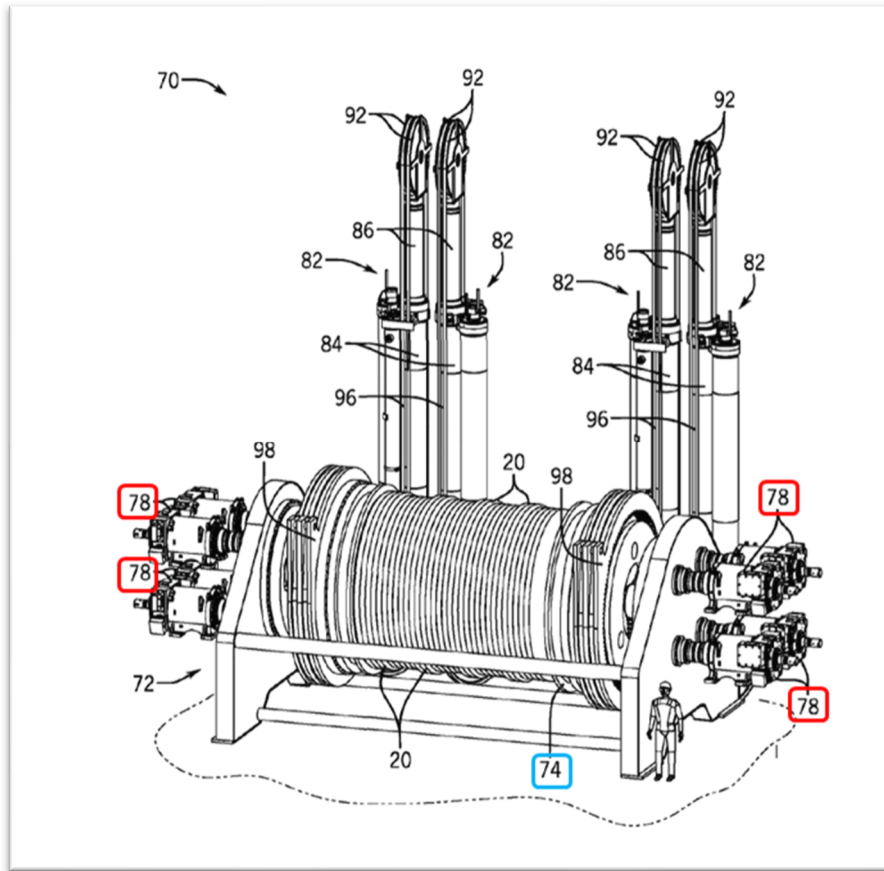
a) A POSITA Would Have Been Motivated to Combine *Buckley* with *Bergan*

Buckley discloses using multiple motors to drive a single rotary load, such as a fluid end of a fracturing pump, and that the motors are connected to the load via a gearbox. EX1004, [0009], Fig. 2; EX1005, 4, 5, Fig. 2. Figure 2 of *Buckley Provisional* depicts such connecting multiple electric motors to the power end of a drive pump:



EX1005, Fig. 2; *see also* EX1004, Fig. 2 (depicting a transmission assembly mounted to a drive pump), Fig. 9 (depicting a transmission assembly comprising multiple motors).

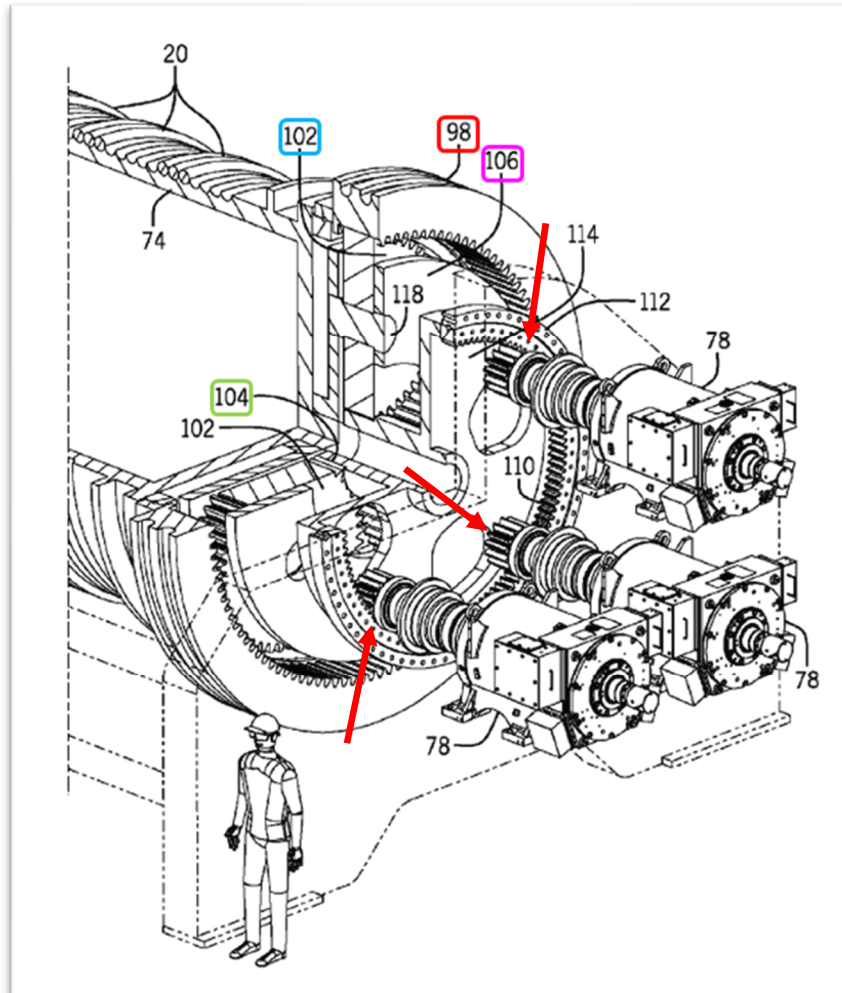
Similarly, *Bergan* teaches the use of a plurality of motors located co-axially with the shaft of the load and connected to the shaft via gearing systems and used in oil and gas drilling, which is at least a closely related field to hydraulic fracturing. EX1003, ¶144; EX1006, [0030] (describing, with reference to Figure 3, copied below, that “[m]otors 78 [annotated in red] can be operated to drive rotation of the drum 74 [annotated in blue]”).



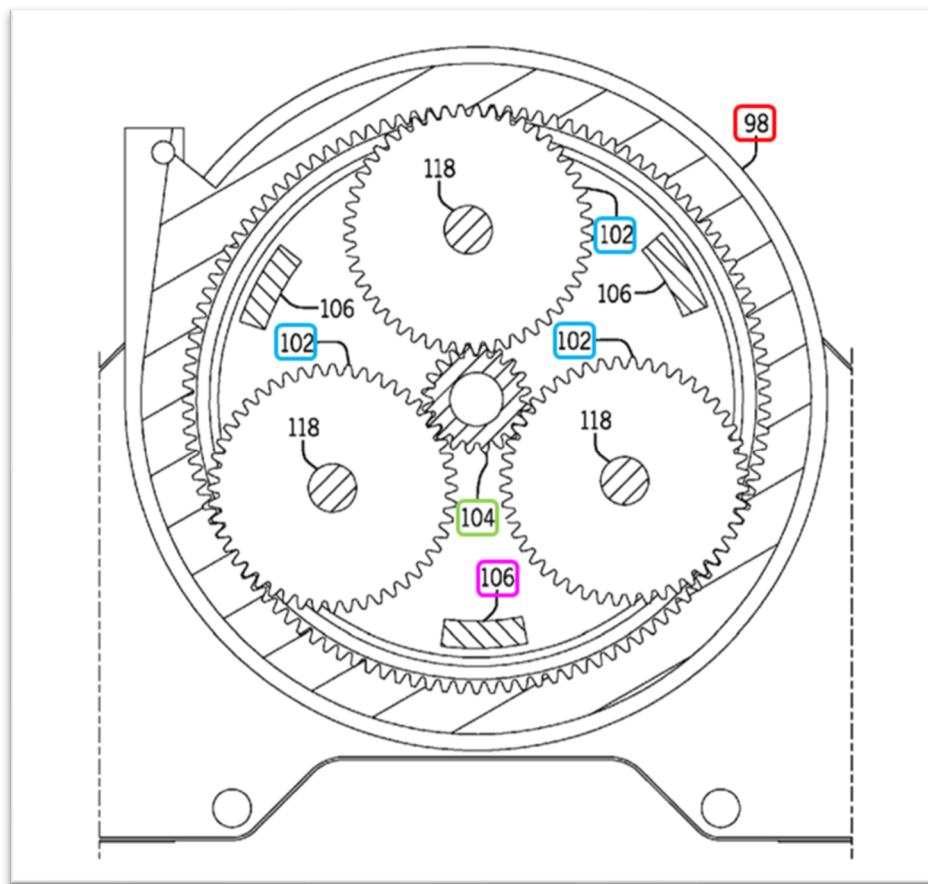
EX1005, Fig. 3 (annotated).

Bergan further teaches the use of a planetary gear system to connect motors to the shaft. *Bergan* discloses, with respect to Figures 4-6, that “the planetary gear system includes the ring gear 98 [annotated in red below], planetary gears 102 [annotated in blue], and a sun gear 104 [annotated in green]. A carrier 106 [annotated in magenta] is coupled to rotate with the planetary gears 102 as they orbit the sun gear 104 in operation,” the rotation of which drives the rotation of the load. EX1006, [0032]. Figure 5 depicts this configuration, along with showing that the motors 78

drive input pinions (annotated with red arrows) allowing the motors to drive the gearing system. EX1003, ¶148 (citing EX1011, definition of “pinion”).



EX1006, Fig. 5 (annotated).



Id., Fig. 6 (annotated).

A POSITA would have been motivated to combine *Bergan*'s planetary gear system, with appropriate changes to gear sizes that would have been obvious to a POSITA, with *Buckley*'s pump system to couple *Buckley*'s multiple motors with its rotating load (*i.e.*, the pump crankshaft) via *Bergan*'s planetary gear system, including the pinion gears taught by *Bergan*. EX1003, ¶149. *Buckley* provides an express motivation to combine with *Bergan*'s planetary gear system. *Buckley* discloses that its “motors are arranged around a gearbox which is used to convert the rotary motion of the electric motors into linear motion for operation of the plungers

in the fluid ends.” EX1004, [0009]; EX1005, 5 (“Selected gearing may be used to assist in mating the electric motors to the power end. ... Also a transfer gear system can be used if required.”). A POSITA would have been motivated to understand different gearing configurations to connect multiple motors to a single load, and would have understood that *Bergan* offers one such solution. EX1003, ¶143.

Further, incorporating *Bergan*’s planetary gear train and use of pinions to connect the motors to the load is applying a known technique (planetary gear trains and motors with pinions) to improve similar devices (*Buckley*’s gearbox) in the same way. EX1003, ¶150; *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). The results of the combination would be predictable: transfer of rotational energy from *Buckley*’s motors to *Buckley*’s pump with straightforward, predictable changes in gear ratios and corresponding changes in speed and torque available. EX1003, ¶150. Further, *Bergan*’s planetary gear system and motors that drive pinions was known in one field of endeavor (oil and gas drilling, as taught by *Bergan*) and would have prompted a POSITA to use it in either the same field or a different one (oil and gas fracturing) based on design incentives (ability to connect multiple motors to a single load and the advantages of a planetary gear train) because the variations used for a pump (as in *Buckley*) would have been predictable to one of ordinary skill in the art. *Id.*; *KSR Int’l*, 550 U.S. at 417. As discussed above, the results of the combination would be predictable: transfer of rotational energy from *Buckley*’s motors to

Buckley's pump with straightforward, predictable changes in gear ratios and corresponding changes in speed and torque available. EX1003, ¶150. Further, modifying *Buckley's* pumping system to use *Bergan's* planetary gearing system requires a simple substitution of one known element (*Bergan's* planetary gearing system) for another (*Buckley's* gearing system) to obtain the predictable result of transferring rotational energy from *Buckley's* motors to *Buckley's* pump. EX1003, ¶150; *KSR Int'l*, 550 U.S. at 416. Accordingly, a POSITA would have been motivated to combine *Buckley* and *Bergan* and would have had a reasonable expectation of success in doing so. EX1003, ¶150.²

b) A POSITA Would Have Been Motivated to Combine the *Buckley-Bergan* Combination with *Jelaska*

As discussed above, the *Buckley-Bergan* combination teaches a multi-plunger pump powered by multiple electric motors via a planetary gearing configuration. *See supra*, VIII.A.1.(a). A POSITA would have searched for other references to

² The USPTO combined *Buckley* and *Bergan* in a similar manner during the prosecution of Application 18/357,271, which was filed as a continuation of, and contained claims similar to, the '258 Patent. *See* EX1042, 443-444 (IDS accompanying Application No. 18/357,271, claiming priority to Application 16/210,807, which issued as the '258 Patent (*see* Ex. 1001, Cover)), 157-162 (Office Action analysis of *Buckley-Bergan* combination).

better understand details of gearing configurations that are not described in *Buckley* and/or *Bergan*. EX1003, ¶151. One such reference is *Jelaska*, which is a publication that provides granular details about gearing configurations that would be invaluable to a POSITA looking to apply the teachings of *Bergan* to a practical system. *Id.* In particular, *Jelaska*'s description of transmission ratio and its effect on the speed of a driven component would aid a POSITA's design of a gearing configuration when implementing *Bergan*'s planetary gearing configuration to result in a particular pump speed. *Id.*; EX1012, 3.

Further, combining *Jelaska*'s teachings regarding transmission ratio to the *Buckley-Bergan* combination's pumping configuration is merely combining prior art elements (designing a transmission system to produce a desired output speed and the planetary gearset of *Bergan*) to known methods (*Bergan*'s planetary gearset) to yield predictable results (producing a desired pump speed as the output of the planetary gearset). EX1003, ¶152. Accordingly, a POSITA would have been motivated to combine *Jelaska*'s teachings of fundamental gearing system operations with the *Buckley-Bergan* combination's pumping configuration, and would have reasonably expected success in doing so. *Id.*

2. Claim 1

a) 1[p]: A hydraulic fracturing system for fracturing a subterranean formation comprising:

Buckley describes a pumping system that “relates generally to hydraulic fracturing in oil and gas wells, and in particular to an electric drive pump used to drive a fluid end for the pumping of a fracturing fluid into a well.” EX1004, [0001]; EX1005, 2. *Buckley* explains that hydraulic fracturing “has been used for decades to stimulate production from conventional oil and gas wells,” and that the process involves “pumping fluid into a wellbore at high pressure” to “fracture[], or create[] fissures, in the formation.” EX1004, [0002]; EX1005, 2; EX1003, ¶¶154-155.

b) 1[a]: a multi-plunger hydraulic fracturing pump fluidly connected to a well associated with the subterranean formation, the multi-plunger pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation;

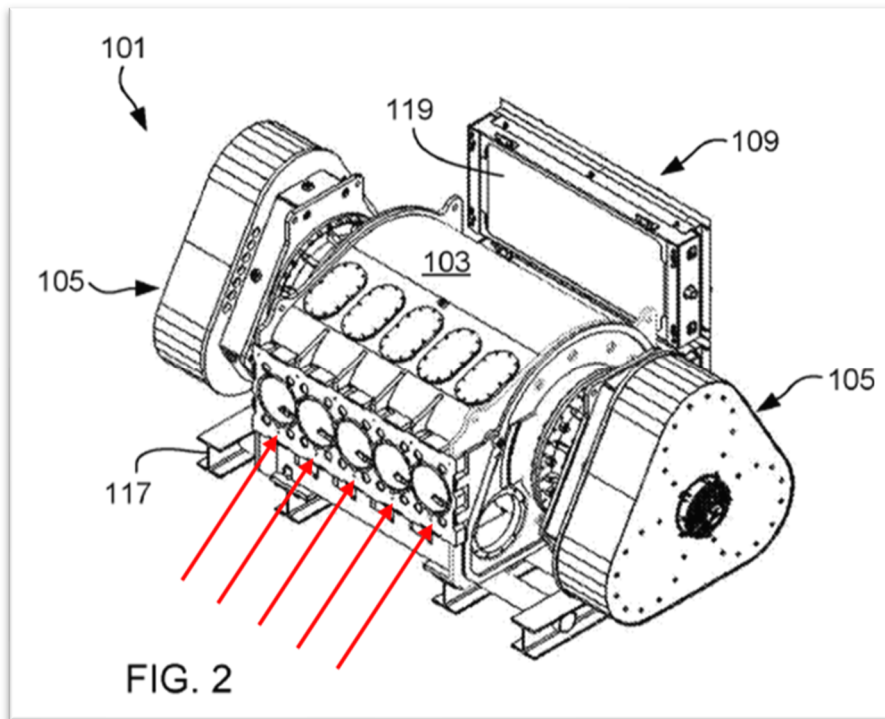
As an initial matter, the '258 Patent admits in its Background section that “[h]ydraulic fracturing operations commonly use diesel-powered pumps to transmit fluid media down the well bore.” EX1001, 1:37-38. Further, the '258 Patent admits that multi-plunger hydraulic fracturing pumps were known. *Id.*, 5:1-3.

Consistent with this admission in the Background of the '258 Patent, *Buckley* discloses a multi-plunger hydraulic pump that meets the elements of Limitation 1[a].

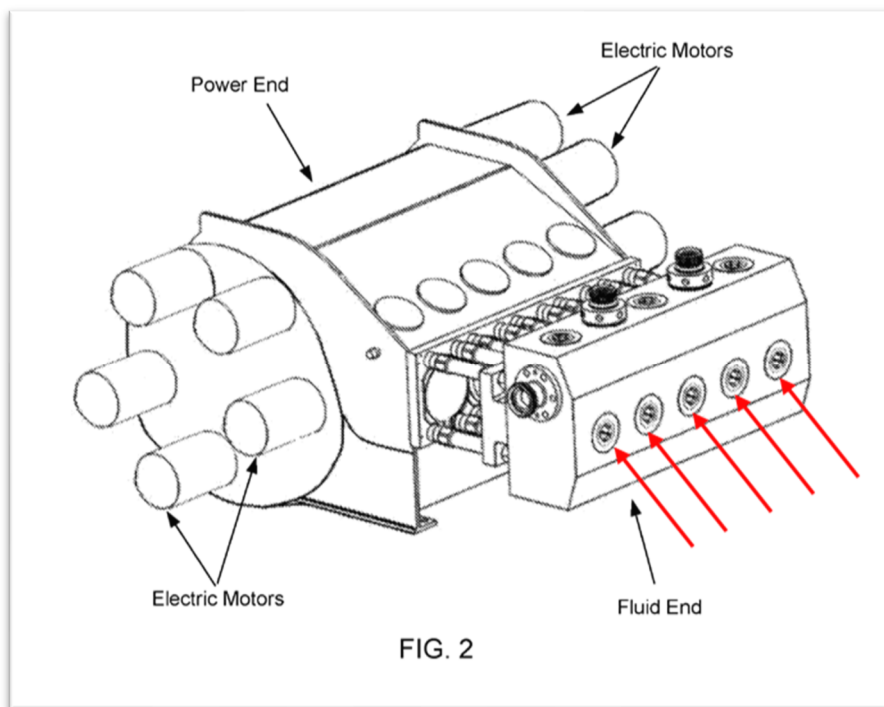
Buckley discloses “an electric drive pump used to drive a fluid end of the pump of a fracturing fluid into a well.” EX1004, [0001]; EX1005, 2. Further, *Buckley* explains that hydraulic fracturing involves “pumping fluid into a wellbore at high pressure (sometimes as high as 50,000 PSI)” to “fracture[], or create[] fissures, in

the formation.” EX1004, [0002]; EX1005, 2. A POSITA would have understood that *Buckley*’s disclosure of pumping fluid into the wellbore discloses that the pump is connected to the well. EX1003, ¶156. Accordingly, a POSITA would have understood that *Buckley* discloses a hydraulic pump that is both connected to a well associated with the subterranean formation and configured to pump fluid into a wellbore associated with the well at high pressure to fracture the subterranean formation. *Id.*

Further, a POSITA would have understood that *Buckley*’s electric drive pump is a “multi-plunger hydraulic pump.” Although *Buckley* does not specifically identify its electric drive pump as a “multi-plunger pump,” a POSITA would have understood that *Buckley*’s electric drive pump comprises five (“multiple”) plungers, which are annotated with red arrows in the below copies of the electric drive pumps disclosed by *Buckley* and *Buckley Provisional*:



EX1004, Fig. 2 (annotated).

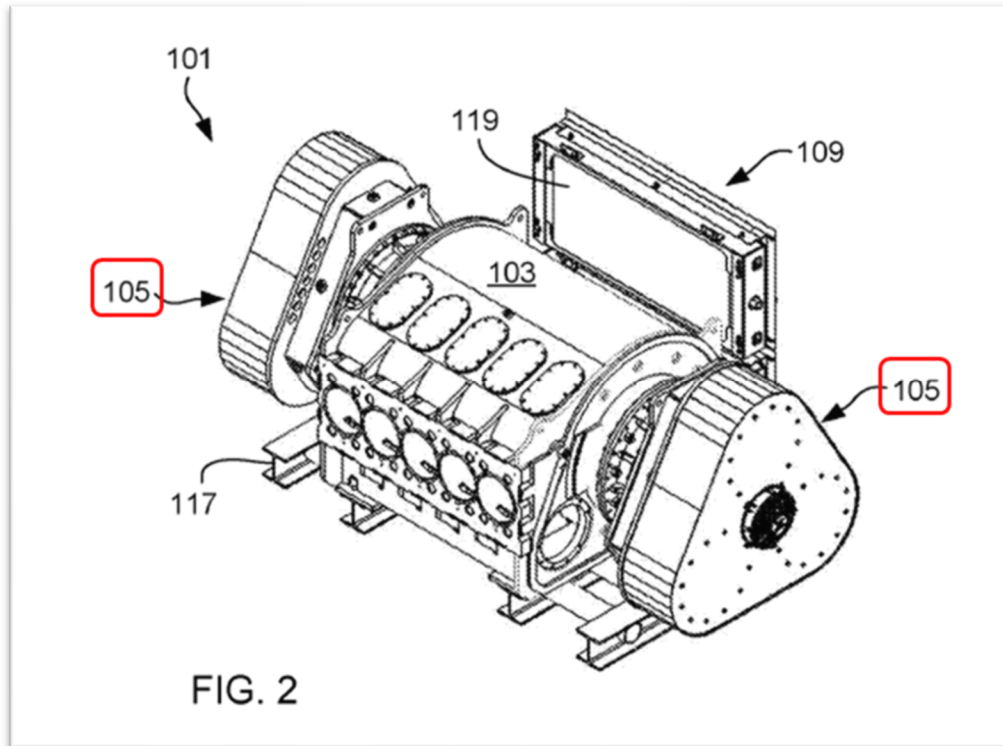


EX1005, Fig. 2; EX1003, ¶¶157-158.

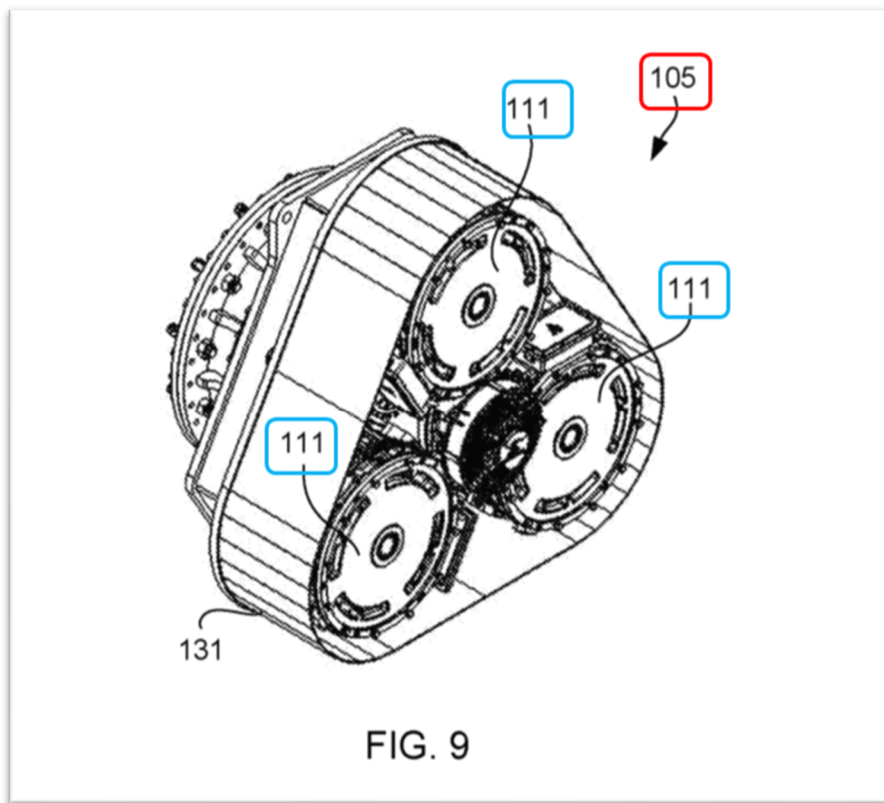
Buckley therefore discloses this limitation.

c) 1[b]: a plurality of motors positioned to simultaneously power the multi-plunger pump; and

Buckley discloses that its electric drive pump system includes “a plurality of individual motors in selective configurations that work together to provide power to a power end,” and that the motors “are arranged around a gearbox which is used to convert the rotary motion of the electric motors into linear motion for operation of the plungers in the fluid end” of the electric drive pump. EX1004, [0009]; *see also* EX1005, 4 (“This system includes a series of electric motors of sufficient number needed to give the required output to operate the one or more fluid ends.”). Figure 2 of *Buckley*, annotated below, shows transmission assembly 105 (annotated in red) mount to drive the electric drive pump:



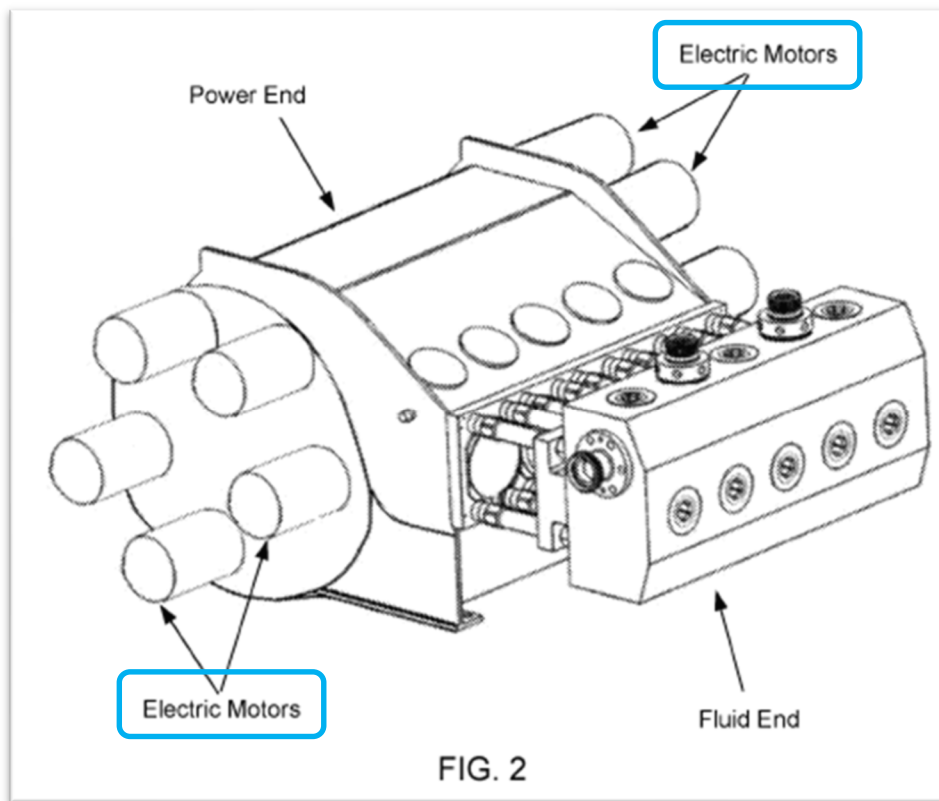
EX1004, Fig. 2 (annotated). And Figure 9 of *Buckley*, copied and annotated below, shows that the transmission assembly 105 (annotated in red) comprises a plurality of motors 111 (annotated in blue):



Id., Fig. 9 (annotated).

Similarly, Figure 2 of *Buckley Provisional*, annotated below, shows “series of electric motors of sufficient number needed to give the required output to operate the one or more fluid ends,” including, as an example, “a total of 10 [motors that] are shown or implied, with 5 being located on either side of the power end.”

EX1005, 4.



EX1005, Fig. 2 (annotated).

Further, *Buckley* discloses that its motors operate “simultaneously” to power the drive pump. *Buckley* discloses that “motors 111 may operate *as a collective whole* or independent of one another.” EX1004, [0056] (emphasis added); EX1005, 5 (“*Collectively, to some degree, a sufficient amount of power needs to be output from some number of the plurality of electric motors as is necessary to achieve the pumps output.* It is understood that if each of the motors are independently operable, *some motors may be on while others are off.*” (emphasis added)). As an example of simultaneous motor operation, *Buckley* describes several scenarios where multiple motors are turned on at the same time to meet the output needs of the drive pump

(e.g., when a “50% output is required,...the even numbered motors 111 are operative while the odd numbered motors 111 are deactivated or turned off.”). *See* EX1004, [0057], Figs. 16-18; EX1005, 6, Figs. 4-6.

Accordingly, *Buckley* discloses this limitation, which, as discussed above in Section III.B, includes the “simultaneously” language that was amended into the independent claims during prosecution and resulted in allowance. *See supra*, III.B; EX1002, 62, 99-102.

d) 1[c]: a planetary gear train having a plurality of input pinion gears in rotational contact with each of the plurality of motors,

Bergan discloses, with respect to Figures 4-6, that “the planetary gear system includes the ring gear 98 [annotated in red below], planetary gears 102 [annotated in blue], and a sun gear 104 [annotated in green]. A carrier 106 [annotated in magenta] is coupled to rotate with the planetary gears 102 as they orbit the sun gear 104 in operation.” EX1006, [0032]. *Bergan* explains that motors 78 drive sun gear 104, which a POSITA would have understood to be the result of motors 78 driving the rotation of a respective “input pinion” (not numbered, annotated with red arrows below). EX1006, [0032]; EX1003, ¶171. A POSITA would have recognized those elements as pinions gears because a “pinion” was known to be “a gear with a small number of teeth designed to mesh with a larger wheel or rack”; *Bergan*’s pinions mesh with the larger gear (wheel) 110. EX1003, ¶171 (citing EX1011, Merriam-

EX1006, Fig. 5 (annotated).

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success in doing so. *See supra*, VIII.A. Accordingly, the *Buckley-Bergan* combination renders obvious this limitation.

e) 1[d]: wherein a gear ratio of the planetary gear train and a speed at which the plurality of motors operates are selected so as to limit a maximum pump speed associated with the multi-plunger pump.

As discussed above with reference to Limitation 1[c], the *Buckley-Bergan* combination renders obvious coupling multiple motors to a drive pump (as taught by *Buckley*) via a planetary gear train (as taught by *Bergan*). It was well-known in the art that the speed of the driver dictates the speed of the driven mechanism according to a transmission ratio, i , of the power transmission that links the driver to the driven mechanism, where the transmission ratio is defined as:

$$i = \frac{n_1}{n_2},$$

where n_1 is the driving shaft speed and n_2 is the driven shaft speed. EX1003, ¶174 (citing *Jelaska* (EX1012), 3). A POSITA would have understood that in the combined *Buckley-Bergan* system, *Bergan*'s planetary gear configuration is the transmission that links *Buckley*'s motors (*i.e.*, driving mechanism) with its drive pump (*i.e.*, driven mechanism), such that the "transmission ratio" of the planetary gear configuration is its "gear ratio." EX1003, ¶174.

Accordingly, in order to "limit a maximum pump speed associated with the multi-plunger pump," a POSITA would simply choose a maximum desired speed of

the pump and coordinate the speed of the motors with the gear ratio of the gear train so that the maximum speed is not exceeded. *Id.* The output speed of a gear train (the rotational speed delivered to the pump) is predictable based on the input speed of the motor(s) and the gear ratio of the drive train (the planetary gear system), as shown above. *Id.* Accordingly, the combination of *Buckley* and *Bergan*, in view of the general knowledge of a POSITA, renders this limitation obvious. *Id.*; *Koninklijke Philips N.V. v. Google LLC*, 948 F.3d 1330, 1337-1338 (Fed. Cir. 2020) (permitting use of general knowledge of POSITA under §103 if supported by evidence of record); *Lone Star Silicon Innovations LLC v. Iancu*, 809 F. App'x 773, 776 (Fed. Cir. 2020) (non-precedential) (finding that Board properly considered evidence of the knowledge of a POSITA even when the evidence was not listed as named references in the petition's only obviousness ground); *Samsung Elecs. Co., Ltd. v. WiPQTUS Inc.*, IPR2024-00023, Paper 7 at 83 (P.T.A.B. March 14, 2024) ("Petitioner properly relies on an ordinarily skilled artisan's knowledge and understanding to establish obviousness."); *Samsung Elecs. Co, Ltd v. Fendgo, LLC*, IPR2024-00113, Paper 11 at 30 (P.T.A.B. May 20, 2024); *Keysight Techs., Inc. v. Centripetal Networks, LLC*, IPR2023-00448, Paper 25 at 43-44 (P.T.A.B. June 3, 2024). In the alternative, Limitation 1[d] is rendered obvious by the *Buckley-Bergan-Jelaska* combination for the same reasons. EX1003, ¶174.

This understanding of the *Buckley-Bergan* combination and the *Buckley-Bergan-Jelaska* combination is consistent with the examiner's rejection of Limitation 1[d] during prosecution, where the examiner found that the prior art's disclosure of a planetary gearing system that "allows for gear reduction...inherently limit[s] maximum pump speed," which was not contested by the applicant. EX1002, 99-102, 116.

3. Claim 3

- a) The system of claim 1, wherein the plurality of motors comprises one of a plurality of electric motors or a plurality of hydraulic motors.

Buckley discloses that the multiple motors used to power the drive pump are "electric motors." EX1004, [0009]; EX1005, 4; *see supra*, VIII.A.2.(c). *Buckley* therefore discloses this limitation.

4. Claim 6

- a) The system of claim 1, wherein the multi-plunger hydraulic fracturing pump comprises an odd number of plungers greater than or equal to five plungers.

A POSITA would have understood that *Buckley*'s drive pump is a quintuplex (five-plunger) pump. *See supra*, VIII.A.2.(b); *see also* EX1001, 5:1-3 (admitting that quintuplex pumps were known in the art). *Buckley* therefore discloses Claim 6.

B. Ground 1B: The combination of Yi and Bergan renders obvious Claims 1, 3 and 6 in view of the knowledge of a POSITA and, in the alternative, Jelaska

1. Motivation to Combine

a) A POSITA Would Have Been Motivated to Combine Yi with Bergan

A POSITA would have been motivated to combine *Bergan*'s planetary gear system with *Yi*'s pump system to couple *Yi*'s multiple motors with its rotating load (*i.e.*, the pump crankshaft) via *Bergan*'s planetary gear system, including the pinion gears taught by *Bergan*, with appropriate changes to gear sizes that would have been obvious to a POSITA. EX1003, ¶190. *Yi* provides an express motivation to combine with *Bergan*'s planetary gear system. *Yi* teaches that it connects its motors to an input power gear via multiple output power gears, but otherwise does not provide detail regarding the particular gearing utilized to transmit rotation from the motors to the pump. *See* EX1010, [0044]. A POSITA would have been motivated to look for other references that disclose particular gearing configurations for, and additional details regarding, connecting multiple motors to a single load, such as *Bergan*, when implementing the pumping system disclosed by *Yi*. EX1003, ¶¶183, 186-189.

Further, incorporating *Bergan*'s planetary gear train and the use of pinions to connect the motors to the load is applying a known technique (planetary gear trains and motors with pinions) to improve similar devices (*Yi*'s gearing system) in the same way. EX1003, ¶191. The results of the combination would be predictable:

transfer of rotational energy from *Yi*'s motors to *Yi*'s pump with straightforward, predictable changes in gear ratios and corresponding changes in speed and torque available. *Id.* Further, *Bergan*'s planetary gear system and motors that drive pinions was known in one field of endeavor (oil and gas drilling) and would have prompted a POSITA to use it in either the same field or a different one (oil and gas fracturing) based on design incentives (ability to connect multiple motors to a single load and the advantages of a planetary gear train) because the variations used for a pump (as in *Yi*) would have been predictable to one of ordinary skill in the art. *Id.* The results of the combination would be predictable: transfer of rotational energy from *Yi*'s motors to *Yi*'s pump with straightforward, predictable changes in gear ratios and corresponding changes in speed and torque available. *Id.* Accordingly, a POSITA would have been motivated to combine *Yi* and *Bergan* and would have had a reasonable expectation of success in doing so.³ *Id.*

b) A POSITA Would Have Been Motivated to Combine *Yi* and *Bergan* with *Jelaska*

For the same reasons discussed above in Ground 1A regarding the combination of the *Buckley-Bergan* combination and *Jelaska*, a POSITA would have

³ As noted above, the Patent Office combined *Bergan* with *Buckley*, which, like *Yi*, discloses a multi-plunger fracturing pump powered by multiple motors, during the prosecution of a continuation application of the '258 Patent. *See supra*, fn. 2.

been motivated to combine the *Yi-Bergan* combination with *Jelaska* and would have reasonably expected success in doing so (*i.e.*, because *Jelaska*'s teachings regarding transmission ratio would aid a POSITA in designing a gearing configuration when implementing *Bergan*'s planetary gearing configuration, and combining *Jelaska*'s teachings to the *Yi-Bergan* combination's pumping configuration is merely combining prior art elements to known methods to yield predictable results). *See supra*, VIII.A.1; EX1003, ¶¶151-152, 192-193.

2. Claim 1

a) 1[p]

Yi generally discloses a “fracturing pump transmission system and a fracturing truck,” and explains that fracturing involves operating in “oil and gas wells” to “inject high-pressure, large-volume fracturing fluid into the formation, causing it to crack open and injecting proppants (such as fracturing sand) into the fractures to enhance the permeability of the formation.” EX1010, [0002]. A POSITA would have recognized that the “formations” that are fractured are “subterranean formations,” and that *Yi* discloses this limitation. EX1003, ¶¶195-197.

b) 1[a]

The '258 Patent admits in its Background section that it was well known to “transmit fluid media down the well bore” in hydraulic fracturing systems (EX1001, 1:37-38) and that the '258 Patent admits that multi-plunger hydraulic fracturing pumps were known (*id.*, 5:1-3); *see supra*, VIII.A.1.(b). Consistent with this

admission in the background of the '258 Patent, *Yi* discloses a multi-plunger hydraulic pump that meets the elements of Limitation 1[a].

Yi discloses “a fracturing pump transmission system and a fracturing truck,” and that the fracturing truck includes a “fracturing pump [that] is a crankshaft-type plunger pump.” EX1010, [0002], [0010]. Further, *Yi* explains that hydraulic fracturing involves operating in “oil and gas wells” to “inject high-pressure, large-volume fracturing fluid into the formation, causing it to crack open and injecting proppants (such as fracturing sand) into the fractures to enhance the permeability of the formation.” EX1010, [0002]. A POSITA would have understood that *Yi*’s disclosure of pumping fluid into the formation discloses that the pump is connected to the well. EX1003, ¶198. Further, a POSITA would have understood that *Yi*’s disclosure of “*inject[ing] high-pressure, large-volume fracturing fluid* into the formation, *causing it to crack open*,” (emphasis added) teaches “pump[ing] the fluid...at a high pressure” and “fractur[ing] the subterranean formation.” EX1003, ¶¶200-201.

Further, to the extent that *Yi* does not explicitly disclose a “wellbore associated with a well,” it would have been obvious to a POSITA that access to the “formation” would have been via a well with a wellbore, as that arrangement has been known to oil and gas operations for over 100 years. EX1003, ¶198.

Further, a POSITA would have understood that *Yi*'s plunger pump is a “multi-plunger hydraulic pump.” Although *Yi* does not specifically identify its electric drive pump as a “multi-plunger pump,” a POSITA would have understood that *Yi*'s pump comprises five (“multiple”) plungers, which are annotated with red arrows:

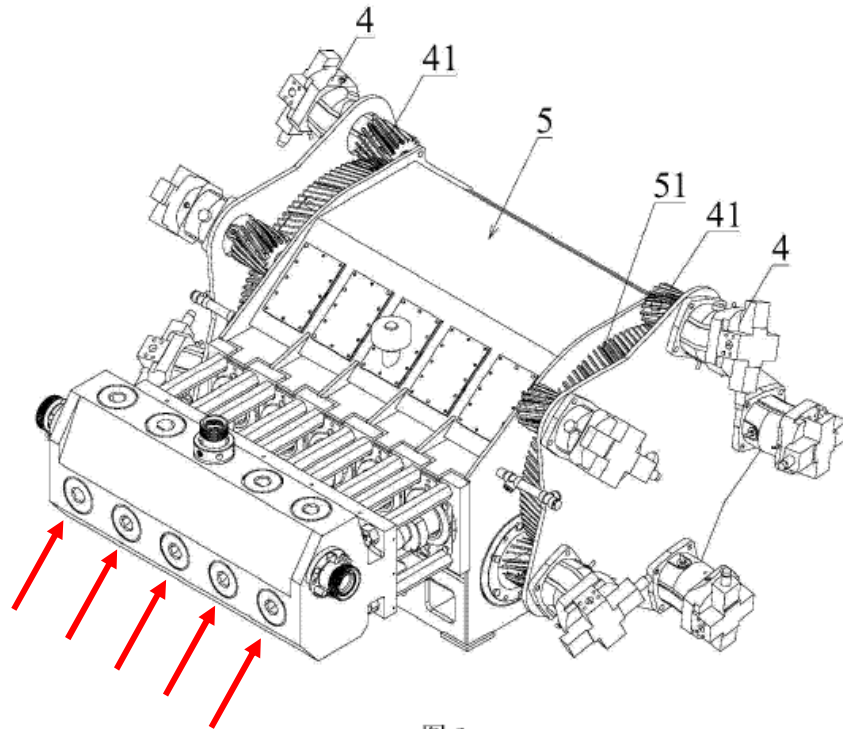


图 2

EX1009, Fig. 2; EX1003, ¶199.

Yi therefore discloses this limitation.

c) 1[b]

Yi teaches “the fracturing pump transmission system includes ... multiple motors,” and that “all the multiple motors are used to drive the fracturing pump.” EX1010, Abstract. Figure 2 of *Yi*, annotated below, shows multiple of motors (labeled as items 4 below):

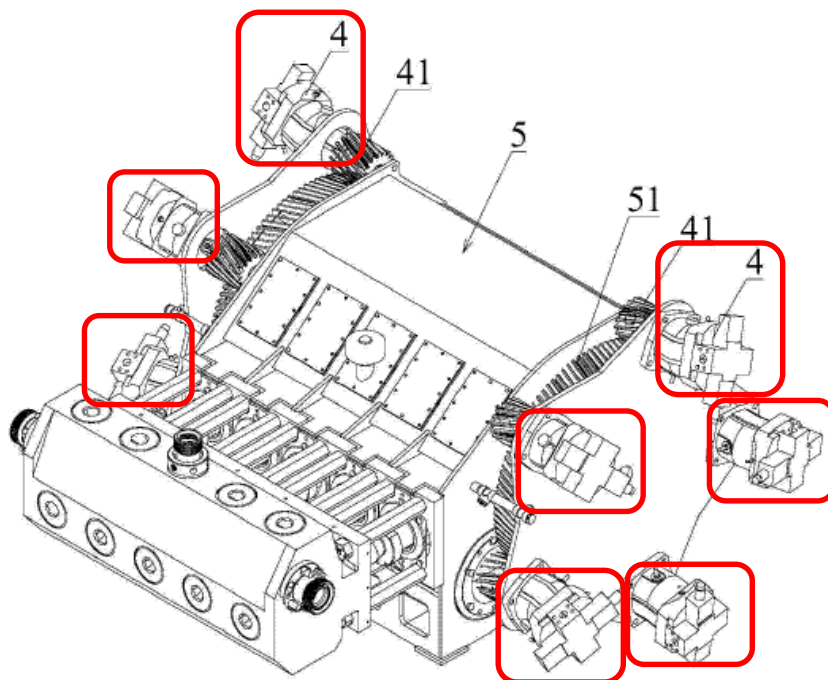


图 2

EX1009, Fig. 2 (annotated).

Yi further discloses that the multiple motors operate “simultaneously,” as *Yi* teaches that during operation, the multiple motors “rotate” and “drive the fracturing pump 5 to rotate.” EX1010, [0046]; EX1003, ¶¶202-204.

Accordingly, *Yi* discloses this limitation, which, as discussed above in Section III.B, includes the “simultaneously” language that was amended into the independent claims during prosecution and resulted in allowance. *See supra*, III.B; EX1002, 62, 99-102.

d) 1[c]

Under the *Yi-Bergan* combination, it would have been obvious to a POSITA that *Bergan*’s planetary gear system would couple *Yi*’s multiple motors to *Yi*’s

fracturing pump for the same reasons discussed in Ground 1A regarding Limitation 1[c]. EX1003, ¶¶206-211.; *see supra*, VIII.A.2.(d).

e) 1[d]

Under the *Yi-Bergan* combination, it would have been obvious to a POSITA to coordinate the speed of *Yi*'s motors with the gear ratio of *Bergan*'s planetary gear train so that the maximum speed of *Yi*'s pump is not exceeded in view of the knowledge of a POSITA and, in the alternative, *Jelaska* for the same reasons discussed above in Ground 1A regarding Limitation 1[d]. *See supra*, VIII.A.2.(e); EX1003, ¶212.

3. Claim 3

Yi discloses that its motors are hydraulic motors. *Yi* explains that oil pumps “supply pressure oil to multiple motors 4, and all the multiple motors 4 are used to drive the fracturing pump 5.” EX1010, [0042]. In particular, *Yi* discloses that “the output of each oil pump is respectively connected through a corresponding oil line to a first oil port of at least one motor, and a second oil port of that at least one motor is connected to a hydraulic oil tank.” *Id.*, [0009]. A POSITA would have understood that this teaches that *Yi*'s motors are hydraulic motors that use the pressurized oil to rotate. EX1003, ¶¶213-214.

4. Claim 6

A POSITA would have understood that *Yi*'s fracturing pump is a quintuplex (five-plunger) pump. *See supra*, VIII.B.2.(b); *see also* EX1001, 5:1-3 (admitting that quintuplex pumps were known in the art). *Yi* therefore discloses Claim 6.

C. Ground 2A: The combination of Buckley and Bergan renders obvious Claims 4 and 5 in view of the knowledge of a POSITA and, in the alternative, Jelaska and Tutterow

1. Motivations to Combine

a) A POSITA Would Have Been Motivated to Combine Buckley with Bergan and Jelaska

See supra, VIII.A.1; EX1003, ¶223.

b) A POSITA Would Have Been Motivated to Further Combine Buckley with Tutterow

As discussed above with reference to Ground 1A, *Buckley* discloses a multi-plunger pump for operating within a fracturing system. *See supra*, VIII.A.2.(b). A POSITA would have searched for other references to better understand details of multi-plunger pumps that are not described in *Buckley*. EX1003, ¶224. One such reference is *Tutterow*, which is a publication that provides granular details about the operation of pumps that would be invaluable to a POSITA looking to apply the teachings of *Buckley* to a practical system. *Id.* Specifically, *Tutterow*'s description of cavitation, its risks, and how to avoid it would aid a POSITA's selection of pump speed when implementing *Buckley*'s pumping system to avoid issues caused by cavitation. *Id.*; EX1013, 20, 30.

Further, combining *Buckley* with *Tutterow* is merely combining prior art elements (limiting pump operation speed to avoid cavitation, as taught by *Tutterow*) to known methods (*Buckley*'s pump) to yield predictable results (avoiding the negative effects of cavitation on the pumping system). EX1003, ¶225. Accordingly, a POSITA would have been motivated to combine *Tutterow*'s fundamental teachings regarding avoiding cavitation in plunger pumps by controlling the speed of the pump with *Buckley*'s pump, and would have reasonably expected success in doing so. *Id.*

2. Claim 4

- a) The system of claim 1, wherein the maximum pump speed correlates to a critical plunger speed associated with the multi-plunger hydraulic fracturing pump.

It would have been obvious to a POSITA to select the maximum speed of the pump in the *Buckley-Bergan* combination to be less than a speed at which cavitation occurs. Cavitation is a well-known problem that occurs in pumps, and is the phenomenon that occurs when “the incoming liquid [into a pump] is at a pressure with insufficient margin above the vapour pressure” of the liquid, which results in “vapour cavities or bubbles” appearing in the liquid. EX1003, ¶¶71, 227 (citing *Tutterow* (EX1013), 20). A POSITA also would have known that cavitation is to be avoided, since it causes several problems such as erosion and increased noise and vibration. *Id.*

Further, it was well-known that for positive displacement pumps (*e.g.*, plunger pumps, such as the pump disclosed by *Buckley*), cavitation begins to occur at a particular speed and the maximum speed of such pumps is therefore limited to avoid cavitation. EX1003, ¶73, 227 (citing *Tutterow* (EX1013), 30 (explaining that cavitation is exacerbated as the speed of a pump is increased, thereby “limiting the maximum speed” of the pump). Accordingly, it would have been obvious to a POSITA to operate the multi-plunger pump disclosed by *Buckley* below the speed at which cavitation occurs (a “critical plunger speed associated with the multi-plunger hydraulic fracturing pump”). EX1003, ¶228. *Tutterow* renders this obvious for the same reasons. *Id.*

This understanding of a “critical plunger speed” is consistent with the ’258 Patent, which refers to “critical speed” of a pump when discussing the speed at which cavitation is avoided in a pump. *See, e.g.*, EX1001, 1:62-64, 2:15-19.

Therefore, the *Buckley-Bergan* combination in view of the knowledge of a POSITA and, in the alternative, in view of *Jelaska* and *Tutterow* renders Claim 4 obvious.

3. Claim 5

a) The system of claim 1, wherein the maximum pump speed is 5% or less over a critical plunger speed associated with the multi-plunger hydraulic fracturing pump.

As an initial matter, the '258 Patent admits that it was well-known for fracturing pumps to have operating speeds above the speed at which cavitation first occurs in the pumps. *See* EX1001, Background, 1:37-49, 1:56-65, 2:4-14; EX1003, ¶229.

As discussed above with respect to Claim 4, a POSITA would have understood that the speed of a pump (*i.e.*, the speed of a pump's plungers) at which cavitation occurs would be a "critical plunger speed" of the pump, which is consistent with the '258 Patent's use of the term "critical speed." *See supra*, VIII.C.2; EX1003, ¶¶226-228.

It would have been obvious to a POSITA that the maximum speed of the pump taught by *Buckley* would be 5% or less over the speed at which cavitation occurs in the pump (the "critical plunger speed"). EX1003, ¶241. A POSITA would have understood that while cavitation may have undesirable results that negatively affect the life and efficiency of the pump, such as erosion of the pump's internal components and increased noise and vibration, cavitation would not immediately stop the pump from running. *Id.* (citing *Tutterow* (EX1013), 20, explaining that "total loss of pump-developed head occurs" only in "extreme cases" of cavitation). Accordingly, a POSITA would have understood that operating a pump above the speed at which cavitation occurs would involve balancing risks (*e.g.*, loss of pump life and pumping pressure) with rewards (*e.g.*, increased flowrate). EX1003, ¶231.

This type of operation—to gain higher flowrate while accepting a small reduction in life of pump components or pumping pressure—was well known. *Id.* In the alternative, *Tutterow* renders such operation obvious for the same reasons. *Id.*, ¶232. Indeed, the '258 Patent admits that such operation was well known, as discussed above. *See* EX1001, 1:37-49, 1:56-65, 2:4-14.

Accordingly, Claim 5 is rendered obvious by the *Buckley-Bergan* combination in view of the knowledge of a POSITA and, in the alternative, in view of *Jelaska* and *Tutterow*. EX1003, ¶232.

D. Ground 2B: The Combination of Yi and Bergan renders obvious Claims 4 and 5 in view of the knowledge of a POSITA and, in the alternative, Jelaska and Tutterow

1. Motivations to Combine

a) A POSITA Would Have Been Motivated to Combine *Yi* with *Bergan* and *Jelaska*

See supra, VIII.B.1; EX1003, ¶234.

b) A POSITA Would Have Been Motivated to Further Combine *Yi* with *Tutterow*

For the same reasons discussed above in Ground 2A regarding the combination of *Buckley* with *Tutterow*, a POSITA would have been motivated to combine *Yi* with *Tutterow* and would have reasonably expected success in doing so (*i.e.*, *Tutterow*'s description of cavitation, its risks, and how to avoid it would aid a POSITA's selection of pump speed when implementing *Yi*'s pumping system to avoid issues caused by cavitation, and combining *Tutterow*'s teachings to the *Yi*'s

pumping configuration is merely combining prior art elements to known methods to yield predictable results). *See supra* VIII.C.1.(b); EX1003, ¶¶234-236.

2. Claim 4

For the same reasons discussed above in Ground 2A regarding Claim 4, the *Yi-Bergan* combination renders Claim 4 obvious in view of the knowledge of a POSITA and, in the alternative, in view of *Jelaska* and *Tutterow*. *See supra*, VIII.C.2; EX1003, ¶¶237-239.

3. Claim 5

For the same reasons discussed above in Ground 2A regarding Claim 5, the *Yi-Bergan* combination renders Claim 5 obvious in view of the knowledge of a POSITA and, in the alternative, in view of *Jelaska* and *Tutterow*. *See supra*, VIII.C.3; EX1003, ¶¶240-243.

E. Ground 3A: The combination of Buckley and Bergan renders obvious Claims 7, 15, and 17 in view of the knowledge of a POSITA and, in the alternative, Jelaska and Nesbitt

1. Motivations to Combine

a) A POSITA Would Have Been Motivated to Combine Buckley with Bergan and Jelaska

See supra, VIII.A.1; EX1003, ¶245.

b) A POSITA Would Have Been Motivated to Further Combine Buckley with Nesbitt

Buckley discloses a multi-plunger pump for operating within a fracturing system. *See supra*, VIII.A.2.(b). A POSITA would have searched for other

references to better understand details of multi-plunger pumps that are not described in *Buckley*. EX1003, ¶245. One such reference is *Nesbitt*, which is a publication that provides granular details about plunger pumps that would be invaluable to a POSITA looking to apply the teachings of *Buckley* to a practical system. *Id.* In particular, *Nesbitt*'s description of the ideal flowrate produced by plunger pumps would aid a POSITA's selection of pump speed and stroke length when implementing *Buckley*'s pumping system to achieve a desired flowrate. *Id.*; EX1014, 140.

Further, combining *Buckley* with *Nesbitt* would simply be combining prior art elements (fundamental of a plunger pump, as taught by *Nesbitt*, and *Buckley*'s plunger pump) according to known methods (operating the pump) to yield predictable results (an increase in the pressure of fluid). EX1003, ¶246. Accordingly, a POSITA would have been motivated to combine *Nesbitt*'s description of inherent characteristics of plunger pumps with the *Buckley* system and would have had a reasonable expectation of success in doing so. *Id.*

2. Claim 7

- a) The system of claim 6, wherein a stroke length of each of the plungers associated with the multi-plunger hydraulic fracturing pump is selected to inversely relate to a pump speed associated with the multi-plunger hydraulic fracturing pump so as to achieve a predetermined flow rate.

It was well known in the art that the ideal flow rate of a single cylinder reciprocating pump is given by the following equation (“Equation 1”):

$$Q_{th} = 0.001 \times s \times \frac{\pi d^2}{4} \times n / 60,$$

where Q_{th} = theoretical flow (cc/s), n = strokes per minute (1/minute), d = piston (i.e., plunger) diameter (mm), and s = stroke length (mm). See EX1003, ¶¶247-248 (citing *Nesbitt* (EX1014), 140).

The following equation is yielded by mathematically rearranging Equation 1 to calculate stroke length with a fixed speed and flowrate:

$$s = \frac{Q_{th} \times 60 \times 4}{0.001 \times n \times \pi d^2}$$

EX1003, ¶248. As can be seen from each of the above equations, there is an inverse relationship between stroke length (s) and pump speed (n) for a fixed flowrate (Q_{th}) (“a predetermined flowrate”). *Id.*, ¶249. This is an inherent characteristic of plunger pumps. *Id.*, ¶250. For a pump with more than one cylinder (e.g., *Buckley’s* quintuplex pump with five plungers), Equation 1 above would be simply multiplied by the number of plungers to obtain the total flowrate from the pump. *Id.* Accordingly, it would have been obvious to a POSITA to select a particular stroke length associated with *Buckley’s* pump to achieve a particular flow rate and that for the particular flow rate, the stroke length would be inversely related to a pump speed

(the speed of the plungers). EX1003, ¶¶249-251. In the alternative, *Nesbitt* renders obvious Claim 7 for the same reasons. *Id.*

Accordingly, Claim 7 is rendered obvious by the *Buckley-Bergan* combination in view of the knowledge of a POSITA and, in the alternative, by the *Buckley-Bergan* combination in view of *Jelaska* and *Nesbitt*.

3. Claim 15

a) 15[p]: A method for pumping fluid into a wellbore associated with a subterranean formation, the method comprising:

See supra VIII.A.2.(b) (explaining how *Buckley* discloses a technique for pumping into a wellbore associated with a subterranean formation using a multi-plunger pump); EX1003, ¶¶156, 253-255.

b) 15[a]: fluidly connecting a multi-plunger hydraulic fracturing pump to a well associated with the subterranean formation such that the multi-plunger pump pumps fluid into the wellbore at a high pressure so that fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation;

See supra, VIII.A.2.(b); EX1003, ¶256.

c) 15[b]: simultaneously powering the multi-plunger pump with a plurality of motors;

See supra, VIII.A.2.(c); EX1003, ¶257.

d) 15[c]: providing a planetary gear train having a plurality of input pinion gears in rotational contact with each of the plurality of motors so as to translate power from the plurality of motors into a desired pump rate of the multi-plunger pump.

The Petition explains above in Limitations 1[b]-[c] how the *Buckley-Bergan* combination discloses a planetary gear train having a plurality of input pinion gears in rotational contact with each of the plurality motors (as taught by *Bergan*) to translate power from the plurality of motors to the crankshaft of the drive pump (as taught by *Buckley*). *See supra*, VIII.A.2.(c)-(d).

It would have been obvious to a POSITA that implementing the *Buckley-Bergan* pumping system would result in *Buckley*'s multi-plunger pump operating at a "desired pump rate." It was well known in the art that the ideal flow rate of a single cylinder reciprocating pump is given by the following equation:

$$Q_{th} = 0.001 \times s \times \frac{\pi d^2}{4} \times n/60,$$

where Q_{th} = theoretical flow (cc/s), n = strokes per minute (1/minute), d = piston (plunger) diameter (mm), and s = stroke length (mm). *See* EX1003, ¶¶248, 258 (citing *Nesbitt* (EX1014), 140). As shown, it was known in the art that the flow rate ("pump rate") of a pump is a function of the speed of its plungers (as indicated by the term n in the above equation). Further, as discussed above in Ground 1A regarding Limitation 1[d], it was well known in the art that the speed of the pump (the speed of the pump's plungers) is a function of the driving component's (the motors') speed and the gear ratio of the gearing systems linking the driving components with the driven component (the pump) (*see supra*, VIII.A.2.(e), citing *Jelaska* (EX1012), 3). Accordingly, a POSITA would know to operate the motors

at a specific speed, taking into account the gear ratio of the entire drive train (the planetary gearing system taught by *Bergan*), to achieve the desired pump speed and corresponding flow rate (“pump rate”).⁴ EX1003, ¶258.

Thus, the *Buckley-Bergan* combination renders obvious Limitation 15[c] in view of the knowledge of a POSITA and, in the alternative, in view of *Jelaska* and *Nesbitt* for same reasons discussed above with reference to Limitations 1[b]-[d] and Claim 7.

4. Claim 17

- a) The method of claim 15, wherein the plurality of motors comprises one of a plurality of electric motors or a plurality of hydraulic motors.

See supra, VIII.A.3; EX1003, ¶259.

F. Ground 3B: The combination of Yi and Bergan renders obvious Claims 7, 15, and 17 in view of the knowledge of a POSITA and, in the alternative, Jelaska and Nesbitt

1. Motivations to Combine

- a) A POSITA Would Have Been Motivated to Combine Yi with Bergan and Jelaska

⁴ This argument assumes that “pump rate” means “flow rate,” as would have been understood by a POSITA. EX1003, ¶¶57, 258. To the extent Patent Owner argues that “pump rate” means “pump speed,” Claim 2 is rendered obvious for the same reasons. *Id.*, ¶258.

See supra, VIII.B.1; EX1003, ¶261.

b) A POSITA Would Have Been Motivated to Further Combine *Yi* with *Nesbitt*

For the same reasons discussed above in Ground 3A regarding the combination of *Buckley* with *Nesbitt*, a POSITA would have been motivated to combine *Yi* with *Nesbitt* and would have reasonably expected success in doing so (*i.e.*, *Nesbitt*'s description of the ideal flowrate produced by plunger pumps would aid a POSITA's selection of pump speed and stroke length when implementing *Yi*'s pumping system to achieve a desired flowrate, and combining *Nesbitt*'s teachings to the *Yi*'s pumping configuration is merely combining prior art elements to known methods to yield predictable results). *See supra* VIII.E.1.(b); EX1003, ¶¶245-246, 261-262.

2. Claim 7

For the same reasons discussed above in Ground 3A regarding Claim 7, it would have been obvious to a POSITA to select a particular stroke length associated with *Yi*'s pump to achieve a particular flow rate and that for the particular flow rate, the stroke length would be inversely related to a pump speed. EX1003, ¶¶263-265. Thus, the *Yi-Bergan* combination renders Claim 7 obvious in view of the knowledge of a POSITA and, in the alternative, in view of *Jelaska* and *Nesbitt*. *Id.*; *see supra*, VIII.E.2.

3. Claim 15

a) 15[p]

See supra VIII.B.2.(b) (explaining how *Yi* discloses a technique for pumping into a wellbore associated with a subterranean formation using a multi-plunger pump); EX1003, ¶¶268-270.

b) 15[a]

See supra, VIII.B.2.(b); EX1003, ¶271.

c) 15[b]

See supra, VIII.B.2.(c); EX1003, ¶272.

d) 15[c]

The Petition explains above in Limitations 1[b]-[c] how the *Yi-Bergan* combination discloses a planetary gear train having a plurality of input pinion gears in rotational contact with each of the plurality motors (as taught by *Bergan*) to translate power from the plurality of motors to the crankshaft of the drive pump (as taught by *Yi*). *See supra*, VIII.B.2.(c)-(d). And for the same reasons discussed above in Ground 3A regarding Limitation 15[c], a POSITA would know to operate the motors at a specific speed, taking into account the gear ratio of the entire drive train (*i.e.*, the planetary gearing system taught by *Bergan*), to achieve the desired pump speed and corresponding flow rate (“pump rate”).⁵ EX1003, ¶273; *see supra*,

⁵ To the extent Patent Owner argues that “pump rate” means “pump speed,” Limitation 15[c] is rendered obvious for the same reasons. *See supra*, fn. 4.

VIII.E.3.(d) (citing *Nesbitt* (EX1014), 140 and *Jelaska* (EX1012), 3). Thus, the *Yi-Bergan* combination renders obvious Limitation 15[c] in view of the knowledge of a POSITA and, in the alternative, in view of *Jelaska* and *Nesbitt* for same reasons discussed above in Ground 3A with reference to Limitation 15[c].

4. Claim 17

See supra, VIII.B.3; EX1003, ¶274.

G. Ground 4A: The Combination of Buckley, Bergan, and Rosman Renders Obvious Claims 2 and 16 in view of the Knowledge of a POSITA and, in the alternative, Jelaska and Nesbitt

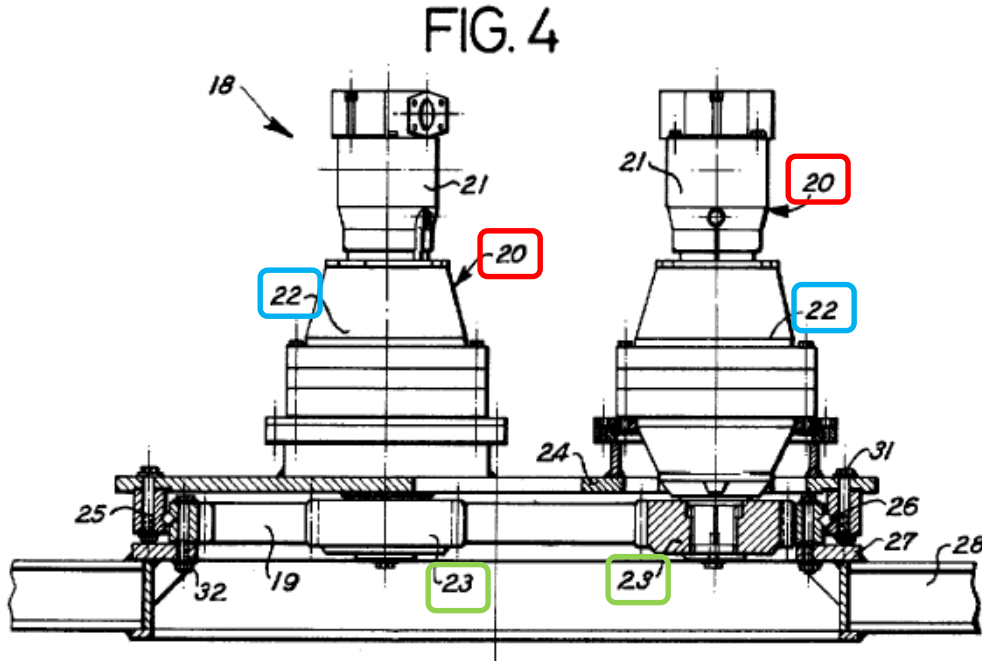
1. Motivation to Combine

a) A POSITA Would Have Been Motivated to Combine Buckley with Bergan, Jelaska, and Nesbitt

See supra, VIII.A.1; VIII.E.1; EX1003, ¶276.

b) A POSITA Would Have Been Motivated to Further Combine Buckley and Bergan with Rosman

Like both *Buckley* and *Bergan*, *Rosman* teaches the use of multiple smaller motors which combine power outputs through gearing to drive a larger, higher torque load. *See, e.g.*, EX1007, 2:15-24, Figs. 1-4. As shown in Figure 4 of *Rosman*, copied and annotated below, “[e]ach drive motor assembly 20 [annotated in red] includes a planetary gear mechanism 22 [annotated in blue] and a pinion member 23 [annotated in green].” And like the system of *Bergan*, *Rosman*’s pinions (annotated in green) mesh with a common gear that drives the load.



EX1007, Fig. 4 (annotated).

A POSITA would have been motivated to modify the *Buckley-Bergan* combination's electric motor and pump configuration to include *Rosman's* "planetary transmission and gear boxes," based at least on design incentives or market forces. EX1003, ¶284. It was well-known in the art that the speed of alternating current (AC) electric motors, such as those taught by *Buckley* and *Bergan*, is a function of the frequency of the power supplied to the motor and the number of magnetic poles in the motor, and is given by:

$$n_s = f(2/p)60,$$

where n_s = synchronous speed of the motor (RPM), f = frequency of power supply (Hertz); and p = number of poles in the motor. EX1003, ¶281 (citing EX1015, 40-4).

As can be seen by the above equation, and as would have been understood by a POSITA, a higher number of poles is needed to operate an electric motor at lower speeds. EX1003, ¶282. For example, to operate the Gardner-Denver GD-2500Q Quintuplex well servicing pump, a well-known multiplunger fracturing pump at the time of the '258 Patent's priority date, at its recommended speeds between 100 and 330 RPM, electric motors driving the pump would need to have at least 22 poles (resulting in 327 RPM) and as many as 60 poles (resulting in 120 RPM). *Id.* (citing EX1016, 14 (showing GD-2500Q specifications)), which a POSITA would have understood to require a significant amount of materials (*e.g.*, copper, magnetic steel, and other components) and effort to build, thereby making such a motor very costly. EX1003, ¶282.

Accordingly, a POSITA would have been motivated to modify the pumping system of the *Buckley-Bergan* combination to include *Rosman's* speed-reduction gearbox based on design incentives and market forces, namely, to reduce cost and complexity associated with implementing the pumping system. *Id.*, ¶284. A POSITA would have recognized that instead of using costly multi-pole electric motors to drive a fracturing pump at its recommended speeds, *Rosman's* speed reduction gearbox would be used to lower the rotational speeds delivered from higher-speed electric motors to the pump at a lower cost (due to lower capital and maintenance costs of the motors, as taught by *Rosman*). EX1003, ¶¶283-284;

EX1007, 4:57-59 (explaining that its motors “are known as fast rotating and have lower torque throughout,” and that by “using the smaller motors there is an advantage that the system is less expensive with respect to initial capitalization and maintenance.”). A POSITA would have also recognized that implementing speed reduction gear boxes would allow for the use of common “off-the-shelf” motors, which would simplify the implementation of *Buckley*’s pumping system as such motors have higher availability than custom components. EX1003, ¶284; EX1007, 4:54-62 (explaining that its gearboxes allow the use of “standard off-the-shelf” motors to develop necessary torque).

A POSITA would have had a reasonable expectation of success in combining *Rosman*’s gearbox between the motors and pinion gears of the *Buckley-Bergan* combination for several reasons. First, this combination represents the application of a known technique (*Rosman*’s planetary gearboxes) to improve similar devices (the motor and gear trains of the *Buckley-Bergan* combination) in the same way (by lowering speed and increasing available torque delivered to the pump). EX1003, ¶286. Second, the combination would have been merely applying a known technique (*Rosman*’s planetary gearboxes) to a known device (the motor and gear trains of the *Buckley-Bergan* combination) ready for improvement (lower capital and maintenance costs and the use of off-the-shelf components) to yield predictable

results (to lower speed and increase available torque while lowering capital and maintenance costs). *Id.*; *KSR Int'l*, 550 U.S. at 418.

2. Claim 2

a) The system of claim 1, the system further comprising a plurality of speed reduction gearboxes positioned between the plurality of input pinion gears and the plurality of motors so as to achieve a desired pump rate.

As discussed above, with reference to Ground 1A, it would have been obvious to modify *Buckley's* pumping system, wherein multiple electric motors power a fracturing pump, to include *Bergan's* planetary gearing system and pinion gears coupling multiple motors to the planetary gearing system. *See supra*, VIII.A.1.(a), VIII.A.2.(d).

As discussed above, *Rosman* teaches the use of multiple smaller motors which combine power outputs through gearing, including pinion gears, to drive a larger, higher torque load. *See, e.g.*, EX1007, 2:15-24, Figs. 1-4; *supra*, VIII.G.1.(b). In combination with the *Buckley-Bergan* combination, it would have been obvious to implement *Rosman's* planetary gearboxes such that the each of *Buckley's* electric motors are coupled with *Bergan's* pinion gears by a respective gearbox, as taught by *Rosman*, such that the gearboxes are “positioned between the plurality of input pinion gears and the plurality of motors.” EX1003, ¶289; EX1007, 2:15-24, Fig. 4; *supra*, VIII.G.1.(b). Further, a POSITA would have understood that *Rosman's* planetary gearboxes are “speed reduction” gear boxes because they increase torque

by lowering speed. EX1003, ¶289; EX1007, 4:55-62 (explaining gearboxes' role in increasing torque).

Further, it would have been obvious to a POSITA that implementing the gearboxes taught by *Rosman* with a particular gear ratio would result in the combined pumping “achiev[ing] a desired pump rate.” As discussed above regarding Limitation 15[c], a POSITA would know to operate the motors at a specific speed, taking into account the gear ratio of the entire drive train (the planetary gearbox taught by *Rosman* and the planetary gearing system taught by *Bergan*), to achieve the desired pump speed and corresponding flow rate (“pump rate”).⁶ EX1003, ¶291; *see supra*, VIII.E.3.(d) (citing *Nesbitt* (EX1014), 140 and *Jelaska* (EX1012), 3).

Accordingly, the *Buckley-Bergan-Rosman* combination in view of the knowledge of a POSITA renders obvious Claim 2. EX1003, ¶292. In the alternative, the *Buckley-Bergan-Rosman* combination in view of *Jelaska* and *Nesbitt* renders obvious Claim 2 for the same reasons provided herein. *Id.*

3. Claim 16

- a) The method of claim 15, further comprising: positioning a plurality of speed reduction gearboxes between the plurality of

⁶ To the extent Patent Owner argues that “pump rate” means “pump speed,” Limitation 15[c] is rendered obvious for the same reasons. *See supra*, fn. 4.

input pinion gears and the plurality of motors so as to achieve the desired pump rate.

See supra, VIII.G.2; EX1003, ¶293.

H. Ground 4B: The Combination of Yi, Bergan, and Rosman Renders Obvious Claims 2 and 16 in view of the Knowledge of a POSITA and, in the alternative, Jelaska and Nesbitt

1. Motivation to Combine

a) A POSITA Would Have Been Motivated to Combine Yi with Bergan, Jelaska, and Nesbitt

See supra, VIII.B.1, VIII.F.1; EX1003, ¶295.

b) A POSITA Would Have Been Motivated to Further Combine Yi and Bergan with Rosman

A POSITA would have been motivated to modify the combined *Yi-Bergan* pumping configuration, including its fracturing pump and plurality of motors, to include *Rosman*'s "planetary transmission and gear boxes," based at least on design incentives or market forces. EX1003, ¶295. A POSITA would have recognized that an objective of *Yi* is to provide a fracturing pump system that offers improved sourcing of components and reduced cost when compared to traditional systems that utilize a single, high-power diesel motor to power fracturing pumps. EX1010, [0003] (describing drawbacks of traditional diesel engine fracking systems, including expensive, low-availability components); EX1003, ¶298. Accordingly, a POSITA would have been motivated to modify *Yi*'s pumping system to include *Rosman*'s speed-reduction gearbox based on design incentives and market forces,

namely, to further improve the cost-efficiency of *Yi*'s pumping system. EX1003, ¶298. A POSITA would have recognized that instead of using costly high-torque motors to drive a fracturing pump, *Rosman*'s speed reduction gearbox would be used to lower the rotational speeds delivered from higher-speed motors to the pump at a lower cost (*e.g.*, due to lower capital and maintenance costs, as taught by *Rosman*). *Id.*; EX1007, 4:57-59. A POSITA would have also recognized that implementing speed reduction gear boxes would allow for the use of common "off-the-shelf" motors (as taught by *Rosman*), which would simplify the implementation of *Yi*'s pumping system as such motors have higher availability (and lower cost) than custom components. EX1003, ¶298; EX1007, 4:54-55.

A POSITA would have had a reasonable expectation of success in combining *Rosman*'s gearbox between the motors and power output gears of the *Yi* pumping system for several reasons. First, this combination represents the application of a known technique (*Rosman*'s planetary gearboxes) to improve similar devices (the motor and gear trains of the *Yi* pumping system) in the same way (by lowering speed and increasing available torque delivered to the pump). EX1003, ¶299; *KSR Int'l*, 550 U.S. at 417. Second, the combination would have been merely applying a known technique (*Rosman*'s planetary gear trains) to a known device (the motor and gear trains of the *Yi* pumping system) ready for improvement (lower capital and maintenance costs and the use of off-the-shelf components) to yield predictable

results (to lower speed and increase available torque while lowering capital and maintenance costs). EX1003, ¶299.

2. Claim 2

Rosman teaches the use of multiple smaller motors which combine power outputs through gearing, including pinion gears, to drive a larger, higher torque load. See, e.g., EX1007, 2:15-24, Figs. 1-4; see *supra*, VIII.G.2.

In combination with the *Yi-Bergan* combination, it would have been obvious to implement *Rosman*'s planetary gearboxes such that the each of *Yi*'s motors are coupled with *Bergan*'s pinion gears by a respective gearbox, as taught by *Rosman*, such that the gearboxes are "positioned between the plurality of input pinion gears and the plurality of motors." EX1003, ¶302; EX1007, 2:15-24, Fig. 4; *supra*, VIII.D.1.(b). Further, a POSITA would have understood that *Rosman*'s planetary gearboxes are "speed reduction" gear boxes because they increase torque by lowering speed. EX1003, ¶302; EX1007, 4:55-62 (explaining gearboxes' role in increasing torque).

Further, for the same reasons discussed above in Ground 4A, it would have been obvious to a POSITA that implementing the gearboxes taught by *Rosman* with a particular gear ratio would result in the combined pumping system "achiev[ing] a desired pump rate." See *supra*, VIII.G.2 (citing *Nesbitt* (EX1014), 140 and *Jelaska* (EX1012), 3); EX1003, ¶¶303-304. Accordingly, a POSITA would know to operate

the motors at a specific speed, taking into account the gear ratio of the entire drive train (*i.e.*, the planetary gear boxes taught by *Rosman* and the planetary gearing system taught by *Bergan*), to achieve the desired pump speed and corresponding flow rate (“pump rate”).⁷ EX1003, ¶304.

Accordingly, the *Yi-Bergan-Rosman* combination in view of the knowledge of a POSITA renders obvious Claim 2. EX1003, ¶305. In the alternative, the *Yi-Bergan-Rosman* combination in view of *Jelaska* and *Nesbitt* renders obvious Claim 2 for the same reasons provided herein. *Id.*

3. Claim 16

See supra, VIII.H.2; EX1003, ¶305.

I. Ground 5A: The combination of Buckley, Bergan, and Payne renders obvious Claims 8-11 and 13 in view of the knowledge of a POSITA and, in the alternative, Jelaska

1. Motivations to Combine

a) A POSITA Would Have Been Motivated to Combine Buckley with Bergan and Jelaska

See supra, VIII.A.1; EX1003, ¶308.

b) A POSITA Would Have Been Motivated to Further Combine Buckley with Payne

⁷ To the extent Patent Owner argues that “pump rate” means “pump speed,” Claim 2 is rendered obvious for the same reasons. *See supra*, fn. 4.

A POSITA would have been motivated to modify the *Buckley-Bergan* combination's pumping system to include the VFD taught by *Payne* for several reasons. First, *Buckley* provides an express motivation for this combination. *Buckley* discloses that its system "may permit the motors [] to run at various speeds or power outputs." EX1004, [0058]; EX1005, 6. A POSITA would have been motivated to look for other references that disclose systems and techniques for controlling electric motors to operate at different speeds and power, such as *Payne*, when implementing the pumping system disclosed by *Buckley*. EX1003, ¶310.

Second, design incentives and market forces would have motivated a POSITA to implement AC motors and VFDs for controlling those motors, as taught in *Payne*, with the pumping system taught by the *Buckley-Bergan* combination. It was well-known in the art that AC motors offered a variety of advantages, including improved reliability, lower cost of operation, and being smaller, lighter, and more commonly available than equivalent direct current (DC) motors. See EX1003, ¶313 (citing EX1008, [0010]-[0011]). A POSITA would have been motivated to apply *Payne*'s use of AC motors, along with one or more VFDs to control the motors' speed, to take advantage of the reliability, lower maintenance and cost savings of such a system over another type of system, such as one that uses DC motors. EX1003, ¶313.

A POSITA would have had a reasonable expectation of success in applying the teachings of *Payne* regarding using an AC motor and controlling speed with a variable frequency drive. Both AC motors and VFDs were well known, established technologies that were subject to industry standards before the '258 Patent's priority date. EX1003, ¶¶104-119, 314 (citing EX1026-36, EX1048-49). Further, adding *Payne*'s VFD to supplement *Buckley*'s teachings regarding electric motors is simply combining prior art elements (AC motors and VFDs, as taught by *Payne*, and the multi-motor pump system of the *Buckley-Bergan* combination) according to known methods (controlling speed/torque of an AC motor with a VFD) to yield predictable results (controlling the plurality of motors in the *Buckley-Bergan* combination). EX1003, ¶314. Further still, such a combination is using a known technique (AC motors and VFDs, as taught by *Payne*) to improve similar devices (the electric motor driven pump of the *Buckley-Bergan* combination, which is similar to *Payne*'s electric motor driven pump) in the same way (using a VFD to control speed/torque of the motors in the combined *Buckley-Bergan* system). *Id.*

2. Claim 8

- a) The system of claim 1, further comprising: a variable frequency drive (VFD) connected to the plurality of motors to control the speed of the plurality of motors, wherein the VFD is positioned to accelerate or decelerate pump rotational speeds associated with the multi-plunger hydraulic fracturing pump.

Payne discloses a “[a] system for stimulating oil or gas production from a wellbore [that] includes a hydraulic fracturing pump unit having one or more hydraulic pumps driven by one or more electrical fracturing motors, [and] a variable frequency drive controlling the electrical fracturing motors.” EX1008, Abstract. As an example of operation, *Payne* teaches the use of a VFD, which, in response to receiving a “speed set point,” “provides ac current which turns the mechanically coupled motor and fracturing pump.” *Id.*, [0039]. A POSITA would have understood that this teaches that the VFD is “connected to the plurality of motors to control the speed of the plurality of motors,” consistent with the well-known functionality of VFDs. EX1003, ¶¶117 (citing EX1035-36), 317. This further discloses that the VFD “is positioned to accelerate or decelerate pump rotational speeds associated with the multi-plunger hydraulic fracturing pump.” EX1003, ¶317.

Accordingly, the *Buckley-Bergan-Payne* combination renders obvious Claim 8 in view of the knowledge of a POSITA and, in the alternative, in view of *Jelaska*.

3. Claim 9

- a) The system of claim 8, wherein the VFD comprises a plurality of VFDs and wherein the plurality of VFDs are configured to share a load required to power the multi-plunger hydraulic fracturing pump.

In addition to *Payne* disclosing “a variable frequency drive controlling the electrical fracturing motors,” as discussed above for Claim 8, *Payne* discloses an

embodiment with an individual VFD associated with each motor. For example, *Payne* discloses “a variable frequency drive housing that houses a first frac motor variable frequency drive (‘VFD’) 410a for driving a first frac motor 411a, a second frac motor VFD 410b for operating a second frac motor 411b.” EX1008, [0047]. In combination with the *Buckley-Bergan* system, wherein multiple electric motors drive a single pump, a POSITA would have applied a VFD to each motor for controlling that motor, as taught by *Payne*. EX1003, ¶320. In this arrangement, a POSITA would have understood that because each motor shares a portion of the load for driving the pump (as taught by *Buckley*), each VFD (which controls a respective motor’s operation, as taught by *Payne*) “share[s] a load required to power the multi-plunger hydraulic fracturing pump.” *Id.*

Accordingly, the *Buckley-Bergan-Payne* combination renders Claim 9 obvious in view of the knowledge of a POSITA and, in the alternative, in view of *Jelaska*.

4. Claim 10

- a) The system of claim 9, wherein the plurality of VFDs are configured to automatically shut off in the event of an overpressure event with respect to the multi-plunger hydraulic fracturing pump.

Payne teaches the use of a “distributed programmable automation controller (PAC) on each hydraulic fracturing unit.” EX1008, [0039]. In addition to “relay[ing] the speed set point” to a VFD, the PAC is operable to shut off the VFD

“[i]f an unsafe condition is detected, for example, an over pressure event.” *Id.* Accordingly, the VFDs of *Payne* are configured, through the PAC, to automatically shut off in the event of an overpressure event. EX1003, ¶323.

Further, *Payne* explains that this automatic shut off occurs “[i]f the pump discharge pressure exceeds the Overpressure setpoint.” EX1008, [0062]. Accordingly, *Payne*’s overpressure event, which triggers the VFDs to “automatically shut off,” is “respect to the multi-plunger hydraulic fracturing pump.” EX1003, ¶324.

Accordingly, the *Buckley-Bergan-Payne* combination renders Claim 10 obvious in view of the knowledge of a POSITA and, in the alternative, in view of *Jelaska*.

5. Claim 11

- a) 11[p]: A hydraulic fracturing system for fracturing a subterranean formation comprising:

See supra, VIII.A.2.(a); EX1003, ¶327.

- b) 11[a]: a multi-plunger hydraulic fracturing pump fluidly connected to a well as-associated with the subterranean formation, the multi-plunger pump con-figured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation;

See supra, VIII.A.2.(b); EX1003, ¶328.

- c) 11[b]: a plurality of motors positioned to simultaneously power the multi-plunger pump;

See supra, VIII.A.2.(c); EX1003, ¶329.

- d) 11[c]: a variable frequency drive connected to the plurality of motors to control the speeds of the plurality of motors; and

See supra, VIII.I.2; EX1003, ¶330.

- e) 11[d]: a planetary gear train having a plurality of input pinion gears in rotational contact with each of the plurality of motors,

See supra, VIII.A.2.(d); EX1003, ¶331.

- f) 11[e]: wherein a gear ratio of the planetary gear train and a speed at which the plurality of motors operates are selected so as to limit a maximum pump speed associated with the multi-plunger pump.

See supra, VIII.A.2.(e); EX1003, ¶332.

6. Claim 13

- a) The system of claim 11, wherein the plurality of motors comprises one of a plurality of electric motors or a plurality of hydraulic motors.

See supra, VIII.A.3; EX1003, ¶333.

J. Ground 5B: The combination of Yi, Bergan, and Payne renders obvious Claims 8-11 and 13 in view of the knowledge of a POSITA and, in the alternative, Jelaska

1. Motivations to Combine

- a) A POSITA Would Have Been Motivated to Combine Yi with Bergan and Jelaska

See supra VIII.B.1; EX1003, ¶334.

- b) A POSITA Would Have Been Motivated to Further Combine Yi and Bergan with Payne

A POSITA would have been motivated to modify *Yi*'s pumping system to use electric, rather than hydraulic, motors to power its pump. EX1003, ¶335. *Yi* discloses a "fracturing pump transmission system" wherein "multiple motors are used to drive the fracturing pump." EX1010, Abstract. And although *Yi* discloses that its "plurality of motors" are hydraulic motors, *Yi* teaches that "there are various ways for multiple motors 4 to drive the fracturing pump, as long as the motor 4 can drive the fracturing pump 5 to rotate, which are not limited in the embodiments of the invention," which suggests to a POSITA that any type of motor, including electric motors, could be used to power *Yi*'s pump. EX1010, [0044]; EX1003, ¶¶336-337. Similarly, *Bergan* teaches the use of a plurality of electric motors that operate together to drive a load. EX1006, [0030] ("The motors 78 can include electric motors, for example."). Further, *Payne* describes "[a] system for stimulating oil or gas production from a well bore includes a hydraulic fracturing pump unit having one or more hydraulic fracturing pumps driven by one or more electrical fracturing motors." EX1008, Abstract. *Payne* further describes "a variable frequency drive controlling the electrical fracturing motors." *Id.*

A POSITA would have been motivated to modify *Yi*'s pumping system to use electric, rather hydraulic, motors to power its pump (as taught by *Bergan* and *Payne* and suggested by *Yi*) and *Payne*'s VFDs for controlling the electric motors, for several reasons. EX1003, ¶¶339-341. It was known in the art that AC electric

motors, like those described in *Payne*, offer particular advantages over mechanical motors, such as the hydraulic motors described by *Yi*, that are desirable in fracturing operations. EX1003, ¶339. For example, *Payne* explains that electrical motors are lighter and easier to transport and obviate the need to supply fuel when compared to mechanical systems (*e.g.*, diesel-driven motors). EX1008, [0008]; EX1003, ¶339. Further, AC electric motors, coupled with VFDs, may be controlled in a more precise manner than DC electric motors, and they are generally more commonly available and less expensive than DC electric motors. EX1008, [0009]-[0011]. Accordingly, design incentives and market forces would have motivated a POSITA to modify the *Yi-Bergan* combination's pumping system to include AC motors and accompanying VFD (as taught by *Payne*) rather than hydraulic motors (as taught by *Yi*). EX1003, ¶¶339-340.

Further, modifying *Yi*'s pumping system to use electric, rather than hydraulic, motors to power its fracturing pump requires a simple substitution of one known element (AC electric motors and accompanying VFD, as taught *Payne*) for another (hydraulic motors, as taught by *Yi*) to obtain the predictable result of driving *Yi*'s fracturing pump with the electric motors. EX1003, ¶342; *KSR Int'l*, 550 U.S. at 416. Indeed, *Payne* discloses doing just that. *See* EX1008.

2. Claim 8

Under the *Yi-Bergan-Payne* combination, it would have been obvious that *Payne*'s VFD would control the speed of the electric motors of the *Yi-Bergan-Payne* combination for the same reasons discussed above in Ground 5A regarding Claim 8. *See supra*, VIII.I.2; EX1003, ¶¶344-345. Thus, the *Yi-Bergan-Payne* combination renders Claim 8 obvious in view of the knowledge of a POSITA and, in the alternative, *Jelaska*. EX1003, ¶344-345.

3. Claim 9

Under the *Yi-Bergan-Payne* combination, it would have been obvious that *Payne*'s VFD would comprise a plurality of VFDs that are configured to share a load required to power Yi's multi-plunger pump for the same reasons discussed above in Ground 5A regarding Claim 8. *See supra*, VIII.I.3; EX1003, ¶¶346-348. Thus, the *Yi-Bergan-Payne* combination renders Claim 9 obvious in view of the knowledge of a POSITA and, in the alternative, in view of *Jelaska*. EX1003, ¶348.

4. Claim 10

For the same reasons discussed above in Ground 5A regarding Claim 10, the *Yi-Bergan-Payne* combination renders Claim 10 obvious in view of the knowledge of a POSITA and, in the alternative, in view of *Jelaska*. *See supra*, VIII.I.4; EX1003, ¶¶350-352.

5. Claim 11

See supra, VIII.B.2, VIII.J.2; EX1003, ¶¶354-359.

6. Claim 13

See supra, VIII.B.3; EX1003, ¶360.

K. Ground 6A: The Combination of Buckley, Bergan, Payne, and Rosman Renders Obvious Claim 12 in view of the Knowledge of a POSITA and, in the alternative, Jelaska and Nesbitt

1. Motivation to Combine

- a) A POSITA Would Have Been Motivated to Combine Buckley with Bergan, Payne, Rosman, Jelaska and Nesbitt

See supra, VIII.A.1, VIII.E.1, VIII.G.1, VIII.I.1; EX1003, ¶362.

2. Claim 12

- a) The system of claim 11, the system further comprising a plurality of speed reduction gearboxes positioned between the plurality of input pinion gears and the plurality of motors so as to achieve a desired pump rate.

See supra, VIII.G.2; EX1003, ¶363.

L. Ground 6B: The Combination of Yi, Bergan, Payne, and Rosman Renders Obvious Claim 12 in view of the Knowledge of a POSITA and, in the alternative, Jelaska and Nesbitt

1. Motivation to Combine

- a) A POSITA Would Have Been Motivated to Combine Yi with Bergan, Payne, Rosman, Jelaska and Nesbitt

See supra, VIII.B.1, VIII.F.1, VIII.H.1, VIII.J.1; EX1003, ¶365.

2. Claim 12

See supra, VIII.H.2; EX1003, ¶366.

M. Ground 7A: The combination of Buckley, Bergan, and Payne renders obvious Claim 14 in view of the knowledge of a POSITA and, in the alternative, Jelaska and Tutterow

1. Motivation to Combine

- a) A POSITA Would Have Been Motivated to Combine Buckley with Bergan, Payne, Jelaska, and Tutterow

See supra, VIII.A.1, VIII.C.1, VIII.I.1; EX1003, ¶368.

2. Claim 14

- a) The system of claim 11, wherein the maximum pump speed correlates to a critical plunger speed associated with the multi-plunger hydraulic fracturing pump.

See supra, VIII.C.2; EX1003, ¶369.

N. Ground 7B: The combination of Yi, Bergan, and Payne renders obvious Claim 14 in view of the knowledge of a POSITA and, in the alternative, Jelaska and Tutterow

1. Motivation to Combine

- a) A POSITA Would Have Been Motivated to Combine Yi with Bergan, Payne, Jelaska, and Tutterow

See supra, VIII.B.1, VIII.D.1; VIII.J.1; EX1003, ¶370.

2. Claim 14

See supra, VIII.D.2; EX1003, ¶371.

O. Ground 8A: The combination of Buckley and Bergan renders obvious Claim 18 in view of the knowledge of a POSITA and, in the alternative, Jelaska, Tutterow, and Nesbitt

1. Motivation to Combine

- a) A POSITA Would Have Been Motivated to Combine Buckley with Bergan, Jelaska, Tutterow, and Nesbitt

See supra, VIII.A.1, VIII.C.1, VIII.E.1; EX1003, ¶373.

2. Claim 18

- a) The method of claim 15, wherein the maximum pump speed correlates to a critical plunger speed associated with the multi-plunger hydraulic fracturing pump.

See supra, VIII.C.2; EX1003, ¶374.

P. Ground 8B: The combination of Yi and Bergan renders obvious Claim 18 in view of the knowledge of a POSITA and, in the alternative, Jelaska, Tutterow, and Nesbitt

1. Motivation to Combine

- a) A POSITA Would Have Been Motivated to Combine Yi with Bergan, Jelaska, Tutterow, and Nesbitt

See supra, VIII.B.1, VIII.D.1, VIII.F.1; EX1003, ¶376.

2. Claim 18

See supra, VIII.D.2; EX1003, ¶377.

Q. Ground 9A: The combination of Buckley, Bergan, and Payne Renders Obvious Claims 19 and 20 in view of the Knowledge of a POSITA and, in the alternative, Jelaska and Nesbitt

1. Motivations to Combine.

- a) A POSITA Would Have Been Motivated to Combine Buckley with Bergan, Payne, Jelaska, and Nesbitt

See supra, VIII.A.1, VIII.E.1, VIII.I.1; EX1003, ¶379.

2. Claim 19

- a) The method of claim 15, further comprising: connecting a variable frequency drive (VFD) to the plurality of motors so as to control the speed of the plurality of motors, wherein the VFD is positioned to accelerate or decelerate pump rotational speeds associated with the multi-plunger hydraulic fracturing pump.

See supra, VIII.I.2; EX1003, ¶380.

3. Claim 20

- a) The method of claim 19, the method further comprising: detecting an overpressure event with respect to the multi-plunger hydraulic fracturing pump; and automatically shutting off the VFD.

See supra, VIII.I.4; EX1003, ¶381.

R. Ground 9B: The combination of Yi, Bergan, and Payne Renders Obvious Claims 19 and 20 in view of the Knowledge of a POSITA and, in the alternative, Jelaska and Nesbitt

1. Motivations to Combine.

- a) A POSITA Would Have Been Motivated to Combine Yi with Bergan, Payne, Jelaska, and Nesbitt

See supra, VIII.B.1, VIII.F.1, VIII.J.1; EX1003, ¶383.

2. Claim 19

See supra, VIII.J.2; EX1003, ¶384.

3. Claim 20

See supra, VIII.J.4; EX1003, ¶385.

IX. OBJECTIVE INDICIA DO NOT SUPPORT PATENTABILITY

Petitioners are unaware of any evidence of secondary considerations of non-obviousness tied to the claimed invention of the '258 Patent identified by PO.

X. CONCLUSION

Petitioners respectfully request that *inter partes* review of the '258 Patent be instituted and that the challenged claims be cancelled as unpatentable under 35 U.S.C. §318(b).

Respectfully submitted,

BAKER BOTTS L.L.P.

A handwritten signature in black ink, appearing to read "Chad C. Walters". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

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CERTIFICATE OF SERVICE

The undersigned hereby certifies on this 31st day of October 2024, that true and correct copies of the foregoing PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 10,598,258, Exhibits 1001-1050, and Petitioners' power of attorney were served in their entirety to Patent Owner via FedEx Express® or Express Mail:

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**CERTIFICATE OF COMPLIANCE WITH TYPE-VOLUME
LIMITATION, TYPEFACE REQUIREMENTS, AND TYPE STYLE
REQUIREMENTS**

1. This Petition complies with the type-volume limitation of 14,000 words, comprising 13,996 words, excluding the parts exempted by 37 C.F.R. § 42.24(a).
2. This Petition complies with the general format requirements of 37 C.F.R. § 42.6(a) and has been prepared using Microsoft® Word in 14-point Times New Roman.

Respectfully submitted,

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