UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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Intelligent Wellhead Systems, Inc.
Petitioner,

v.

Downing Wellhead Equipment, LLC
Patent Owner

_____

Case No. IPR2024-00583
Patent No. 11,401,779

_____

DECLARATION OF DR. ROBERT DURHAM

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INTRODUCTION

1. My name is Dr. Robert A. Durham. I make this declaration based upon my own personal knowledge and, if called upon to testify, would testify competently to the matters contained herein.

2. I have been asked to provide technical assistance in the *inter partes* review of U.S. Patent No. 11,401,779, which I may abbreviate as the "'779 Patent" or "Challenged Patent." This declaration is a statement of my opinions on issues related to the unpatentability of claims of the '779 Patent. I am being compensated at my standard rate of $305 per hour for my analysis and expense reimbursements. My compensation does not depend on the content of my opinions or the outcome of this proceeding.

I. EXPERIENCE AND QUALIFICATIONS

3. In formulating my opinions, I have relied upon my knowledge, training, and experience in the relevant art. My qualifications are stated more fully in my curriculum vitae ("CV"), which has been provided in Appendix A. My CV also lists publications on which I am a named author and identifies parties on behalf of whom I have previously offered expert testimony within the past four years. Here, I provide a summary of my qualifications.

4. I am a consulting engineer with experience in several technical areas. I have expertise in the electrification of the oil and gas industry from drilling and

completion to downstream. I have worked with oil field production companies, refining and chemical plants, equipment manufacturers, and technology development companies for nearly twenty years as a consultant. My work relates to the subject matter of the Challenged Patent, which I describe below in Section VII ("Overview of the Challenged Patent").

5. I received my Bachelor of Science in Electrical Engineering and Master of Engineering and Technology Management degrees, from the University of Tulsa in 1992 and 1997, respectively. After years of professional work and research I received my Ph.D. in Engineering Management from Kennedy Western University in 2004.

6. I have also served in leadership positions in the Petroleum and Chemical Industry Committee (PCIC) of the Institute of Electrical and Electronics Engineers (IEEE) for nearly twenty years. IEEE is the world's largest technical professional association. The PCIC is the premier forum for exchanging electrical applications technology related to the petroleum and chemical industry. From 2005 to 2012, I served as Secretary, Vice Chair and ultimately Chair of the Production Subcommittee of the PCIC. The Production Subcommittee is the primary method for PCIC members to communicate technical papers related to drilling, wellhead and facilities operations of oil and gas wells. In 2013, I was appointed Vice Chair of the Standards Subcommittee of the PCIC, a role which then transitioned to Chair in

2014. I served as Chair until 2022. The Standards Subcommittee of the PCIC is the Sponsor of IEEE standards relating to electrification and electrical equipment operations in the oil and gas industry. The PCIC Standards Subcommittee sponsors nearly 50 electrical, oil, and gas-related standards. In September 2022, I was elected as an Executive Officer of the PCIC. I will serve as an Executive Officer for eight years, serving two-year terms in each position: Secretary, Vice Chair, Chair, and Chair of Advisory and Awards.

7. My peers have recognized my contributions, particularly in the area of electrical equipment in the oil and gas industry. Because of this recognition, in 2019 I was elevated to the grade of Fellow of the IEEE for "contributions to submersible electrical equipment analysis and multi-point ground methods in hazardous petroleum and chemical environments." The IEEE Fellow grade is limited to the top 0.1% of the membership of IEEE worldwide.

8. I have worked directly in the electrification of oil and gas fields both as an employee and as a consulting engineer. From 2000 until the end of 2002, I was employed as Manager of Electric Infrastructure for New Dominion, LLC (NDL). In that capacity, I administratively owned and was responsible for all electrical equipment, including overhead power lines, transformers, switchgear, drives, and motors, throughout NDL's production, exploration, and drilling areas.

9. After a brief stint as Vice President for EDG Power Group, responsible for Engineering and Project Management of generation and co-generation facilities across the U.S., I transitioned to consulting engineer. In that role, I have worked in designing, constructing, and analyzing all kinds of power and fluid systems, especially those in the oil and gas industry. This has included the design and selection of equipment and the analysis of equipment failures in the oil and gas field from drilling/completion sites to production facilities, midstream and downstream (refinery) locations.

10. I am also a principal of PEDOCS, Inc., an oil and gas production company operating nearly 50 oil and gas production wells in Oklahoma. As such, I am well-versed and familiar with the operations of oil and gas wells, including well stimulation, completion, hydraulic fracturing, and production.

11. I have been familiar with oil and gas drilling, fracturing (fracking)[1] and completion operations for nearly twenty years. In addition to being responsible for interfacing with drilling and fracturing operations about electrical needs as an employee of NDL, I have been further educated about drilling, fracturing and operations as I have consulted and investigated incidents on multiple well drilling, fracturing, and completion pad sites over my engineering consulting engagements.

[1] "Frac*" and "frack*" are used interchangeably in the industry and herein.

12. I am familiar with power distribution, including generation, transmission, and distribution equipment. As an employee, I worked as a design and construction engineer for generation facilities for Central and Southwest (now American Electric Power (AEP). I was also responsible for the design and construction of generation facilities when employed by EDG Power Group, as discussed above. While at AEP, I spent three years as a transmission planner, modeling transmission systems and developing plans for increased power distribution capacities at high voltages. While at NDL, I owned and was responsible for the design, construction, and maintenance of several hundred miles of medium voltage (5 – 25 kV) distribution lines, switchgear, drives, and motors used for oil and gas drilling, completion, and production. Over the last approximately 20 years, I have consulted with numerous clients ranging from utilities to oil and gas development and production companies on the design, upgrades, and maintenance of generation and power distribution facilities.

13. I am a Principal Scientist of THEWAY Labs. My responsibilities include overseeing the Health Safety and Environmental (HSE) program at THEWAY Labs, and establishing policies and procedures commensurate with Occupational Safety and Health Administration ("OSHA") requirements at all locations, including the requirements for oil and gas sites. I am familiar with OSHAand its responsibilities at oil and gas locations. I have consulted and

investigated incidents on multiple oil and gas sites where OSHA investigated injuries and fatalities that have occurred at oil and gas locations, including drilling, fracturing, and completion operations.

14. I have been familiar with valves, control systems for valves, and relief valve systems for my entire practice. I have designed and supervised the installation of such systems, including relief valves, control valves, and control systems for valves in applications including water handling, steam handling, liquid oil handling, and natural gas handling and other fluids. I have studied the operation of valves and relief valve systems as part of these control systems for over 30 years.

15. I authored or co-authored over fifty published papers and five books. A list of publications that I have written over the last thirty years is included in my professional CV, which is attached as Appendix A.

16. Therefore, based on my education, professional experience of over 30 years, and scholarly books and publications, I am an expert in the relevant field of the Challenged Patent at issue here and have been an expert in this field since before the Challenged Patent was filed with the United States Patent and Trademark Office ("USPTO"). I am familiar with how a person having ordinary skill in the art would have understood and used the terminology found in the '779 Patent at the time of its filing.

II. TASK SUMMARY AND MATERIALS REVIEWED

17. I have been asked to review the Challenged Patent and its prosecution history, to provide an understanding of the technology relevant to the Challenged Patent, to review certain prior-art references, and to analyze whether or not those references disclose or teach limitations of claims from the Challenged Patent. The opinions stated in this declaration are from the perspective of a person of ordinary skill in the art ("POSITA").

III. LIST OF EXHIBITS

18. In forming my opinions, I have reviewed the Challenged Patent, its prosecution history and references cited by the Examiner, the materials cited in the List of Exhibits, and the materials cited throughout my declaration.

Ex.	Description
1001	U.S. Patent No. 11,401,779 by Jordan Kuehn *et al.* entitled "HYDRAULIC FRACTURING PLAN AND EXECUTION OF SAME" (the "'779 Patent")
1002	Declaration of Dr. Robert Durham in Support of Petition in IPR2024-00256.
1003	U.S. Patent Publication 2022/0268141 A1 by Andrew Krupa *et al.* entitled "System and Method for an Automated and Intelligent Frac Pumping" ("*Krupa*")
1004	U.S. Patent Publication 2017/0275980 by Saurabh Kajaria entitled "Systems and Methods for Fracturing a Multiple Well Pad" ("*Kajaria*")

Ex.	Description
1005	U.S. Patent Publication 2007/0023184 A1 by Robert Jackson *et al.* entitled "Well Product Recovery Process" ("*Jackson*")
1006	U.S. Patent Publication 2017/0315566 by Martino et al. entitled "Variable Frequency Drive for a Fluid-handling System" ("*Martino*")
1007	*Downing Wellhead Equipment, LLC v. Intelligent Wellhead Systems, Inc., et al*., No. 1:23-cv-01180 (D. Colo.) ("the Litigation"), First Amended Complaint (ECF No. 29)
1008	Jacobs, Trent. "The Shale Evolution: Zipper Fracture Takes Hold," J Pet Technol 66 (2014): 60–67. doi: https://doi.org/10.2118/1014-0060-JPT
1009	'779 Patent Prosecution History
1010	Excerpt from Ex. 1009, Office Action dated January 5, 2022
1011	Patent Family Priority Diagram
1012	Patent Family Specification Comparisons
1013	Claim-By-Claim Priority Analysis
1014	Downing's Objections and Responses to IWS's First Set of Interrogatories in the Litigation
1015	Michael Morton, "Unlocking the Earth: A Short History of Hydraulic Fracturing," GEO ExPro, Vol. 10, No. 6, December 2013 (https://geoexpro.com/unlocking-the-earth-a-short-history-of-hydraulic-fracturing/) (last accessed July 17, 2023)
1016	B.A. Wells and K.L. Wells. "Shooters – A "Fracking" History." American Oil & Gas Historical Society, (https://aoghs.org/technology/hydraulic-fracturing) (last accessed July 17, 2023)
1017	Carl T. Montgomery and Michael B. Smith, "Hydraulic

Ex.	Description
	Fracturing: History of an Enduring Technology," *Journal of Petroleum Technology*, Vol. 62, Issue 12 (Dec. 2010).
1018	Bourgoyne, A. T., Jr., K. K. Millheim, M. E. Chenevert and F. S. Young, Jr. (1986). Applied Drilling Engineering, Society of Petroleum Engineers.
1019	Vassiliou, M. S. (2018), Historical dictionary of the petroleum industry, Rowman & Littlefield
1020	U.S. Patent Application Publication No. 2013/0306322 to Sanborn*et al.* entitled "System and Process for Extracting Oil and Gas by Hydraulic Fracturing" ("*Sanborn*")
1021	U.S. Patent Publication No. 2012/0255734 to Coli *et al.* ("*Coli*") entitled "Mobile, Modular, Electrically Powered System for Use in Fracturing Underground Formations"
1022	Waters, George, Dean, Barry, Downie, Robert, Kerrihard, Ken, Austbo, Lance, and Bruce McPherson. "Simultaneous Hydraulic Fracturing of Adjacent Horizontal Wells in the Woodford Shale." Paper presented at the SPE Hydraulic Fracturing Technology Conference, The Woodlands, Texas, January 2009. doi: https://doi.org/10.2118/119635-MS ("*Waters*")
1023	Pearson, C.M., Bond, A.J., Eck, M.E., and J.H. Schmidt. "Results of Stress-Oriented and Aligned Perforating in Fracturing Deviated Wells." J Pet Technol 44 (1992): 10–18. doi: https://doi.org/10.2118/22836-PA
1024	Mutalik, P N, and Bob Gibson. "Case History of Sequential and Simultaneous Fracturing of the Barnett Shale in Parker County." Paper presented at the SPE Annual Technical Conference and Exhibition, Denver, Colorado, USA, September 2008. doi: https://doi.org/10.2118/116124-MS ("*Mutalik*")

Ex.	Description
1025	Mayerhofer, M. J., Lolon, E. P., Warpinski, N. R., Cipolla, C. L., Walser, D., and C. M. Rightmire. "What is Stimulated Reservoir Volume (SRV)?" Paper presented at the SPE Shale Gas Production Conference, Fort Worth, Texas, USA, November 2008. doi: https://doi.org/10.2118/119890-MS ("*Mayerhofer*")
1026	Roussel, Nicolas P., and Mukul M. Sharma. "Optimizing Fracture Spacing and Sequencing in Horizontal-Well Fracturing." SPE Prod & Oper 26 (2011): 173–184. doi: https://doi.org/10.2118/127986-PA ("*Roussell*")
1027	K. R. Webster, W. C. Goins, Jr., and S. C. Berry, "A Continuous Multistage Tracing Technique," *Journal of Petroleum Technology,* vol. 17, no. 06, pp. 619-625, 1965, doi: 10.2118/977-pa. ("*Webster*")
1028	A. Casero, G. Pace, B. Malone, F. Cantaloube, L. Tealdi, H. Malonga, and R. Seale, "Continuous Pumping, Multistage, Hydraulic Fracturing in Kitina Field, Offshore Congo, West Africa," in *SPE International Symposium and Exhibition on Formation Damage Control*, 2008, vol. All Days, SPE-112442-MS, doi: 10.2118/112442-ms. [Online]. Available: https://doi.org/10.2118/112442-MS ("*Casero*")
1029	S. Rassenfoss, "A Look Into What Fractures Really Look Like," *Journal of Petroleum Technology,* vol. 70, no. 11, pp. 28-36, 2018, doi: 10.2118/1118-0028-jpt. at 6 ("*Rassenfoss*")
1030	R. Oberhofer, "Application of Ball-Drop Technology to Improve Efficiency and Stimulation of Limited Entry Completion Systems," in *Abu Dhabi International Petroleum Exhibition & Conference*, 2016, vol. Day 2 Tue, November 08, 2016, D021S052R004, doi: 10.2118/183427-ms. [Online]. Available: https://doi.org/10.2118/183427-MS ("*Oberhofer*")

Ex.	Description
1031	Tolman, R. C., et al. (2009). Method and Apparatus for Simultaneous Stimulation of Multi-Well Pads. SPE Hydraulic Fracturing Technology Conference ("*Tolman*")
1032	G. R. Holzhausen and R. P. Gooch, "Impedance of Hydraulic Fractures: Its Measurement and Use for Estimating Fracture Closure Pressure and Dimensions," in *SPE/DOE Low Permeability Gas Reservoirs Symposium*, 1985, vol. All Days, SPE-13892-MS, doi: 10.2118/13892-ms. [Online]. Available: https://doi.org/10.2118/13892-MS ("*Holzhausen*")
1033	R. W. Paige, L. R. Murray, and J. D. M. Roberts, "Field Application of Hydraulic Impedance Testing for Fracture Measurement," *SPE Production & Facilities,* vol. 10, no. 01, pp. 7-12, 1995, doi: 10.2118/26525-pa ("*Paige*").
1034	L. V. Massaras, A. Dragomir, and D. Chiriac, "Enhanced Fracture Entry Friction Analysis of the Rate Step-Down Test," in *SPE Hydraulic Fracturing Technology Conference*, 2007, vol. All Days, SPE-106058-MS, doi: 10.2118/106058-ms. [Online]. Available: https://doi.org/10.2118/106058-MS ("*Massaras*")
1035	S. Mondal, "Pressure transients in wellbores: Water hammer effects and implications for fracture diagnostics," 2010 ("*Mondal*")
1036	PCT International Patent Application Publication WO2020/145978 A1 by Beuterbaugh et al. entitled "Simulfrac Pulsed Treatment" ("*Beuterbaugh*")
1037	PCT International Patent Application Publication WO2017/201526 A1 by Ciezobka et al. entitled "Hydraulic Fracturing System and Method" ("*Ciezobka*")
1038	U.S. Patent Publication 2007/0125543 A1 by McNeel et al. entitled

Ex.	Description
	"Method and Apparatus for Centralized Well Treatment" ("*McNeel*")
1039	Excerpts from Downing's Response to IWS's Initial Invalidity Contentions in the Litigation, dated January 19, 2024
1040	Downing's Supplemental Objections and Responses to IWS's First Set of Interrogatories in the Litigation
1041	Declaration of Dr. Robert Durham
1042	*Intelligent Wellhead Systems, Inc. v. Downing Wellhead Equipment, LLC*, IPR2024-00256, Petition for *Inter Partes* Review of U.S. Patent No. 11,401,779 (Paper 1)
1043	*Intelligent Wellhead Systems, Inc. v. Downing Wellhead Equipment, LLC*, IPR2024-00300, Petition for *Inter Partes* Review of U.S. Patent No. 11,560,770 (Paper 1)
1044	APA 6A 20th Edition, Specification for Wellhead and Christmas Tree Equipment, October 2010
1045	Order Granting Stay in The Litigation

19. Other than citations to the prosecution history (Ex. 1009), all citations to exhibits reference original page numbers found in the underlying document, and all emphases are added.

IV. SUMMARY OF CONCLUSIONS AND GROUNDS FOR CHALLENGE

20. After reviewing the materials identified in the List of Exhibits, I have concluded that each of the Challenged Claims (Claims 1-3, 6, 8-10, 13, 15-18, 25-28, 31, and 36) of the '779 Patent would have been anticipated and/or obvious to a POSITA, based on the following grounds. I explain and show below why each of the Challenged Claims is unpatentable in the detailed discussion of Grounds 1-4. I have considered each of the claims as a whole but have addressed each subpart separately for ease of discussion.

Ground	'779 Claims	Basis for Challenge
1	1-3, 6, 15, 16, 18, and 36	Anticipated by *Ciezobka* under 35 U.S.C. § 102
2	All Asserted Claims	Obvious under 35 U.S.C. § 103 over *Ciezobka* alone
3	6, 8-10, 13, 16-18, 25-28, and 31	Obvious under 35 U.S.C. § 103 over *Ciezobka* in view of *McNeel*
4	All Asserted Claims	Obvious under 35 U.S.C. § 103 over *Beuterbaugh* in view of *Jackson*

V. LEGAL STANDARDS

A. LEVEL OF ORDINARY SKILL IN THE ART

21. When interpreting a patent, I understand that it is important to identify the relevant art pertaining to the patent-in-suit as well as the level of ordinary skill in that art at the time of the claimed invention. The "art" is the field of technology to which the patent is related.

22. I have been instructed by counsel that the POSITA is a hypothetical person who is presumed to know the relevant prior art. I understand that the actual inventor's skill is not determinative of the level of ordinary skill. I further understand that the factors that may be considered in determining the level of skill include: the types of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field. I understand that not all such factors may be present in every case, and one or more of them may predominate.

B. LEGAL STANDARD FOR CLAIM CONSTRUCTION

23. I understand that the first step in determining whether a patent claim would have been anticipated or obvious is to ascertain how a POSITA would have understood the claim terms.

24. I have been instructed by counsel on the law regarding claim construction and patent claims, and I understand that a patent may include two types of claims: independent claims and dependent claims. An independent claim stands alone and includes only the limitations it recites. A dependent claim can depend from an independent claim, or it can further depend from another dependent claim. I understand that a dependent claim includes all the limitations that it recites, in addition to all the limitations recited in the claim(s) from which it depends.

25. It is my understanding that in proceedings before the USPTO, the claims of a patent are to be construed under what is referred to as the "*Phillips* standard." I understand that this means that claim terms of a patent are given the meaning the terms would have to a POSITA, in view of the description provided in the patent itself and the patent's file history.

26. I understand that to determine how a person of ordinary skill would have understood a claim term, one should look to those sources available that show what a person of skill in the art would have understood the disputed claim language to mean. I understand that, in construing a claim term, one looks primarily to the intrinsic patent evidence, including the words of the claims themselves, the remainder of the patent, and the patent's prosecution history. I understand that extrinsic evidence, which is evidence external to the patent and the prosecution history, may also be useful in interpreting patent claims when the intrinsic evidence itself is insufficient.

27. I understand that words or terms should be given their ordinary and accepted meaning unless it appears that the inventors were using them to mean something else. In making this determination, the claims, the remainder of the patent, and the prosecution history are of paramount importance. Additionally, the patent and its prosecution history must be reviewed to confirm whether the patentee has acted as its own lexicographer (i.e., provided its own special meaning to any

disputed terms), or intentionally disclaimed, disavowed, or surrendered any claim scope.

28. In comparing the claims of the Challenged Patent to the prior art, I have considered the Challenged Patent and its file history in light of the understanding of a person of skill at the time of the alleged invention.

C. ANTICIPATION

29. It is my understanding that the claims of a patent are anticipated by a prior art reference if each and every element of the claim is found either explicitly or inherently in a single prior art reference or system. I understand that inherency requires a showing that the missing descriptive matter in the claim is necessarily or implicitly present in the allegedly anticipating reference, and that it would have been so recognized by a POSITA. In addition, I understand that an enabling disclosure is a disclosure that allows a POSITA to make the invention without undue experimentation. Although anticipation typically involves the analysis of a single prior art reference, I understand that additional references may be used to show that the primary reference has an enabling disclosure, to explain the meaning of a term used in the primary reference, and/or to show that a characteristic is inherent in the primary reference.

D. OBVIOUSNESS

30. I understand that the prior art may render a patent claim "obvious." I understand that two or more prior art references (e.g., prior art articles, patents, or publications) that each disclose fewer than all elements of a patent claim may nevertheless be combined to render a patent claim obvious if the combination of the prior art collectively discloses all elements of the claim and one of ordinary skill in the art at the time would have been motivated to combine the prior art in such a way. I understand that this motivation to combine need not be explicit in any of the prior art but may be inferred from the knowledge of one of ordinary skill in the art at the time the patent was filed. I also understand that one of ordinary skill in the art is not an automaton but is a person having ordinary creativity. I further understand that one or more prior art references, articles, patents or publications that disclose fewer than all of the elements of a patent claim may render a patent claim obvious if including the missing element would have been obvious to one of skill in the art (e.g., the missing element represents only an insubstantial difference over the prior art or a reconfiguration of a known system).

31. I understand that under the doctrine of obviousness, a claim may be invalid if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a POSITA to which the subject matter pertains.

32. To assess obviousness, I understand that I am to consider the scope and content of the prior art, the differences between the prior art and the claim, the level of ordinary skill in the art, and any secondary considerations to the extent they exist.

33. I understand that any evidence of secondary indicia of non-obviousness should be considered when evaluating whether a claimed invention would have been obvious to one of ordinary skill at the time of invention. These secondary indicia of non-obviousness may include, for example:

- a long felt but unmet need in the prior art that was satisfied by the claimed invention;
- commercial success of processes claimed by the patent;
- unexpected results achieved by the invention;
- praise of the invention by others skilled in the art;
- the taking of licenses under the patent by others; and
- deliberate copying of the invention.

34. I understand that there must be a nexus between any such secondary indicia and the claimed invention.

35. It is also my understanding that there are additional considerations that may be used as further guidance as to when the above factors will result in a finding that a claim is obvious, including the following:

- the claimed subject matter is simply a combination of prior art elements according to known methods to yield predictable results;

- the claimed subject matter is a simple substitution of one known element for another to obtain predictable results;

- the claimed subject matter uses known techniques to improve similar devices or methods in the same way;

- the claimed subject matter applies a known technique to a known device or method that is ready for improvement to yield predictable results;

- the claimed subject matter would have been "obvious to try" choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;

- there is known work in one field of endeavor that may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to a POSITA;

- there existed at the time of the invention a known problem for which there was an obvious solution encompassed by the patent's claims; and

- there is some teaching, suggestion, or motivation in the prior art that would have led a POSITA to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed subject matter.

36. Finally, I understand that a claim may be deemed invalid for obviousness in light of a single prior art reference, without the need to combine references, if the elements of the claim that are not found in the reference can be supplied by the knowledge or common sense of one of ordinary skill in the relevant art.

E. PRIORITY DATE

37. I understand that, subject to the next paragraph, the "priority date" of a patent is the earlier of: (a) the date on which a patent application is filed; or (b) the

date on which an earlier-filed patent application is filed if the patentee properly claims the benefit of priority to that earlier-filed patent application.

38. I understand that it is not enough for a patent to merely claim the benefit of an earlier-filed application, but that additional criteria must be met. In particular, the prior application itself must describe the claimed invention, and must do so in sufficient detail that one skilled in the art can clearly conclude that the inventor invented the claimed invention as of the filing date sought. First, I understand that a priority date analysis is on a claim-by-claim basis. Second, I understand that, in order for a patent claim to be entitled to the filing date of an earlier patent application, a "Section 112 analysis" must be conducted. I am informed that a "Section 112" analysis encompasses looking to the earlier patent application, and ascertaining whether that earlier patent application meets both the written-description and enablement requirements as of the filing date of the earlier application. I understand that for purposes of Section 112 it is not enough that the claim would have been obvious from the earlier application, but that the earlier application itself must describe the claimed invention.

39. I understand that in order to satisfy the written description requirement the earlier application must reasonably convey to those skilled in the art that the inventors had possession of the subject matter of the patent as of the filing date of the earlier application. I have been informed that it is the disclosures of the earlier

patent application that count, and that while the meaning of terms, phrases, or diagrams in the earlier patent application must be interpreted from the vantage point of one skilled in the art, all of the claimed limitations must appear in the specification. Further, I understand that this analysis is not a question of whether one skilled in the art might be able to construct the claimed invention from the teachings of the disclosure or whether a claimed invention is an obvious variant of that which is disclosed in the specification; rather, I understand that an earlier application must itself describe each of the claim limitations. I also understand that in order to satisfy the enablement requirement, the earlier application must enable a POSITA to practice the claimed invention without undue experimentation.

F. INDEPENDENT AND DEPENDENT CLAIM ANALYSIS

40. I understand that an independent claim does not refer to any preceding claim. The ’779 Patent includes numerous dependent claims that refer to the independent claims. Further, I understand that each dependent claim depends from an independent claim or from another dependent claim. I understand that, as a result, each dependent claim incorporates all of the elements of the claim(s) that it refers to. Therefore, in my analysis of the dependent claims, my analysis of the claim(s) from which they depend is also incorporated.

VI. OVERVIEW OF THE CHALLENGED PATENT

41. I have reviewed the '779 Patent, which is entitled "Hydraulic Fracturing Plan and Execution of Same." Ex. 1001. I understand that the application for patent was filed on July 29, 2021, and that it was issued on August 2, 2022. The '779 Patent claims priority to several other patent applications/patents, but as I discuss below in the "Priority Date of the '779 Patent" section, those earlier applications/patents do not provide support for all claim limitations of the '779 Patent.

A. THE SUBJECT MATTER OF THE CHALLENGED PATENT

42. The '779 Patent generally relates to hydraulic fracturing operations of subterranean formations. The '779 Patent includes a section entitled "Background." The Background section describes the Patent application as relating "generally to oil and gas hydraulic fracturing operations."[2] The Background section does not describe the state of the art for fracturing systems at the time of the application. Further, the '779 Patent does not describe how the systems and methods described in the Patent improve upon already known fracturing applications.

B. THE CHALLENGED CLAIMS OF THE '779 PATENT

43. The Challenged Claims of the '779 Patent, which are Claims 1-3, 6, 8-10, 13, 15-18, 25-28, 31, and 36, are set forth below. Some of the claim elements

[2] Ex. 1001 2:6-10.

have been further sub-divided (and labeled as part "1.2", "1.3" or "1.1.1", "1.1.2" or similar, where the first number indicates the claim number, and the following decimals refer to sub parts of that claim) for ease of reference.

Claim Element	Claim Language from '779 Patent
1.1.1	1. A method, comprising:
1.1.2	(a) permitting performance of a first hydraulic fracturing operation on a first well, which first hydraulic fracturing operation comprises pumping fluid into the first well via a first valve associated with the first well, and
1.2	measuring a flow rate of the fluid being pumped into the first well;
1.3	(b) determining that the flow rate of the fluid being pumped into the first well is below a flow rate threshold and
1.4	has been below the flow rate threshold for a threshold amount of time;
1.5	(c) during pumping of the fluid into the first well via the first valve, opening a second valve associated with a second well;
1.6	(d) permitting performance of a second hydraulic fracturing operation on the second well, which second hydraulic fracturing operation comprises pumping fluid into the second well via the second valve; and
1.7	(e) during pumping of the fluid into the second well via the second valve, closing the first valve associated with the first well;

Claim Element	Claim Language from ’779 Patent
1.8	wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped to the first valve, the second valve, or both the first valve and the second valve.
2	2. The method of claim 1, wherein each of the first and second valves is in fluid communication with a hydraulic manifold from which fluid is pumped to the first valve and/or the second valve; and wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped from the hydraulic manifold to the first valve, the second valve, or both the first valve and the second valve.
3	3. The method of claim 1, wherein the second valve is opened after step (b).
6	6. The method of claim 1, wherein each of the first and second valves is a zipper valve.
8.1.1	8. An apparatus, comprising:
8.1.2	a non-transitory computer readable medium; and
8.2.1	a plurality of instructions stored on the non-transitory computer readable medium and executable by one or more processors,
8.2.2	wherein, when the instructions are executed by the one or more processors, the following steps are executed:
8.3	(a) permitting performance of a first hydraulic fracturing operation on a first well, which first hydraulic fracturing operation comprises pumping fluid into the first well via a first valve associated with the first well, and
8.4	measuring a flow rate of the fluid being pumped into the first well; and

Claim Element	Claim Language from ’779 Patent
8.5	(b) determining that the flow rate of the fluid being pumped into the first well is below a flow rate threshold and
8.6	has been below the flow rate threshold for a threshold amount of time;
8.7	(c) during pumping of the fluid into the first well via the first valve, opening a second valve associated with a second well;
8.8	(d) permitting performance of a second hydraulic fracturing operation on the second well, which second hydraulic fracturing operation comprises pumping fluid into the second well via the second valve; and
8.9	(e) during pumping of the fluid into the second well via the second valve, closing the first valve associated with the first well;
8.10	wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped to the first valve, the second valve, or both the first valve and the second valve.
9	9. The apparatus of claim 8,wherein each of the first and second valves is in fluid communication with a hydraulic manifold from which fluid is pumped to the first valve and/or the second valve; wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped from the hydraulic manifold to the first valve, the second valve, or both the first valve and the second valve.
10	10. The apparatus of claim 8, wherein the second valve is opened after step (b).
13	13. The apparatus of claim 8, wherein each of the first and second valves is a zipper valve.
15.1	15. A method of hydraulically fracturing at least first and second wells of a plurality of wells, the first and second wells being

Claim Element	Claim Language from ’779 Patent
	associated with first and second valves, respectively, the method comprising:
15.2	(a) permitting hydraulic fracturing of the second well, comprising: opening the second valve associated with the second well to permit pumping of fluid into the second well via the second valve; and
15.3	measuring a flow rate of the fluid being pumped into the second well;
15.4.1	(b) swapping from permitting hydraulic fracturing of the second well to permitting hydraulic fracturing of the first well, comprising:
15.4.2	opening the first valve associated with the first well to permit pumping of fluid into the first well via the first valve; and
15.4.3	closing the second valve associated with the second well;
15.5	wherein, during step (b), hydraulic fracturing fluid is continuously pumped to the first and second valves via a hydraulic manifold; and
15.6	wherein: in response to determining that the flow rate measured at step (a) has satisfied one or more flow rate conditions, the first valve associated with the first well is opened at step (b) before the second valve associated with the second well is closed at step (b);
15.7	or in response to determining that the flow rate measured at step (a) has not satisfied one or more flow rate conditions, the first valve associated with the first well is opened at step (b) during or after the second valve associated with the second well is closed at step (b).
16.1	16. The method of claim 15, wherein the plurality of wells further comprises third and fourth wells, the third and fourth wells being associated with third and fourth valves, respectively; and wherein the method further comprises:
16.2	(c) permitting hydraulic fracturing of the fourth well; and

Claim Element	Claim Language from ’779 Patent
16.3	(d) swapping from permitting hydraulic fracturing of the fourth well to permitting hydraulic fracturing of the third well.
17	17. The method of claim 16, wherein steps (a) and (c) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold; and wherein steps (b) and (d) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold.
18.1	18. The method of claim 16, wherein, during step (d), hydraulic fracturing fluid is continuously pumped to the third and fourth valves via the hydraulic manifold;
18.2	wherein step (c) comprises opening the fourth valve associated with the fourth well to permit pumping of fluid into the fourth well via the fourth valve; and
18.3.1	wherein step (d) comprises: opening the third valve associated with the third well to permit pumping of fluid into the third well via the third valve; and
18.3.2	closing the fourth valve associated with the fourth well.
25.1	An apparatus adapted to hydraulically fracture first and second wells, the first and second wells being associated with first and second valves, respectively, the apparatus comprising:
25.2	a non-transitory computer readable medium; and
25.3	a plurality of instructions stored on the non-transitory computer readable medium and executable by one or more processors, wherein, when the instructions are executed by the one or more processors, the following steps are executed:
25.4	(a) permitting hydraulic fracturing of the second well, comprising: opening the second valve associated with the second well to permit pumping of fluid into the second well via the second valve; and

Claim Element	Claim Language from ’779 Patent
25.5	measuring a flow rate of the fluid being pumped into the second well;
25.6.1	(b) swapping from permitting hydraulic fracturing of the second well to permitting hydraulic fracturing of the first well, comprising:
25.6.2	opening the first valve associated with the first well to permit pumping of fluid into the first well via the first valve; and
25.6.3	closing the second valve associated with the second well;
25.7	wherein, during step (b), hydraulic fracturing fluid is continuously pumped to the first and second valves via a hydraulic manifold; and wherein:
25.8	in response to determining that the flow rate measured at step (a) has satisfied one or more flow rate conditions, the first valve associated with the first well is opened at step (b) before the second valve associated with the second well is closed at step (b);
25.9	or in response to determining that the flow rate measured at step (a) has not satisfied one or more flow rate conditions, the first valve associated with the first well is opened at step (b) during or after the second valve associated with the second well is closed at step (b).
26.1	The apparatus of claim 25, wherein the apparatus is further adapted to hydraulically fracture third and fourth wells, the third and fourth wells being associated with third and fourth valves, respectively; and wherein, when the instructions are executed by the one or more processors, the following steps are also executed:
26.2	(c) permitting hydraulic fracturing of the fourth well;
26.3	(d) swapping from permitting hydraulic fracturing of the fourth well to permitting hydraulic fracturing of the third well.

Claim Element	Claim Language from ’779 Patent
27	27. The apparatus of claim 26, wherein steps (a) and (c) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold; and wherein steps (b) and (d) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold.
28.1	28. The apparatus of claim 26, wherein, during step (d), hydraulic fracturing fluid is continuously pumped to the third and fourth valves via the hydraulic manifold;
28.2	wherein step (c) comprises opening the fourth valve associated with the fourth well to permit pumping of fluid into the fourth well via the fourth valve; and
28.3.1	wherein step (d) comprises: opening the third valve associated with the third well to permit pumping of fluid into the third well via the third valve; and
28.3.2	closing the fourth valve associated with the fourth well.
31.1	31. The method of claim 25, wherein the flow rate measured at step (a) has satisfied the one or more flow rate conditions when the flow rate measured at step (a) is below an upper flow rate threshold, above a lower flow rate threshold, or both; and
31.2	wherein the flow rate measured at step (a) has not satisfied the one or more flow rate conditions when the flow rate measured at step (a) is above the upper flow rate threshold or below the lower flow rate threshold.
36.1	36. The method of claim 15, wherein the flow rate measured at step (a) has satisfied the one or more flow rate conditions when the flow rate measured at step (a) is below an upper flow rate threshold, above a lower flow rate threshold or both and

Claim Element	Claim Language from ’779 Patent
36.2	wherein the flow rate measured at step (a) has not satisfied the one or more flow rate conditions when the flow rate measured at step (a) is above the upper flow rate threshold or below the lower flow rate threshold.

C. PROSECUTION HISTORY OF THE ’779 PATENT

44. In the subsections below, I summarize the prosecution history of the ’779 Patent. As can be seen, all claims of the ’779 Patent were allowed because all of the independent claims recited or were amended to recite meeting “a flow rate threshold,” a “flow rate threshold for a threshold amount of time,” or “one or more flow rate conditions.” The Applicant did not dispute that the remaining limitations of the claims were disclosed in the prior art.

45. The ’779 Patent was filed as U.S. Application No. 17/388,716 (“the ’716 Application) on July 29, 2021, with 30 claims and a Request for Prioritized Examination (Track II). The Application Data Sheet (ADS) filed along with the ’716 Application indicated that the application claimed the benefit of U.S. Provisional Application No. 63/189,663 (“the ’663 Provisional”), which was filed May 17, 2021, and also indicated that the application was a “continuation of” of U.S. Application No. 17/319,854 (“the ’854 Application”), which was filed May 13, 2021. The ADS for the ’716 Application also indicated the ’716 Application claimed the benefit of a long family chain of the ’854 Application.

46. I also note that the ’854 Application listed two inventors (Ronnie B. Beason and Nicholas J. Cannon), whereas the later-filed ’663 Provisional listed four inventors (Ronnie B. Beason, Nicholas J. Cannon, Jordan Kuehn, and Austin Johnson). The ’716 Application lists the same four inventors as the ’663 Provisional.

47. On January 5, 2022, the USPTO issued a non-final rejection in which claims 1-3, 5-6, 8-10, and 12-13 were indicated as allowed, claims 4, 7, 11, 14-17, 20-25, and 28-30 were rejected, and claims 18, 19, 26, and 27 were objected to. In the Office Action, claims 15, 16, 20-24, 28-30 were rejected under 35 U.S.C. § 102(a)(1) as being anticipated by U.S. Publication No. 2017/0275980 (“Kajaria”). Claims 17 and 25 were rejected under 35 U.S.C. § 103 as being obvious over Kajaria in view of U.S. Publication No. 2014/0352968 (“Pitcher”).

48. In response to the Office Action, Patent Owner filed a reply on April 5, 2022, maintained allowed claims in their original form, and amended rejected claims to include subject matter that the Examiner indicated was allowable (including limitations directed to operating valves in response to determining whether a flow rate meets a flow rate threshold for a time threshold). Patent Owner also added new dependent claims.

49. The USPTO issued a Notice of Allowance on April 25, 2022, in which the Examiner entered further amendments to claims 15, 23, 31, and 36, including changing “met a flow rate threshold” to “satisfied one or more flow rate conditions”

in claims 15 and 23, and adding definitions for satisfying or not satisfying the flow rate conditions in claims 31 and 36, and allowed the claims.

50. After prosecution closed on the merits, Patent Owner filed a corrected ADS to change the '716 Application from a "continuation" application to a "continuation-in-part" ("CIP") application and amended the specification to reflect the same.

51. The issue fee was paid on June 15, 2022, and the '716 Application issued as the '779 Patent on August 2, 2022.

D. PRIORITY DATE OF THE '779 PATENT

52. As discussed, the '779 Patent claims the benefit of the '663 Provisional, which was filed May 17, 2021, and is a CIP of the '854 Application, which was filed May 13, 2021. The '854 Application purports to claim priority to seven non-provisional applications, each being related through CIP filings. The '854 Application and the seven parent non-provisional applications are collectively referred to as the "CIP parent applications." The '854 Application also claims priority to nine provisional applications, collectively referred to as the "parent provisional applications."

53. Except for some generic background language, the '779 Patent does not contain any copied portions of the CIP parent applications or the parent provisional applications. Instead, the specification of the '779 Patent contains originally drafted

descriptions of fracturing systems and methods, including detailed descriptions of frac legs and associated valve operation for a plurality of wells.

54. The CIP parent applications and the parent provisional applications are not related to and do not disclose valve sequencing for continuous pumping zipper fracturing of multiple wells or determining if flow rate thresholds into the wells are met. Further, some of the CIP parent applications and parent provisional applications do not even disclose multiple well fracturing systems or operations, such as parent applications titled "Unibody valve and methods of using the valve" and "Method of operating a valve and extending an object through the valve and into a well," which are instead directed to valve assemblies for passing objects into a well, and parent applications titled "Delivering and metering grease to process valves" and "Grease system for valves used in oil and gas operations," which are directed to valve greasing systems.

55. I understand that to rely on a parent application's filing date, the parent application must disclose each element of the claim to an extent where it is clear the inventor had possession of the claimed invention at the time of the parent application. I have also been instructed that only subject matter which is actually or inherently disclosed in a parent application is entitled to the parent application's filing date. Subject matter that is obvious over the parent application's disclosure is not entitled to the parent application's filing date.

56. Because none of the CIP parent applications or the parent provisional applications disclose all the limitations in claims of the ’779 Patent, the claims are not entitled to any of the claimed earlier filing dates of the CIP parent applications or the parent provisional applications. Therefore, the earliest priority date to which any claim of the ’779 Patent is entitled is that of the ’663 Provisional: May 17, 2021.

57. Additionally, I understand that Downing, in response to interrogatories in the parallel district court litigation, admitted that the “earliest effective filing date” of the challenged claims is May 17, 2021. *See* Ex. 1040.

58. That being said, it is also possible that certain claims of the ’779 Patent are not even entitled to claim priority as far back as to the ’663 Provisional filing date of May 17, 2021. Depending on claim construction, for example, support for certain claim limitations may not be found in the ’663 Provisional, in which case, the earliest priority date to which the claims of the ’779 Patent may be entitled could be the actual filing date of the ’779 Patent, July 2021.

59. I am also aware that on January 19, 2024, after having seen IWS’s invalidity contentions in the parallel district court litigation, and after having seen IWS’s prior art and arguments in related IPRs (IPR2024-00256 and IPR2024-00300), Downing took the position that Downing made a public disclosure of the invention claimed in the ’779 Patent as early as September 1, 2020. Ex. 1039. Assuming only for the sake of argument this is true, and to be clear, I do not agree

that Downing's evidence qualifies as a public disclosure based on my understanding of a public disclosure under the patent laws, then additional references that disclose, teach, and/or suggest the limitations of the claims of the '779 Patent beyond those explored in the first IPR petition can be examined, as discussed further in this declaration.

E. COMPARISON OF ASSERTED REFERENCES TO PRIOR ART DISCUSSED DURING PROSECUTION

60. I have been asked to analyze the technical references that I understand Petitioner is asserting as prior art (*Ciezobka*, *Beuterbaugh*, *McNeel*, and *Jackson*) and to compare them to the references cited by the USPTO Examiner during prosecution of the '779 Patent and to the claims of the '779 Patent.

61. **Primary references:** I have relied upon *Ciezobka* and, alternatively, *Beuterbaugh* as the base (or primary) references.

62. **Secondary references:** I have relied upon additional references (secondary references) including *McNeel* and *Jackson*, as well as the knowledge of a person of ordinary skill in the art, that are used in combination with the primary references.

VII. LEVEL OF ORDINARY SKILL IN THE ART

63. A POSITA would have a Bachelor of Science in Engineering as well as at least two years of academic or industry experience in the oil and gas industry, including well-related operations experience, such as well drilling, completion, or

production. Additional education could offset experience and vice versa. I meet this standard.

VIII. CLAIM CONSTRUCTION

64. In the sections below, I have sought to provide the ordinary and customary meaning of claim terms using the principles I discuss above in the Legal Standards section.

65. I do not believe that any claim terms of the '779 Patent need to be construed to assess whether the prior art reads on the challenged claims.[3]

IX. TECHNOLOGY BACKGROUND AND STATE OF THE ART

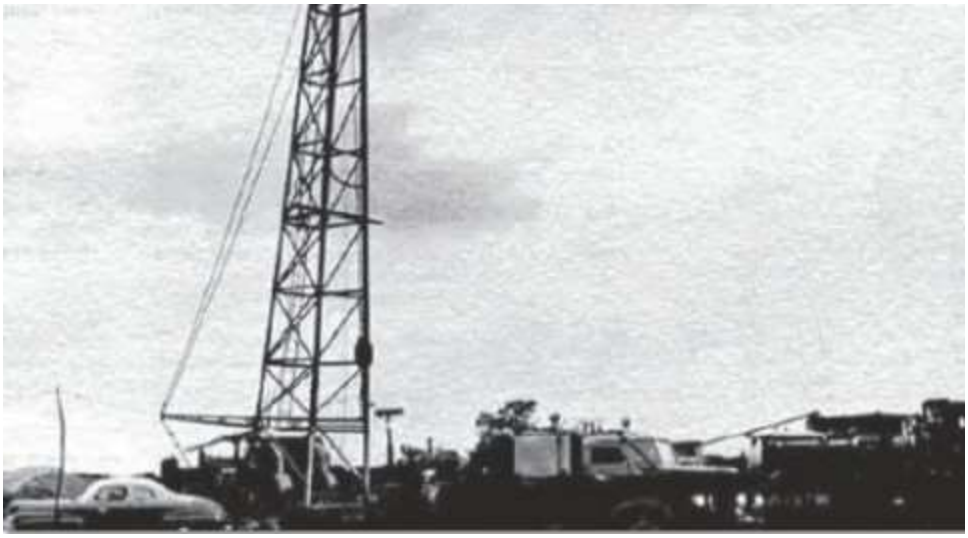
66. In the subsections below, I describe some of the basic principles of engineering that would be used, or at least considered for use, on a hydraulic fracturing site. The principles discussed in the subsections below would have been well-known to a POSITA in 2019-2021, and long before.

A. HISTORY OF HYDRAULIC FRACTURING

67. Fracturing the hydrocarbon-bearing formations is a technique that has been used to increase or speed up oil and gas production for nearly as long as oil and

[3] I reserve the right to raise or address claim construction of the claims of the '779 Patent and other arguments in district court. For example, all challenges to the '779 Patent are not raised in the petition, including, for example, validity under 35 U.S.C. 112, and controversies may arise during litigation that require resolution through claim construction not presented here because of the similarities between the prior art and the '779 Patent.

gas production has existed. As early as the 1850's fracturing methods used explosives such as gunpowder ignited by red-hot iron or nitroglycerin "torpedoes."[4] Hydraulic fracturing, in its modern form of pumping using pumps and valves to control fluids and proppants (*e.g.*, sand) pumped into the formation, began in the 1940s using a process developed by Stanolind Oil and used by Halliburton in the mid-continent region.[5] Early hydraulic fracturing in the 1940s and 1950s used frac pumps that could operate at around 1500 Hp.[6]



[4] Michael Morton, "Unlocking the Earth: A Short History of Hydraulic Fracturing," GEO ExPro, Vol. 10, No. 6, December 2013 (https://geoexpro.com/unlocking-the-earth-a-short-history-of-hydraulic-fracturing/) (last accessed November 30, 2023) (Ex. 1015).

[5] B.A. Wells and K.L. Wells. "Shooters – A "Fracking" History." American Oil & Gas Historical Society, (https://aoghs.org/technology/hydraulic-fracturing) (last accessed November 30, 2023) (Ex. 1016).

[6] Carl T. Montgomery and Michael B. Smith, "Hydraulic Fracturing: History of an Enduring Technology," *Journal of Petroleum Technology*, Vol. 62, Issue 12, p. 26 (Dec. 2010) (Ex. 1017).

68. The expansion of directional and horizontal drilling extended the use of hydraulic fracturing into previously underdeveloped "tight" formations, including shale.[7] In oil and gas exploration, directional drilling is a technique for accessing hydrocarbon-bearing formations (oil and gas formations) that are not located immediately beneath the surface location or to increase the amount of formation exposed to the wellbore. In directional drilling, some tool or process is used to cause the wellbore to deviate from the vertical to reach previously inaccessible formation locations, to expose more of the hydrocarbon-bearing formation to the wellbore, or to drill several wells from a single surface location, such as an offshore platform or a land-based drilling pad. Like most oil and gas industry developments "the early drilling of directional wells was clearly motivated by economics."[8] The offshore fields of California spawned the technology that led to modern directional and horizontal drilling. In the 1930s, directional drilling was used in the Huntington Beach, California field to reach an offshore oil-bearing formation from a well initiated on an onshore pad.

69. Throughout the 1980s, directional drilling increased, particularly on offshore pads and in the Austin Chalk trend of central Texas. Horizontally deviated

[7] Ex. 1015.

[8] Bourgoyne, A. T., Jr., K. K. Millheim, M. E. Chenevert and F. S. Young, Jr. (1986). Applied Drilling Engineering, Society of Petroleum Engineers, 351 (Ex. 1018).

wells were drilled into the chalk to intersect several of the natural fractures, allowing for transport of the hydrocarbons into the wellbore. This was combined with artificial fracturing to increase the flowrate of hydrocarbons. By at least 1986, horizontal drilling techniques were well-known and heavily developed. In 1986, the "first successful multifracture horizontal well is drilled in Wayne County, West Virginia."[9] This well used directional drilling to cause the wellbore to enter a more or less horizontal orientation (parallel to the surface of the earth) and combined it with advanced hydraulic fracturing techniques to not only expose large lengths of the hydrocarbon formation to the wellbore, but also to create artificial cracks or "fractures" in the formation from multiple locations to allow the hydrocarbons to "leak" out of the formation into the wellbore.

70. The use of horizontal drilling and fracturing systems in shale formations led to the United States vastly increasing its oil and especially natural gas production—starting in the 1980s and continuing to the present day.[10]

[9] Vassiliou, M. S. (2018), Historical Dictionary of the Petroleum Industry, Rowman & Littlefield, xliii (Ex. 1019).

[10] Ex. 1016 at 9 (showing a 2011 map from the Energy Information Administration showing shale plays where hydraulic fracturing is common).



71. As more formation is exposed to be fractured, horizontal wells use much higher volumes of fracturing fluid and proppant than vertical wells. This requires the use of more and bigger blending and pumping systems. As discussed by Sanborn, pumping systems of 32,000 hp were typically used as early as 2012.[11] Other references, such as *Coli*, suggest systems of pumps as large as 2,500 hp each, with total system power as high as 40,000 hp were used in the same period (four

[11] U.S. Patent Application Publication No. 2013/0306322 to Sanborn *et al.* entitled "System and Process for Extracting Oil and Gas by Hydraulic Fracturing" ("*Sanborn*"), [0005] (Ex. 1020).

trailers, each with four 2500 hp pumps operating in parallel).[12] These pumps are typically triplex or quintuplex positive displacement (plunger) type pumps.[13] Although some fracturing systems had been converted to electric-driven pump motors, most hydraulic pumping systems at the time "are typically mobilized on skids or tractor-trailers and powered using diesel motors."[14] These diesel engines require large amounts of diesel fuel and the requisite extra safeguards to address potential safety concerns.[15]

B. TYPES OF PUMPS – FRACTURING PUMP CHAIN

72. The basics of hydraulic fracturing have not changed significantly since 1949 when Halliburton first commercialized the "hydrafrack" process. Hydraulic fracturing still involves pumping water (or another fluid) blended with a proppant (*e.g.*, sand) and other chemicals into the downhole reservoir at a sufficient pressure to crack (fracture) the downhole rock. The sand-water mixture is then forced into the cracks, where the sand keeps the cracks (fractures) open to allow hydrocarbons, such as oil and natural gas, to flow out of the formation into the well bore. What has

[12] U.S. Patent Publication No. 2012/0255734 to Coli *et al.* entitled "Mobile, Modular, Electrically Powered System for Use in Fracturing Underground Formations" ("*Coli*"), [0049], FIG. 2 (Ex. 1021).

[13] *Sanborn* (Ex. 1020), at [0005]; *Coli* (Ex. 1021), at [0011].

[14] *Coli* (Ex. 1021), [0005]; *see also*, [0007] ("standard fluid pumps require large volumes of diesel fuel and extensive equipment maintenance programs").

[15] *Sanborn* (Ex. 1020), [0007].

changed are the pressures and flow rate of the fracturing jobs, the sizes of equipment and the particular proppants, chemicals, and liquids used.

73. A modern fracturing process requires multiple pumps operating together as a system to provide fracturing fluid with the suitable composition at the right flow rate[16], and at a pressure sufficient to fracture the formation. At the beginning of the pumping chain are the water transfer pumps. These pumps operate at a relatively low pressure to move water from storage (e.g., ponds, tanks) to the blender or the hydration unit.

74. In the blender, the water is mixed with a proppant, such as sand, resin-coated sand, or ceramics, to form the fracturing slurry. Other chemicals, such as acids, gels, friction reducers, biocides, and the like, are added to the slurry. Dry products, such as sand, are transported into the blender tub using gravity, conveyors, or augers. Liquid products, such as acids, are transported into the blender tub using various sizes and types of pumps. These are typically relatively small horsepower pumps operating at lower pressures, as the blender tub operates at more or less ambient pressures.

75. Once the fracturing slurry is blended to the proper makeup and consistency, it is transferred to the fracturing pumps using a blender discharge pump.

[16] "Flowrate," "flow rate," and "flow-rate" are used interchangeably in the industry and herein.

This pump typically operates at a higher pressure than the water or chemical transfer pumps for several reasons. First, the viscosity of the slurry is typically higher than that of water, which requires higher pressures to move the same volume of slurry. Second, the slurry is heavier than plain water, requiring additional horsepower to move the slurry (as compared to plain water). Finally, the large fracturing pumps are piston (or plunger) positive displacement pumps, requiring a higher suction (input) pressure to ensure flow sufficient to prevent cavitation, as explained below.

76. A fracturing piston (or plunger) pump works similarly to a car engine without the step of igniting the fuel to provide energy to the shaft. In a piston (plunger) pump, the shaft is rotated by an external power source, such as an engine or electric motor. Pistons (plungers), typically 3-5, are arranged along the shaft and connected so that the rotational motion of the shaft is translated into the linear motion of the pistons. As the shaft rotates, the piston (plunger) moves away from the head, creating suction which draws the slurry into the piston chamber. As the piston (plunger) moves toward the head, pressure is created which drives the fluid out of the chamber and down the line to and into the wellbore. A key characteristic of these fracturing pumps is that the same amount of liquid is discharged from the pump with every stroke, largely independent of the pressure downstream. The result is that flow at a particular pump speed is relatively constant, while pressure changes as downstream conditions change. Accordingly, as fracturing begins, reducing the

downstream impedance of the fluid flow system, pressure tends to drop as flow rate stays relatively constant. Conversely, pressure rises with a relatively stable flow rate as downstream impedance increases. As a boundary condition, if a valve is closed downstream of a fracturing pump, flow rate through the pump will remain relatively constant while pressure rises extremely fast. Pressure will continue to rise until some condition reduces the downstream impedance. This is typically equipment failure, such as pump seals, piping failure, or rupturing of valve bodies.

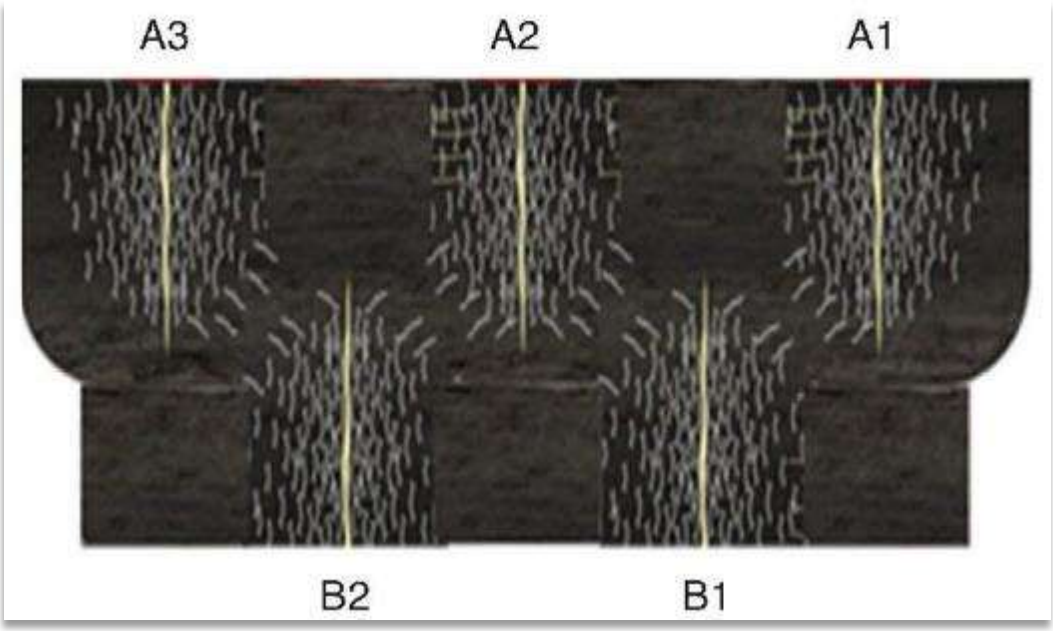
77. Because the pistons (plungers) are so large (~5" in diameter with ~8" stroke), a large amount of fluid must flow into the piston on each stroke. This tends to lower the suction pressure, as the void of the piston (plunger) must be filled by the incoming slurry. If the suction pressure gets too low, then cavitation occurs. Cavitation is the condition where bubbles form in the liquid because the vapor pressure of the liquid is higher than the suction pressure. When the bubbles collapse, such as when the piston reaches the bottom of its stroke, noise, vibration and damaging forces are created. To avoid cavitation and the associated problems, the suction pressure must be maintained higher than the fluid's vapor pressure of the fluid (e.g., slurry), even during the intake phase of the piston. This is called maintaining a Net Positive Suction Head (NPSH).

C. SIMULTANEOUS OR SEQUENTIAL FRACTURING (SIMULFRAC OR ZIPPER FRAC)

78. For most of the history of hydraulic fracturing, technological advances have been mainly geared towards advancements in chemicals (such as the development of corrosion inhibitors, gels, and slickwater fracking) and proppants, as well as increasing the flow and pressure of fracturing operations. The goal, as always, was to create fractures that expose the hydrocarbon-bearing formation to the wellbore, allowing the hydrocarbons to flow into the wellbore. For most of its history, hydraulic fracturing has been performed one well at a time, potentially with several stages (zones) being fractured in a single well. With the increased popularity of horizontal drilling in the 1990s and 2000s, the number of fracturing stages in a well increased dramatically as the "pay zone" (the hydrocarbon-bearing formation) of the well exposure rose from tens to hundreds of feet to several thousand feet.

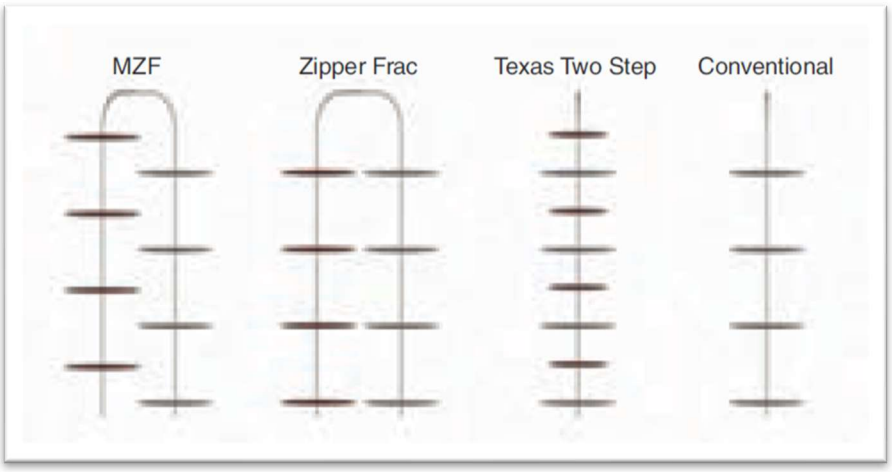
79. In the mid-2000s, operators began experimenting with, and then using a technique dubbed "zipper fracturing," in which multiple wells, closely spaced in the formation, were fractured simultaneously or sequentially. The result was that the fractures formed in one well were affected by the pressures and fractures in another well, leading to so-called "zipper fractures" that were longer, multidirectional, and exposed more formation to the wellbores than single well fracturing produced.

80. The image below was captured from *Jacobs*[17] and shows the influence that simultaneous or sequencing fracturing has on the fractures caused by wells. For the fractures nearest the wellbores, the fractures show a typical pattern of being aligned with the perforations, as shown in the below figure where A1-A3 are perforations and associated fractures from a first horizontal wellbore and B1-B2 are the perforations/fractures from a second parallel wellbore. However, for fractures near other wellbores, the fracture lengthens and turns, creating a zipper-like pattern to the fracture. This exposes more of the formation to the wellbore and allows for earlier and more complete recovery of hydrocarbons from the formation.



[17] Ex. 1008; Jacobs, Trent. "The Shale Evolution: Zipper Fracture Takes Hold," J Pet Technol 66 (2014): 60–67. doi: https://doi.org/10.2118/1014-0060-JPT.

81. The figure below (with the wellbores represented vertically) from *Jacobs* shows various types of fracturing configurations beginning with conventional fracking (to the right) and ending with modified zipper fracturing (MZF) on the left. The changes in the location of the perforation and fracturing operations are intended to increase the development of zipper fractures and expand the interface with the hydrocarbon-bearing formation.



82. Zipper fracturing has had the most success in Shale regions. As discussed in *Waters*, a lower Youngs Modulus allows for tighter spacing of the fractures, allowing for an easier formation of zipper fractures.[18]

[18] Waters, George, Dean, Barry, Downie, Robert, Kerrihard, Ken, Austbo, Lance, and Bruce McPherson. "Simultaneous Hydraulic Fracturing of Adjacent Horizontal Wells in the Woodford Shale." Paper presented at the SPE Hydraulic Fracturing Technology Conference, The Woodlands, Texas, January 2009. doi: https://doi.org/10.2118/119635-MS (Ex. 1022).

Two conclusions are apparent:

- In order for hydraulic fractures to be very close together very high stresses are required. A fracture spacing of 1 ft requires stresses in excess of 4,000 psi for all listed moduli. This is unrealistic and will certainly lead to the truncation of most fractures and the creation of a dominant, single fracture at this spacing.
- The rock stiffness greatly influences the achievable fracture spacing. For example, at a fracture spacing of 25 ft the increase in stress is >800 psi for a rock with a Young's Modulus of $5x10^6$ psi. Yet the stress increase is only 170 psi for a rock with a Young's Modulus of only $1x10^6$ psi.

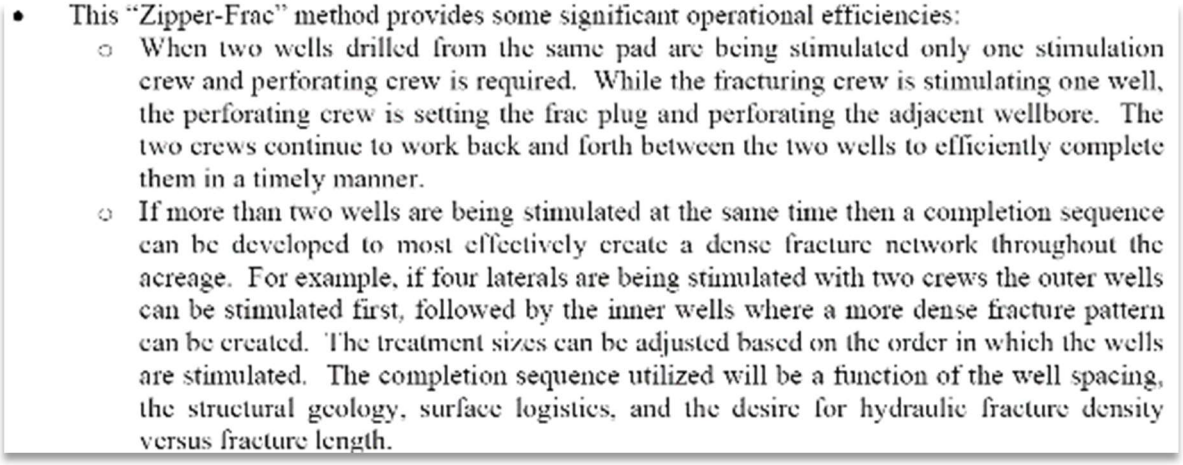
Waters at 5.

83. As further described by *Waters*, developing zipper fractures involves maintaining pressure in the formation from one wellbore, while initiating fractures by pressuring up a proximate wellbore. "In ultra-low permeability reservoirs such as shales the stimulations do not necessarily have to occur concurrently. Since little to no fluid leak off into the rock matrix, the fracture systems will remain pressurized until they are flown back. This pressurized system can provide the diversion [zipper fracture] desired when the adjacent lateral is stimulated subsequent to the initial stimulation." [19]

84. This allows one well stage to be pressurized and shut in (such as with a valve, plug, or a ball seal), then an adjacent well stage to be pressurized and benefit from the stress induced by the other pressurized well. This has advantages not only to the development of fractures downhole but also operational advantages. As *Waters* states below, one fracturing crew and one perforating crew can treat multiple

[19] Ex. 1022 at 8.

wells simultaneously or in an alternating arrangement, allowing for faster completion of the fracturing process.[20]



- This "Zipper-Frac" method provides some significant operational efficiencies:
  - When two wells drilled from the same pad are being stimulated only one stimulation crew and perforating crew is required. While the fracturing crew is stimulating one well, the perforating crew is setting the frac plug and perforating the adjacent wellbore. The two crews continue to work back and forth between the two wells to efficiently complete them in a timely manner.
  - If more than two wells are being stimulated at the same time then a completion sequence can be developed to most effectively create a dense fracture network throughout the acreage. For example, if four laterals are being stimulated with two crews the outer wells can be stimulated first, followed by the inner wells where a more dense fracture pattern can be created. The treatment sizes can be adjusted based on the order in which the wells are stimulated. The completion sequence utilized will be a function of the well spacing, the structural geology, surface logistics, and the desire for hydraulic fracture density versus fracture length.

85. The advantages of zipper fractures have been known for decades, as shown by *Pearson*, an article published in the Journal of Petroleum Technology in 1992.[21] While not directly discussing the simultaneous or alternating process, *Pearson* does discuss the results of such a process. "This paper reports the first results of stress-oriented and aligned perforating of deviated wells at the Kuparuk River field, Alaska. Preferred perforation alignment and spacing are calculated for each well so the fractures from individual perforations link to produce a single 'zipper' fracture plane along the deviated [horizontal] wellbore."[22] *Pearson* further

[20] *Id*.

[21] Pearson, C.M., Bond, A.J., Eck, M.E., and J.H. Schmidt. "Results of Stress-Oriented and Aligned Perforating in Fracturing Deviated Wells." J Pet Technol 44 (1992): 10–18. doi: https://doi.org/10.2118/22836-PA (Ex. 1023).

[22] *Id.* at Summary.

states that "[d]uring the past 7 years [prior to 1992], more than 600 new development wells have been fracture stimulated in the Kapurak River field. The large number of treatments has provided the opportunity for significant advances in the technical and operational aspects of hydraulically fracturing deviated wells."[23]

86. The Zipper-frac process (alternating perforations and pressurization of adjacent wells) has been well-known in the industry since at least 2008, particularly to those operators and fracturing companies operating in Shale regions such as the Barnett, Woodford, and Marcellus shale formations. This contributes to the general engineering knowledge that a fracturing designer (engineer) had when planning operations of fracturing systems. *Waters* is one example of the well-known nature of this process, and dates to 2009.

87. Another example of the well-known nature of the zipper-frac process in shale-producing regions is *Mutalik,* a paper published by the SPE in 2008.[24] *Mutalik* discusses multiple case studies of wells using a "simo-frac" process to create more effective downhole formation fractures in the Barnett Shale. "In this paper, the case history of sequential and simultaneous fracturing of four similarly drilled and

[23] Ex. 1023 at Introduction.

[24] Mutalik, P N, and Bob Gibson. "Case History of Sequential and Simultaneous Fracturing of the Barnett Shale in Parker County." Paper presented at the SPE Annual Technical Conference and Exhibition, Denver, Colorado, USA, September 2008. doi: https://doi.org/10.2118/116124-MS (Ex. 1024).

completed horizontal azimuth wells in Eastern Parker County, is discussed."[25]

Mutalik further describes:[26]

> Simultaneous fracturing (simo-fracs) of paired offset wells is one of the recent trends in Barnett fracturing and is being increasingly used by many operators. In this technique, two or more adjacent wells that are roughly parallel to each other are fractured simultaneously. The goal is to expose the shale to more pressure and produce a more complex, "three-dimensional web" of fractures by increasing the density of the hydraulic fracture network and increasing the surface area created by the frac job.

Mutalik describes the operational benefits of a simultaneous frac process. "Simo-fracs are expensive and require much more coordination and logistics and a larger location. At the same time, they are cost-effective as the fracturing equipment is being utilized more efficiently and two wells are being completed in one week instead of two weeks."[27] *Mutalik* further teaches that, as of 2008, "[simultaneous fracturing] operators are now experimenting with triple fracs ('trifectas') or even quad-fracs in some cases.[28]

[25] Ex. 1024 at Abstract.

[26] Ex. 1024 at Background.

[27] *Id*.

[28] *Id*.

88. In addition to the above references, *Mayerhofer*[29] and *Rousell*[30] provide more information on the advantages and benefits of such a process. For example, *Mayerhofer* discusses "it may be more beneficial to drill laterals at closer spacing, with the chance of overlapping SRV's" (Stimulated Reservoir Volume).[31] "This is the reason for the so-called "simul-fracs" and "zipper-fracs" in shale reservoirs where multiple parallel wellbores are either stimulated simultaneously or in short alternating sequence from one lateral to the next."[32]

89. *Rousell* teaches that "[t]he numerical calculation of the fracture spacing required to avoid fracture deviation during propagation, for all three fracturing techniques, demonstrate the potential advantages of alternate fracture sequencing and zipper-fracs to improve the performance of stimulation treatments in horizontal wells. …. Simultaneous fracturing of two or more parallel adjacent wells, also

[29] Mayerhofer, M. J., Lolon, E. P., Warpinski, N. R., Cipolla, C. L., Walser, D., and C. M. Rightmire. "What is Stimulated Reservoir Volume (SRV)?" Paper presented at the SPE Shale Gas Production Conference, Fort Worth, Texas, USA, November 2008. doi: https://doi.org/10.2118/119890-MS (Ex. 1025).

[30] Roussel, Nicolas P., and Mukul M. Sharma. "Optimizing Fracture Spacing and Sequencing in Horizontal-Well Fracturing." SPE Prod & Oper 26 (2011): 173–184. doi: https://doi.org/10.2118/127986-PA (Ex. 1026).

[31] Ex. 1025 at 12.

[32] Ex. 1025 at 12.

referred to as simul-fracs or zipper-fracs, aim to generate a more complex fracture network in the reservoir."[33]

90. By at least 2014, the zipper-frac process was widespread in hydraulic fracturing operations. As described by *Jacobs*:[34]

> A horizontal well completion method known as zipper fracturing has been rapidly adopted over the last couple of years by companies in the Eagle Ford shale of south Texas. Instead of drilling and hydraulically fracturing one well at a time, the zipper method involves drilling multiple wells from a pad site and then hydraulically fracturing a stage in one well, while getting ready for the next, as wireline and perforation operations take place in another. The multiwell completion method earns its name from the zipper-like configuration of the fracture stages from wells drilled with relatively tight spacing.

In addition to discussing the production and operational benefits of such a process, *Jacobs* examines the prevalence of this process by 2014. For example, by 2014 nearly half of Schlumberger's completions in North America were completed with the zipper-fracturing method, and "in less than 3 years, the proportion of zipper-fracturing completions … in the Eagle Ford shale of Texas … increased threefold to 85%."[35]

[33] Ex. 1026 at 1.

[34] Ex. 1008 at 1.

[35] *Id.* at 3.

D. CONTINUOUS PUMPING FRACTURING

91. As hydraulic fracturing has increased in the number of stages and wells treated, various techniques have been employed to meet the overall goal of reducing financial costs and non-productive time (NPT) at the well site. At the same time, techniques were developed to minimize wear and damage to the high-horsepower pumps, valves, and related equipment. One technique that furthers both goals is the use of continuous pumping to treat multiple stages in a well or multiple wells simultaneously or sequentially.

92. Early continuous pumping techniques from at least the 1960s were directed toward treating multiple zones (stages) in a well without stopping the pumps. "Wells with multiple producing zones can be fractured one zone at a time during continuous pumping."[36] *Webster* further describes that continuous pumping "is less expensive than treating one zone at a time using isolating packers."[37] By at least 2007, continuous pumping equipment and techniques were well-known and practiced internationally. In 2007, *Casero* described the completion of three wells in the Kitina field of West Africa using a "Continuous Pumping Multi-State System

[36] K. R. Webster, W. C. Goins, Jr., and S. C. Berry, "A Continuous Multistage Tracing Technique," *Journal of Petroleum Technology,* vol. 17, no. 06, pp. 619-625, 1965, doi: 10.2118/977-pa (Ex. 1027).

[37] Ex. 1027 at Abstract.

(CPMSS) technique," which "ha[d] been used for six years in North America."[38] The CPMSS technique "allows pumping multiple hydraulic fracturing treatments without the need of intermediate operation such as bridge plugs or proppant plugs."[39] *Casero* further teaches multiple benefits of a continuous pumping system, including:

- With adequate bulk capacity, all stimulation can be done in hours instead of weeks.
- Quicker fluid recovery due to the short time for the injection process.
- Reducing rig costs may encourage additional fracturing treatments for enhanced well stimulation.

93. By 2018, *Rasenfross* observed that wells drilled in 2015 in the Permian basin were fractured using "zipper fracturing" and teaches "[z]ipper fracturing speed work by allowing continuous pumping and it reduces the risk of frac hits because the method only fractures rock where pressure has not been depleted by production. Now zipper fracturing is used to fracture even more wells at once."[40] *Rasenfross*

[38] A. Casero, G. Pace, B. Malone, F. Cantaloube, L. Tealdi, H. Malonga, and R. Seale, "Continuous Pumping, Multistage, Hydraulic Fracturing in Kitina Field, Offshore Congo, West Africa," in *SPE International Symposium and Exhibition on Formation Damage Control*, 2008, vol. All Days, SPE-112442-MS, doi: 10.2118/112442-ms. [Online]. Available: https://doi.org/10.2118/112442-MS, at Abstract (Ex. 1028).

[39] Ex. 1028 at Introduction.

[40] S. Rassenfoss, "A Look Into What Fractures Really Look Like," *Journal of Petroleum Technology,* vol. 70, no. 11, pp. 28-36, 2018, doi: 10.2118/1118-0028-jpt. at 6 (Ex. 1029).

further observed "[s]imultaneous fracturing is likely to create stronger connections [between wells] because the time between stages is relatively short."[41]

E. OPERATION PARAMETERS FOR FRACTURING

94. Whether part of a zipper fracturing operation and/or continuous pumping operation, a hydraulic fracturing operation includes operational parameters such as fluid flow and pressure specific to the operation. For example, operators have long known to open a second well for continuous pumping only if there is sufficient flow to support the operation of two wells, but not so much flow that it would blow a valve or cause damage to the system. *Casero* further discusses a reducing the flow rate between stages to allow a mechanical operation during a frac job. Using the CPMSS technique, a mechanical operation includes dropping a ceramic ball into a well on a packer sleeve.[42] As *Oberhofer* details, the ball performs two functions. First, it acts as a seal to isolate the stages below the ball (like a valve). Secondly, after the ball lands and the pump rate is increased again, the differential pressure across the ball/seat causes activation of a sleeve, opening access to the perforations to be fractured.[43]

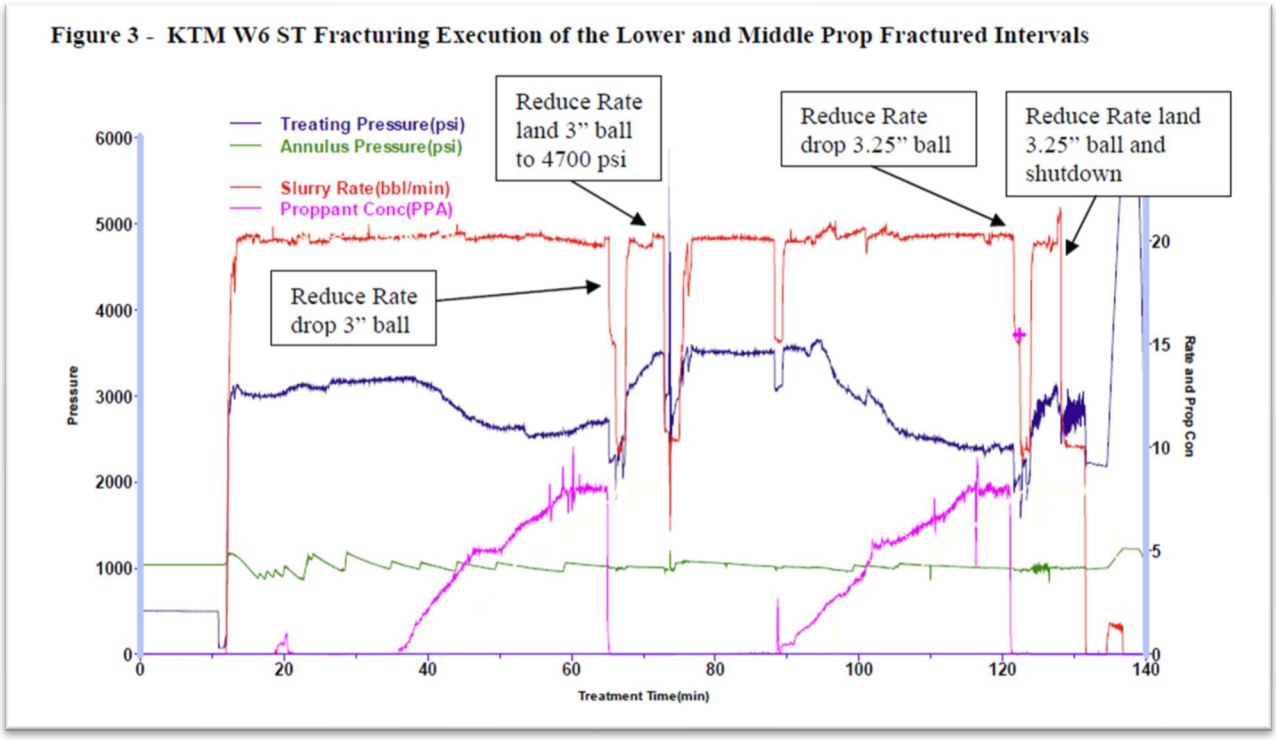
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[41] *Id*.

[42] Ex. 1028 at 4

[43] R. Oberhofer, "Application of Ball-Drop Technology to Improve Efficiency and Stimulation of Limited Entry Completion Systems," in *Abu Dhabi International Petroleum Exhibition & Conference*, 2016, vol. Day 2 Tue, November 08, 2016,

95. Before the mechanical operations are completed, *Casero* described "[t]he pumping rate is consistent at 20 bpm until the rate is reduced to have a controlled launch of the frac ball on the surface and then again when the ball is calculated to land at the fracture port."[44] *Casero*'s Figure 3 shows the rate reduction used to complete the mechanical operation.[45]



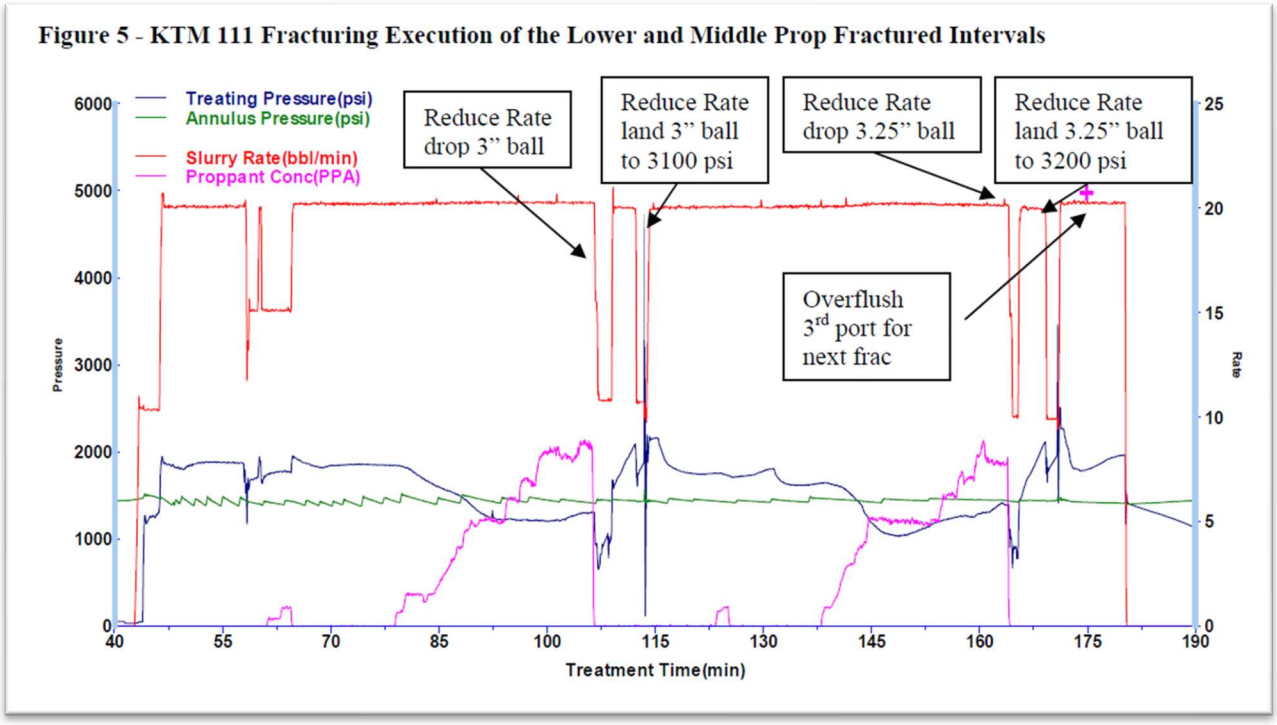
96. Figure 3 shows not only the reduction in rates necessary for controlled mechanical operations, but also the increase and then decaying pressures consistent

D021S052R004, doi: 10.2118/183427-ms. [Online]. Available: https://doi.org/10.2118/183427-MS (Ex. 1030).

[44] Ex. 1028 at 5.

[45] *Id.* at 16.

with a fracturing operation taking place when using positive displacement pumps. As further teaching, Figure 5 of *Casero* shows similar rate reductions to undertake mechanical operations.



97. *Tolman* describes another "Method and Apparatus Associated for Simultaneous Stimulation of Multi-Well Pads" in which "ExxonMobil has drilled multiple wells from single pads, and new technologies have been developed to efficiently stimulate the multiple pay zones in each well." The technologies described by *Tolman* enable "simultaneous stimulation of multiple wells on the same

or different well pads, and while drilling additional wells."[46] Like *Casero*, *Tolman* teaches suspending mechanical operations during high flow (high pressure) operations.[47] In the *Tolman* system, where the pumps are continuously operating, the "high-pressure pumping" which results in/from high-flow pumping must be reduced in order for mechanical operations, such as valve manipulations, to occur.

98. The restriction on mechanical operations during high flow / high-pressure conditions described by at least *Casero* and *Tolman* is because mechanical operations, such as closing a valve or opening a valve during high flow / high pressure conditions could result in damage to equipment and safety concerns. For example, closing a valve when there is high flow through the valve would result in high fluid velocity through the valve orifice, particularly as the valve neared a full close position. This high velocity increases damage to components such as the valve seats and seals, as well as causing vibrations through the piping system. Additionally, in systems using positive displacement pumps, such as those used for hydraulic fracturing, closing a valve during high flow conditions would create extremely high-pressure increases and damage to pumps, seals, piping (iron), or

[46] Tolman, R. C., et al. (2009). Method and Apparatus for Simultaneous Stimulation of Multi-Well Pads. SPE Hydraulic Fracturing Technology Conference, at 1 (Ex. 1031).

[47] Ex. 1031 at 4.

other mechanical equipment. This is due to the inherent characteristics of positive displacement pumps. (*See* Section IX.B).

99. The above examples show that it has been well-known and documented that operational parameters, including flow rate, are commonly considered during valve and pump mechanical operations for hydraulic fracturing.

F. TESTING

100. It has also long been established to vary operational parameters to conduct performance testing for fracturing operations. For example, since at least the 1980s the value of measuring oscillations in the pressure of a fracturing system to indicate the extent of the fractures downhole has been known. Oscillations in the well are created in two primary ways. First, during flowing conditions, if the flow is suddenly changed (reduced) either through shutting a valve or a reduction in rate, the momentum of the flowing fluid creates a natural oscillation called a water hammer. Second, during some well tests, an intentional pressure transient or spike is created by suddenly opening and then closing a valve or by the forced oscillations of the positive displacement pumps. The changes in the pressure oscillations, either natural or artificial, provide information about the extent of the fractures downhole.

101. According to *Holzhausen*, as early as 1985, "[t]he growth of a hydraulic fracture increases the period of free oscillation in a well. Simultaneously, the decay

rate of free oscillations decreases."[48] *Holzhausen* refers to the "impedance of the hydraulic fracture" as the effect that fractures have on the fluid stream. "Because impedance is a function of fracture dimensions and the elasticity of the surrounding rock, impedance analysis offers a promising new approach for evaluating fracture geometry."[49] *Holzhausen* defines fracture impedance as "the ratio of volume change [in a fracture] to head [pressure] change" and is used to describe the effect that fractures have on the fluid stream .[50] The primary reason that analysis of the fracture impedance is possible is "[t]he configuration of surface and downhole pipe (tubing, casing, etc.) remains constant during a hydraulic-fracturing treatment, whereas the geometry of the fracture changes continuously as it is being created."[51] Accordingly, any change in the behavior of the oscillations (decay, period, etc.) can be attributed to the changes in the fracture geometry. According to *Holzhausen* "[i]t is a well-known result from steady-state LaPlace analysis that the character of free

[48] G. R. Holzhausen and R. P. Gooch, "Impedance of Hydraulic Fractures: Its Measurement and Use for Estimating Fracture Closure Pressure and Dimensions," in *SPE/DOE Low Permeability Gas Reservoirs Symposium*, 1985, vol. All Days, SPE-13892-MS, doi: 10.2118/13892-ms. [Online]. Available: https://doi.org/10.2118/13892-MS, at 1 (Ex. 1032).

[49] Ex. 1032 at 1.

[50] *Id.* at 3

[51] *Id.* at 2

oscillations is determined by the singularities of the impedance with respect to frequency."[52]

102. *Paige* tested *Holzhausen's* concepts in field testing. During *Paige's* tests "[a] pressure pulse is introduced into a well, and the resulting pressure trace is interpreted to give fracture dimensions."[53] *Paige* refers to this as "Hydraulic impedance testing (HIT)"[54] Further, "HIT uses the transient response of the fluid in the wellbore and fracture that results from the introduction of a pressure pulse into the well to provide information about the fracture."[55] Through a series of field tests, Paige determined that "fracture length is obtained from the delay time (tf = 1.8 sec in Fig. 6) and the wavespeed."[56] Thus, as was common in well testing, *Paige's* testing involved varying and monitoring operational parameters over a period of time to assess the effects in the well.

[52] *Id.* at 4

[53] R. W. Paige, L. R. Murray, and J. D. M. Roberts, "Field Application of Hydraulic Impedance Testing for Fracture Measurement," *SPE Production & Facilities,* vol. 10, no. 01, pp. 7-12, 1995, doi: 10.2118/26525-pa., at 1 (Ex. 1033).

[54] Ex. 1033 at 1.

[55] *Id*.

[56] *Id*. at 4.

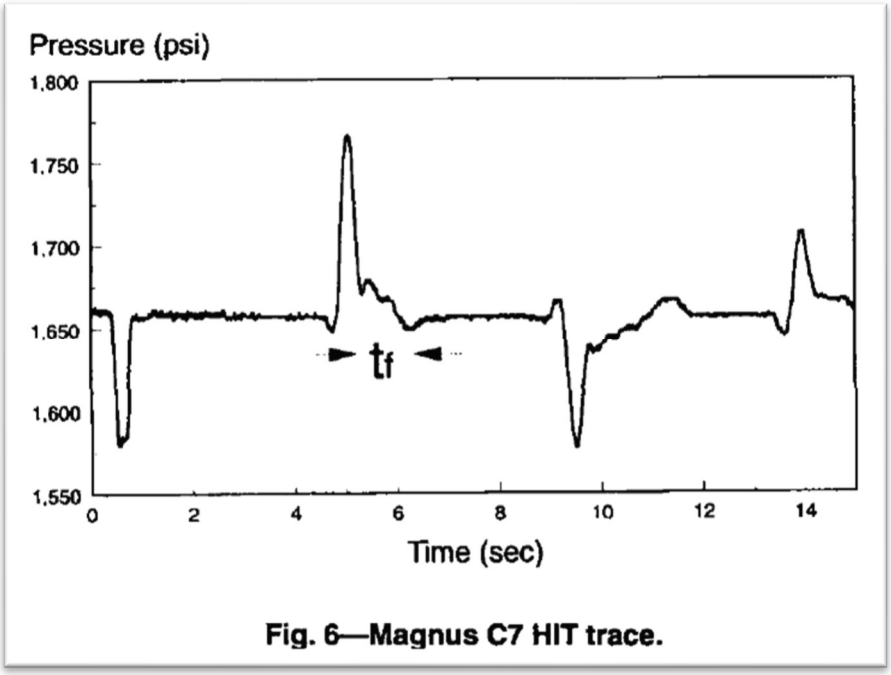


Fig. 6—Magnus C7 HIT trace.

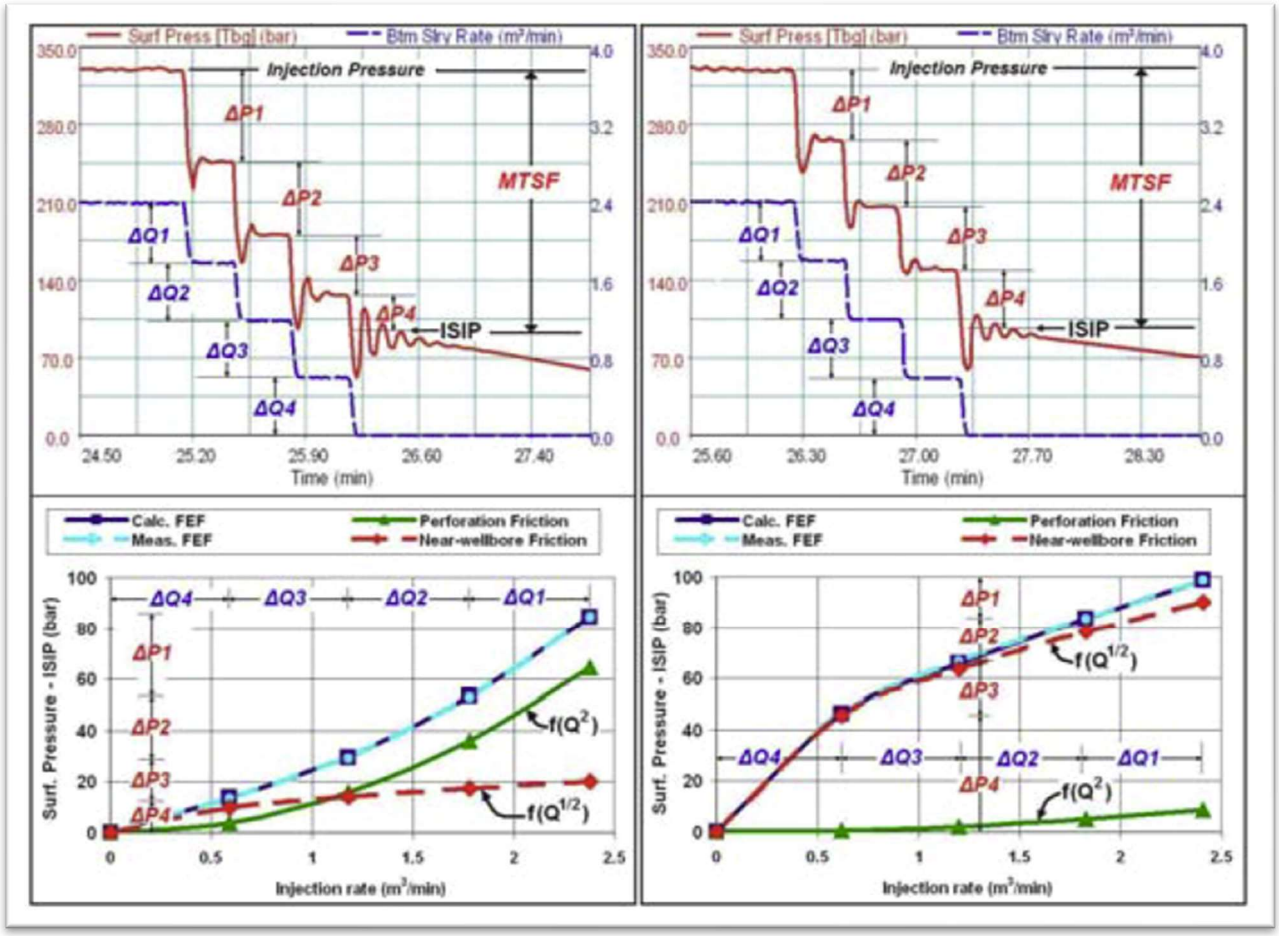
Paige at 4.

103. *Massaras* describes using the same principles as *Paige* and *Halzhousen* to analyze fracture geometry using a "Rate Step-down Test (RST) also referred to as "Step-Down Test (SDT)" which, by 2007 had "been used worldwide for over 15 years."[57] To properly execute an RST, "a relatively large fluid volume should be injected prior to initiating the RST procedure of abrupt flow rate changes."[58] During a properly designed RST "the fracture geometry will not change dramatically during the very short RST procedure" because of the large volume injected into the fractures

[57] L. V. Massaras, A. Dragomir, and D. Chiriac, "Enhanced Fracture Entry Friction Analysis of the Rate Step-Down Test," in *SPE Hydraulic Fracturing Technology Conference*, 2007, vol. All Days, SPE-106058-MS, doi: 10.2118/106058-ms. [Online]. Available: https://doi.org/10.2118/106058-MS, at 1 (Ex. 1034).

[58] *Id.* at 6.

prior to the RST.[59] Using the tests in *Massaras*, the characteristics of the pressure transients after a flow-rate reduction (often referred to as water hammer), such as shown in Figure 9, may be used to indicate fracture geometry.



Massaras, Figure 9.

104. *Mondal* expanded the understanding of pressure transient analysis, particularly regarding measured "water hammer." "Water hammer is a surge or

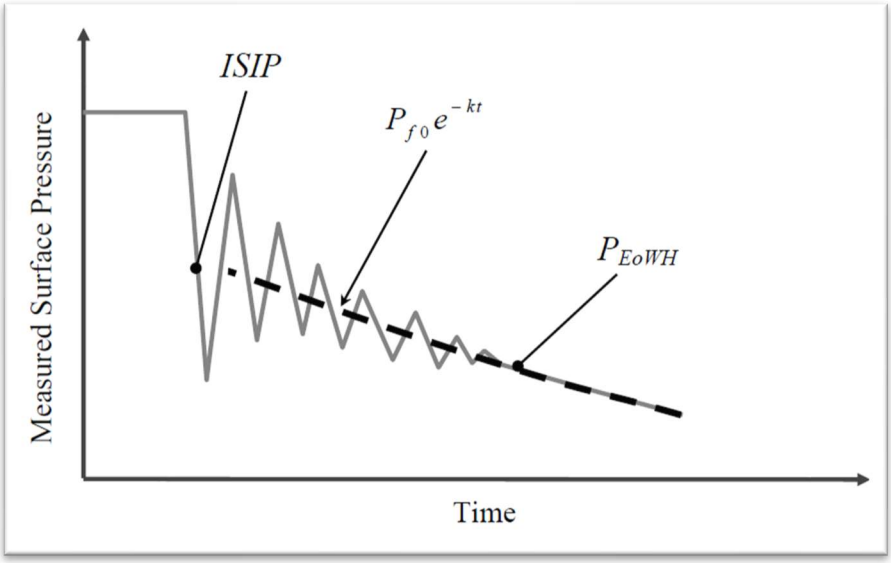
[59] *Id*. at 7.

pressure wave created due to a sudden change in flow velocity in a confined system."[60] According to *Mondal*, water hammer analysis was known as early as 1900. However, traditional water hammer analysis is incomplete in a fractured well as "the presence of a porous medium [fractures] at the downstream/upstream end of an injection/production well makes it different from the traditional pipeline water hammer analysis."[61] In *Mondal*, based on work by *Paige* and others, "pressure and rate transients can be calculated at any point in the well or at the bottomhole" based on known well and fluid parameter relationships.[62] In *Mondal's* analysis, a step change reduction in flow rate was applied to a well, the resulting pressure oscillations (water hammer) were evaluated and applied using the known well and fluid relationships to determine the geometry of the fractures at the end of the wellbore. The energy storage characteristics of the wellbore and fluid create the resonance, as measured by the period (length of time) of the wellbore, and resistive features of the wellbore create a loss of oscillation height over time. The relationships between these yield information regarding characteristics of the fractures.

[60] S. Mondal, "Pressure transients in wellbores: Water hammer effects and implications for fracture diagnostics," 2010, at 12 (Ex. 1035).

[61] Ex. 1035 at 32.

[62] *Id.* at 34.



Mondal, Figure 2.9

105. *Mondal* teaches that the period of these oscillations is several seconds (~6-10 seconds, depending on well length). To properly evaluate the characteristics of the well, a sufficient number of oscillations must be captured to calculate the period and decay rate, as shown in Figure 2.9 above. This data allows the user to "estimate fracture dimensions from water hammer data."[63] Accordingly, a POSITA would have been well aware of operationally reducing flow at the end of the fracture stage to perform a rate step down (RST) or water hammer analysis. Further, a POSITA would have been well aware that the reduction in flow would need to be held steady for a period of time necessary to capture sufficient oscillations for the trend described above to be determined. Flow schedules such as the ones in

[63] Ex. 1035 at 66.

Massaras and *Tolman* with intentional reductions in flow rate below a threshold would have been well known to a POSITA long before the '779 Patent application.

X. OVERVIEW OF THE PRIOR ART

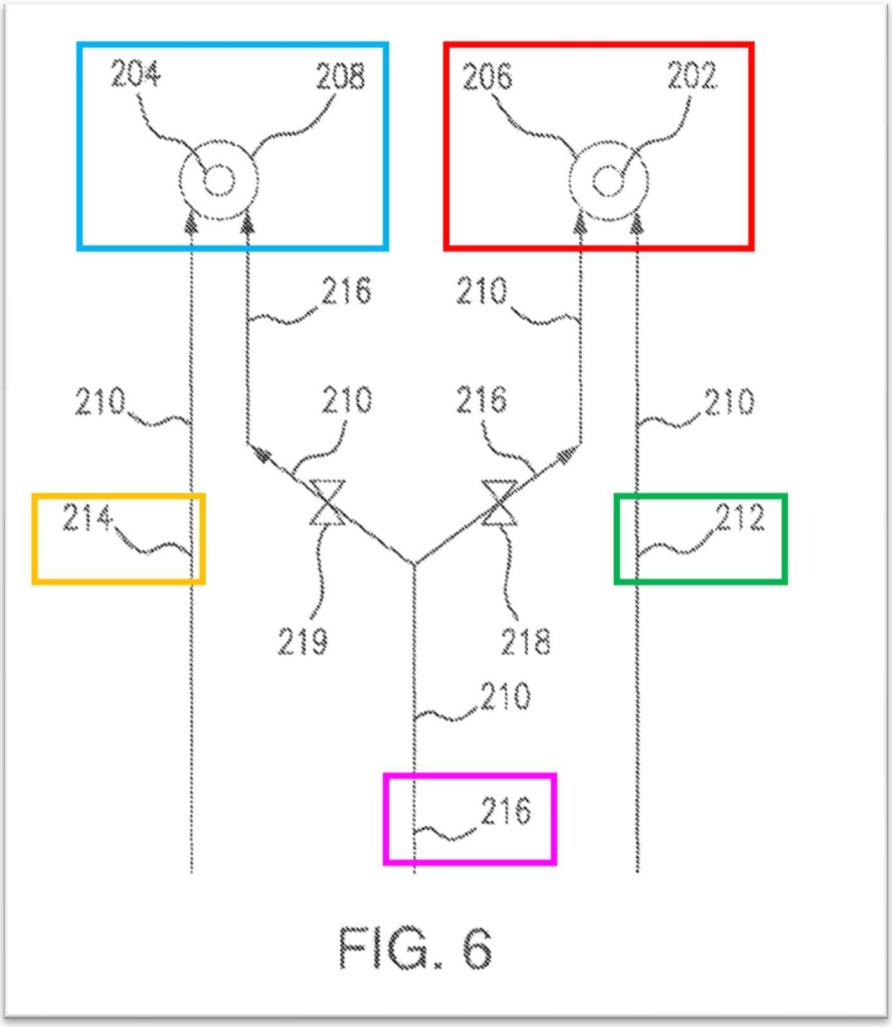
A. CIEZOBKA

106. WO2017/201526 ("*Ciezobka*") was filed on May 22, 2017, and published November 23, 2017, before the earliest possible priority date (May 17, 2021) of the '779 Patent and before the filing date of the earliest application in the chain of CIP parent applications to the '779 Patent (December 14, 2017). (Ex. 1037). Thus, *Ciezobka* is prior art to the '779 Patent.

107. *Ciezobka* is entitled, "Hydraulic Fracturing System and Method." *Ciezobka* discloses hydraulic fracturing systems and methods for "enhancing effective permeability of earth formations to increase hydrocarbon production, enhance operation efficiency by reducing fluid entry friction due to tortuosity and perforation, and to open perforations that are either unopened or not effective using traditional techniques"[64] Further, the system "includes a pair of wellheads **202**, **204** [annotated in red, blue] each connected to a wellbore **206**, **208**"[65] as shown in Fig. 6.

[64] Ex. 1037 at Abstract.

[65] Ex. 1037 at 11:24-25.



Ciezobka Fig. 6, annotated

108. *Ciezobka* teaches that in a fracturing process, both diverter valves 218 and 219 are initially open, allowing fluid flow "to be provided to both of the wellheads **202**, **204**."[66] The second diverter valve **219** (e.g., second valve) is then closed for a "short period of time." At the same time, the first diverter valve **218** (e.g., first valve) remains open to provide a decreased flow rate (shown as **232** in

[66] Ex 1037 at12:7-9.

Fig. **7**) to the second well **204** and an increased flow rate (shown as **222** in Fig. 7) to the first well **202** for a "short period of time."[67]

109. As depicted in Fig. 7, after the short period of time with the second diverter valve closed, the second valve (e.g., **219**) is opened to resume fluid flow "to both of the wellheads **202**, **204**."[68] The sequence of events is depicted in Fig. 7. Hydraulic fluid flow paths to the first well are identified in pink, and hydraulic fluid flow paths to the second well are identified in green.

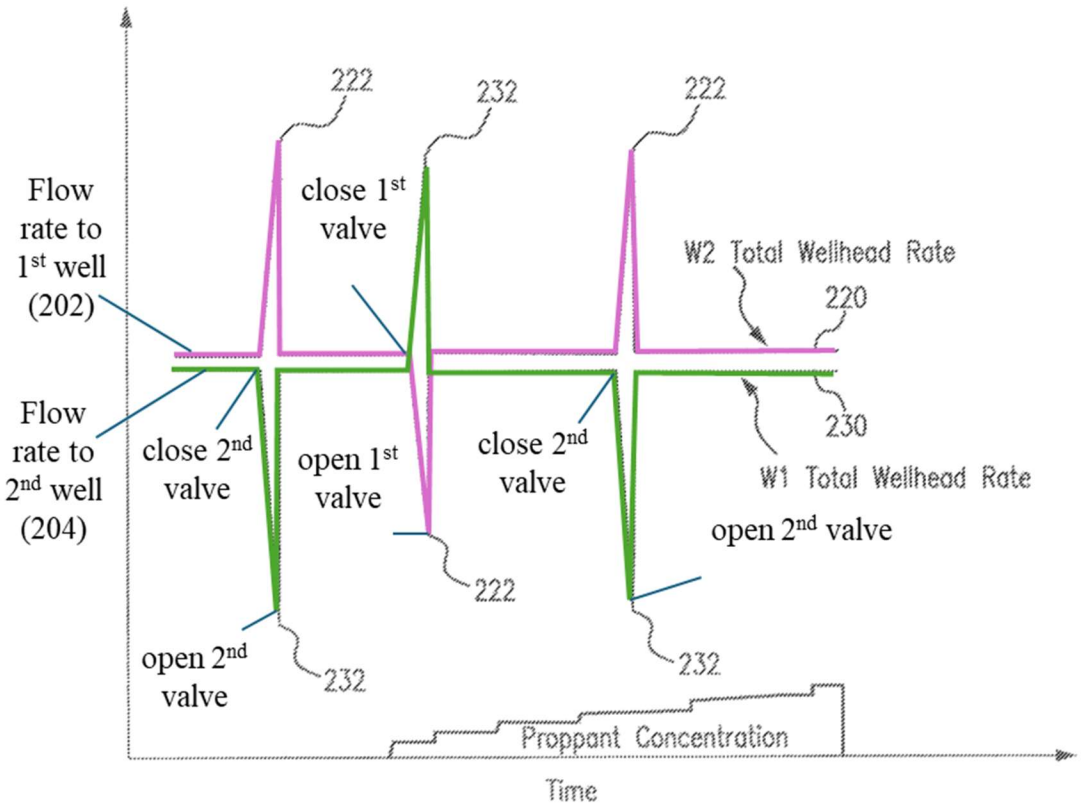


FIG. 7

[67] Ex 1037 at 12:8-13.

[68] *Id. at* 12:5-11.

Ciezobka Fig. 7, annotated

110. *Ciezobka* discloses hydraulic fracturing systems and methods that include controlling the flow rate to multiple wells to deliver pressure pulses to improve fracturing of the wells and enhance hydrocarbon production.[69] The flow rate may be varied by alternatingly opening and closing valves along flow lines to the wells to divert fluid a portion of flow from one well to another.[70] *Ciezobka* also discloses fracturing evaluation methods "implemented in a software toolbox which incorporates all of the data handling and data analysis elements for real time application in the field during hydraulic fracturing operations as well as post completion using the data collected during field activities." These methods "provide[] the 'effectiveness' and 'confidence' measures in the output," which "are then used to decide on further rate fluctuations as envisioned to be part of subject hydraulic fracturing method." [71]

B. BEUTERBAUGH

111. WO2020/145978 ("*Beuterbaugh*") was filed on January 10, 2019, and published July 16, 2020, before the earliest possible priority date (May 17, 2021) of the '779 Patent. (Ex. 1036). Thus, *Beuterbaugh* is prior art to the '779 Patent.

[69] Ex. 1037 at Abstract; 2:24-26.

[70] *Id*. at 11:21-12:15.

[71] *Id.* at 27:26-28:2.

112. *Beuterbaugh* is entitled, "Simulfrac Pulsed Treatment." *Beuterbaugh* discloses fracking multiple wells by alternatingly opening and closing valves to the wells, including switching valves and plug valves, to divert high pressure "fracturing fluid near instantaneously from one well to the other well."[72] High-pressure pump(s) "run at a constant rate to provide a substantially constant pressure of … fracturing fluid" to the wells' switching valves.[73] Plug valves, positioned downstream from associated switching valves, are operated (opened/closed) before and after switching valves are operated, e.g., to allow absolute fluid flow shut off to associated wells.[74] In an example, a second switching valve **105b** to a second well is opened. In contrast, a first switching valve **150a** to a first well is at least partially closed or closing, as shown in Fig. 3B, and associated plug valves are opened/closed before and after operation of the switching valves.[75]

[72] Ex. 1036 at Abstract.

[73] Ex. 1036 at [0018], [0022].

[74] Ex. 1036 at [0019].

[75] Ex. 1036 at [0021].

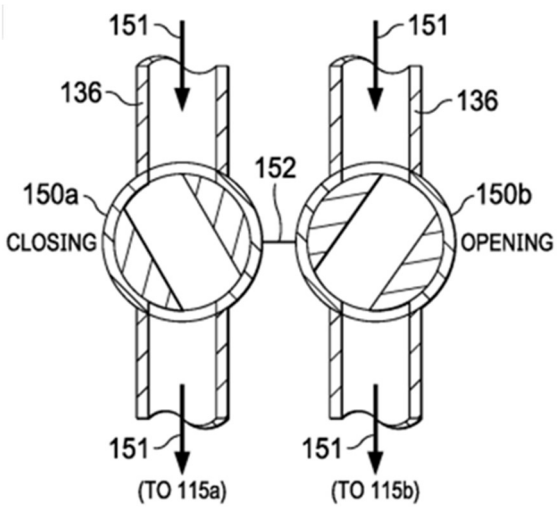


FIG. 3B

113. *Beuterbaugh* teaches that "the time duration that a switching valve … is open can vary, or can be maintained of a constant duration from cycle to cycle."[76] Additionally, "[t]he number of high pressure pumps and total flow rate from the one or more high pressure pumps … determine the pulse size of the fracturing fluid that are selectively diverted to the plurality of wells" by time duration between operating the valves.[77]

C. JACKSON

114. U.S. Patent Publication No. 2007/0023184 ("*Jackson*") was filed on May 30, 2006, and published February 1, 2007. (Ex. 1005). *Jackson* is prior art to the '779 Patent because Jackson's filing date and publication date are before the '779's earliest possible priority date (May 17, 2021) and are even before the filing

[76] Ex. 1036 at [0022].

[77] Ex. 1036 at [0018].

date of the earliest application in the chain of CIP parent applications to the '779 Patent (December 14, 2017).

115. *Jackson* is directed to "[a] process for fracturing a selected region of a formation including: introducing a supply of fracturing fluid to the region of the formation until a first threshold is reached."[78] *Jackson* describes a fracturing process that includes "introducing a supply of fracturing fluid to the region of the formation until a first threshold is reached, adjusting the flow of the fracturing fluid … to reach a second threshold, adjusting the flow of the fracturing fluid ... to reach a third threshold, and ceasing flow of the fracturing fluid to the region of the formation."[79] *Jackson* teaches that these thresholds "may be defined by at least one criterion selected from a set of criteria consisting of: (a) *a time period threshold*; (b) a non-participating gas [fracturing fluid] flow rate threshold; (c) a well bore surface or bottom hole pressure threshold; (d) a well bore surface or bottom hole rate of pressure change threshold (e) a gas quantity threshold and (f) a formation condition threshold."[80]

116. *Jackson* teaches that fracturing is conducted in "stages" and using thresholds, such as a flowrate threshold, a time threshold, or a combination of

[78] Ex. 1005 at Abstract.

[79] Ex. 1005 at Abstract.

[80] Ex. 1005 at [0017]; *see also* Claim 20.

flowrate and time, to determine when the stage is complete. As an example, *Jackson* discloses "The first threshold may be reached during a pressurization step and that pressurization may be stopped after a fixed time, such as at least one minute, after a peak pressure is reached, after a fixed quantity of flow (which may be measured either as a mass flow or as a normalized volumetric flow, for example) or after a formation condition is determined."[81] *Jackson* provides an example of the fracturing stages, including the reduced flow that signals the end of the fracturing stage. For example, Fig. 3 shows a reduction in "Nitrogen Rate" and "Proppant," which together form the fracturing fluid, at the end of the fracturing stage.

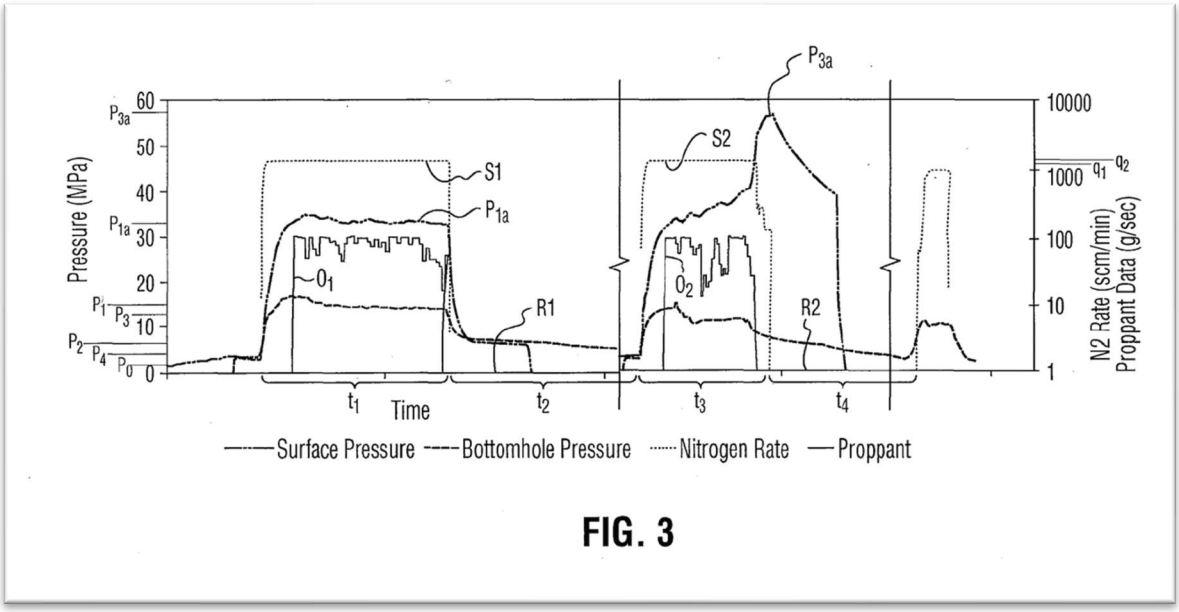


FIG. 3

Jackson Fig. 3

[81] Ex. 1005 at [0018].

117. Finally, *Jackson* discloses several specific flowrate thresholds as examples including at least "300 scm (standard cubic meters per minute)", "0 scm" and "1000 scm." Further, *Jackson* discloses several specific combined flowrate and time thresholds including "time period of more than 1 minute and less than 24 hours of a flow rate of dilation fluid[82] of less than 300 scm" [83] and "the first threshold may be defined, at least in part, by an introduction of dilation fluid for a period of 30 seconds to 20 minutes at a flow rate of at least 300 scm, the second threshold may be defined as a time period of more than 1 minute and less than 24 hours of a flow rate of dilation fluid of less than 300 scm, which may include 0 scm, and the third threshold may be defined as an introduction of dilation fluid for a period of 30 seconds to 20 minutes at a flow rate of at least 300 scm."[84]

D. MCNEEL

118. U.S. Patent Publication No. 2007/0125543 ("*McNeel*") was filed December 1, 2005, and published June 7, 2007. (Ex. 1038). *McNeel* is prior art to the '779 Patent because *McNeel*'s filing date and publication date are before the '779's earliest possible priority date (May 17, 2021) and are even before the filing

[82] A dilation fluid is a type of fracturing fluid, as *Jackson* teaches that the disclosed methods include "pressurizing" and "urging a fracture dilation fluid with a proppant" into the well. *See, e.g.*, Ex. 1005 at Claim 30.

[83] Ex. 1005 at [0021]; *see also* Claim 22.

[84] Ex. 1005 at [0021].

date of the earliest application in the chain of CIP parent applications to the '779 Patent (December 14, 2017).

119. *McNeel* is entitled "Method and Apparatus for Centralized Well Treatment," and discloses "a method of communicating between a central location and multiple well locations … that includes the steps of stimulating a first well from the central location using a first stimulation fluid through a first fluid line; and simultaneously stimulating a second well from the central location using a second stimulation fluid through a second fluid line."[85]

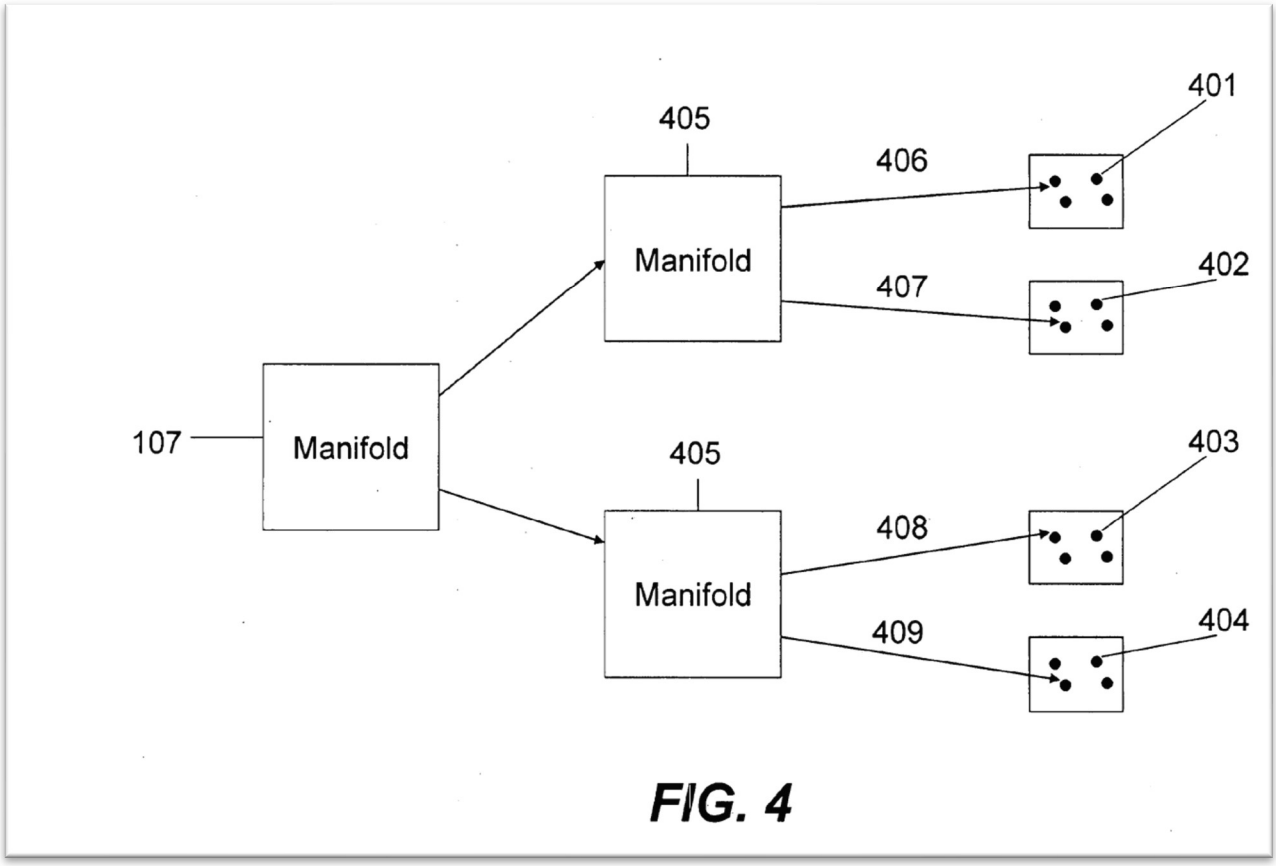
120. *McNeel* also discloses "[a]n apparatus for centralized well operations … that includes a well treatment operations factory which manufactures and pumps a well stimulation fluid; a first connection between a first well location and the well operations factory; a second connection between a second well location and the well operations factory; and means for simultaneously flowing a first stimulation fluid to the first well location and a second stimulation fluid to a second well location. Manifolds for centralized well stimulation are disclosed."[86]

121. *McNeel* explicitly discloses simultaneous flow to third and fourth wells, explaining "[i]n reference to FIG. **4**, in one embodiment, the central manifold **107** can be connected to one or more additional manifolds **405**. The additional manifolds

[85] Ex. 1038 at Title and Abstract.

[86] Ex. 1038 at Abstract.

are operable to connect to multiple well locations **401-404** and deliver well treatment fluids and receive production fluids via connections **406-409**, respectively, in the same way as the central manifold **107** described above."[87]



McNeel Fig. 4

122. *McNeel* also discloses valves in flow lines between a manifold and a well and that the "valves may be either plug valves or check valves and can be manually or electronically monitored and controlled."[88]

[87] Ex. 1038 at [0024].

[88] Ex. 1038 at [0025].

XI. GROUNDS 1 & 2: ALL CHALLENGED CLAIMS ARE ANTICIPATED BY AND/OR RENDERED OBVIOUS BY CIEZOBKA

123. It is my opinion that *Ciezobka* discloses and/or renders obvious each and every element of all challenged claims (claims 1-3, 6, 8-10, 13, 15-18, 25-28, 31, 36) of the '779 Patent. Specifically, it is my opinion that *Ciezobka* explicitly or inherently discloses each and every limitation of Independent Claims 1 and 15 and Dependent Claims 2, 3, 6, 16, 18, and 36, and thus Claims 1-3, 6, 15-18, and 36 would have been anticipated by *Ciezobka*. It is also my opinion that Ciezobka renders obvious each of Claims 1-3, 6, 8-10, 13, 15, 25, 31, and 36. Specific disclosures of *Ciezobka* are contained in the sections below.

A. INDEPENDENT CLAIM 1

124. It is my opinion that *Ciezobka* discloses (and therefore anticipates), or at least renders obvious, Claim 1 of the '779 Patent. Details regarding the specific disclosures of *Ciezobka* are contained in the following subsections following. To the extent the Board determines that *Ciezobka* does not explicitly disclose the limitations of Claim 1, a POSITA would have found Claim 1 to be obvious in light of the disclosure and teachings of *Ciezobka*.

a. 1.1.1: "1. A method, comprising:"

125. To the extent the preamble is limiting, *Ciezobka* discloses a method of hydraulically fracturing multiple wells simultaneously.[89] The title of *Ciezobka* is "Hydraulic Fracturing System and Method."[90] *Ciezobka* further describes a "hydraulic fracturing system and method for enhancing effective permeability of earth formations to increase hydrocarbon production, enhance operation efficiency by reducing fluid entry friction due to tortuosity and perforation, and to open perforations that are either unopened or not effective using traditional techniques"[91] Further, *Ciezobka* teaches a "system and method for enhancing an effective permeability of low permeability earth formations to increase hydrocarbon production."[92] Further, *Ciezobka*'s system "includes a pair of wellheads **202**, **204** [annotated in red, blue] each connected to a wellbore **206**, **208**"[93] as shown in Fig. 6.

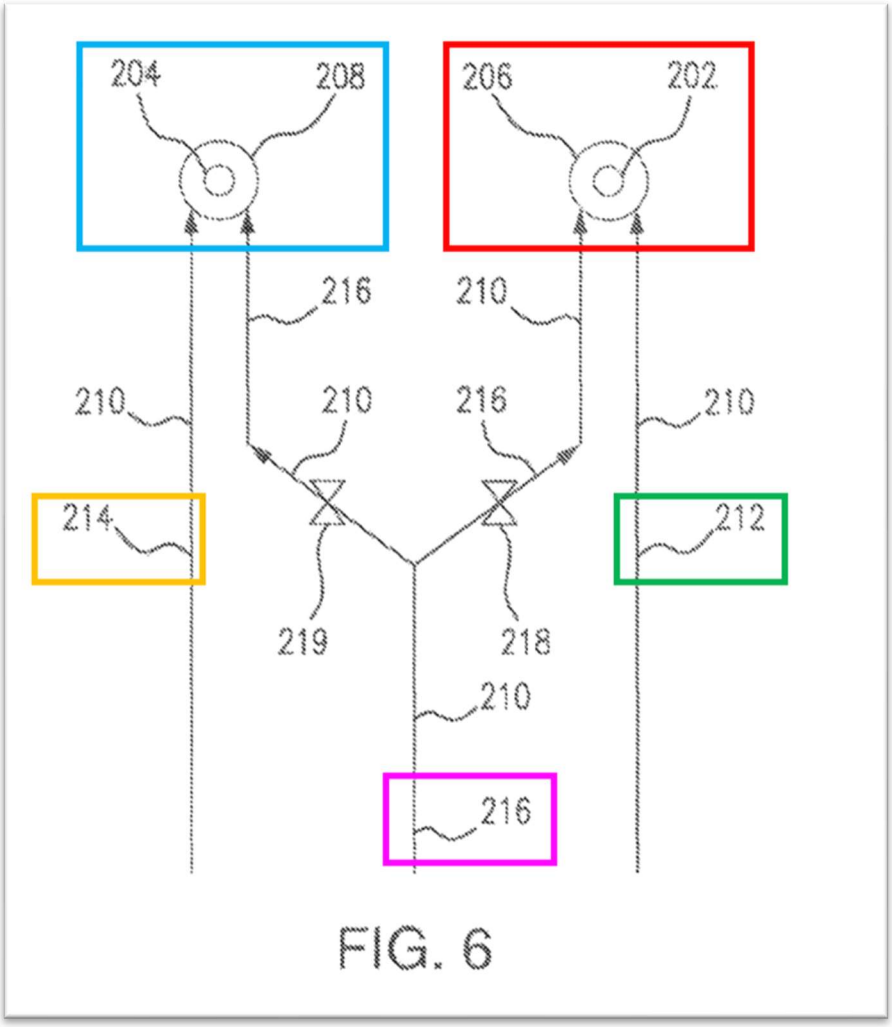
[89] I understand that the preambles may not be limiting. However, I include analysis of the preamble for Claim 1 out of an abundance of caution.

[90] Ex. 1037 at Title.

[91] Ex. 1037 at Abstract.

[92] Ex. 1037 at 1:11-12.

[93] Ex. 1037 at 11:25.



Ciezobka, Fig. 6

126. *Ciezobka* further discloses, "[a] first percentage of the flow rate passes through the first constant rate flow line 212, [annotated in green] a second percentage of the flow rate passes through the second constant flow rate line 2014 [sic, **214**], [annotated in orange] and a third percentage of the flow rate passes the diverter line

216 [annotated in pink]."[94] A POSITA would have understood this teaching to mean that the system and methods of *Ciezobka* apply to multiple wells, and that fracturing fluid is pumped to multiple wells simultaneously. A POSITA would have further recognized this to mean that the fluid is pumped continuously to the valves at each well during the fracturing process.

127. Accordingly, *Ciezobka* discloses "a method" as recited in the preamble to Claim 1.

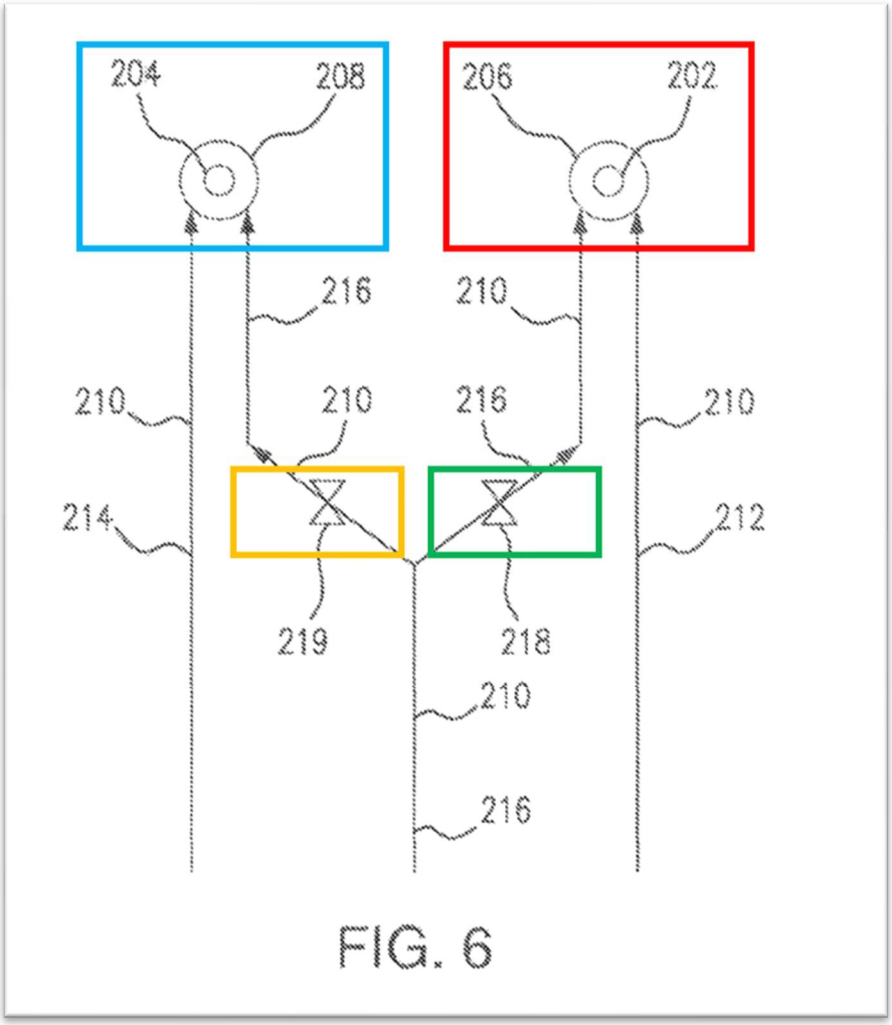
b. 1.1.2: "(a) permitting performance of a first hydraulic fracturing operation on a first well, which first hydraulic fracturing operation comprises pumping fluid into the first well via a first valve associated with the first well, and"

128. *Ciezobka* discloses this limitation. As discussed above regarding the preamble, *Ciezobka* teaches hydraulic fracturing operations at a multi-well fracturing site. *Ciezobka* further discloses "the high-pressure fracturing pump, not shown, supplies the fracturing fluid or the fracturing slurry to the flow lines **210** at a constant flow rate. A first percentage of the flow rate passes through the first constant rate flow line **212**, a second percentage of the flow rate passes through the second constant flow rate line 2014 [sic, **214**], and a third percentage of the flow rate passes the diverter line **216**."[95]

[94] Ex. 1037 at 11:34-12:2.

[95] Ex. 1037 at 11:33-12:2.

129. Still further, *Ciezobka* discloses "the high-pressure fracturing pump provides a first total flow rate **220** to the first wellhead **202** [annotated in red] and a second total flow rate **230** to the second wellhead **204** [annotated in blue]. Initially, both valves **218** [sic **218**, **219**, annotated in green, yellow] are open allowing the third percentage of the flow rate to be provided to both of the wellheads **202**, **204**."[96]



Ciezobka, Fig. 6

[96] Ex. 1037 at 12:5-8.

130. In addition to the explicit valves **218** associated with the first well **202** and **219** associated with well 204, *Ciezobka* teaches that "one or more of the flow lines **44** may include a valve, not shown, that can be opened and closed to restrict a flow of fluid to the wellbore."[97] Thus, applying this teaching to Fig. 6, a POSITA would understand flow lines **212** and **214** also to include valves which can be opened and closed to restrict fluid to wellbores **202** and **204**. This would include valves **218** and **219** shown in Fig. 6. Accordingly, *Ciezobka* teaches permitting performance of a hydraulic fracturing operation on the first well (e.g. **202**) that includes opening and closing valves to "restrict a flow of fluid to a wellbore."[98] *Ciezobka*'s disclosure makes clear to a POSITA that a first hydraulic fracturing operation includes pumping fluid into the first well (e.g. **218**) via a first valve associated with the first well (e.g., **202**).

131. Additionally, *Ciezobka*'s valves associated with flowlines that "can be opened and closed to restrict a flow of fluid to the wellbore"[99] would include valves 218 and 219, shown in Fig. 6. Because the valves are opened and closed to "restrict a flow of fluid to a wellbore," a POSITA would have understood that the fluid is

[97] Ex. 1037 at 11:21-22.

[98] *Id*.

[99] *Id*.

pumped into the first well (e.g., 218) via a first valve associated with the first well (e.g., 202).

132. A POSITA would, therefore, have understood *Ciezobka* to disclose "permitting performance of a first hydraulic operation on a first well, which first hydraulic fracturing operation comprises pumping fluid into the first well via a first valve associated with the first well," as claimed. Accordingly, *Ciezobka* discloses Limitation 1.1.2.

c. <u>1.2: "measuring a flow rate of the fluid being pumped into the first well;"</u>

133. *Ciezobka* discloses this limitation, or at least renders it obvious. *Ciezobka* teaches "[i]n Fig. 7, the high-pressure fracturing pump provides a first total flow rate **220** [annotated in blue] to the first wellhead **202** and a second total flow rate **230** [annotated in green] to the second wellhead **204**."[100] *Ciezobka* further teaches that this flow rate is measured, as graphs showing flow rate changes over time are included in *Ciezobka*, including Fig. 7. In order to graph the flowrates, the flowrates must be measured.

[100] Ex. 1037 at 12:5-7.

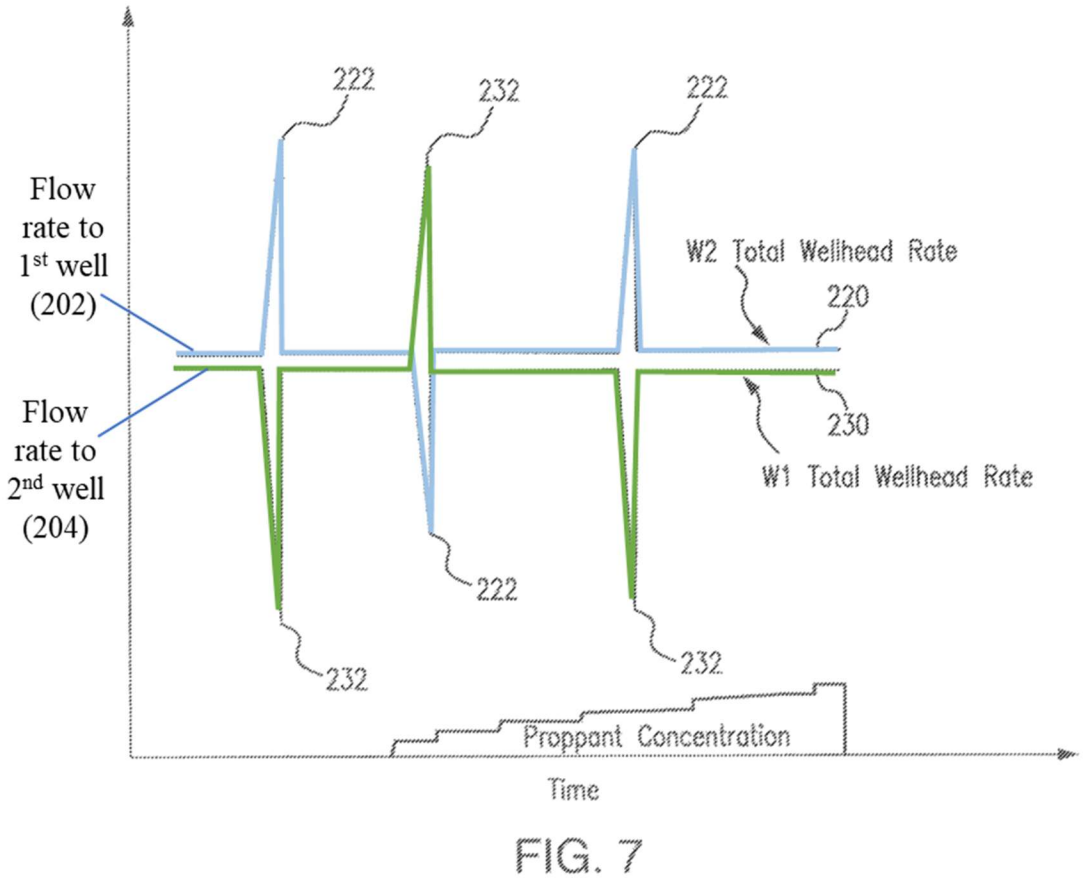


FIG. 7

Ciezobka Fig. 7, annotated

134. Further, *Ciezobka* teaches specific flowrate measurements including "for example the constant flow line supplies a constant flow rate **92** of 50% of the total flow, equaling 45 bpm, and the variable flow line supplies a variable flow rate **94** of 50% of the total flow, equaling 45 bpm."[101]

135. Additionally, *Ciezobka* discloses "a method of hydraulic fracturing stimulation … includes pumping the fracturing fluid, with or without the proppant, at a pump rate and injecting the fracturing fluid under pressure into the wellhead at

[101] Ex. 1037 at 10:32-34, *see also* 9:4-6; 9:9-15.

an initial flow rate and creating small fractures in deep rock formations."[102] *Ciezobka* discloses that "[a]s the system moves towards an equilibrium pressure with few or no new fractures being created and/or a fracture network complexity is no longer increasing, the method … includes introducing a pressure pulse into the wellbore … [the] pressure pulse comprises changing the initial flow rate to a primary or pulse flow rate and then to a secondary flow rate."[103] According to *Ciezobka*, "the primary or pulse flow rate [may be] less than the initial flow rate, ranging from 10% lower to nearly 100% lower, and the secondary flow rate [may be] equal to the initial flow rate," or "the primary or pulse flow rate may range from 25% to 75% lower that the initial flow rate … [or] 50% lower than the initial flow rate … [or] the primary or pulse flow rate is ideally dropped to zero, however a zero flow rate may not be practical because of limitations on the equipment and/or because a zero flow rate will cause proppant transport issues and may damage equipment."[104]

136. *Ciezobka's* fracturing operations are evaluated for performance, where theoretical modeling is matched "with the actual pressure vs. rate data observed" during field testing.[105] In "[a]ctual field tests" of Ciezobka's variable rate fracturing

[102] Ex. 1037 at 3:29-33.

[103] Ex. 1037 at 3:33-4:3.

[104] Ex. 1037 at 4:4-11.

[105] Ex. 1037 at 14:13-15:2.

methods, "steady state flow rates are maintained the same (within a narrow error band of ± 2 bpm)" between pulse flow rate variations.[106] For example, Figure 8 shows using measured flow rate, collected from the field, for performance evaluation of *Ciezobka's* fracturing treatments.[107]

137. A POSITA would recognize that these flow rates are measured in *Ciezobka*'s system in order to compare percentages or actual flowrates (e.g., flow rates in units "bpm"). To the extent the Board determines that *Ciezobka* does not explicitly teach measuring flow rate, a POSITA would have found it obvious to measure the flowrate, including flowrate into the first well, to operate the pulses at the reduced flow percentages, or specific flow rate values disclosed by *Ciezobka*. Further, a POSITA would have found it obvious to measure flowrates to generate the flowrate measurement charts, such as Fig. 7 of *Ciezobka.*

138. Accordingly, *Ciezobka* discloses, or at least renders obvious, Limitation 1.2. A POSITA having general engineering knowledge would have known that measuring flowrate into a well was well-known long before the '779 Patent. (*See* Sections IX.A – IX.E).

[106] *Id*. at 16:7-9.

[107] *Id*. at 16:6-15.

d. 1.3: "(b) determining that the flow rate of the fluid being pumped into the first well is below a flow rate threshold and"

139. *Ciezobka* discloses, or at least renders obvious this limitation. To the extent the Board determines *Ciezobka* does not explicitly teach a flow rate threshold, *Ciezobka* renders obvious, "determining the flow rate of the fluid being pumped into the first well is below a flow rate threshold" as claimed. As discussed above regarding Limitation 1.2, *Ciezobka* discloses and/or renders obvious to a POSITA measuring a flowrate. *Ciezobka* teaches a total flow rate pumped to each well. Further, *Ciezobka* teaches several specific thresholds such as "90 bpm," "45 bpm," "20 bpm."[108] Further, *Ciezobka* teaches several percentage flowrate thresholds for the pulses including "from 10% to nearly 100% lower," "25% to 75% lower," and "50% lower" than the primary flowrate.[109] A POSITA would understand that, in each of these cases, the flowrate of the fluid being pumped into the first well is being determined and compared against a flow rate threshold to determine if the flow rate is below a flow rate threshold of, for example, "10% lower" or "25% lower."

140. To the extent *Ciezobka* does not explicitly call the identified flowrates thresholds, it would have been obvious to apply the various flowrates, such as percentages or explicit/actual flowrates, as thresholds in order to determine that the

[108] Ex. 1037 at 9-11.

[109] *See generally*, Ex. 1037 at 4.

pulse is performing as desired. Accordingly, *Ciezobka* discloses, or at least renders obvious, Limitation 1.3.

e. 1.4: "has been below the flow rate threshold for a threshold amount of time;"

141. *Ciezobka* discloses, or at least renders obvious, this limitation. As discussed above regarding Limitation 1.3 *Ciezobka* discloses, or at least renders obvious, flow rate thresholds for the pressure pulses. Specifically, *Ciezobka* discloses that "the primary or pulse flow rate [may be] less than the initial flow rate, ranging from 10% lower to nearly 100% lower, and the secondary flow rate [may be] equal to the initial flow rate," or "the primary or pulse flow rate may range from 25% to 75% lower that the initial flow rate … [or] 50% lower than the initial flow rate … [or] the primary or pulse flow rate is ideally dropped to zero."[110] *Ciezobka* also teaches combining a time threshold with the flow rate thresholds. For example, *Ciezobka* teaches valves to first and second wells are opened/closed to "increase[e] the total flow rate" to one well "and decreas[e] the total flow rate to" the other well "for a short period of time."[111] "In a preferred embodiment of this invention, the pulse period of time is less than 10 seconds."[112] As another example, *Ciezobka* teaches the pulse "may range from 1 minute to 1 second. Preferably, the short period

[110] Ex. 1037 at 4:4-9.

[111] Ex. 1037 at 12:8-11.

[112] Ex. 1037 4:14-15.

of time equals 10 seconds. Alternatively, any period of time may be used."[113] In other words, *Ciezobka* discloses that the pressure pulse has a flow rate above and/or below a flow rate threshold (*e.g.*, pulse flow rate is 10% to 100% or 25% to 75% lower than the initial flow rate) for a threshold amount of time (pulse period of time, *e.g.*, 1 minute to 1 second).

142. To the extent the Board finds that *Ciezobka* does not explicitly disclose a combination of flowrate and time as a threshold, a POSITA would have found this limitation obvious based on *Ciezobka*'s teachings regarding reduced flowrates during a pulse (i.e., 25% to 75% lower, from 10% to nearly 100% lower, etc.) with *Ciezobka's* teachings of timing the pulses (i.e. 1 minute to 1 second, etc.). A POSITA would recognize that a combination of flowrate and time thresholds yields a threshold regarding the change in volume of fluid being pumped into the well. The volume of fluid is directly related to the change in energy in the well and formation, and a POSITA would have recognized that it is energy in the formation (at a particular time) which affects the fracturing of the formation. Thus, a threshold of combined time and flow rate would allow the operator to see that the pulse of *Ciezobka* is performing correctly.

143. Accordingly, *Ciezobka* discloses, or at least renders obvious, Limitation 1.4.

[113] Ex. 1037 at 11:3-5.

f. 1.5: "(c) during pumping of the fluid into the first well via the first valve, opening a second valve associated with a second well;"

144. *Ciezobka* discloses this limitation. *Ciezobka* teaches in a fracturing process, initially, both diverter valves **218**, **219** "are open allowing" fluid flow "to be provided to both of the wellheads **202**, **204**." [114] The second diverter valve **219** (e.g. second valve) is then closed for a "short period of time" while the first diverter valve **218** (e.g. first valve) remains open to provide decreased flow rate (shown as **232** in Fig. **7**)) to the second well **204** and increased flow rate (shown as **222** in Fig. 7) to the first well **202** for a "short period of time."[115] In the annotated Fig.6 below, hydraulic fluid flow paths to the first well are identified in pink and hydraulic fluid flow paths to the second well are identified in green.

[114] Ex. 1037 at 12:7-8.

[115] Ex. 1037 at 12:9-11.

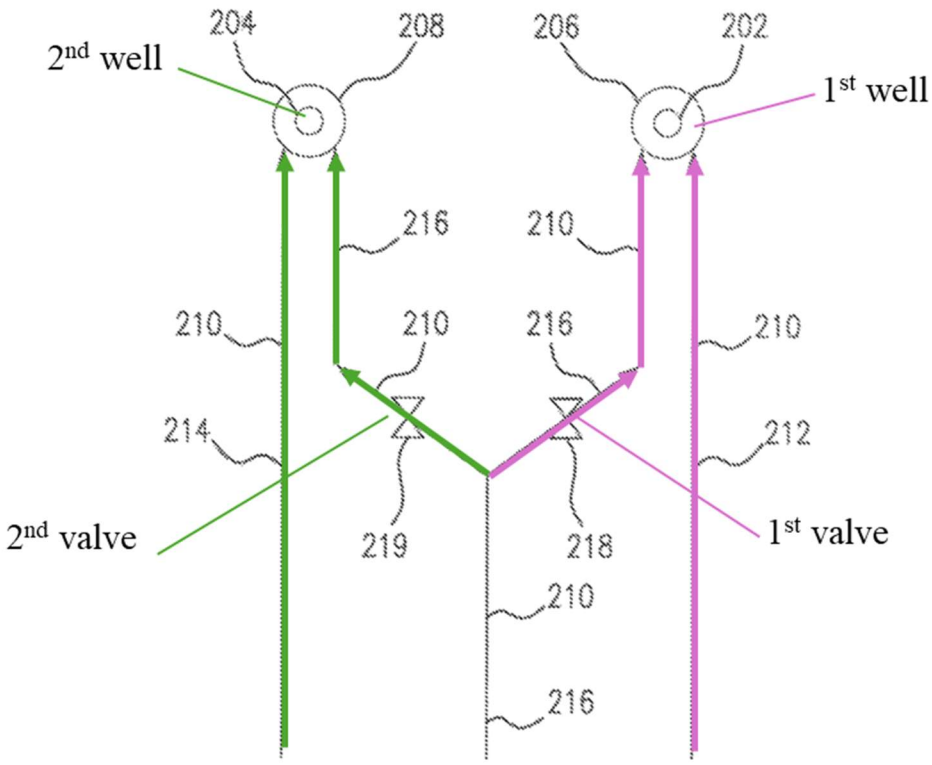


FIG. 6

Ciezobka, Fig. 6 , annotated

145. A POSITA would have understood, based on the description of the sequence of events, particularly the "short period of time," and the flowrates depicted in Fig. 7 that, after the short period of time with the second diverter valve closed, the second valve (e.g. **219**) is opened to resume fluid flow "to both of the wellheads **202**, **204**."[116] Therefore, *Ciezobka* discloses opening a second valve associated with a second well during pumping of the fluid into the first well via the first valve. The sequence of events is depicted in Fig. 7. As with Fig. 6 above,

[116] Ex. 1037 at 12:9.

hydraulic fluid flow paths to the first well are identified in pink and hydraulic fluid flow paths to the second well are identified in green.

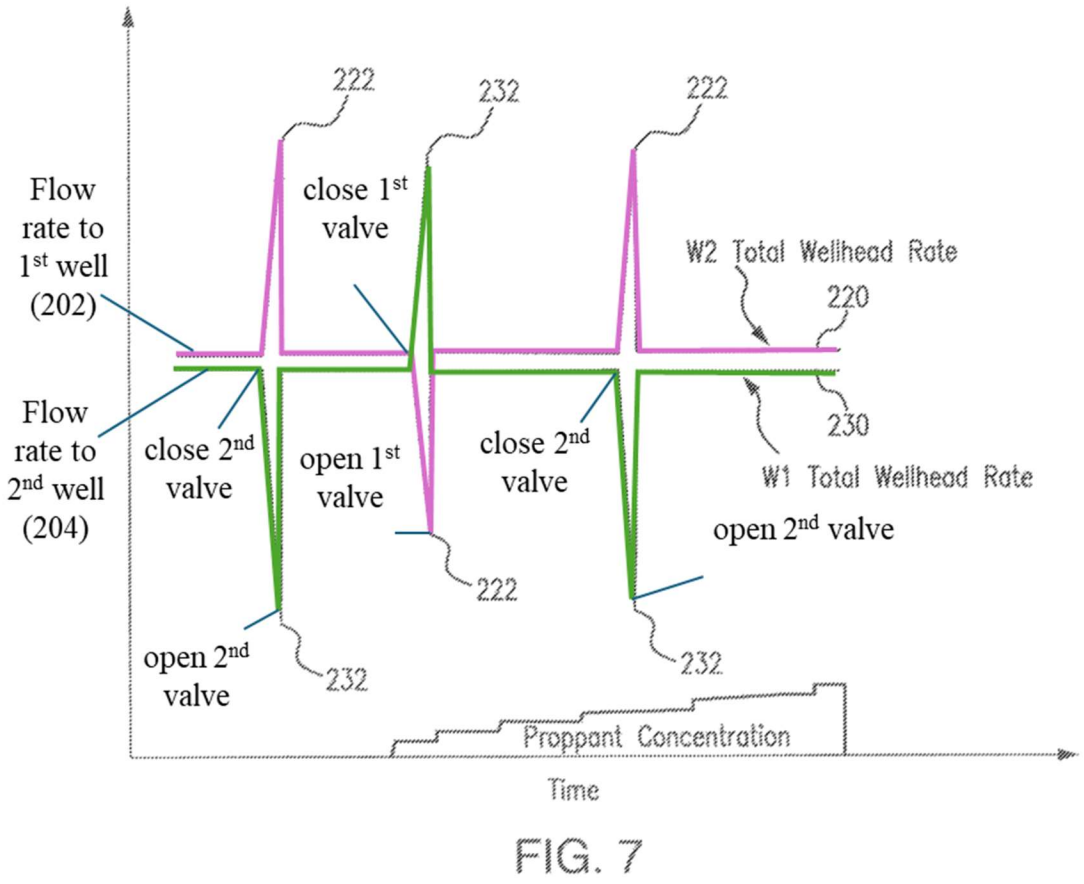
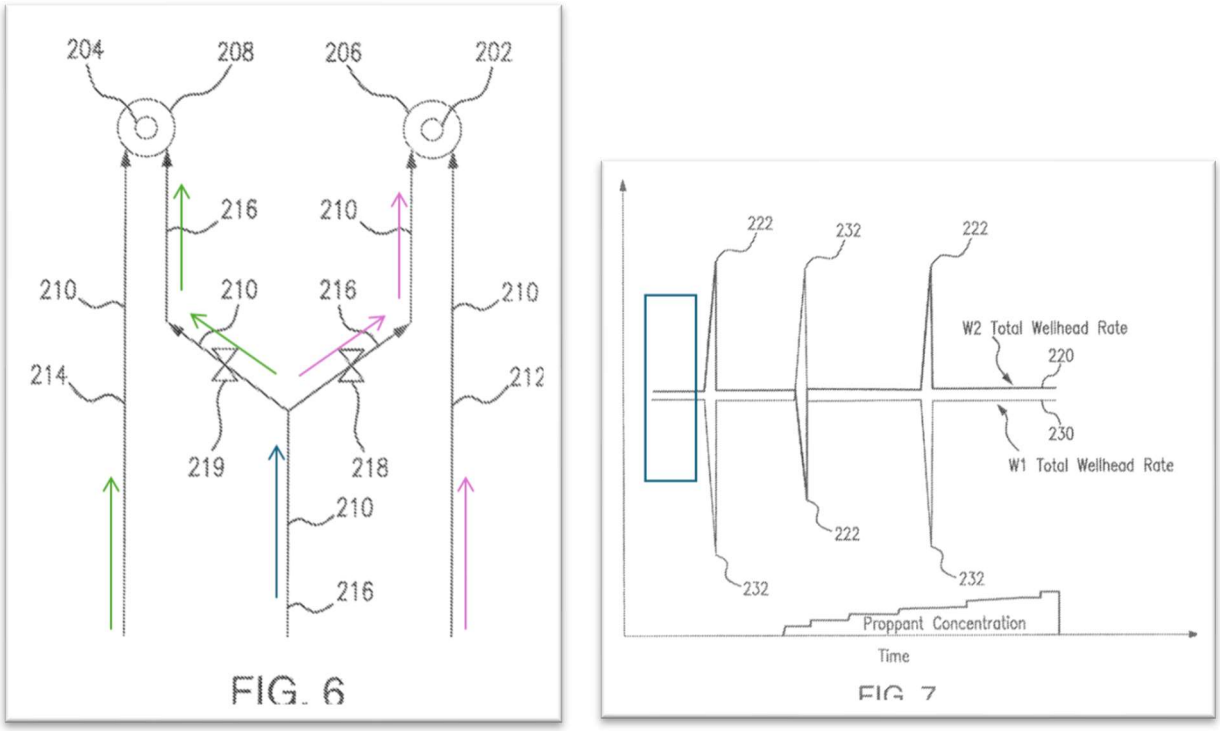


FIG. 7

Fig. 7 of *Ciezobka*, annotated

146. A POSITA would have understood that *Ciezobka*'s disclosure of closing valve **219** for a "short period of time" would include opening a second valve (e.g., **219**) associated with a second well (e.g. **204**) while fluid is being pumped into the first well (e.g. **202**) via the first associated valve (e.g. **218**) and that this occurs while fluid is being pumped to the second well. As Fig. 7 shows, fluid is being pumped continuously to wells **202** and **204** and both valves **218** and **219**.

147. The sequence of valve openings and closings is described below using annotated Fig. 6 and Fig. 7 (duplicated below) showing valves open (valve body blank) and valves closed (valve body filled in). *Ciezobka* discloses "[i]nitially, both valves **218** [and **219**] are open allowing [a] third percentage of the flow rate to be provided to both of the wellheads **202**, **204**."[117] In this case, both valves **218** and **219** are open. The portion of Fig. 7 representative of this stage is shown below (within the blue box).

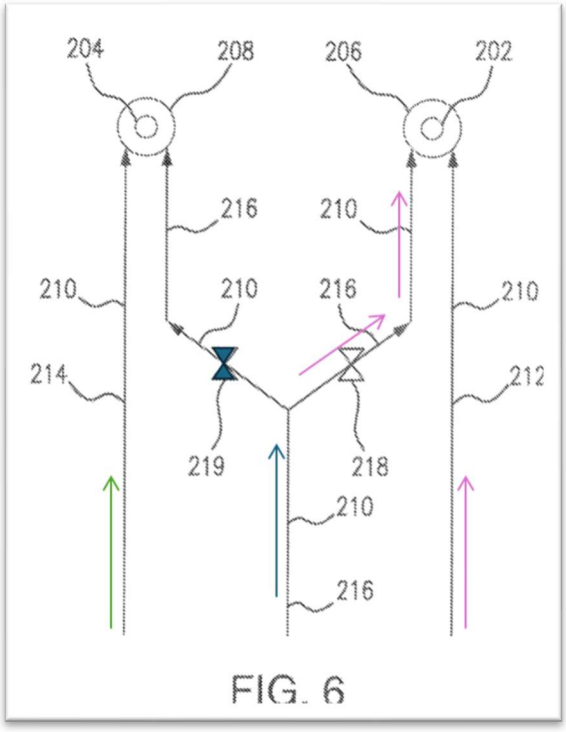


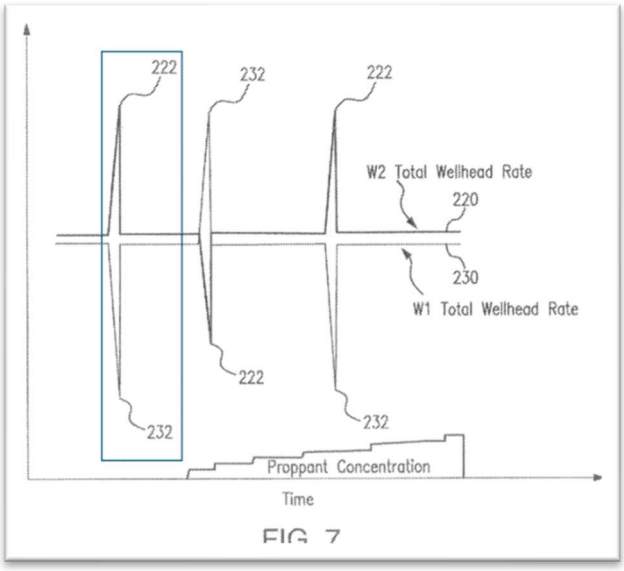
Figs. 6 & 7 of *Ciezobka*, annotated

[117] Ex. 1037 at 12:7-8.

148. *Ciezobka* further describes "[a] pressure pulse … is induced by closing one of the valves **219**, increasing the total flow rate… to the first wellhead **202** and decreasing the total flow rate… to the second wellhead **204** for a short period of time." [118] This case is shown below. As can be seen, fluid is still pumped to valves **218** and **219**. However, valve **219** is closed, and flow is restricted to the second well.

[118] Ex. 1037 at 12:8-11.





Figs. 6 & 7 of *Ciezobka*, annotated

149. As shown in the above images, this stage is represented in Fig. 7 in the annotated portion (blue box) up to the time of events **222** / **232**. At the time of events

222 / **232**, valve **219** is opened, allowing full fracturing fluid flow to second well **204** to resume. Pressure stabilizes and flow to the wells stabilizes. During the opening of the second valve (e.g., **219**), fluid is continuously pumped into the first well (**202**) via the first valve (**218**).

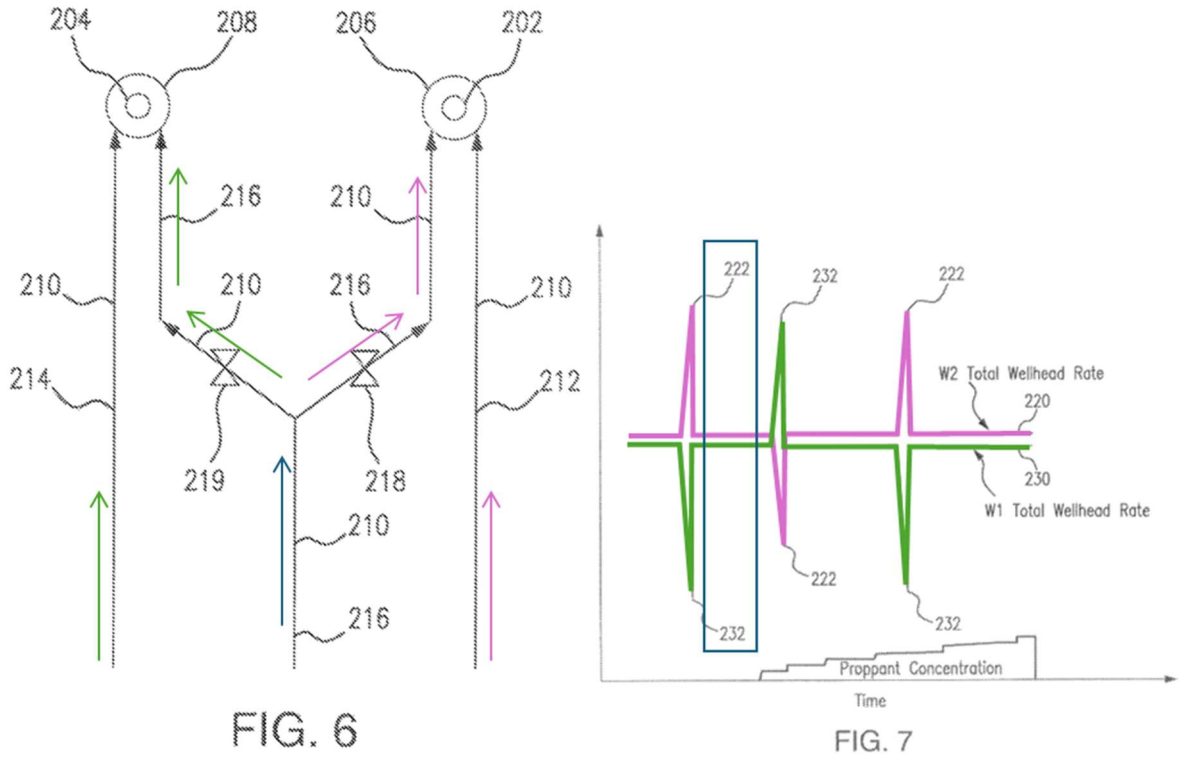


FIG. 6

FIG. 7

Figs. 6 & 7 of *Ciezobka*, annotated

150. *Ciezobka,* then, discloses during pumping of the fluid into the first well (**202**) via the first valve (**218**), opening a second valve (**219**) associated with the second well (**204**). Accordingly, *Ciezobka* discloses claim Limitation 1.5.

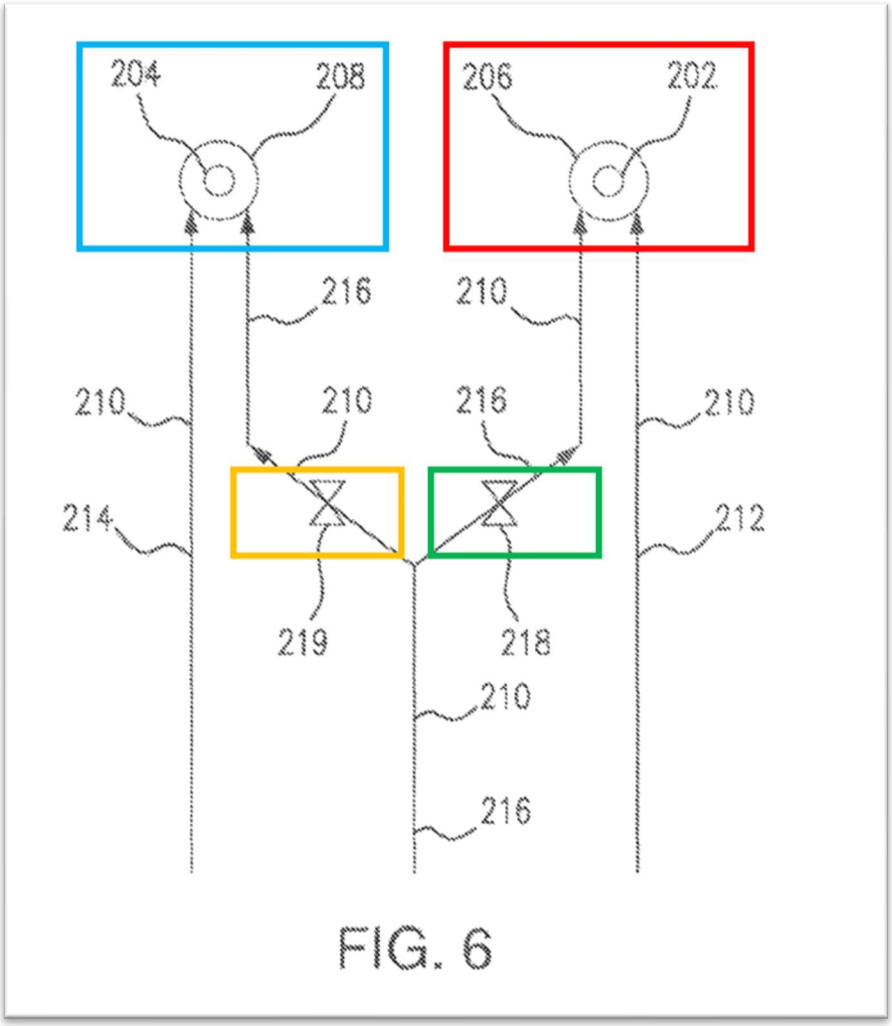
g. 1.6: "(d) permitting performance of a second hydraulic fracturing operation on the second well, which second hydraulic fracturing operation comprises pumping fluid into the second well via the second valve; and"

151. *Ciezobka* discloses this limitation. *Ciezobka* teaches hydraulic fracturing operations at a multi-well fracturing site. *Ciezobka* further discloses "the high-pressure fracturing pump, not shown, supplies the fracturing fluid or the fracturing slurry to the flow lines **210** at a constant flow rate. A first percentage of the flow rate passes through the first constant rate flow line **212**, a second percentage of the flow rate passes through the second constant flow rate line **214**, and a third percentage of the flow rate passes the diverter line **216**."[119]

152. Still further, *Ciezobka* discloses "the high-pressure fracturing pump provides a first total flow rate **220** to the first wellhead **202** [annotated in red] and a second total flow rate **230** to the second wellhead **204** [annotated in blue]. Initially, both valves **218** [sic **218**, **219**, annotated in green, yellow] are open allowing the third percentage of the flow rate to be provided to both wellheads **202**, **204**."[120]

[119] Ex. 1037 at 11:33-12:2.

[120] Ex. 1037 at 12:5-8.



Ciezobka, Fig. 6

153. In addition to the explicit valve **218** associated with the first well **202** and second valve **219** associated with second well **204**, *Ciezobka* teaches that "one or more of the flow lines **44** may include a valve, not shown, that can be opened and closed to restrict a flow of fluid to the wellbore."[121] Thus, applying this teaching to Fig. 6, a POSITA would understand flow lines **212** and **214** to also include valves

[121] Ex. 1037 at 11:21-22.

that can be opened and closed to restrict fluid to wellbores **202** and **204**. Accordingly, *Ciezobka* teaches permitting performance of a hydraulic fracturing operation on the second well (e.g., **204**).

154. Accordingly, *Ciezobka* discloses claim Limitation 1.6.

h. 1.7: "(e) during pumping of the fluid into the second well via the second valve, closing the first valve associated with the first well;"

155. *Ciezobka* discloses this limitation. As described above regarding Limitation 1.5, *Ciezobka* teaches continuous pumping to the first and second wells and closing and opening valves to create pressure pulses. As described above regarding Limitation 1.5, *Ciezobka* teaches that, during a fracturing process, initially, both diverter valves **218**, **219** "are open allowing" fluid flow "to be provided to both of the wellheads **202**, **204**." [122] The second diverter valve **219** (e.g. second valve) is then closed for a "short period of time" while the first diverter valve **218** (e.g. first valve) remains open to provide a decreased flow rate (shown as **232** in Fig. **7**) to the second well **204** and an increased flow rate (shown as **222** in Fig. 7) to the first well **202** for a "short period of time."[123]

[122] Ex. 1037 at 12:7-8.

[123] Ex. 1037 at 12:9-11.

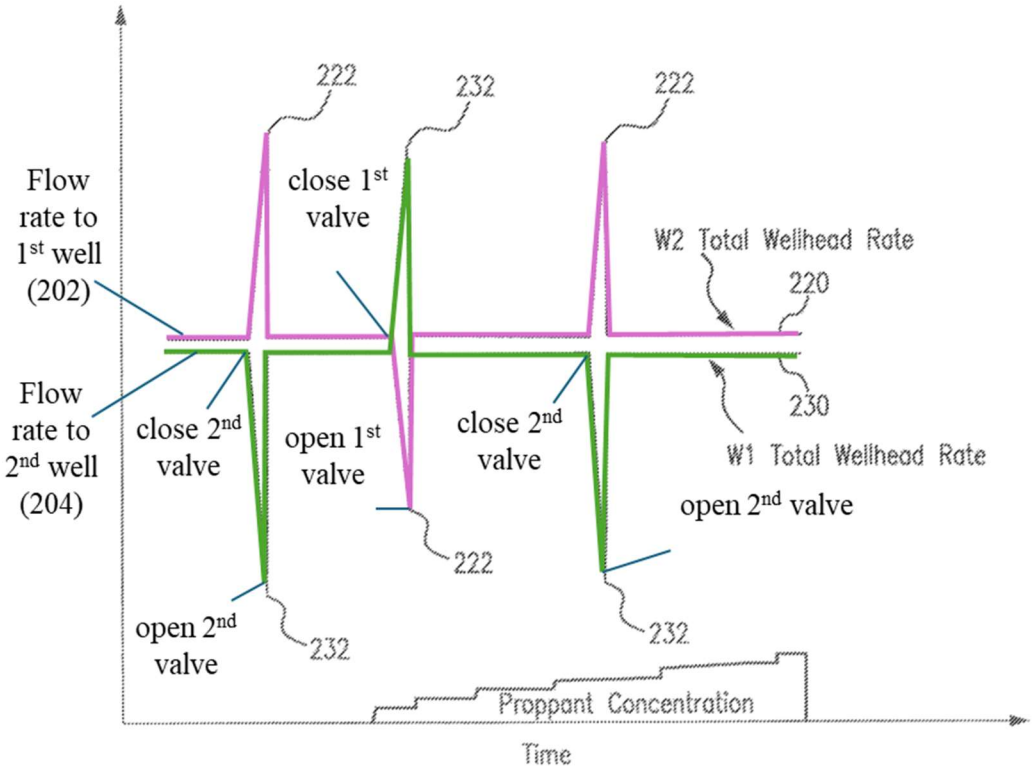


FIG. 7

Ciezobka, Fig. 7

156. As further described above regarding Limitation 1.5, a POSITA would understand, based on the description of the "short period of time" and the flowrates depicted in Fig. 7 that, after the short period of time with the second diverter valve closed, the second valve (e.g., **219**) is opened to resume fluid flow "to both of the wellheads **202**, **204**."[124]

157. *Ciezobka* further teaches, "[t]he process is then repeated by closing the valve **218**, increasing the total flow rate **230** to the second wellhead **204** and

[124] Ex. 1037 at 12:6-8.

decreasing the total flow rate **220** to the first wellhead **202** for a short period of time."[125] This condition is shown in Fig. 6 below, with flows annotated as above, open valves having blank valve bodies and closed valves showing filled-in valve bodies. This stage is represented in Fig. 7 in the annotated portion up to the time of events **222** / **232**. At the time of events **222** and **232**, valve **218** is opened, allowing full fracturing fluid flow to first well **202** to resume. Pressure stabilizes and flow to the wells stabilizes. During the opening of the first valve (e.g., **218**), fluid is continuously pumped into the second well (**204**) via the second valve (**219**).

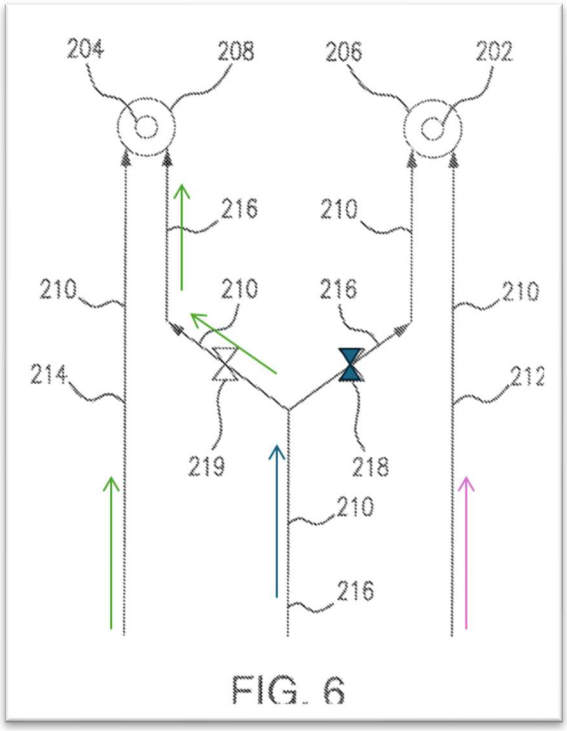


FIG. 6

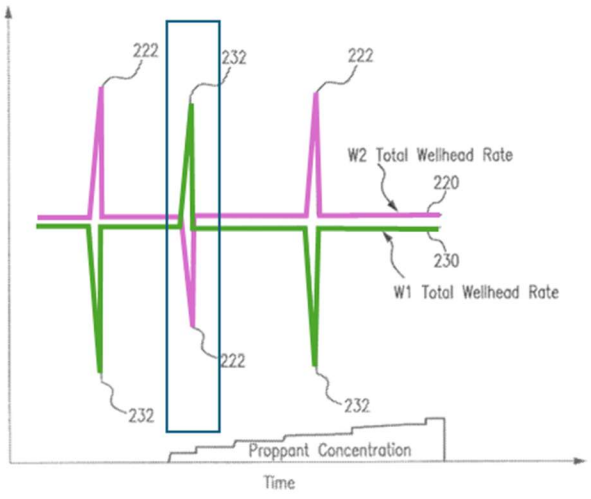


FIG. 7

Ciezobka, Fig. 6 and Fig. 7

[125] Ex. 1039 at 12:13-15.

158. A POSITA would have understood that *Ciezobka's* disclosure of closing the valve for a short period of time while fluid is continuously being pumped to both wells would include closing a first valve associated with a first well while fluid is being pumped into the second well via the second associated valve. This procedure would allow a sequence of operations of fracturing on wells while continuously directing flow into both the first and second wells as *Ciezobka* teaches opening and closing valves to continuously direct flow to the wells.

159. Accordingly, *Ciezobka* discloses claim Limitation 1.7.

i. 1.8: "wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped to the first valve, the second valve, or both the first valve and the second valve."

160. *Ciezobka* discloses this limitation. As described above regarding Limitation 1.5, *Ciezobka* teaches continuous pumping to the first and second wells and closing and opening valves to create pressure pulses during the entire fracturing process. As described above regarding Limitation 1.5, *Ciezobka* teaches that, during a fracturing process, initially, both diverter valves **218**, **219** "are open allowing" fluid flow "to be provided to both of the wellheads **202**, **204**."[126] In operation, fracturing fluid is pumped by a high-pressure fracturing pump to all "the flow lines 210 at a

[126] Ex. 1037 at 12:7-8.

constant flow rate."[127] *Ciezobka* also explains that "[a] first percentage of the flow rate passes through the first constant rate flow line 212, a second percentage of the flow rate passes through the second constant flow rate line 2014, and a third percentage of the flow rate passes the diverter line 216."[128]

161. First and second diverter valves 218, 219 along the branch portions of the diverter lines to the associated first and second wells are alternatingly opened/closed to selectively divert the "third percentage of the flow rate" from the shared portion of diverter line 216 to deliver pulses of fracturing fluid to each well.[129] *Ciezobka* also discloses that "[i]n a preferred embodiment, the flow rate supplied by each of the constant rate flow lines 212, 214 does not change during the pressure pulse," "[w]hile the flow rate supplied by the diverter line 216 is diverted to each" well by opening/closing associated diverter line valves 218, 219.[130]

162. Thus, *Ciezobka* discloses during steps (a), (b), (c), (d), and (e) (addressed above), fluid is continuously pumped to the first valve, the second valve, or both the first valve and the second valve.

163. Accordingly, *Ciezobka* discloses claim Limitation 1.8.

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[127] *Id.* at 11:32-33.

[128] *Id*. at 11:34-12:2.

[129] *Id*. at 11:30-32; 12:7-15.

[130] *Id*. at 12:2-5.

164. In view of the above, *Ciezobka* discloses each and every limitation of Claim 1 and therefore anticipates Claim 1. Alternatively, Claim 1 is rendered obvious by *Ciezobka* alone for the reasons discussed above.

B. DEPENDENT CLAIM 2

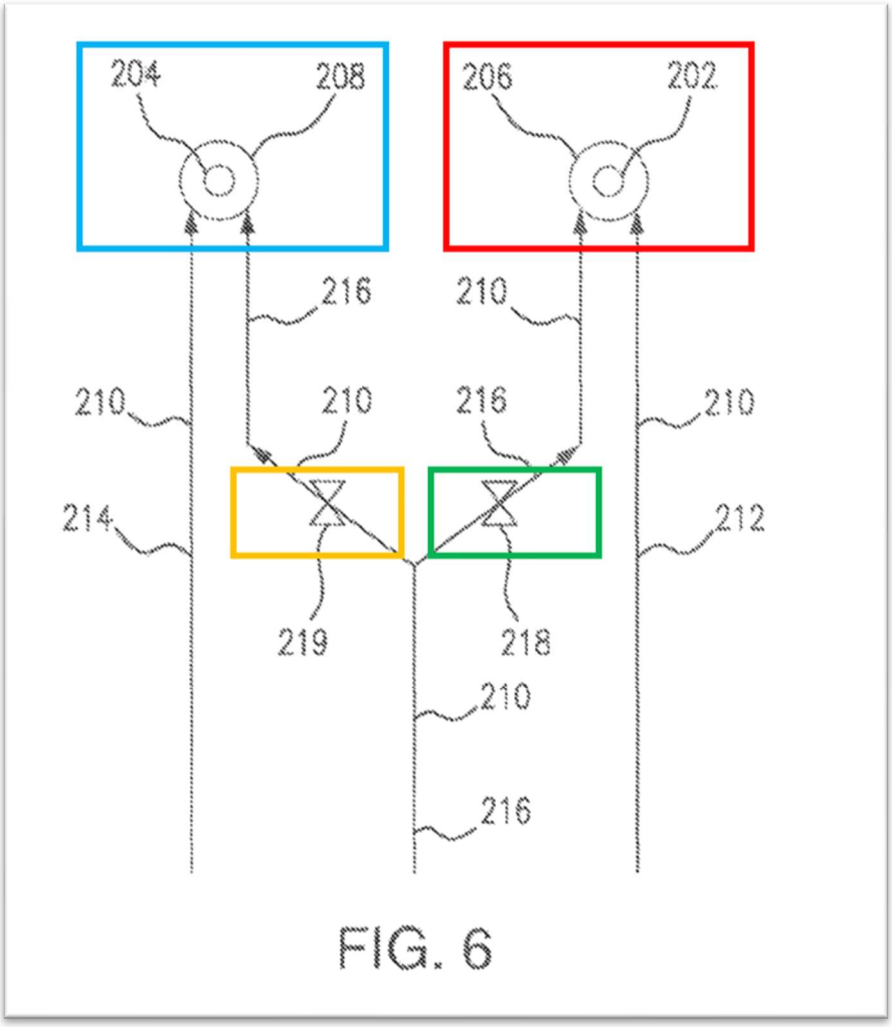
165. Dependent Claim 2 depends from Claim 1. In addition to the disclosure of Claim 1 discussed above, *Ciezobka* discloses Claim 2.

a. "2. The method of claim 1, wherein each of the first and second valves is in fluid communication with a hydraulic manifold from which fluid is pumped to the first valve and/or the second valve; and wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped from the hydraulic manifold to the first valve, the second valve, or both the first valve and the second valve."

166. *Ciezobka* discloses this Claim. As discussed above regarding Claim 1, *Ciezobka* teaches hydraulic fracturing operations at a multi-well fracturing site.

167. Further still, *Ciezobka* discloses "the high-pressure fracturing pump provides a first total flow rate **220** to the first wellhead **202** [annotated in red] and a second total flow rate **230** to the second wellhead **204** [annotated in blue]. Initially, both valves **218** [sic **218**, **219**, annotated in green, yellow] are open allowing the third percentage of the flow rate to be provided to both of the wellheads **202**, **204**."[131]

[131] Ex. 1037 at 12:5-8.



Ciezobka, Fig. 6

168. In addition to the explicit valves **218** associated with the first well **202** and **219** associated with well **204**, *Ciezobka* teaches that "one or more of the flow lines **44** may include a valve, not shown, that can be opened and closed to restrict a flow of fluid to the wellbore."[132] Thus, applying this teaching to Fig. 6, a POSITA

[132] Ex. 1037 at 11:21-22.

would understand flow lines **212** and **214** to also include valves which can be opened and closed to restrict fluid to wellbores **202** and **204**.

169. *Ciezobka* further teaches "[t]he manifold receives the fracturing fluid, with or without proppant, at a low pressure from the pre-blender or the slurry-blender and distributes the fluid and/or slurry to the high-pressure fracturing pumps. The manifold then receives the fluids at a high pressure from the high-pressure fracturing pumps and directs the fluid to a ground iron leading to the wellhead and wellbore."[133] Further still, "the flow line comprises a plurality of pipes which connect the high-pressure fracturing pumps, through a single or multiple common manifolds, to a wellhead of the wellbore. In an embodiment of this invention, the plurality of flow lines comprise at least one constant-flow flow line and at least one variable-flow flow line."[134]A POSITA would have understood, based on the teachings of *Ciezobka*, that flow lines **212**, **214** and **216** as well as valves **218** and **219** are supplied fluid "through a single or multiple common manifolds." Thus, *Ciezobka* discloses each of the first and second valves is in fluid communication with a hydraulic manifold from which fluid is pumped to the first valve and/or the second valve, and wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped

[133] Ex. 1037 at 3:10-14.

[134] Ex. 1037 at 3:16-20.

from the hydraulic manifold to the first valve, the second valve, or both the first valve and the second valve.

170. Accordingly, *Ciezobka* anticipates and/or renders obvious Claim 2 for the reasons discussed above.

C. DEPENDENT CLAIM 3

171. Dependent Claim 3 depends from Claim 1. In addition to the disclosure of Claim 1 discussed above, *Ciezobka* discloses Claim 3:

a. "3. The method of claim 1, wherein the second valve is opened after step (b)."

172. *Ciezobka* teaches a multi-well fracturing system that provides continuous pumping to both first and second well and closing and opening valves to create pressure pulses. *Ciezobka* teaches that during a fracturing process both diverter valves **218**, **219** "are open allowing" fluid flow "to be provided to both of the wellheads **202**, **204**." [135] The second diverter valve **219** (e.g., second valve) is then closed for a "short period of time" while the first diverter valve **218** (e.g., first valve) remains open to provide decreased flow rate (shown as **232** in Fig. **7**) to the second well **204** and increased flow rate (shown as **222** in Fig. 7) to the first well **202** for a "short period of time."[136] A POSITA would understand, based on the

[135] Ex. 1037 at 12:7-8.

[136] Ex. 1037 at 12:9-11.

description of the "short period of time" and the flowrates depicted in Fig. 7 that, after the short period of time within a flow rate threshold with the second diverter valve closed, the second valve (e.g., **219**) is opened to resume fluid flow "to both of the wellheads **202**, **204**."[137]

173. A POSITA would have understood that *Ciezobka's* disclosure would include opening a second valve associated with a second well while fluid is pumped into the first well via the first associated valve to pump fluid between the first and second wells continuously. For fluid to be "continuously" pumped between the wells, opening the second valve while the previous valve is still open would be necessary.

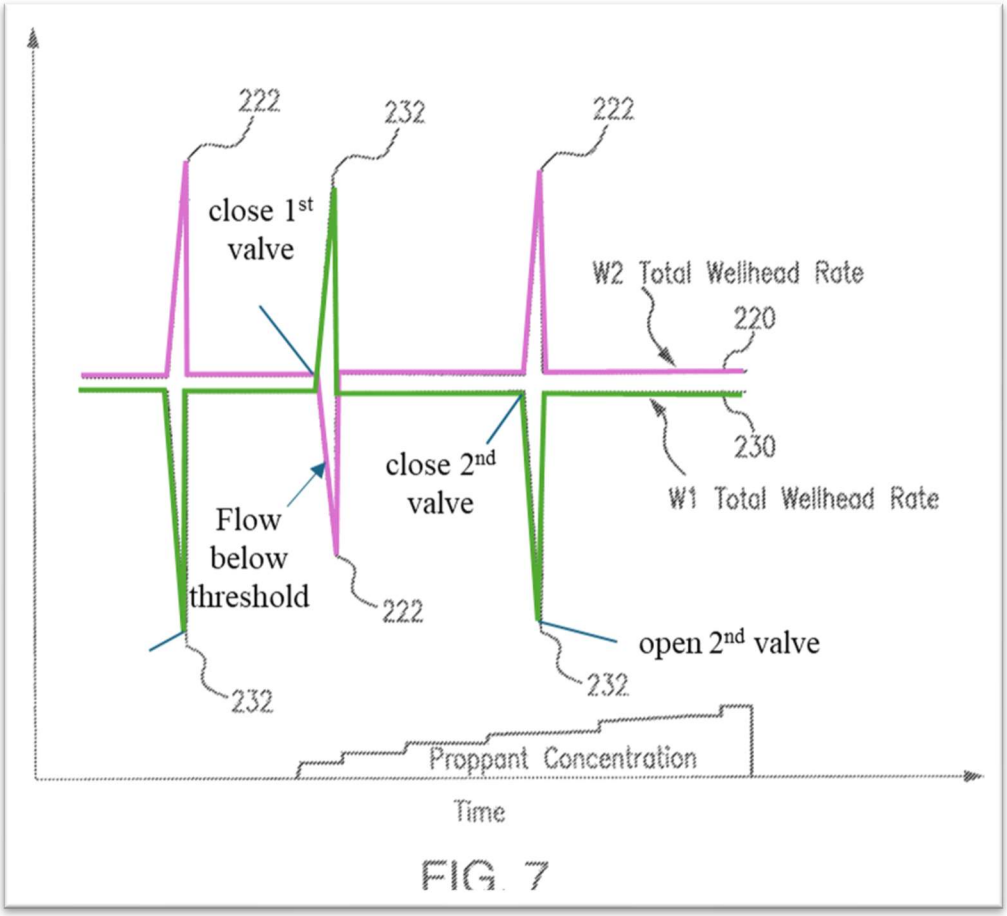
174. As discussed above regarding Limitation 1.2, *Ciezobka* discloses and/or renders obvious to a POSITA measuring a flow rate. *Ciezobka* teaches a total flow rate pumped to each well. Further, *Ciezobka* teaches several specific thresholds such as "90 bpm," "45 bpm," and "20 bpm." Further, *Ciezobka* teaches several percentage thresholds for flowrate in the pulses, including "from 10% to nearly 100% lower," "25% to 75% lower," and "50% lower."[138] A POSITA would understand that, in each of these cases, the flowrate of the fluid being pumped into the first well is being

[137] Ex. 1037 at 12:5-8.

[138] *See*, Ex. 1037, e.g. pages 3-4, generally.

determined and compared against a flow rate threshold to determine if the flow rate is below a flow rate threshold of, for example "10% lower" or "25% lower."

175. As discussed above regarding Limitations 1.5, 1.6, and 1.7, *Ciezobka* teaches a sequence of fracturing operations, including opening and closing valves **218** and **219** while continuously pumping fluid to the valves and wells **202** and **204**. This sequence is shown in Figure 7, annotated below.



Ciezobka, Fig. 7

176. As shown in Fig. 7, the first valve is closed and then the flow rate into the first well is determined to be below any of the thresholds identified by *Ciezobka*, for example "25% lower" than the primary flow. Subsequently, the first valve is opened to end the pulse and the second valve (**219**) is also opened. To the extent *Ciezobka* does not explicitly call the identified flowrates thresholds, it would have been obvious to apply the various thresholds, such as percentages or explicit flowrates, as thresholds in order to determine that the pulse is performing as desired. *Ciezobka* discloses opening the second valve (at **232**) after the pressure pulse is below a flow rate threshold (*e.g.*, pulse flow rate is 10% to 100% or 25% to 75% lower than the initial flow rate) for a threshold amount of time (pulse period of time, *e.g.*, 1 minute to 1 second). Accordingly, *Ciezobka* discloses, or at least renders obvious, the additional limitations of Claim 3.

177. Accordingly, *Ciezobka* anticipates and/or renders obvious Claim 3 for the reasons discussed above.

D. DEPENDENT CLAIM 6

178. Dependent Claim 6 depends from Claim 1. In addition to the disclosure of Claim 1 discussed above, *Ciezobka* discloses Claim 6.

a. "6. The method of claim 1, wherein each of the first and second valves is a zipper valve."

179. *Ciezobka* discloses this limitation, or at least renders it obvious. The '779 Patent describes a zipper valve **170a-170b** [annotated in red] as "operably

coupled to, and adapted [to] communicate fluid between the zipper manifold **145** [annotated in blue] and the well **105a** [annotated in green]."[139] The '779 Patent describes the zipper manifold as being "adapted to communicate the pressurized hydraulic fracturing fluid from the discharge manifold 130 to a plurality of hydraulic fracturing legs (or "frac legs") **150A** through **150C+n**, each of which is adapted to communicate the pressurized hydraulic fracturing fluid from the zipper manifold **145** to a corresponding one of the wells **105A** through **105C+n**."[140] In other words, a zipper manifold is used to distribute fluid from a pump discharge manifold to multiple wells.

[139] Ex. 1001 at 7:59-61.

[140] Ex .1001 at 5:59-61.

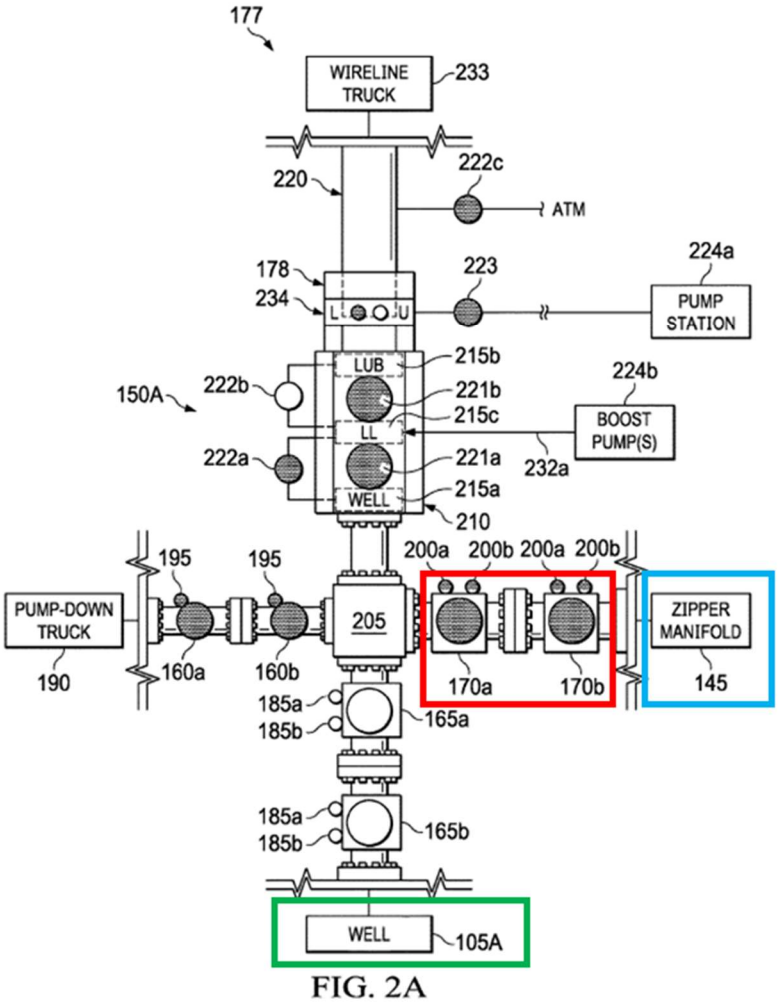


FIG. 2A

Fig. 2A of the ’779 Patent

180. As discussed above, the ’779 Patent does not specifically define or limit the “zipper valve” as any particular valve type or configuration, but rather, merely identifies one example: “such as, for example, gate valves.” A gate valve is a well-known valve commonly used in the oil and gas industry, including in fracturing.[141]

[141] *See*, *e.g.*, API 6A 20th Edition, *Specification for Wellhead and Christmas Tree Equipment,* October 2010 (Ex. 1044), at 12 (Section 3.1.51 defining “gate valve”

The ’779 Patent similarly describes other valves as being any type of valve (“such as, for example, a gate valve”), including master valves and pump down valves. Thus, a POSITA would have understood a “zipper valve” to be any valve that is “operably coupled to, and adapted [to] communicate fluid between the zipper manifold … and the well.”[142] The ’779 Patent explains “a zipper manifold” is “adapted to communicate the pressurized hydraulic fracturing fluid from the discharge manifold **130** to a plurality of hydraulic fracturing legs (or “frac legs”) **150A** through **150C+n**, each of which is adapted to communicate the pressurized hydraulic fracturing fluid from the zipper manifold **145** to a corresponding one of the wells **105A** through **105C+n**.”[143]

181. *Ciezobka* discloses such a configuration. *Ciezobka* teaches, “[t]he manifold receives the fracturing fluid, with or without proppant, at a low pressure from the pre-blender or the slurry-blender and distributes the fluid and/or slurry to the high-pressure fracturing pumps. The manifold then receives the fluids at a high pressure from the high-pressure fracturing pumps and directs the fluid to a ground iron leading to the wellhead and the wellbore.”[144] Further still, “the flow line

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as a “valve assembly with a gate operating within the body, 90º to the conduit, to effect a closure.”

[142] Ex. 1001 at 7:58-61.

[143] Ex. 1001 at 5:55-61.

[144] Ex. 1037 at 3:10-14.

comprises a plurality of pipes which connect the high-pressure fracturing pumps, through a single or multiple common manifolds, to a wellhead of the wellbore. In an embodiment of this invention, the plurality of flow lines comprise at least one constant-flow flow line and at least one variable-flow flow line."[145] A POSITA would have understood, based on the teachings of *Ciezobka*, that flow lines **212**, **214** and **216** as well as valves **218** and **219** are supplied fluid "through a single or multiple common manifolds." A POSITA would also have understood that *Ciezobka*'s manifold connected to valves **218** and **219** is a "zipper manifold" as it is used to distribute fluid from one of the "common manifolds" to multiple wells through valves **218** and **219**.

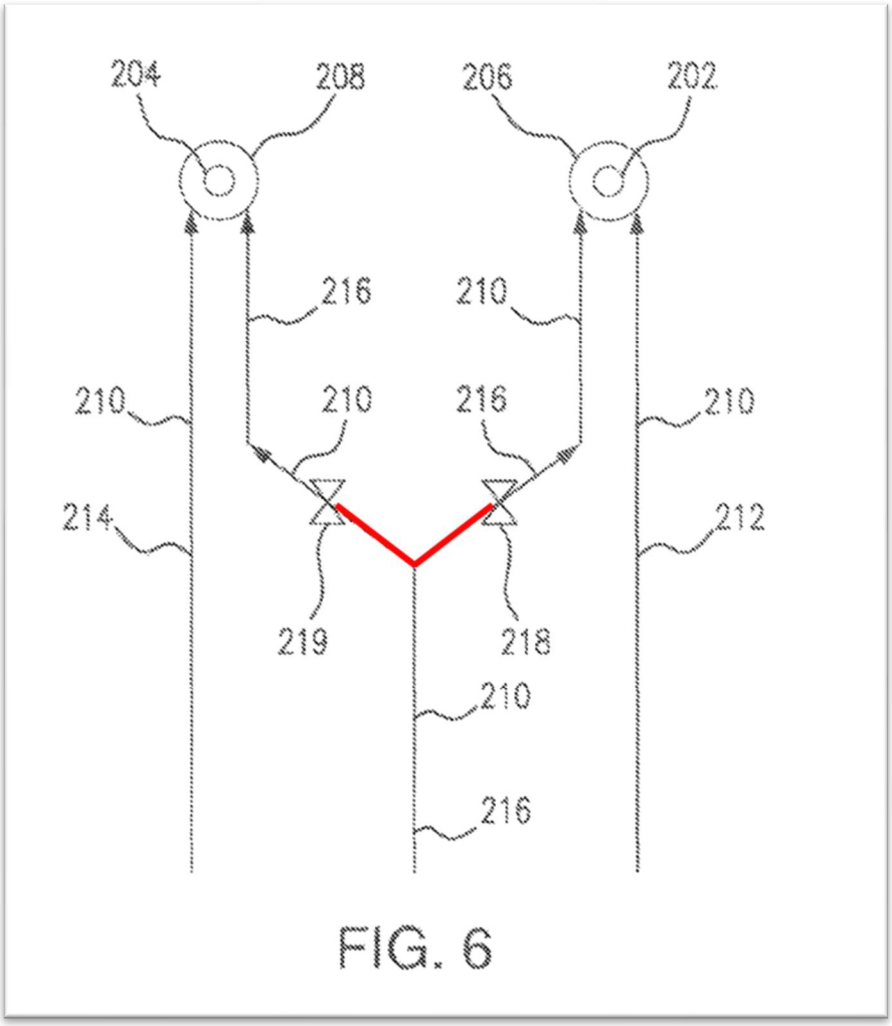
182. A POSITA would have understood that a "gate valve," which the '779 Patent describes may be a "zipper valve," is a common type of valve used widely throughout the Oil and Gas industry, including in fracturing operations.[146] Thus, a POSITA would have understood a "zipper valve" to be any valve that is "operably coupled to, and adapted [to] communicate fluid between the zipper manifold … and the well."[147] As seen in Fig. 6 of *Ciezobka*, these valves are associated both the zipper

[145] Ex. 1037 at 3:16-20.

[146] *See e.g.*, Ex. 1044.

[147] Ex. 1001 at 7:58-61.

manifold (annotated in red) and the wells (e.g. **202**, **204**) to communicate fluid between the zipper manifold and the wells.



Ciezobka, Fig. 6

183. To the extent that the Board determines that the portion of Fig. 6 used to distribute fluid from the flow line **216** to multiple wells is not a zipper manifold, it would have been obvious to a POSITA to use a zipper manifold for such a purpose. It would have been obvious to include the use of a zipper manifold as manifolds for

zipper fracturing were well-known to efficiently distribute fluid from the discharge manifold to one or more valves, at the time of the '779 Patent.[148]

184. Accordingly, *Ciezobka* discloses Claim 6. To the extent that the Board determines that a "zipper valve" is not explicitly disclosed by *Ciezobka,* then it would have been obvious to a POSITA with general engineering knowledge regarding such operations that the valves associated with a zipper manifold would have been "zipper valves," based on the teachings of *Ciezobka* regarding simultaneous (i.e., zipper) fracturing operations.[149]

185. Accordingly, *Ciezobka* anticipates and/or renders obvious Claim 6 for the reasons discussed above.

E. INDEPENDENT CLAIM 8

186. It is my opinion that Claim 8 of the '779 Patent would have been obvious based on the teachings of *Ciezobka*. With the exception of Claim 8 being an "apparatus" claim, and the claim further containing a description of structure of the apparatus, namely known computer elements for executing instructions, Claim 8 is substantially similar to Claim 1. As discussed below, *Ciezobka* discloses the apparatus claimed in Claim 8 of the '779 Patent.

[148] *See*, *e.g.*, Section IX.C.

[149] *See*, *e.g.*, Sections IX-X.

a. 8.1.1: "An apparatus comprising:"

8.1.2: "a non-transitory computer readable medium; and"

8.2.1: "a plurality of instructions stored on the non-transitory computer readable medium and executable by one or more processors,"

8.2.2: "wherein, when the instructions are executed by the one or more processors, the following steps are executed:"

187. A POSITA would have recognized the claimed apparatus elements contained in 8.1.2 – 8.2.2 as a generic computer operating software. *Ciezobka* discloses using a "a software toolbox which incorporates all of the data handling and data analysis elements for real-time application in the field during hydraulic fracturing operations."[150] A POSITA would have understood that the description of using the software toolbox "real time in the field" to necessarily require a generic computing device, such as described in 8.1.1 – 8.2.2, to be "in the field" at the location of the hydraulic fracturing. A POSITA would have also recognized that using the computer for "all of the data handling and data analysis elements" requires the computer to be connected to the system of *Ciezobka* in such a way that all flow rate measurements, pressure measurements, proppant concentrations, etc. are fed into the computer for "real time application in the field."

[150] Ex. 1037 at 27:26-28.

188. To the extent that *Ciezobka* does not explicitly disclose using this computer for control of the valves, it would have been obvious to a POSITA to use the computer of *Ciezobka* for both measurement and determination functions (i.e., data handling and analysis) as well as control of the valves. *Ciezobka* describes that, through the data handling and analysis, the computer of *Ciezobka* would decide when to open/close the diverter valves of *Ciezobka*, what flowrate reduction/increases were appropriate, and in what sequence to open/close the valves. It would have been obvious to use the computer to perform the switching of the valves. At the time of *Ciezobka*, computerized control systems, including a non-transitory computer readable medium, a plurality of instructions stored on the non-transitory computer readable medium and executable by one or more processors, wherein, when the instructions are executed by the one or more processors a series of steps are performed, for valves at fracturing operations were well known and understood by a POSITA as such control systems had been used at fracturing locations for decades.[151]

189. Accordingly, *Ciezobka* discloses, or at least renders obvious, a computing system, an example of the apparatus as described in Claim 8.

[151] *See*, *e.g.*, Ex. 1020 at [0030]; Ex. 1021 at [0072].

b. **8.3: "(a) permitting performance of a first hydraulic fracturing operation on a first well, which first hydraulic fracturing operation comprises pumping fluid into the first well via a first valve associated with the first well, and**

8.4: measuring a flow rate of the fluid being pumped into the first well; and

8.5: (b) determining that the flow rate of the fluid being pumped into the first well is below a flow rate threshold and

8.6: has been below the flow rate threshold for a threshold amount of time;

8.7: (c) during pumping of the fluid into the first well via the first valve, opening a second valve associated with a second well;

8.8: (d) permitting performance of a second hydraulic fracturing operation on the second well, which second hydraulic fracturing operation comprises pumping fluid into the second well via the second valve; and

8.9: (e) during pumping of the fluid into the second well via the second valve, closing the first valve associated with the first well;

8.10: wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped to the first valve, the second valve, or both the first valve and the second valve.

190. With the exception of being rewritten as an apparatus claim, the language in Claim Limitations 8.3 through 8.10 is identical to that of Limitations 1.1.2 through 1.8. *Ciezobka* discloses or at least renders obvious Limitations 8.3 through 8.10 for the same reasons as those discussed regarding Limitations 1.1.2 through 1.8 in Section XI.A.

191. It would have been obvious for *Ciezobka*'s software toolbox to execute the step disclosed by *Ciezobka* in Limitations 8.3 through 8.10 to provide "real time application in the field" of "all of the data handling and data analysis elements" and operation of the system based on the data. In view of the above, *Ciezobka* discloses or renders obvious each and every element of Claim 8.

192. Accordingly, *Ciezobka* renders obvious Claim 8 for the reasons discussed above.

F. DEPENDENT CLAIM 9

a. "9. The apparatus of claim 8, wherein each of the first and second valves is in fluid communication with a hydraulic manifold from which fluid is pumped to the first valve and/or the second valve; wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped from the hydraulic manifold to the first valve, the second valve, or both the first valve and the second valve."

193. Except for depending from Claim 8 and being an apparatus claim, Claim 9 is identical to Claim 2 and is disclosed by *Ciezobka* for the same reasons as those described above regarding Claim 2 in Section XI.B. Accordingly, Claim 9 is rendered obvious by *Ciezobka* for the reasons discussed above.

G. DEPENDENT CLAIM 10

a. "10. The apparatus of claim 8, wherein the second valve is opened after step (b)."

194. Except for depending from Claim 8 and being an apparatus claim, Claim 10 is identical to Claim 3 and is disclosed by *Ciezobka* for the same reasons

as those described above regarding Claim 3 in Section XI.C. Accordingly, Claim 10 is rendered obvious by *Ciezobka* for the reasons discussed above.

H. DEPENDENT CLAIM 13

a. "13. The apparatus of claim 8, wherein each of the first and second valves is a zipper valve."

195. Except for depending from Claim 8 and being an apparatus claim, Claim 13 is identical to Claim 6 and is disclosed by *Ciezobka* for the same reasons as those described above regarding Claim 6 in Section XI.D. Accordingly, Claim 13 is rendered obvious by *Ciezobka* for the reasons discussed above.

I. INDEPENDENT CLAIM 15

196. It is my opinion that *Ciezobka* discloses, or at least renders obvious, Claim 15 of the '779 Patent. Details regarding the specific disclosures of *Ciezobka* are contained in the following subsections.

a. 15.1: "15. A method of hydraulically fracturing at least first and second wells of a plurality of wells, the first and second wells being associated with first and second valves, respectively, the method comprising:"

197. To the extent the preamble is limiting, *Ciezobka* discloses a method of hydraulically fracturing multiple wells simultaneously.[152] The title of *Ciezobka* is "Hydraulic Fracturing System and Method."[153] *Ciezobka* further describes a

[152] I understand that the preambles may not be limiting. However, I include analysis of the preamble for Claim 15 out of an abundance of caution.

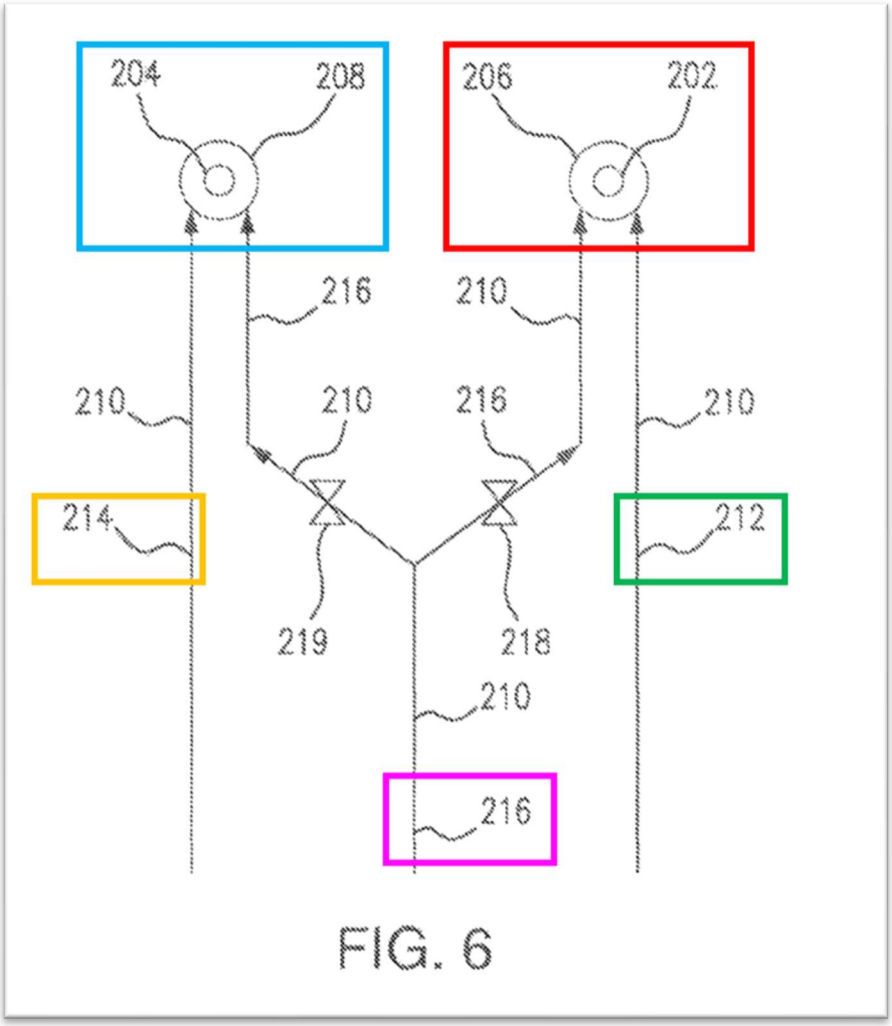
[153] Ex. 1037 at Title.

"hydraulic fracturing system and method for enhancing effective permeability of earth formations to increase hydrocarbon production, enhance operation efficiency by reducing fluid entry friction due to tortuosity and perforation, and to open perforations that are either unopened or not effective using traditional techniques."[154] Further, *Ciezobka* teaches a "system and method for enhancing an effective permeability of low permeability earth formations to increase hydrocarbon production."[155] Further, *Ciezobka*'s system "includes a pair of wellheads **202**, **204** [annotated in red, blue below] each connected to a wellbore **206**, **208**"[156] as shown in Fig. 6.

[154] Ex. 1037 at Abstract.

[155] Ex. 1037 at 1:11-12.

[156] Ex. 1037 at 11:24-25.



Ciezobka, Fig. 6

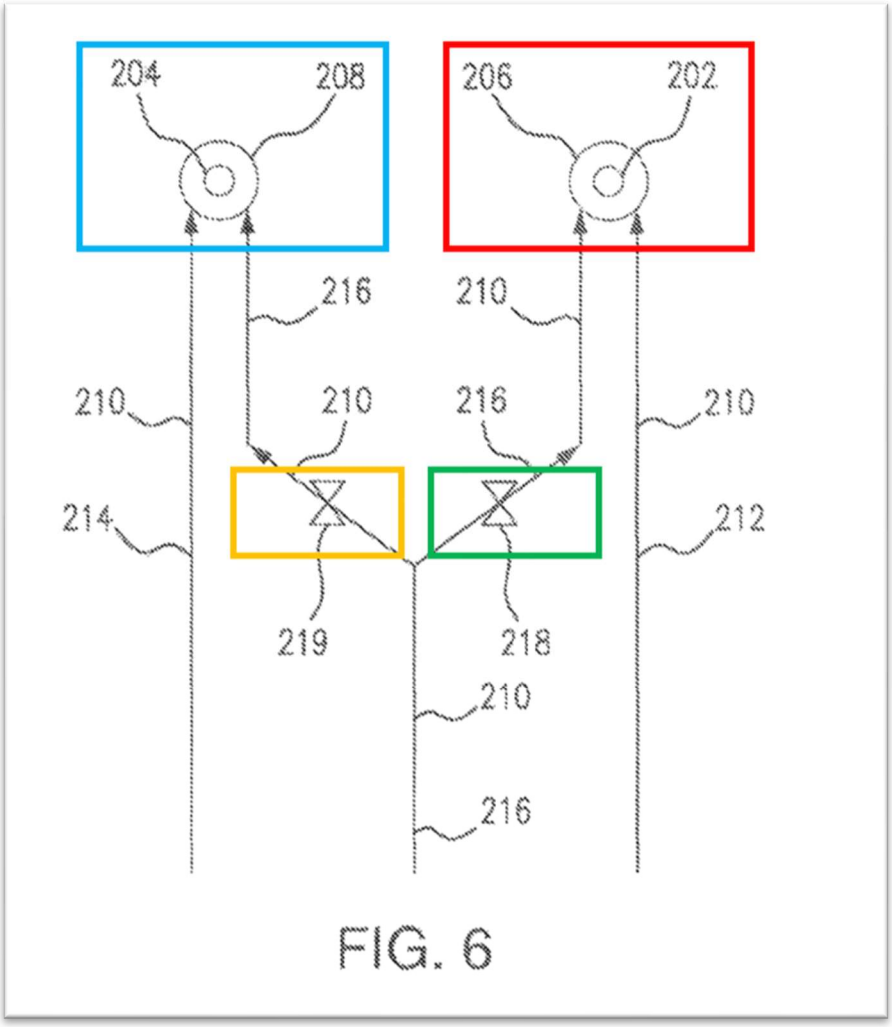
198. *Ciezobka* further discloses "[a] first percentage of the flow rate passes through the first constant rate flow line **212** [annotated in green], a second percentage of the flow rate passes through the second constant flow rate line **214** [annotated in orange], and a third percentage of the flow rate passes the diverter line **216** [annotated in pink]."[157] A POSITA would have understood this teaching to mean

[157] Ex. 2037 at 11:35-12:2.

that the system and methods of *Ciezobka* apply to multiple wells, and that fracturing fluid is pumped to multiple wells simultaneously. A POSITA would have further recognized this to mean that the fluid is pumped continuously to the valves at each well during the fracturing process.

199. Still further, *Ciezobka* discloses "the high-pressure fracturing pump provides a first total flow rate **220** to the first wellhead **202** [annotated in red] and a second total flow rate **230** to the second wellhead **204** [annotated in blue]. Initially, both valves **218** [sic **218**, **219**, annotated in green, yellow below] are open allowing the third percentage of the flow rate to be provided to both of the wellheads **202**, **204**."[158]

[158] Ex. 1037 at 12:5-8.



Ciezobka, Fig. 6

200. In addition to the explicit valves **218** associated with the first well **202** and **219** associated with well 204, *Ciezobka* teaches that "one or more of the flow lines **44** may include a valve, not shown, that can be opened and closed to restrict a flow of fluid to the wellbore."[159] Thus, applying this teaching to Fig. 6, a POSITA would understand flow lines **212** and **214** to include valves that can be opened and

[159] Ex. 1037 at 11:21-22.

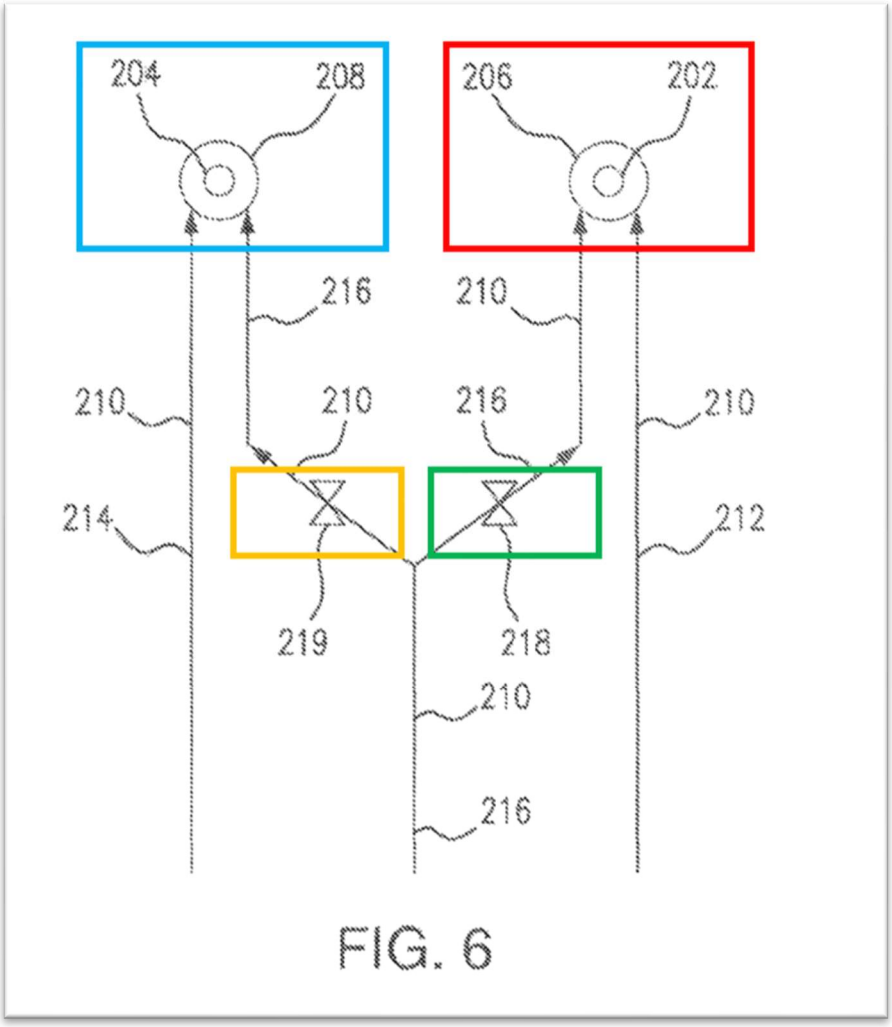
closed to restrict fluid to wellbores **202** and **204**. Accordingly, *Ciezobka* teaches first and second wells (e.g., **202**, **204**) and first and second valves associated with the first and second wells (e.g., **218**, **219**) and a method of hydraulically fracturing at least the first and second wells of a plurality of wells, the first and second wells being associated with the first and second valves, respectively.

201. Accordingly, *Ciezobka* discloses at least a first and second well and associated first and second valves. Thus, *Ciezobka* discloses the preamble.

b. 15.2: "(a) permitting hydraulic fracturing of the second well, comprising: opening the second valve associated with the second well to permit pumping of fluid into the second well via the second valve; and"

202. As discussed above regarding the preamble, *Ciezobka* discloses hydraulic fracturing operations of multiple wells, which would include a second well. Further, as discussed above regarding the preamble, each well has an associated valve. As discussed above regarding Limitation 1.6 in Section XI.A(g), *Ciezobka* discloses "[a] first percentage of the flow rate passes through the first constant rate flow line **212** [annotated in green], a second percentage of the flow rate passes through the second constant flow rate line **214** [annotated in orange], and a third percentage of the flow rate passes the diverter line **216** [annotated in pink]."[160]

[160] Ex. 1037 at 11:35-12:2.



Ciezobka, Fig. 6

203. A POSITA would have understood this teaching to mean that the system and methods of *Ciezobka* apply to multiple wells, and that fracturing fluid is pumped to multiple wells simultaneously. A POSITA would have further recognized this to mean that the fluid is pumped continuously to the valves at each well during fracturing because each valve permits hydraulic fluid flow at a hydraulic fracturing

well site when in the open position. *Ciezobka* discloses permitting hydraulic fracturing of the second well.

204. As discussed above regarding Limitations 1.5 and 1.6, *Ciezobka* teaches hydraulic fracturing of the second well by opening the second valve associated with the second well to allow fluid to be pumped into the second well. Further, *Ciezobka* discloses, regarding Fig. 6, during a fracturing process, initially, both diverter valves **218**, **219** "are open allowing" fluid flow "to be provided to both of the wellheads **202**, **204**." [161] *Ciezobka* teaches opening the second valve **219** to allow fluid to flow to the wellhead **204**, as shown below in Fig. 6 and corresponding sections of Fig. 7. In Fig. 6 below, both valves **218** and **219** are shown "open" (blank valve body). Flow is shown going to well **202** (annotated in pink) and flow is shown going to well **204** (annotated in green). In Fig. 7, this stage of the process is shown in the annotated blue box.

[161] Ex.1037 at 12:7-8.

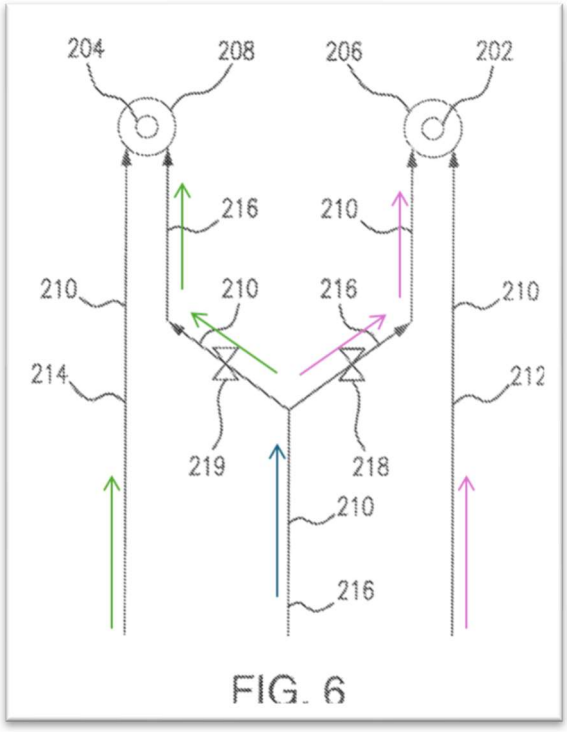


FIG. 6

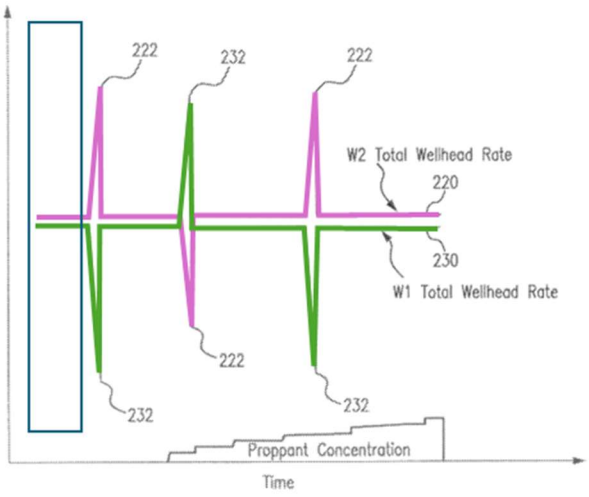


FIG. 7

Ciezobka, Fig. 6 and Fig. 7

205. Accordingly, *Ciezobka* discloses claim Limitation 15.2. Thus, *Ciezobka*, discloses and/or renders obvious Limitation 15.2.

c. <u>15.3: "measuring a flow rate of the fluid being pumped into the second well;"</u>

206. As discussed above regarding Limitation 1.2, *Ciezobka* teaches, or at least renders obvious measuring flow rate, including flow rate of the fluid pumped into the second well. *Ciezobka* teaches, "[i]n Fig. 7, the high-pressure fracturing pump provides a first total flow rate **220** [annotated in blue] to the first wellhead **202** and a second total flow rate **230** [annotated in green] to the second wellhead **204**."[162]

[162] Ex. 1037 at 12:5-7.

Ciezobka further teaches that this flowrate is measured, as graphs showing flow rate changes over time are included in *Ciezobka*, including Fig. 7.

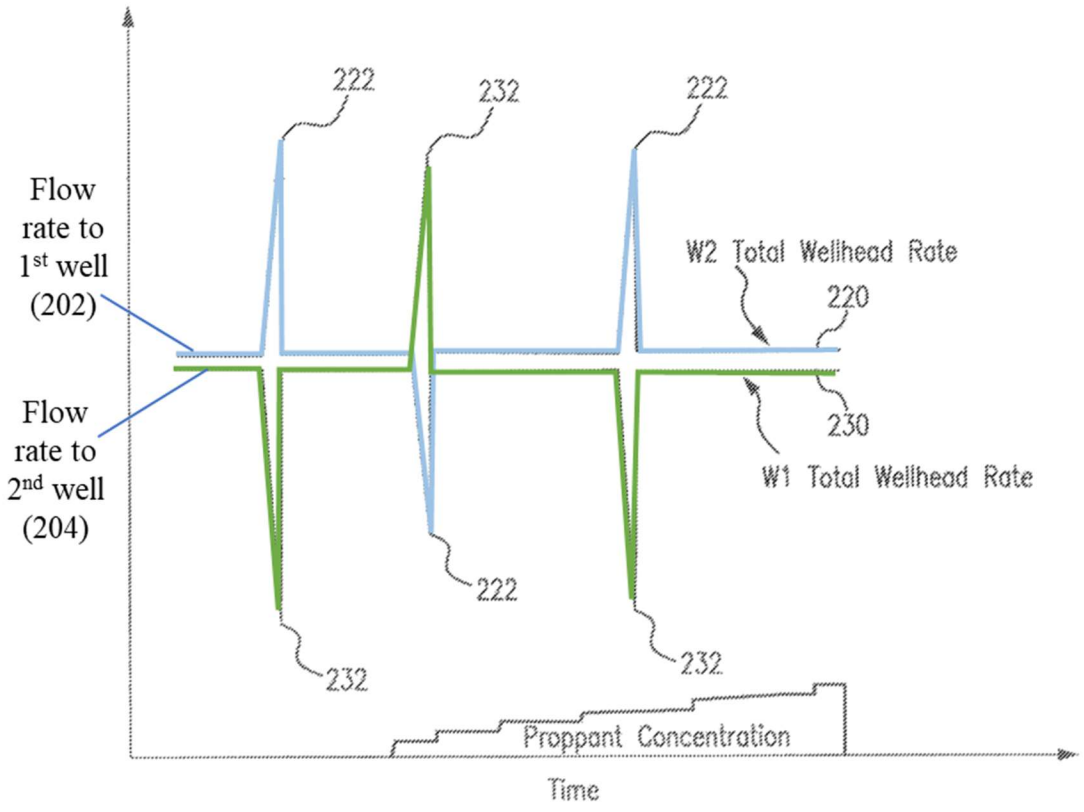


FIG. 7

Fig. 7 of *Ciezobka*

207. Further, *Ciezobka* teaches specific flowrate measurements including "for example the constant flow line supplies a constant flow rate 92 of 50% of the total flow, equaling 45 bpm, and the variable flow line supplies a variable flow rate 94 of 50% of the total flow, equaling 45 bpm."[163]

[163] Ex 1037 at 10:33-35, *see also* 9:4-6; 9:9-13.

208. Additionally, *Ciezobka* discloses "a method of hydraulic fracturing stimulation … includes pumping the fracturing fluid, with or without the proppant, at a pump rate and injecting the fracturing fluid under pressure into the wellhead at an initial flow rate and creating small fractures in deep rock formations."[164] *Ciezobka* discloses that "[a]s the system moves towards an equilibrium pressure with few or no new fractures being created and/or a fracture network complexity is no longer increasing, the method … includes introducing a pressure pulse into the wellbore … [the] pressure pulse comprises changing the initial flow rate to a primary or pulse flow rate and then to a secondary flow rate."[165] According to *Ciezobka*, "the primary or pulse flow rate [may be] less than the initial flow rate, ranging from 10% lower to nearly 100% lower, and the secondary flow rate [may be] equal to the initial flow rate," or "the primary or pulse flow rate may range from 25% to 75% lower that the initial flow rate … [or] 50% lower than the initial flow rate … [or] the primary or pulse flow rate is ideally dropped to zero, however a zero flow rate may not be practical because of limitations on the equipment and/or because a zero flow rate will cause proppant transport issues and may damage equipment."[166]

[164] Ex. 1037 at 3:29-32.

[165] Ex. 1037 at 3:33-4:3.

[166] Ex. 1037 at 4:4-11.

209. A POSITA would recognize that these flow rates are measured in the *Ciezobka*'s system. To the extent the Board determines that *Ciezobka* does not explicitly teach measuring flow rate, a POSITA would have found it obvious to measure flowrate, including flowrate into the second well, to operate the pulses at the reduced flow percentages, or specific flow rate values disclosed by *Ciezobka*. Further, a POSITA would have found it obvious to measure flowrates to generate the flowrate measurement charts, such as Fig. 7 of *Ciezobka.*

210. Accordingly, *Ciezobka* discloses, or at least would have rendered obvious, claim Limitation 15.3. A POSITA with general engineering knowledge would have known that measuring flow rate into a well was well-known long before the '779 Patent. (See Sections XI.A(c)).

d. <u>15.4.1: "(b) swapping from permitting hydraulic fracturing of the second well to permitting hydraulic fracturing of the first well, comprising:"</u>

211. *Ciezobka* discloses this limitation. As discussed above regarding the preamble, *Ciezobka* discloses hydraulic fracturing operations of multiple wells, which would include a second well.

212. Initially, although claim 15 refers to permitting hydraulic fracturing of a "second well" and then "first well," there is no technical distinction between "first" and "second" wells and no specific sequence tied to the use of "first" and "second" with respect to the "well," other than that recited in Limitation 15.4.1 (*i.e.*, swapping

from … second well to … first well"). Rather, the terms "first" and "second" in the claims merely distinguish between two different wells.

213. Further, as discussed above regarding the preamble, each well has an associated valve. As described above regarding Limitation 1.5, *Ciezobka* teaches continuous pumping to both the first and second wells and closing and opening valves to create pressure pulses. As described above regarding Limitation 1.5, *Ciezobka* teaches that during a fracturing process, initially, both diverter valves **218** and **219** "are open allowing" fluid flow "to be provided to both of the wellheads **202**, **204**." [167] The second diverter valve **219** (*e.g.*, second valve) is then closed for a "short period of time" while the first diverter valve **218** (*e.g.*, first valve) remains open to provide a decreased flow rate (shown as **232** in Fig. **7**) to the second well **204** and an increased flow rate (shown as **222** in Fig. 7) to the first well **202** for a "short period of time."[168] This increases the flow rate into the first well and "caus[es] a temporary increase of pressure leading to opening new fractures."[169]

[167] Ex. 1037 at 12:7-8.

[168] Ex. 1037 at 4:1-2..

[169] Ex. 1037 at 4:1-2.

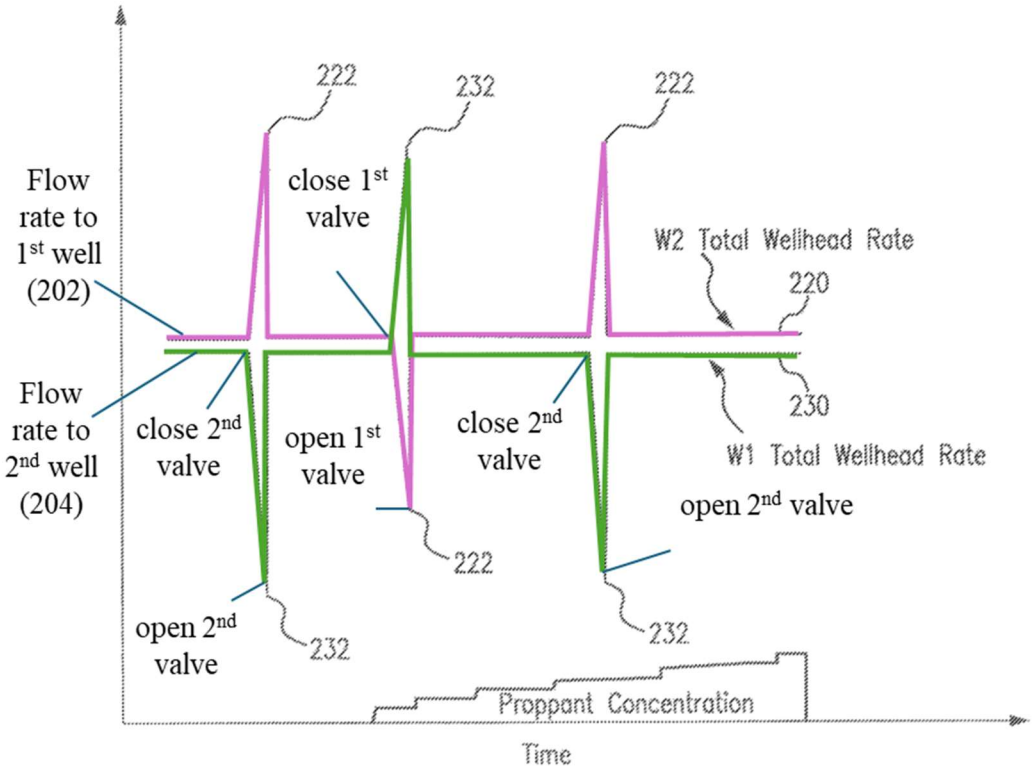


FIG. 7

Ciezobka, Fig. 7

214. As further described above regarding Limitation 1.5, a POSITA would have understood, based on the description of the "short period of time" and the flowrates depicted in Fig. 7, that after the short period of time with the second diverter valve closed, the second valve (*e.g.*, **219**) is opened to resume fluid flow "to both of the wellheads **202**, **204**."[170]

215. *Ciezobka* further teaches "[t]he process is then repeated by closing the valve **218**, increasing the total flow rate **230** to the second wellhead **204** and

[170] Ex. 1037 at 12:5-11.

decreasing the total flow rate **220** to the first wellhead **202** for a short period of time."[171] This condition is shown in Fig. 6 below, with flows annotated as above, open valves having blank valve bodies and closed valves having filled-in valve bodies. This stage is represented in Fig. 7 in the annotated portion up to the time of events **222** / **232**. This has the effect of increasing flow rate and pressure. This increases flow rate into the second well and "caus[es] a temporary increase of pressure leading to opening new fractures."[172] Accordingly, the fracturing has "swapped" from the second well (during the second pulse) to the first well (third pulse).

[171] Ex. 1037 at 12:13-15.

[172] Ex. 1037 at 4:1-2.

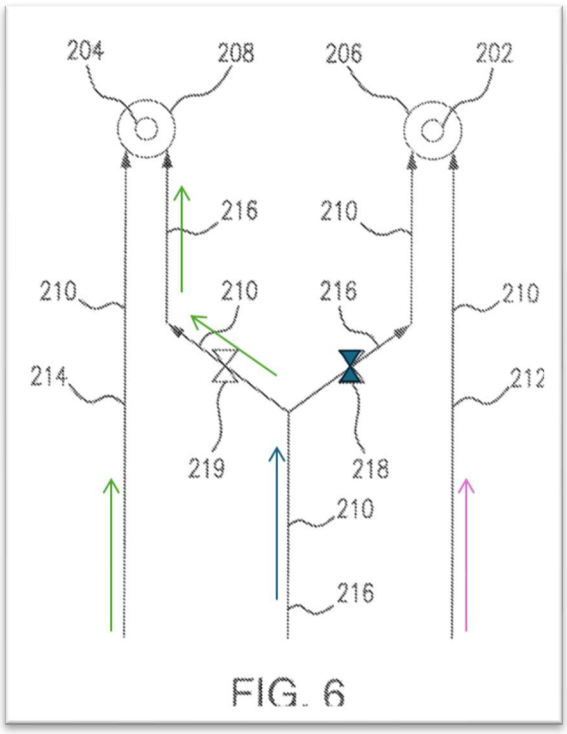


FIG. 6

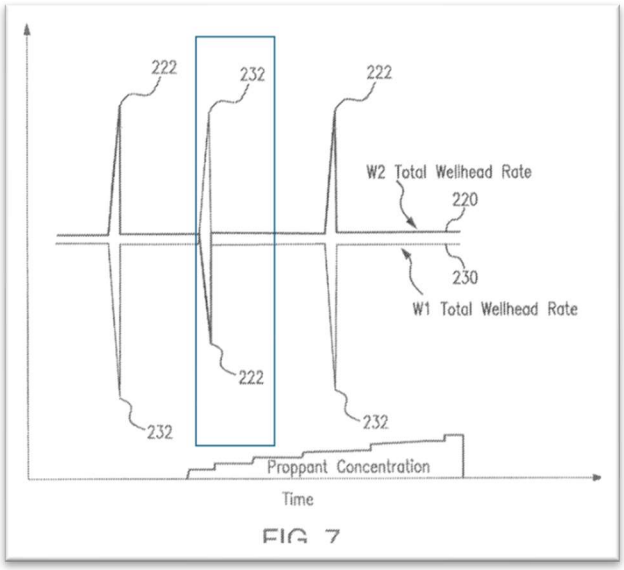


FIG. 7

216. Thus, *Ciezobka* discloses swapping from permitting hydraulic fracturing of the second well to permitting hydraulic fracturing of the first well.

217. Accordingly, *Ciezobka* discloses claim Limitation 15.4.1.

e. <u>15.4.2: "opening the first valve associated with the first well to permit pumping of fluid into the first well via the first valve; and"</u>

218. As discussed above regarding 15.4.1, *Ciezobka* teaches hydraulic fracturing of the first well by opening the first valve associated with the first well. As discussed above regarding 15.4.1, *Ciezobka* discloses pumping fluid to a first wellhead as part of a hydraulic fracturing operation and that valves are associated with the flowlines "that can be opened and closed to restrict a flow of fluid to the

wellbore."[173] This would include valves **218** and **219** shown in Fig. 6. Because the valves are opened and closed to "restrict a flow of fluid to a wellbore," a POSITA would have understood that the hydraulic fracturing fluid is pumped into the first well (*e.g.*, **218**) via a first valve associated with the first well (*e.g.*, **202**). Fluid flow into the first well is annotated by pink flow lines and is the result of valve **218** being opened.

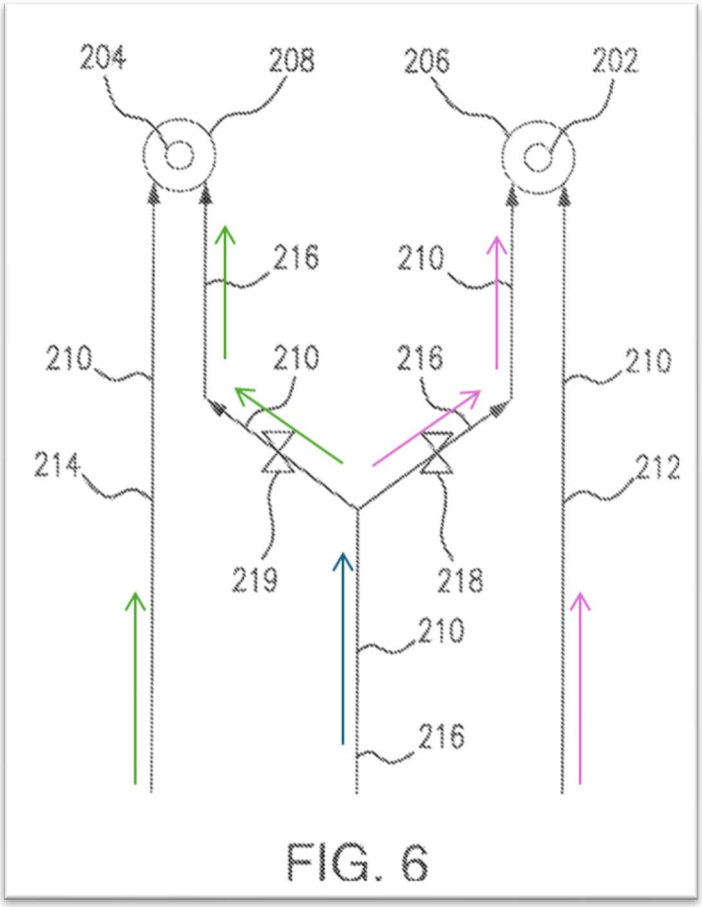


FIG. 6

[173] Ex. 1037 at 11:22.

219. The resulting flow rates and pressures are shown in Fig. 7, with the location of "open[ing] the first valve" annotated.

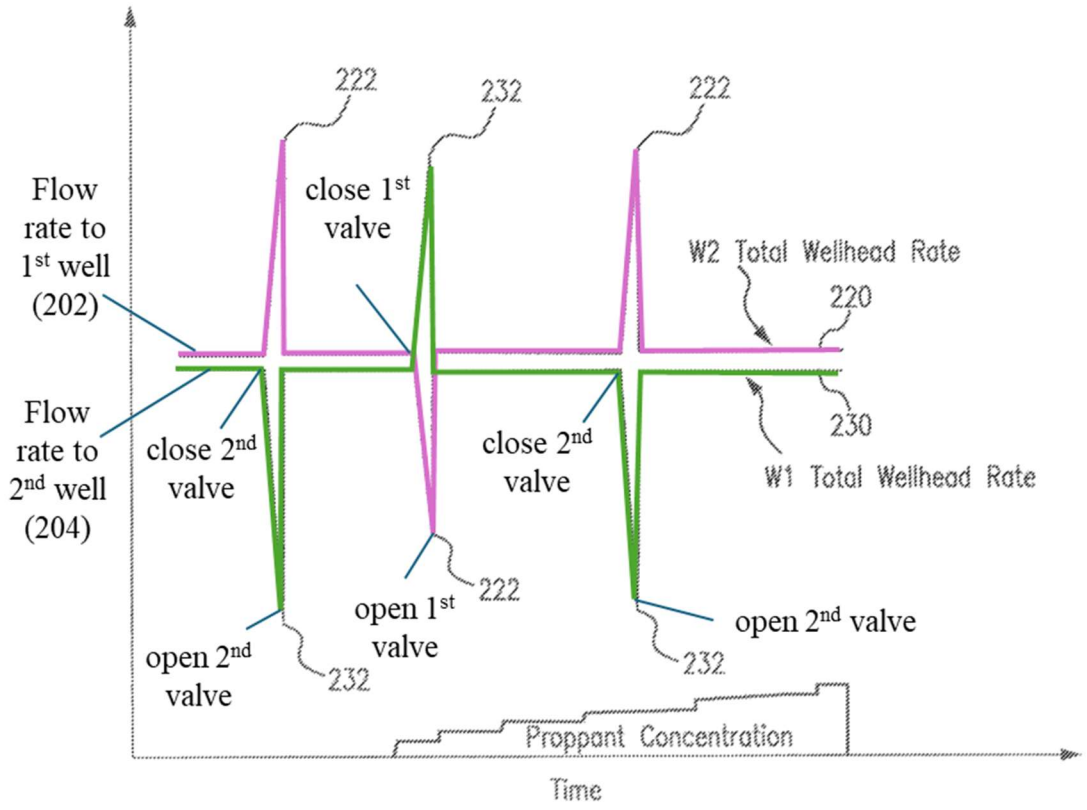


FIG. 7

220. Accordingly, *Ciezobka* discloses Limitation 15.4.2.

15.4.3: "closing the second valve associated with the second well;"

221. *Ciezobka* discloses this limitation. As described above regarding Limitation 15.4.1, *Ciezobka* teaches that during a fracturing process, both diverter valves **218** and **219** "are open allowing" fluid flow "to be provided to both of the

wellheads **202**, **204**."[174] The second diverter valve **219** (*e.g.*, second valve) is then closed for a "short period of time" while the first diverter valve **218** (*e.g.*, first valve) remains open to provide decreased flow rate (shown as **232** in Fig. **7**) to the second well **204** and increased flow rate (shown as **222** in Fig. 7) to the first well **202** for a "short period of time."[175] This increases the flow rate into the first well and "caus[es] a temporary increase of pressure leading to opening new fractures."[176] This is shown in annotated Fig. 7 below, with the location of the closing of the second valve identified.

[174] Ex. 1037 at 12:7-8.

[175] Ex. 1037 at 12:9-11.

[176] Ex. 1037 at 4:1-2.

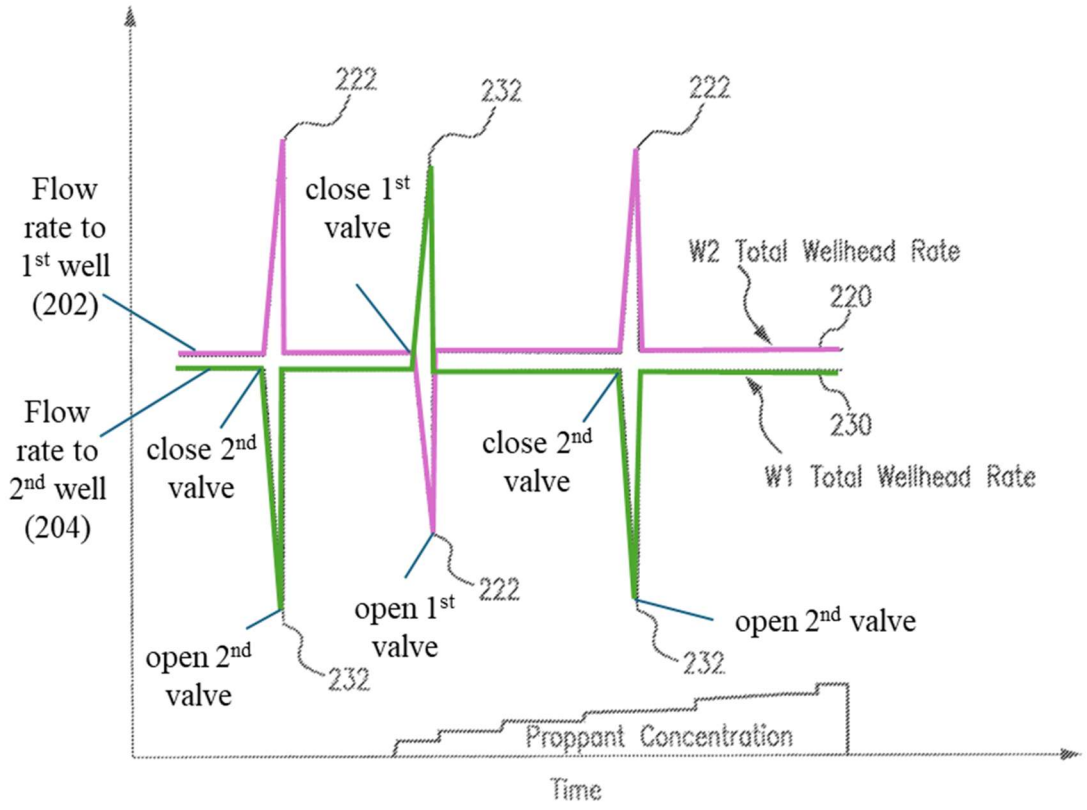


FIG. 7

222. Accordingly, *Ciezobka* discloses Limitation 15.4.2.

f. 15.5: "wherein, during step (b), hydraulic fracturing fluid is continuously pumped to the first and second valves via a hydraulic manifold; and"

223. *Ciezobka* discloses performing the valve switching operations while hydraulic fluid is continuously pumped to the first and second wells via the first and second valves and a hydraulic manifold. This is displayed explicitly in Fig. 7, which shows continuous flow to both wells (*e.g.*, **202**, **204**), and both valves (*e.g.*, **218**, **219**) via total wellhead rates **220** and **230** while the valves are opened and closed as described above.

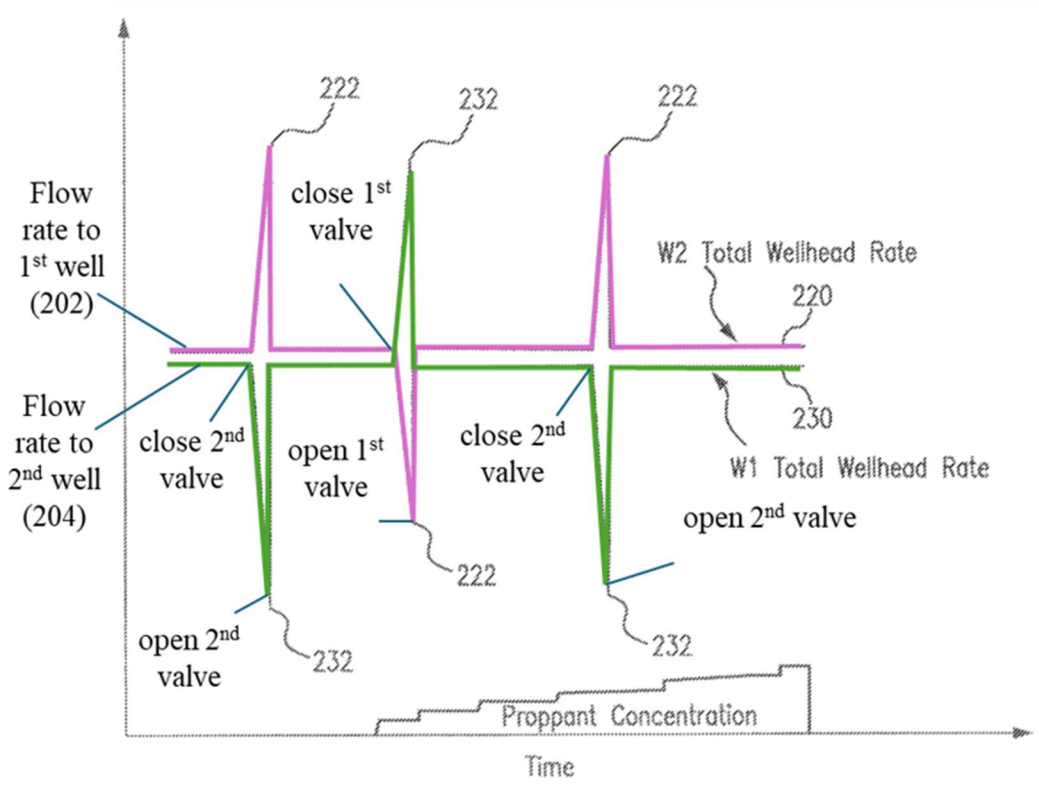


FIG. 7

224. Further, *Ciezobka* discloses that the fluid is a hydraulic fluid noting that "[i]n a preferred embodiment, the fracturing tank supplies a primary component of a fracturing fluid and/or a fracturing slurry, each of which preferably comprise water."[177]

225. *Ciezobka* further teaches "[t]he manifold receives the fracturing fluid, with or without proppant, at a low pressure from the pre-blender or the slurry-blender and distributes the fluid and/or slurry to the high-pressure fracturing pumps. The manifold then receives the fluids at a high pressure from the high-pressure fracturing

[177] Ex. 1037 at 3:1-2.

pumps and directs the fluid to a ground iron leading to the wellhead and wellbore."[178] Further still, "the flow line comprises a plurality of pipes which connect the high pressure fracturing pumps, through a single or multiple common manifolds, to a wellhead of the wellbore. In an embodiment of this invention, the plurality of flow lines comprise at least one constant-flow flow line and at least one variable-flow flow line."[179]A POSITA would have understood, based on the teachings of *Ciezobka*, that flow lines **212**, **214** and **216** as well as valves **218** and **219** are supplied fluid "through a single or multiple common manifolds." Thus, *Ciezobka* discloses during step (b) [swapping from … the second well to … the first well…], hydraulic fracturing fluid is continuously pumped to the first and second valves via a hydraulic manifold.

226. Accordingly, *Ciezobka* discloses during step (b), hydraulic fracturing fluid is continuously pumped to the first and second valves via a hydraulic manifold as claimed in Limitation 15.5.

[178] Ex. 1037 at 3:10-14.

[179] Ex. 1037 at 3:16-20.

g. <u>15.6: "wherein in response to determining that the flow rate measured at step (a) has satisfied one or more flow rate conditions, the first valve associated with the first well is opened at step (b) before the second valve associated with the second well is closed at step (b);"</u>

227. *Ciezobka* discloses this limitation. As discussed above regarding the preamble, *Ciezobka* discloses hydraulic fracturing operations of multiple wells, which would include a second well. Further, as discussed above regarding the preamble, each well has an associated valve. As described above regarding Limitation 1.5, *Ciezobka* teaches continuous pumping to both the first and second wells and closing and opening valves to create pressure pulses. As described above regarding Limitation 1.5, *Ciezobka* teaches that, during a fracturing process, initially, both diverter valves **218** and **219** "are open allowing" fluid flow "to be provided to both of the wellheads **202**, **204**." [180] The second diverter valve **219** (*e.g.*, second valve) is then closed for a "short period of time" while the first diverter valve **218** (*e.g.*, first valve) remains open to provide decreased flow rate (shown as **232** in Fig. **7**) to the second well **204** and increased flow rate (shown as **222** in Fig. 7) to the first well **202** for a "short period of time."[181] This increases the flowrate into the

[180] Ex. 1037 at 12:7-8.

[181] Ex. 1037 at 12:9-11.

first well and "caus[es] a temporary increase of pressure leading to opening new fractures."[182]

228. As further described above regarding Limitation 1.5, a POSITA would understand, based on the description of the "short period of time" and the flowrates depicted in Fig. 7 that, after the short period of time with the second diverter valve closed, the second valve (*e.g.*, **219**) is opened to resume fluid flow "to both of the wellheads **202**, **204**."[183]

229. *Ciezobka* further teaches "[t]he process is then repeated by closing the valve **218**, increasing the total flow rate **230** to the second wellhead **204** and decreasing the total flow rate **220** to the first wellhead **202** for a short period of time."[184] This condition is shown in Fig. 6 below, with flows annotated as above, open valves having blank valve bodies and closed valves having filled-in valve bodies. This stage is represented in Fig. 7 in the annotated portion up to the time of events **222** / **232**. This has the effect of increasing flow rate and pressure. This increases the flowrate into the second well and "caus[es] a temporary increase of pressure leading to opening new fractures."[185] Accordingly, the fracturing has

[182] Ex. 1037 at 4:1-2.

[183] Ex. 1037 at 12:5-11.

[184] Ex. 1037 at 12:13-15.

[185] Ex. 1037 at 4:1-2.

"swapped" from the first well (during the first pulse) to the second well (second pulse).

230. As discussed above regarding Limitation 15.3, *Ciezobka* discloses measuring a flow rate. Further, *Ciezobka* teaches several percentage flow rate thresholds for the pulses including "from 10% to nearly 100% lower," "25% to 75% lower," and "50% lower" than the primary flowrate. [186] A POSITA would understand that, in each of these cases, the flowrate of the fluid being pumped into the first well is being determined and compared against a flow rate threshold to determine if the flow rate is below a flow rate threshold of for example "10% lower" or "25% lower." A POSITA would recognize this as a flowrate condition. Accordingly, the first valve is opened once the flowrate has met the flowrate condition (*e.g.*, 10% lower, 25% lower, etc.).

231. As shown in Fig. 7, the first valve is closed, and then flow rate into the first well is determined to be below any of the thresholds identified by *Ciezobka*, for example, "25% lower" than the primary flow. Subsequently, the first valve (**218**) is opened. At some later time, after flow into the first well has been re-established at near 100% primary flow, the 2nd valve (**219**) is closed. Accordingly, the second valve is closed in response to the flowrate condition (*e.g.*, 100% primary flow) being met (*i.e.*, satisfied).

[186] *See*, *Ciezobka*, *e.g.*, pages 3-4, generally.

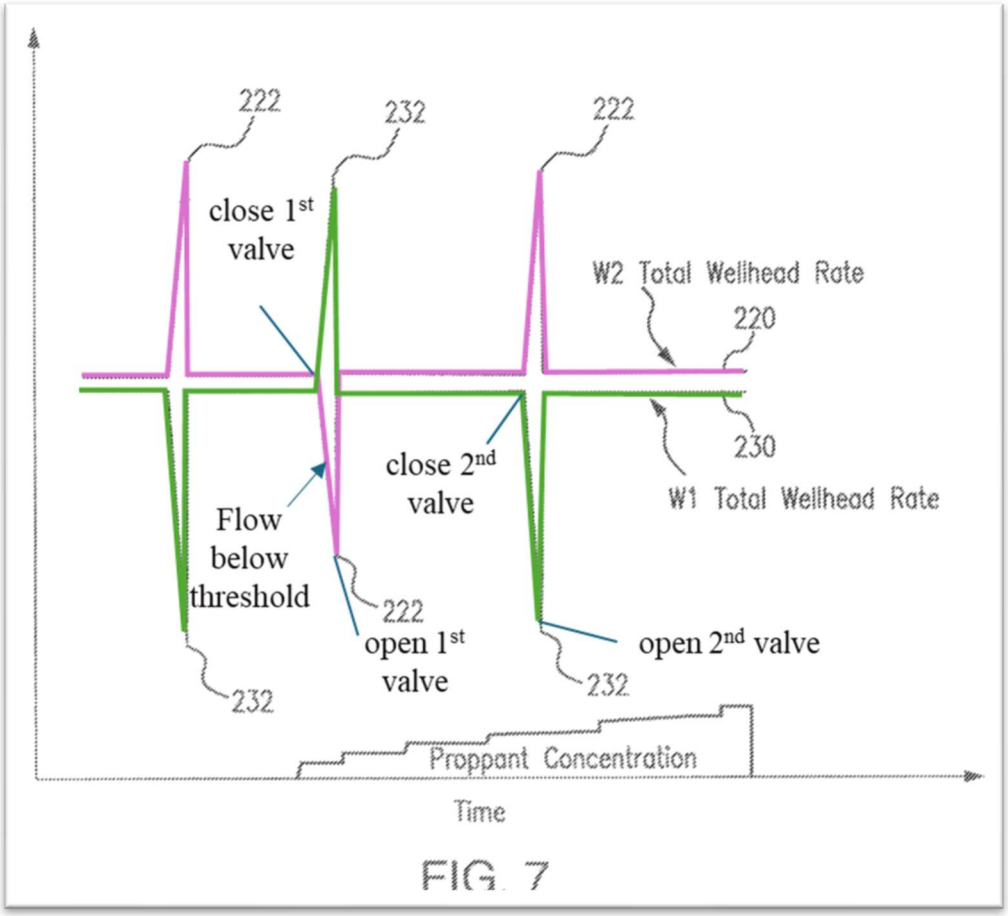


FIG. 7

Ciezobka, Fig. 7

232. Accordingly, Limitation 15.6 would have been anticipated by, or at least obvious over, *Ciezobka* for the reasons discussed above.

h. <u>15.7: "or in response to determining that the flow rate measured at step (a) has not satisfied one or more flow rate conditions, the first valve associated with the first well is opened at step (b) during or after the second valve associated with the second well is closed at step (b)."</u>

233. Claim Limitation 15.7 is the second prong of an "OR" statement in claim 15. As discussed above regarding 15.6, the first prong of the "OR" is satisfied

by the disclosures of *Ciezobka*, and as a result, *Ciezobka* discloses, or at least renders obvious, the entire "OR" statement.

234. Further, if *Ciezobka* does not expressly disclose 15.7/25.9, it would have been obvious to a POSITA to open a first valve after closing a second valve. When flowrate conditions are met, *Ciezobka* discloses alternating pulses to different wells by diverting flow according to Fig. 7's schedule. If flowrate conditions are not met, Fig. 7's schedule would not be implemented. Instead, the wells would be operated individually as needed, *e.g.*, closing one well before the other.

235. Nevertheless, it would have been obvious to a POSITA that if the flow and/or time conditions of the *Ciezobka's* system/method are not met (e.g., where the flow does not meet a minimum flow threshold or exceeds a maximum flow threshold) to close one valve before opening another to avoid generating a pressure pulse when it is not desired, or to reduce any risk of damage to the equipment or formation. Such a valve sequence (which the '779 Patent admits is a "regular swap") would have been obvious to a POSITA as an ordinary valve sequence for controlling or responding to unexpected or undesired flow.

236. For the reasons described above, *Ciezobka* anticipates Claim 15 as a whole or at least renders Claim 15, as a whole, obvious.

J. DEPENDENT CLAIM 16

237. Dependent Claim 16 depends from Claim 15. In addition to the disclosure of the limitations of Claim 15 discussed above, *Ciezobka* discloses, or at least renders obvious, the additional limitations of Claim 16:

a. 16.1: "16. The method of claim 15, wherein the plurality of wells further comprises third and fourth wells, the third and fourth wells being associated with third and fourth valves, respectively; and wherein the method further comprises:"

238. *Ciezobka* discloses Limitation 16.1 or at least renders it obvious. As discussed above regarding Claim 15, *Ciezobka* discloses opening/closing valves to associated first and second wells to alternate delivering pulses of increased and decreased flowrates into the wells, where the pulses of increased flow rate open new fractures in the well. *Ciezobka* teaches valves associated with the first well (*e.g.*, **218**) and second well (*e.g.*, **219**). These valves are used as part of a hydraulic fracturing method. Specifically, *Ciezobka* discloses, when discussing its process, "[s]imilar variations may utilize multiple wells or multiple fluid flow lines to the wellhead or from one or more pumps."[187] There is no limitation in *Ciezobka* restricting "multiple wells" to one or two wells. Accordingly, a POSITA would recognize the teachings of *Ciezobka* to include a third, fourth, or any number of wells.

[187] Ex. 1037 at 28:22-23.

239. To the extent the Board finds that *Ciezobka* does not expressly disclose "third and fourth wells," it would have been obvious to a POSITA to apply the teachings of a "first and second well" from *Ciezobka* to a "third and fourth well" to take advantage of the increased hydrocarbon production, operating efficiencies and reduced friction taught by *Ciezobka* at multiple well locations.

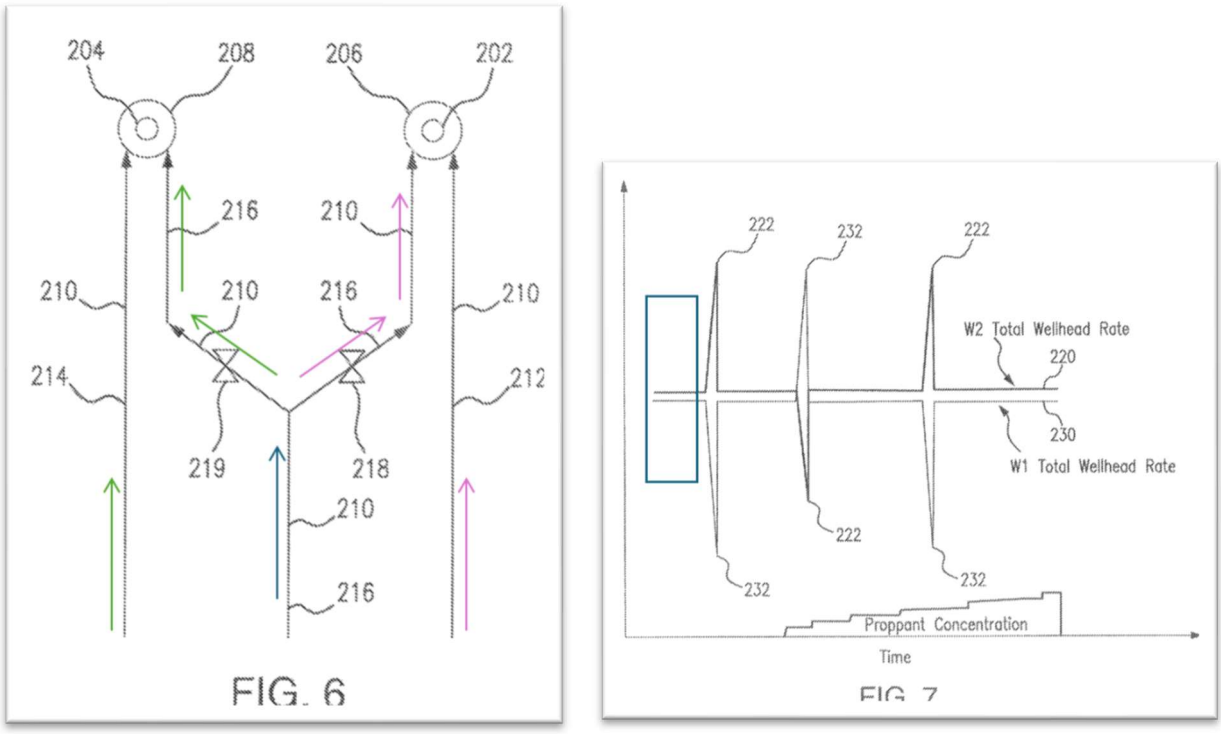
240. As discussed above regarding Claim Limitation 15.1, *Ciezobka* discloses communicating fluid to a well in a multi-well environment. As was well known to a POSITA, a well pad may include one, two, three, four, or more wells. Thus, although *Ciezobka* discusses a first well and a second well in detail, it would have been obvious to a POSITA to perform the same method or sequence of the first and second wells on a third well, a fourth well, and any additional wells based on *Ciezobka's* teaching of performing the method on multiple wells. Moreover, mere repetition of elements has no patentable significance unless a new and unexpected result is produced. Here, performing the method of Claim 15 on additional wells in the same environment (*i.e.*, third well and fourth well) would be performed in the same way and produce the same expected results as using the method on the first and second wells and, therefore, would have been obvious to a POSITA.

b. 16.2: "(c) permitting hydraulic fracturing of the fourth well; and"

241. *Ciezobka* discloses this limitation, or at least renders it obvious. As discussed above regarding Limitations 15.2.1 and 15.2.2, *Ciezobka* discloses permitting hydraulic fracturing of a first well and a second well. Further, as discussed above regarding Limitation 16.1, *Ciezobka* discloses, or at it is obvious based on the teachings of *Ciezobka*, to apply the methods of *Ciezobka* to a third well, a fourth well, or any number of wells.

242. Further, *Ciezobka* discloses, with regard to Fig. 6, a fracturing process in which, initially, both diverter valves **218** and **219** "are open allowing" fluid flow "to be provided to both of the wellheads **202**, **204**." [188] *Ciezobka* teaches opening the second valve **219** to allow fluid to flow to the wellhead **204**, as shown below in Fig. 6 and corresponding sections of Fig. 7. In Fig. 6 below, both valves **218** and **219** are shown "open" (blank valve body), flow is shown going to well **202** (annotated in pink), and flow is shown going to well **204** (annotated in green). In Fig. 7, this stage of the process is shown in the annotated blue box.

[188] Ex. 1037 at 12:7-8.



Ciezobka, Figs. 6 & 7

243. As discussed above regarding Limitation 16.1, *Ciezobka* discloses, or at least renders obvious, applying the teachings of *Ciezobka,* including swapping between fracturing of wells to a third well, fourth well, and any number of wells. A POSITA would have further found it obvious to apply "fracturing a second well" to fracturing a fourth well to take advantage of the benefits claimed by *Ciezobka* at multiple well sites. Further, fracturing multiple wells was well-known long before the '779 Patent. (*See* Sections IX.C–IX.F).

244. Accordingly, *Ciezobka* discloses, or at least renders obvious, "permitting hydraulic fracturing of a fourth well" as claimed by Limitation 16.2.

c. 16.3: "(d) swapping from permitting hydraulic fracturing of the fourth well to permitting hydraulic fracturing of the third well."

245. As discussed above regarding 16.2, *Ciezobka* discloses hydraulic fracturing operations of multiple wells, including fourth and third wells. Further, as discussed above regarding Limitation 15.4.1, *Ciezobka* discloses swapping from fracturing a second well to fracturing a first well. *Ciezobka* discloses that during a fracturing process, initially, both diverter valves **218** and **219** "are open allowing" fluid flow "to be provided to both of the wellheads **202**, **204**."[189] The second diverter valve **219** (*e.g.*, second valve) is then closed for a "short period of time" while the first diverter valve **218** (*e.g.*, first valve) remains open to provide decreased flow rate (shown as **232** in Fig. **7**) to the second well **204** and increased flow rate (shown as **222** in Fig. 7) to the first well **202** for a "short period of time."[190] This increases flowrate into the first well and "caus[es] a temporary increase of pressure leading to opening new fractures."[191]

[189] Ex. 1037 at 12:7-8.

[190] Ex. 1037 at 12:9-11.

[191] Ex. 1037 at 4:1-2.

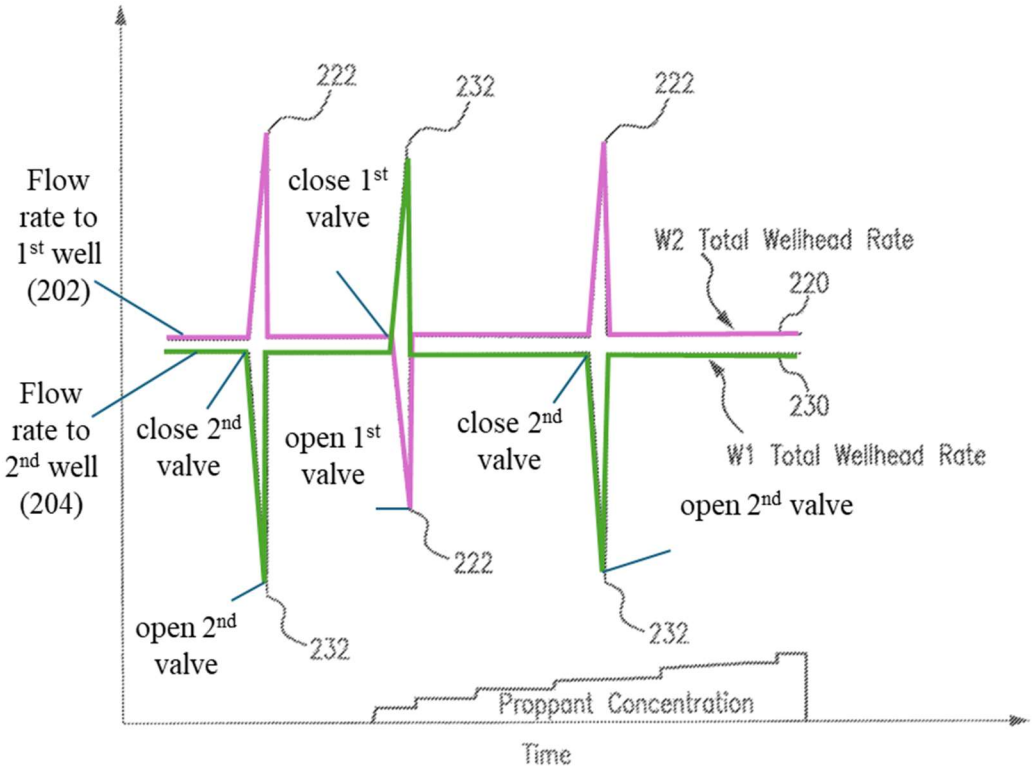


FIG. 7

Ciezobka, Fig. 7

246. As further described above regarding Limitation 1.5, a POSITA would understand, based on the description of the "short period of time" and the flowrates depicted in Fig. 7 that, after the short period of time with the second diverter valve closed, the second valve (*e.g.*, **219**) is opened to resume fluid flow "to both of the wellheads **202**, **204**."[192]

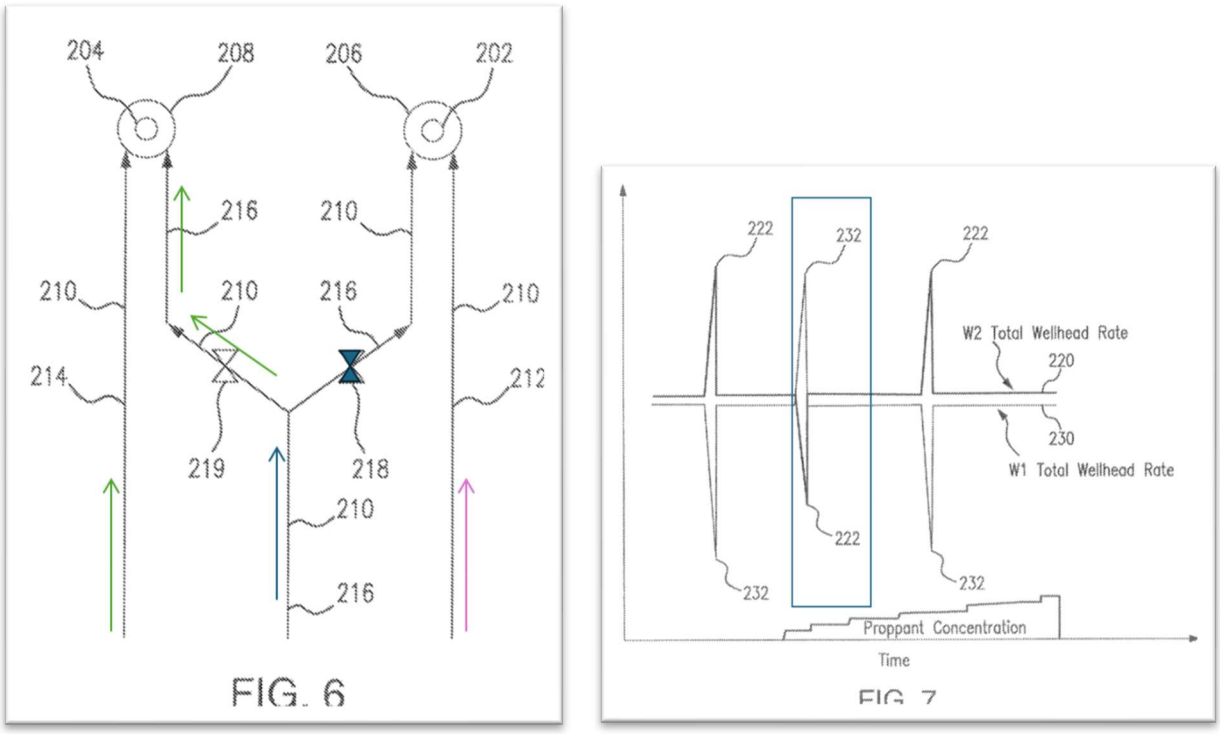
247. *Ciezobka* further teaches "[t]he process is then repeated by closing the valve **218**, increasing the total flow rate **230** to the second wellhead **204** and

[192] Ex. 1037 at 12:5-11.

decreasing the total flow rate **220** to the first wellhead **202** for a short period of time."[193] This condition is shown in Fig. 6 below, with flows annotated as above, open valves having blank valve bodies, and closed valves having filled in valve bodies. This stage is represented in Fig. 7 in the annotated portion up to the time of events **222** / **232**. This has the effect of increasing flow rate and pressure. This increases flowrate into the second well and "caus[es] a temporary increase of pressure leading to opening new fractures."[194] Accordingly, the fracturing has "swapped" from the first well (during the first pulse) to the second well (second pulse) and again from the second well (second pulse) to the first well (third pulse).

[193] Ex. 1037 at 12:13-15.

[194] Ex. 1037 at 4:1-2.



Ciezobka, Fig. 6 and Fig. 7

248. As discussed above regarding Limitation 16.1, *Ciezobka* discloses, or at least renders obvious, applying the teachings of *Ciezobka,* including swapping between fracturing of wells to a third well, fourth well, and any number of wells. A POSITA would have further found "swapping from a second well to a first well by switching valves" obvious to apply to a fourth well and third well to take advantage of the benefits claimed by *Ciezobka* at multiple well sites. Accordingly, *Ciezobka* discloses or at least renders obvious swapping from permitting hydraulic fracturing of a fourth well to permitting hydraulic fracturing of a third well.

249. Thus, *Ciezobka* discloses, or at least renders obvious, Limitation 16.3.

250. *Ciezobka* discloses, or renders obvious, each and every limitation of Claim 16. Accordingly, *Ciezobka* anticipates, or at least renders obvious, Claim 16 as a whole.

K. DEPENDENT CLAIM 17

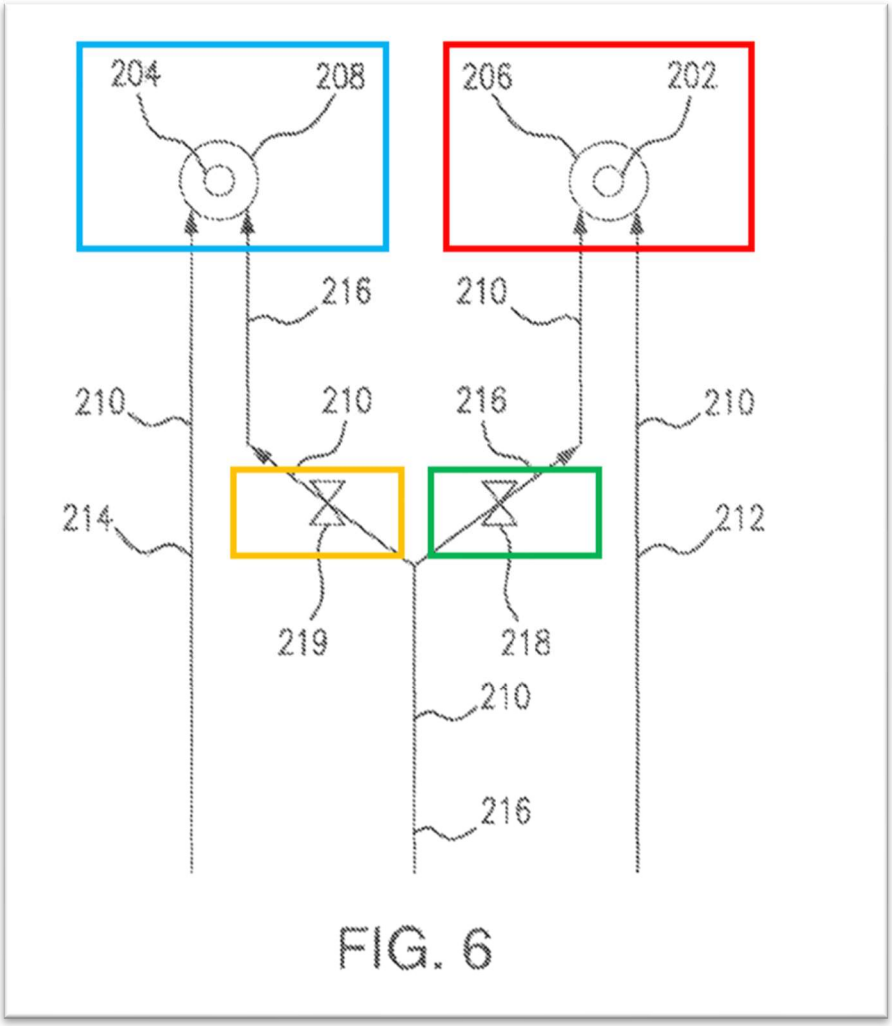
251. Dependent Claim 17 depends from Claim 16. In addition to the disclosure of the limitations of Claim 16 discussed above, *Ciezobka* discloses the additional limitations of Claim 17:

a. "17. The method of claim 16, wherein steps (a) and (c) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold; and wherein steps (b) and (d) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold."

252. As discussed above regarding Claim 2, *Ciezobka* teaches directing fluid between wells continuously by operating the valves associated with individual wells.

253. *Ciezobka* discloses "the high-pressure fracturing pump provides a first total flow rate **220** to the first wellhead **202** [annotated in red] and a second total flow rate **230** to the second wellhead **204** [annotated in blue]. Initially, both valves **218** [sic, **218**, **219**, annotated in green, yellow] are open allowing the third percentage of the flow rate to be provided to both of the wellheads **202**, **204**."[195]

[195] Ex. 1037 at 12:5-8.



Ciezobka, Fig. 6

254. In addition to the explicit valves **218** associated with the first well **202** and **219** associated with well **204**, *Ciezobka* teaches that "one or more of the flow lines **44** may include a valve, not shown, that can be opened and closed to restrict a flow of fluid to the wellbore."[196] Thus, applying this teaching to Fig. 6, a POSITA

[196] Ex. 1037 at 11:21-22.

would understand flow lines **212** and **214** to include valves that can be opened and closed to restrict fluid to wellbores **202** and **204**.

255. *Ciezobka* further teaches "[t]he manifold receives the fracturing fluid, with or without proppant, at a low pressure from the pre-blender or the slurry-blender and distributes the fluid and/or slurry to the high-pressure fracturing pumps. The manifold then receives the fluids at a high pressure from the high-pressure fracturing pumps and directs the fluid to a ground iron leading to the wellhead and wellbore."[197] Further still, "the flow line comprises a plurality of pipes which connect the high-pressure fracturing pumps, through a single or multiple common manifolds, to a wellhead of the wellbore. In an embodiment of this invention, the plurality of flow lines comprise at least one constant-flow flow line and at least one variable-flow flow line."[198] A POSITA would have understood, based on the teachings of *Ciezobka*, that flow lines **212**, **214** and **216** as well as valves **218** and **219** to be supplied fluid "through a single or multiple common manifolds."

256. As discussed above regarding Claim 16, a POSITA would have understood the teachings of *Ciezobka* to contain "variations [that] may utilize multiple wells,"[199] with no limitation on the number of wells. Further, a POSITA

[197] Ex. 1037 at 3:10-14.

[198] Ex. 1037 at 3:16-20.

[199] Ex. 1037 28:22-23.

would have found it obvious to apply the teachings of *Ciezobka* to a third well, fourth well and any number of wells, as discussed regarding Claim 16. Accordingly, a POSITA would understand the teachings of *Ciezobka* regarding a manifold and continually pumping to a first valve and second valve to apply equally to a manifold associated with a third valve and a fourth valve, or at least a POSITA would have found it obvious to do so. Further, *Ciezobka* discloses using "multiple flow lines" and "one or more pumps." Accordingly, a POSITA would have found it obvious to, for example, create a pulse in the first and third wells simultaneously using different pumps and valves to take advantage of efficiency taught by *Ciezobka*. Similarly, a POSITA would have found it obvious to, for example, create a pulse in the second and fourth wells simultaneously using different pumps and valves to take advantage of the efficiencies of *Ciezobka*.

257. To the extent that the Board finds that *Ciezobka* does not disclose this limitation, the limitation of Claim 17 would have been obvious to a POSITA. Even if *Ciezobka* is found to only disclose a first and second wells (even though it explicitly discloses multiple wells), simply duplicating *Ciezobka*'s method on another two wells of the multiple wells at least renders obvious performing steps (a), (b), (c), and (d). Claim 17 then merely limits duplication of the steps to occur "simultaneously," which would have been obvious to a POSITA given that "simul frac" or "simultaneous fracturing" was well known in the art before the '779 Patent's

effective filing.[200] This would simply require performing the same method and function in the same way with predictable results. Further, a POSITA would have understood the benefits of simultaneously treating wells (*e.g.*, second and fourth wells) to gain the benefits of "zipper factures" which were well known.[201]

258. Thus, in addition to the limitations of Claim 15, *Ciezobka* discloses, or at least renders obvious, the limitations of Claim 17. Accordingly, *Ciezobka* renders obvious Claim 17 for the reasons discussed above.

L. DEPENDENT CLAIM 18

259. Dependent Claim 18 depends from Claim 16. In addition to the disclosure of the limitations of Claim 16 discussed above, *Ciezobka* discloses, or at least renders obvious, the additional limitations of Claim 18:

a. 18.1: "18. The method of claim 16, wherein, during step (d), hydraulic fracturing fluid is continuously pumped to the third and fourth valves via the hydraulic manifold;"

260. As discussed above regarding Claim 2 and Claim 17, *Ciezobka* teaches pumping hydraulic fluid between wells continuously by operating the valves associated with individual wells. Further, as discussed above regarding Claim 16, a POSITA would have understood the teachings of *Ciezobka* to contain "variations

[200] *See* Sections IX.C-IX.D.

[201] *See*, *e.g.*, Sections, IX.C-IX.D.

[that] may utilize multiple wells,"[202] with no limitation on the number of wells. Further still, a POSITA would have found it obvious to apply the teachings of *Ciezobka* to a third well, fourth well and any number of wells, as discussed regarding Claim 16. Accordingly, a POSITA would understand the teachings of *Ciezobka* regarding a manifold and continually pumping to a first valve and second valve to apply equally to a manifold associated with a third valve and a fourth valve, or at least a POSITA would have found it obvious to do so. Thus, *Ciezobka* discloses, or renders obvious, both continuously pumping to the third and fourth valves and that this pumping is completed using a manifold.

261. Accordingly, *Ciezobka* discloses (or it would have been at least obvious to a POSITA) during step (d) [swapping from permitting hydraulic fracturing of the fourth well to permitting hydraulic fracturing of the third well], hydraulic fracturing fluid is continuously pumped to the third and fourth valves via the hydraulic manifold.

262. Thus, *Ciezobka* discloses or renders obvious Limitation 18.1.

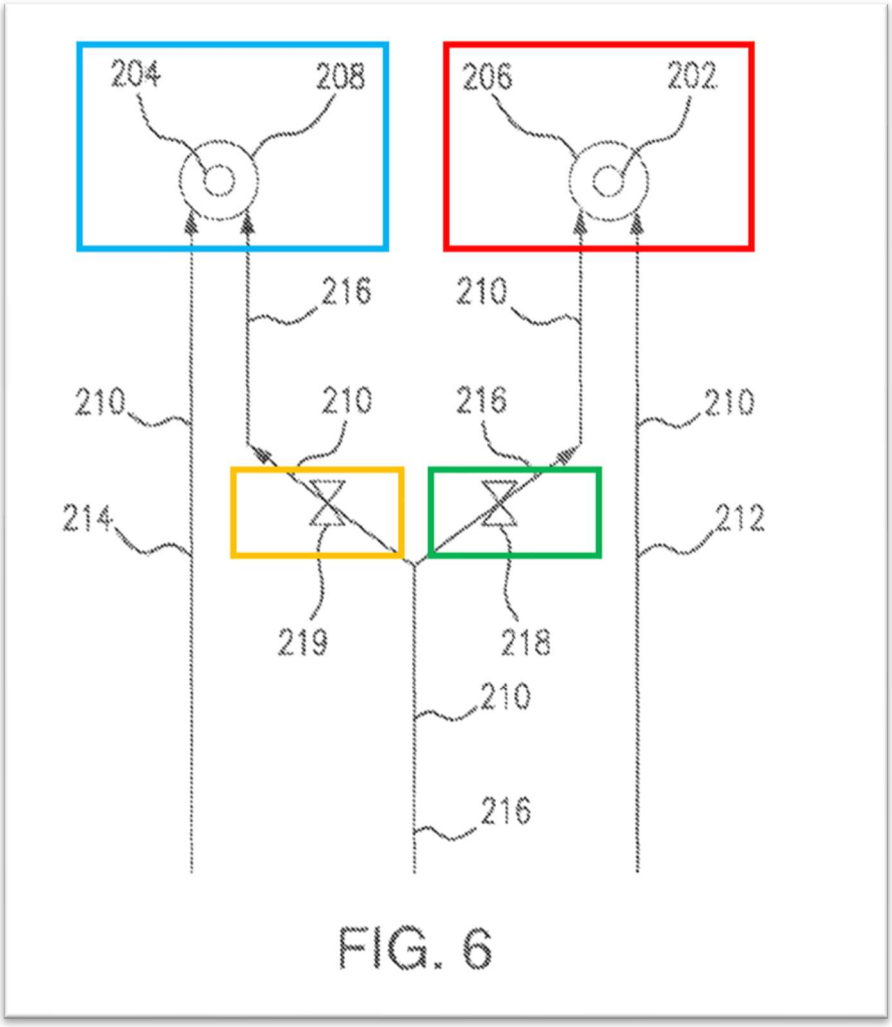
b. <u>18.2: "wherein step (c) comprises opening the fourth valve associated with the fourth well to permit pumping of fluid into the fourth well via the fourth valve; and"</u>

263. As discussed above regarding Claim 16, *Ciezobka* discloses, or at least renders obvious, a fourth valve associated with the fourth well and opening the valve

[202] Ex. 1037 at 28:22-23.

to permit hydraulic fracturing. Applying the teachings of *Ciezobka* as discussed in Claim 16, *Ciezobka* discloses (or at least renders obvious) pumping fluid to the plurality of wells, including the fourth well. *Ciezobka* discloses "the high-pressure fracturing pump provides a first total flow rate **220** to the first wellhead **202** [annotated in red] and a second total flow rate **230** to the second wellhead **204** [annotated in blue]. Initially, both valves **218** [sic **218**, **219**, annotated in green, yellow] are open allowing the third percentage of the flow rate to be provided to both of the wellheads **202**, **204**."[203]

[203] Ex. 1037 at 12:5-8.



Ciezobka, Fig. 6

264. As discussed above regarding Claim 16, a POSITA would have understood the teachings of *Ciezobka* to contain "variations [that] may utilize multiple wells,"[204] with no limitation on the number of wells. Further, a POSITA would have found it obvious to apply the teachings of *Ciezobka* to a third well, fourth well and any number of wells, as discussed regarding Claim 16. Accordingly, a

[204] Ex. 1037 at 28:22-23.

POSITA would have understood *Ciezobka* to disclose, or at least suggest, opening a fourth valve to allow the pumping of hydraulic fracturing fluid into a fourth well in the same manner as *Ciezobka* discloses opening a second valve to enable the pumping of fluid into a second well. Thus, *Ciezobka* discloses, or at least renders obvious, wherein step (c) [permitting hydraulic fracturing of the fourth well] comprises opening the fourth valve associated with the fourth well to permit pumping of fluid into the fourth well via the fourth valve.

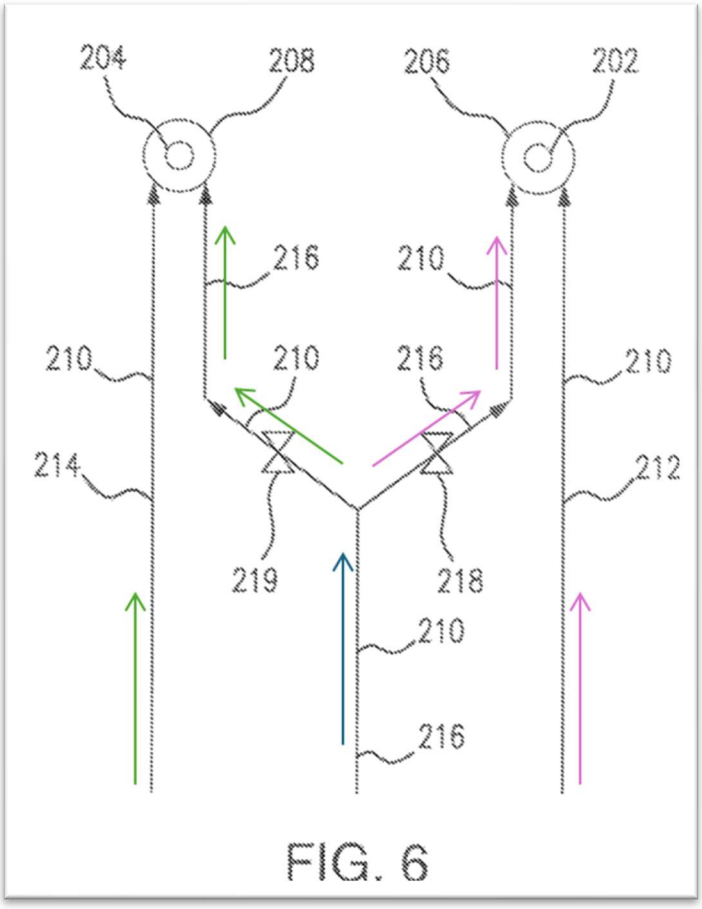
265. Accordingly, *Ciezobka* discloses, or at least renders obvious, Limitation 18.2.

c. 18.3.1: "wherein step (d) comprises opening the third valve associated with the third well to permit pumping of fluid into the third well via the third valve; and"

266. As discussed above regarding 15.4.1, *Ciezobka* teaches hydraulic fracturing of the first well by opening the first valve associated with the first well. As discussed above regarding Limitation 1.1.2, *Ciezobka* discloses pumping fluid to a first wellhead as part of a hydraulic fracturing operation and that valves associated with the flowlines "can be opened and closed to restrict a flow of fluid to the wellbore."[205] This would include valves **218** and **219**, shown in Fig. 6. As the valves are opened and closed to "restrict a flow of fluid to a wellbore" a POSITA would

[205] Ex. 1037 at 11:21-22.

have understood that the hydraulic fracturing fluid is pumped into the first well (*e.g.*, **218**) via a first valve associated with the first well (*e.g.*, **202**). Pink flow lines annotate fluid flow into the first well and are the result of valve **218** being opened.



Ciezobka, Fig. 6

267. The resulting flow rates and pressures are shown in Fig. 7, with the location of "opening the first valve" annotated in red.

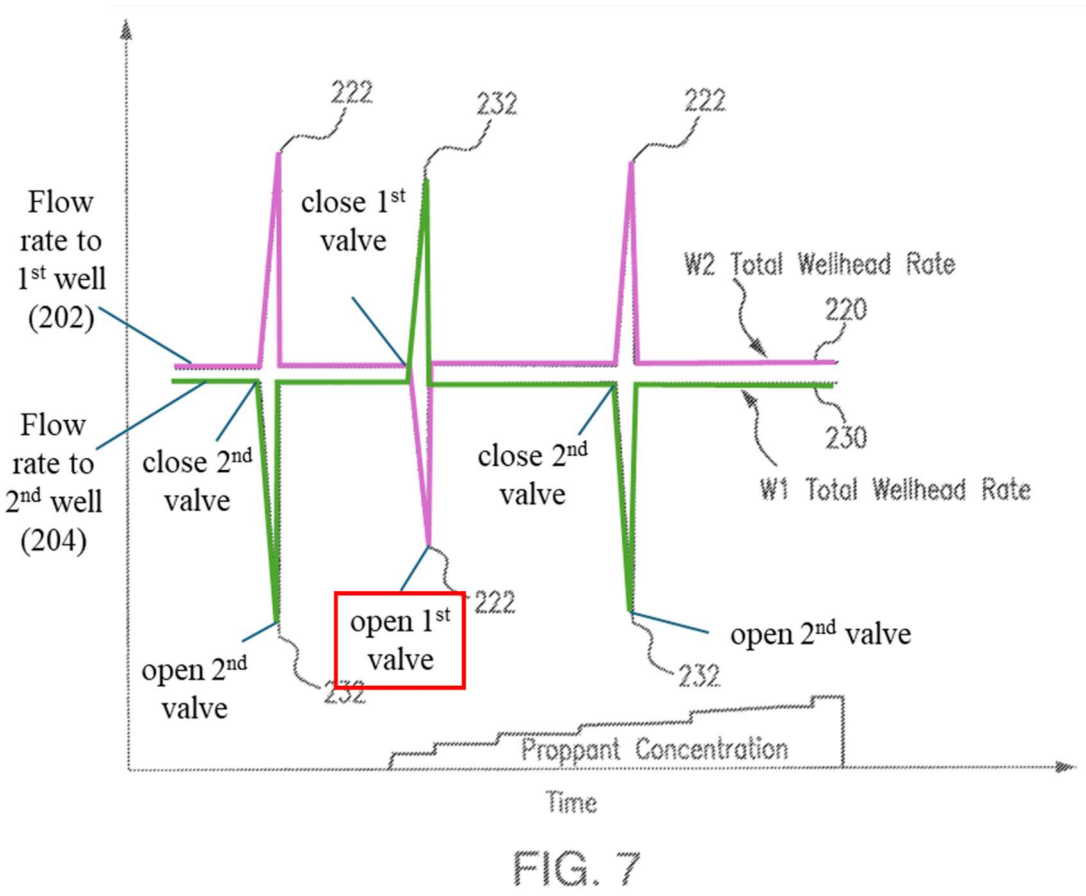


FIG. 7

Ciezobka, Fig. 7

268. As discussed above regarding Claim 16, a POSITA would have understood the teachings of *Ciezobka* to contain "variations [that] may utilize multiple wells,"[206] with no limitation on the number of wells. Further, a POSITA would have found it obvious to apply the teachings of *Ciezobka* to a third well, fourth well, and any number of wells, as discussed regarding Claim 16. Accordingly, a POSITA would have understood *Ciezobka* to disclose, or at least suggest, opening a third valve to allow pumping of hydraulic fracturing fluid into a third well in the

[206] Ex. 1037 at 28:22-23.

same manner as *Ciezobka* discloses, or at least renders obvious, opening a first valve to allow pumping of fluid into a first well. Accordingly, *Ciezobka* discloses Limitation 18.3.1.

d. <u>18.3.2: "closing the fourth valve associated with the fourth well."</u>

269. *Ciezobka* discloses, or at least suggests, this limitation. As described above regarding Limitation 15.4.1, *Ciezobka* teaches that, during a fracturing process, both diverter valves **218** and **219** "are open allowing" fluid flow "to be provided to both of the wellheads **202**, **204**."[207] The second diverter valve **219** (*e.g.*, second valve) is then closed for a "short period of time" while the first diverter valve **218** (*e.g.*, first valve) remains open to provide decreased flow rate (shown as **232** in Fig. **7**) to the second well **204** and increased flow rate (shown as **222** in Fig. 7) to the first well **202** for a "short period of time."[208] This increases flow rate into the first well and "caus[es] a temporary increase of pressure leading to opening new fractures."[209] This is shown in annotated Fig. 7 below, with the location of the closing of the second valve identified in red.

[207] Ex. 1037 at 12:7-8.

[208] Ex. 1037 at 12:9-11.

[209] Ex. 1037 at 4:1-2.

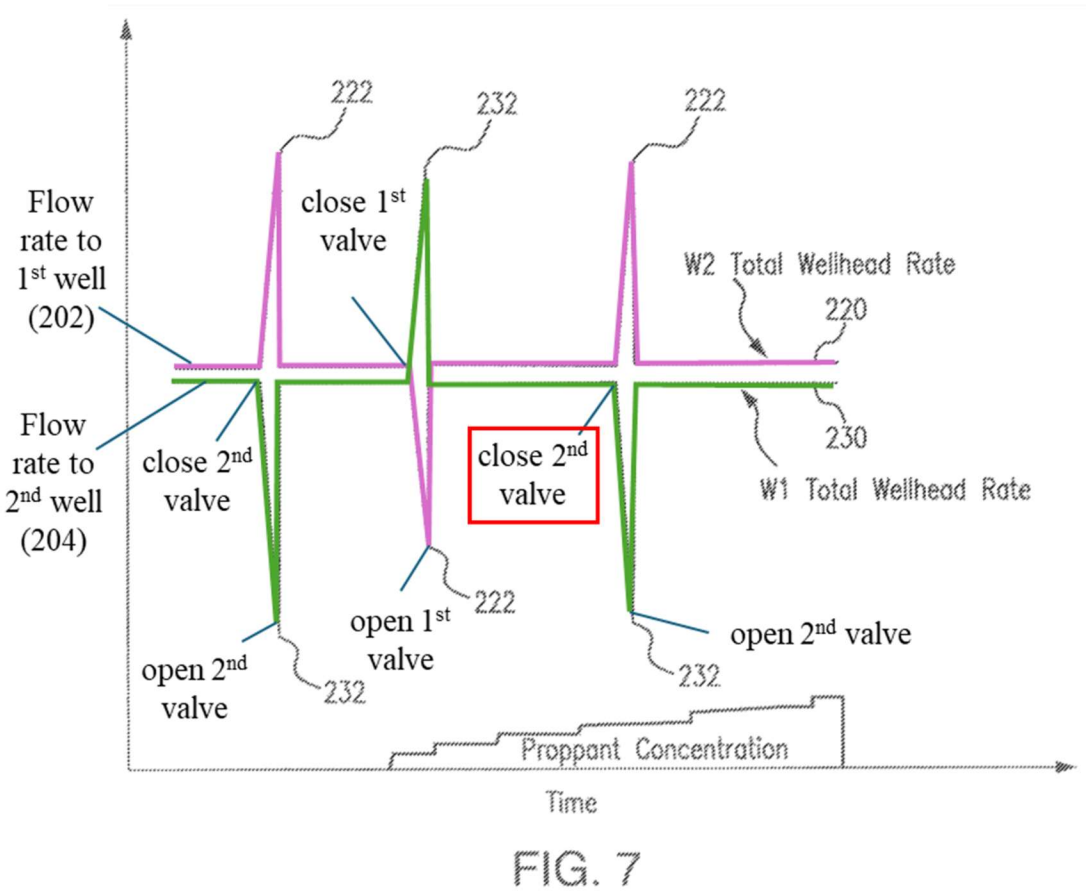


FIG. 7

Ciezobka, Fig. 7

270. Fig. 7 of *Ciezobka*As discussed above regarding Claim 16, a POSITA would have understood the teachings of *Ciezobka* to contain "variations [that] may utilize multiple wells,"[210] with no limitation on the number of wells. Further, a POSITA would have found it obvious to apply the teachings of *Ciezobka* to a third well, fourth well and any number of wells, as discussed regarding Claim 16. Accordingly, a POSITA would have understood *Ciezobka* to disclose, or at least suggest, closing a fourth valve in the same manner as *Ciezobka* discloses closing a

[210] Ex. 1037 at 28:22-23.

second valve. Accordingly, *Ciezobka* discloses, or at least renders obvious, Limitation 18.3.2.

271. Accordingly, *Ciezobka* anticipates and/or renders obvious Claim 18 for the reasons discussed above.

M. INDEPENDENT CLAIM 25

272. It is my opinion that *Ciezobka* discloses Claim 25 or at least renders obvious Claim 25 of the '779 Patent. With the exception of this being an "apparatus" claim, and the claim further containing a description of the structure of the apparatus, namely known computer elements for executing instructions, Claim 25 is essentially similar to Claim 15. It would have been obvious to perform Claim 15's method with a computer, such that the method steps may be performed more safely and efficiently. As discussed below, *Ciezobka* contains disclosure of the structure of the apparatus that is equivalent to that of Claim 25 of the '779 Patent.

a. 25.1: "An apparatus adapted to hydraulically fracture first and second wells, the first and second wells being associated with first and second valves, respectively, the apparatus comprising:"

273. For the same reasons discussed above regarding Limitation 15.1, *Ciezobka* discloses a system for hydraulically fracturing first and second wells, the first and second wells being associated with first and second valves. Additionally, for the same reasons discussed above regarding Limitations 8.1.1-8.2.2, *Ciezobka* discloses, or renders obvious, using an apparatus having a non-transitory computer

readable medium and a plurality of instructions stored on the non-transitory computer readable medium and executable by one or more processors, wherein, when the one or more processors execute the instructions, the claimed steps are executed.

b. 25.2: "a non-transitory computer readable medium; and"

25.3: "a plurality of instructions stored on the non-transitory computer readable medium and executable by one or more processors, wherein, when the instructions are executed by the one or more processors, the following steps are executed:"

274. Limitations 25.2 and 25.3 are identical to Limitations 8.1.2-8.2.2 and are disclosed or rendered obvious by *Ciezobka* for the same reasons as those described above regarding Claim 8 in Section XI.E(a).

c. **25.4: "(a) permitting hydraulic fracturing of the second well, comprising: opening the second valve associated with the second well to permit pumping of fluid into the second well via the second valve; and**

25.5: "measuring a flow rate of the fluid being pumped into the second well;"

25.6.1: "(b) swapping from permitting hydraulic fracturing of the second well to permitting hydraulic fracturing of the first well, comprising:"

25.6.2: "opening the first valve associated with the first well to permit pumping of fluid into the first well via the first valve; and"

25.6.3: "closing the second valve associated with the second well;"

25.7: "wherein, during step (b), hydraulic fracturing fluid is continuously pumped to the first and second valves via a hydraulic manifold; and"

25.8: "wherein in response to determining that the flow rate measured at step (a) has satisfied one or more flow rate conditions, the first valve associated with the first well is opened at step (b) before the second valve associated with the second well is closed at step (b);"

25.9: "or in response to determining that the flow rate measured at step (a) has not satisfied one or more flow rate conditions, the first valve associated with the first well is opened at step (b) during or after the second valve associated with the second well is closed at step (b)."

275. The language in claim Limitations 25.4 through 25.9 is identical to Limitations 15.2 through 15.7. *Ciezobka* discloses Limitations 25.4 through 25.9 for the same reasons as those discussed regarding 15.2 through 15.7 in Section XI.I(b)-

(h). It would have been obvious for *Ciezobka*'s software toolbox to execute the step disclosed by *Ciezobka* in Limitations 25.4 through 25.9 to provide "real time application in the field" of "all of the data handling and data analysis elements" and operation of the system based on the data.

276. In view of the above, the combination of *Ciezobka* discloses, or at least renders obvious, each and every element of Claim 25. Once the pulse flowrate

277. Accordingly, *Ciezobka* renders obvious Claim 25 for the reasons discussed above.

N. DEPENDENT CLAIM 26

a. 26.1: "26. The apparatus of claim 25, wherein the apparatus is further adapted to hydraulically fracture third and fourth wells, the third and fourth wells being associated with third and fourth valves, respectively; and wherein, when the instructions are executed by the one or more processors, the following steps are also executed"

278. Other than depending from Claim 25 and being an apparatus claim with computer language to execute the steps (which is already discussed concerning to Claim 25), this limitation is substantially similar to 16.1 and is disclosed or rendered obvious by *Ciezobka* for the same reasons as those discussed regarding 16.1 in Section XI.J(a).

b. 26.2: "(c) permitting hydraulic fracturing of the fourth well;"

279. Other than depending from Claim 25 and being an apparatus claim, this limitation is substantially similar to 16.2 and is disclosed or rendered obvious by *Ciezobka* for the same reasons as those discussed regarding 16.2 in Section XI.J(b).

c. 26.3: "(d) swapping from permitting hydraulic fracturing of the fourth well to permitting hydraulic fracturing of the third well.

280. Other than depending from Claim 25 and being an apparatus claim, this limitation is substantially similar to 16.3 and is disclosed or rendered obvious *Ciezobka* for the same reasons as those discussed regarding 16.3 in Section XI.J(c).

281. In view of the above, *Ciezobka* discloses, or at least renders obvious, each and every limitation of Claim 26.

282. Accordingly, *Ciezobka* renders obvious Claim 26 for the reasons discussed above.

O. DEPENDENT CLAIM 27

283. *Ciezobka* discloses, or at least suggests, Claim 27 of the '779 Patent. Further detail is provided below.

a. "27. The apparatus of claim 26, wherein steps (a) and (c) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold; and wherein steps (b) and (d) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold."

284. Other than depending from Claim 26 and being an apparatus claim, this limitation is substantially similar to Claim 17 and is disclosed or rendered obvious by *Ciezobka* for the same reasons as those discussed regarding Claim 17 in Section XI.K.

285. Accordingly, *Ciezobka* renders obvious Claim 27 for the reasons discussed above.

P. DEPENDENT CLAIM 28

286. *Ciezobka* discloses, or at least renders obvious, Claim 28 of the '779 Patent. Further detail is provided below.

a. 28.1: "28. The apparatus of claim 26, wherein, during step (d), hydraulic fracturing fluid is continuously pumped to the third and fourth valves via the hydraulic manifold;"

287. Other than depending from Claim 26 and being an apparatus claim, this limitation is substantially similar to Claim 18.1 and is disclosed or rendered obvious by *Ciezobka* for the same reasons as those discussed regarding Claim 18.1 in Section XI.L(a).

b. 28.2: "wherein step (c) comprises opening the fourth valve associated with the fourth well to permit pumping of fluid into the fourth well via the fourth valve; and"

288. Other than depending from Claim 26 and being an apparatus claim, this limitation is substantially similar to Claim 18.2 and is disclosed or rendered obvious by *Ciezobka* for the same reasons as those discussed regarding Claim 18.2 in Section XI.L(b).

c. 28.3.1: "wherein step (d) comprises: opening the third valve associated with the third well to permit pumping of fluid into the third well via the third valve; and"

28.3.2: "closing the fourth valve associated with the fourth well."

289. The language in Limitations 28.3.1 and 28.3.2 is identical to that in Limitations 18.3.1 and 18.3.2 in Claim 18 and is disclosed or rendered obvious by *Ciezobka* for the same reasons as those discussed regarding Limitation 18.3 in Section XI.L(c)-(d).

290. In view of the above, *Ciezobka* renders obvious Claim 28.

Q. DEPENDENT CLAIM 31

291. Dependent Claim 31 depends from Claim 25. In addition to the disclosure of the limitations of Claim 25 discussed above, *Ciezobka* discloses the additional limitations of Claim 31:

a. 31.1: "31. The method of claim 25, wherein the flow rate measured at step (a) has satisfied the one or more flow rate conditions when the flow rate measured at step (a) is below an upper flow rate threshold, above a lower flow rate threshold, or both; and"

292. This claim limitation merely sets forth optional flowrate measurements, including flowrates below an upper flowrate threshold, above a lower flowrate threshold, or both, and thus only one needs to be shown in the prior art.

293. As discussed above regarding Limitation 1.2, the combination of *Ciezobka* discloses, or at least renders obvious to a POSITA, measuring a flow rate. *Ciezobka* teaches a total flow rate pumped to each well. Further, *Ciezobka* teaches several specific thresholds such as "90 bpm," "45 bpm," and "20 bpm." Further, *Ciezobka* teaches several percentage flowrate thresholds for the pulses, including "from 10% to nearly 100% lower," "25% to 75% lower," and "50% lower" than the primary flowrate. [211] A POSITA would understand that a flow rate that is between 25% to 75% lower than the primary flow rate, as described by *Ciezobka*, to be both above a lower flowrate threshold (75% lower) and below an upper threshold (25% lower). Similarly, a flow rate between 10% to nearly 100% lower would be both above a lower flow rate threshold (100% lower) and below an upper threshold (10% lower).

[211] See, *Ciezobka*, *e.g.*, pages 3-4, generally.

294. To the extent *Ciezobka* does not explicitly call the identified flowrates thresholds, it would have been obvious to apply the various flowrates, such as percentages or explicit flowrates, as thresholds to determine that the pulse is performing as desired. Moreover, this is standard practice for any flow system—if a measured flowrate is inside or outside the required flowrate, then a flowrate condition is met or not met. Accordingly, *Ciezobka* discloses, or at least renders obvious, Limitation 31.1

b. <u>31.2: "wherein the flow rate measured at step (a) has not satisfied the one or more flow rate conditions when the flow rate measured at step (a) is above the upper flow rate threshold or below the lower flow rate threshold.</u>

295. Claim Limitation 31.2 essentially defines the portion excluded by claim Limitation 31.1. In other words, claim Limitation 31.2 merely says that if the flowrate conditions in claim Limitation 31.1 are not met, then the flow rate measured at step (a) "has not been satisfied." Thus, this limitation does not add anything more technically to Claim 31 other than the use of the phrase "not met." Because *Ciezobka* discloses meeting certain flow rate thresholds, as discussed above, *Ciezobka* also discloses that when the flow rate does not meet the desired threshold, whether it is above an upper threshold or lower than a lower threshold, the measured flow rate "has not satisfied the one or more flow rate conditions." Moreover, this is standard practice for any flow system—if a measured flow rate is outside the required flow rate, then a flow rate condition is not met.

296. *Ciezobka* discloses, or at least renders obvious, each and every limitation of Claim 31. Accordingly, Claim 31 would have been at least obvious to a POSITA in light of the disclosures of *Ciezobka* alone for the reasons discussed above.

297. Accordingly, *Ciezobka* renders obvious Claim 31.

R. DEPENDENT CLAIM 36

298. Dependent Claim 36 depends from Claim 15. In addition to the disclosure of the limitations of Claim 15 discussed above, *Ciezobka* discloses the additional limitations of Claim 36:

a. **36.1: "36. The method of claim 15, wherein the flow rate measured at step (a) has satisfied the one or more flow rate conditions when the flow rate measured at step (a) is below an upper flow rate threshold, above a lower flow rate threshold or both and"**

36.2: "wherein the flow rate measured at step (a) has not satisfied the one or more flow rate conditions when the flow rate measured at step (a) is above the upper flow rate threshold or below the lower flow rate threshold."

299. With the exception of depending from Claim 15, Limitations 36.1-36.2 are identical to Limitations 31.1-31.2 and are disclosed and/or rendered obvious by *Ciezobka* for the same reasons as those discussed above regarding 31.1-31.2 in Section XI.Q.

300. In view of the above, the *Ciezobka* anticipates Claim 36, or at least renders Claim 36 obvious in view of *Ciezobka* alone.

XII. GROUND 3: CLAIMS 6, 8-10, 13, 16-18, 25-28, AND 31 ARE OBVIOUS OVER THE COMBINATION OF CIEZOBKA AND MCNEEL

301. As discussed above regarding Grounds 1 and 2 (incorporated herein), it is my opinion that *Ciezobka* discloses, or at least renders obvious, Claims 1-3, 6, 8- 10, 13, 15-18, 25-28, 31, and 36 of the '779 Patent. To the extent *Ciezobka* alone does not anticipate or render obvious Claims 1-3, 6, 8- 10, 13, 15-18, 25-28, 31, and 36*,* it is my further opinion that the combination of *Ciezobka* and *McNeel* discloses and/or suggests all limitations of Claims 1-3, 6, 8- 10, 13, 15-18, 25-28, 31, and 36, thereby rendering these claims obvious. Ground 3 incorporates by reference the discussion of Grounds 1 and 2 above. The relevant limitations disclosed by *McNeel* are presented below. All other elements of claims 1-3, 6, 8-10, 13, 15-18, 25-28, 31, 36 are disclosed or rendered obvious by *Ciezobka* as described above in Grounds 1 and 2. Although disclosed, or at least rendered obvious by *Ciezobka*, *McNeel* provides additional disclosure regarding a third and fourth well with associated valves and electronic monitoring and control of valves recited in certain claims as addressed below.

A. RATIONALE AND MOTIVATION FOR COMBINING *CIEZOBKA* WITH *MCNEEL*

302. A POSITA would have been motivated to combine *McNeel* with *Ciezobka. McNeel* is in the same field of endeavor of oil and gas well systems as *Ciezobka* (as well as the '779 Patent) and is directed to solving the same problem –

controlling well operations, particularly fracturing operations. *Ciezobka* is directed to "[a] hydraulic fracturing system and method for enhancing effective permeability of earth formations to increase hydrocarbon production."[212] *McNeel* is directed "generally to well operations, and more particularly to methods and apparatuses for simultaneously treating multiple wells from a centralized location and simultaneously connecting multiple wells to a single manifold, so as to conserve labor, infrastructure, and environmental impact."[213]

303. Both *Ciezobka* and *McNeel* address the introduction of a fracturing fluid, including proppant into wells to be fractured, the fluid being pressurized by one or more pressure pumps. *Ciezobka* teaches "[t]he manifold receives the fracturing fluid, with or without proppant, at a low pressure from the pre-blender or the slurry-blender and distributes the fluid and/or slurry to the high-pressure fracturing pumps. The manifold then receives the fluids at a high pressure from the high-pressure fracturing pumps and directs the fluid to a ground iron leading to the wellhead and wellbore."[214] *McNeel* similarly teaches "a well operations factory that manufactures and pumps a well treatment fluid, a first connection between a first well location and the factory, and a second connection between a second well

[212] Ex. 1037 at Abstract.

[213] Ex. 1038 at [0001]

[214] Ex. 1037 at 3:10-14.

location and the factory. The "well treatment operations factory comprises a means for simultaneously flowing a first stimulation fluid to the first well location via the first connection and a second stimulation fluid to the second well location via the second connection."[215] Further, *McNeel* discloses that its system "can be used to stimulate wells simultaneously or singly."[216]

304. *Ciezobka* teaches that its process "variations may utilize multiple wells or multiple fluid flow lines to the wellhead or from one or more pumps."[217] There are no limitations on the number of "multiple" wells or "one or more" pumps in *Ciezobka.* From this, a POSITA would have understood that *Ciezobka*'s process could be applied to two, three, four or more wells.

305. *McNeel* explicitly teaches hydraulic fracturing operations at a third well and fourth well. *McNeel* teaches, about Fig. 2, "the means for simultaneously flowing treatment fluid is a central manifold **107**. The central manifold **107** is connected to the pumping grid **111** and is operable to flow stimulation fluid, for example, to multiple wells at different pads simultaneously."[218] *McNeel* further

[215] Ex. 1038 at [0006].

[216] Ex. 1038at [0025].

[217] Ex. 1037 at 28:22-23.

[218] Ex. 1038 at [0023].

discloses "[t]he manifold **107** is operable to treat simultaneously two separate wells, for example, as shown in FIG. 2 via connections **204** and **205**."[219]

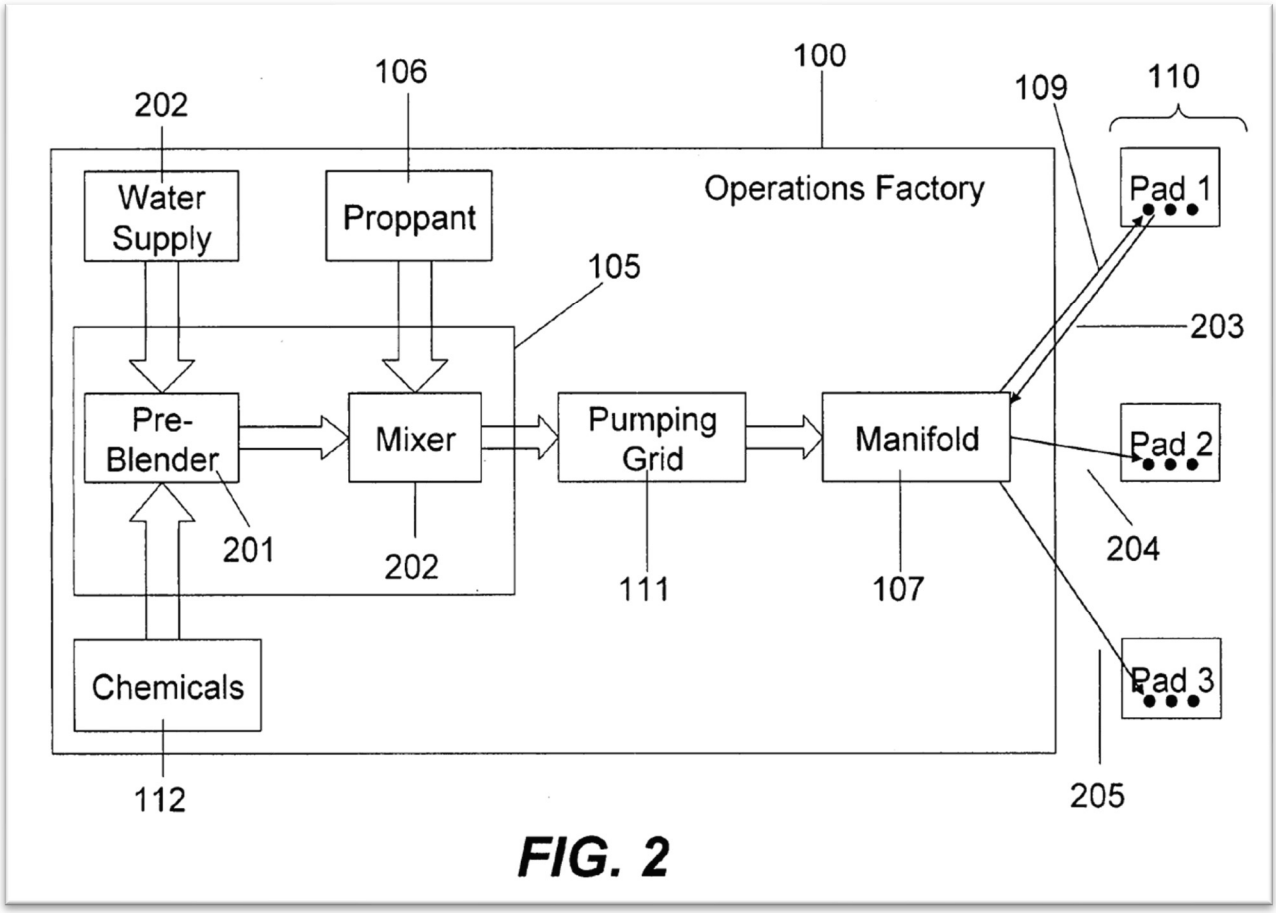


FIG. 2

McNeel, Fig. 2

306. While Fig. 2 shows the fracturing of three wells via connections **203**, **204** and **205**, *McNeel* further clarifies that the same process can be applied to even more wells. For example, "[i]n reference to FIG. 4, in one embodiment, the central

[219] *Id*.

manifold **107** can be connected to one or more additional manifolds **405**. The additional manifolds are operable to connect to multiple well locations **401**-**404** and deliver well treatment fluids and receive production fluids via connections **406**-**409**, respectively, in the same way as the central manifold **107** described above."[220]

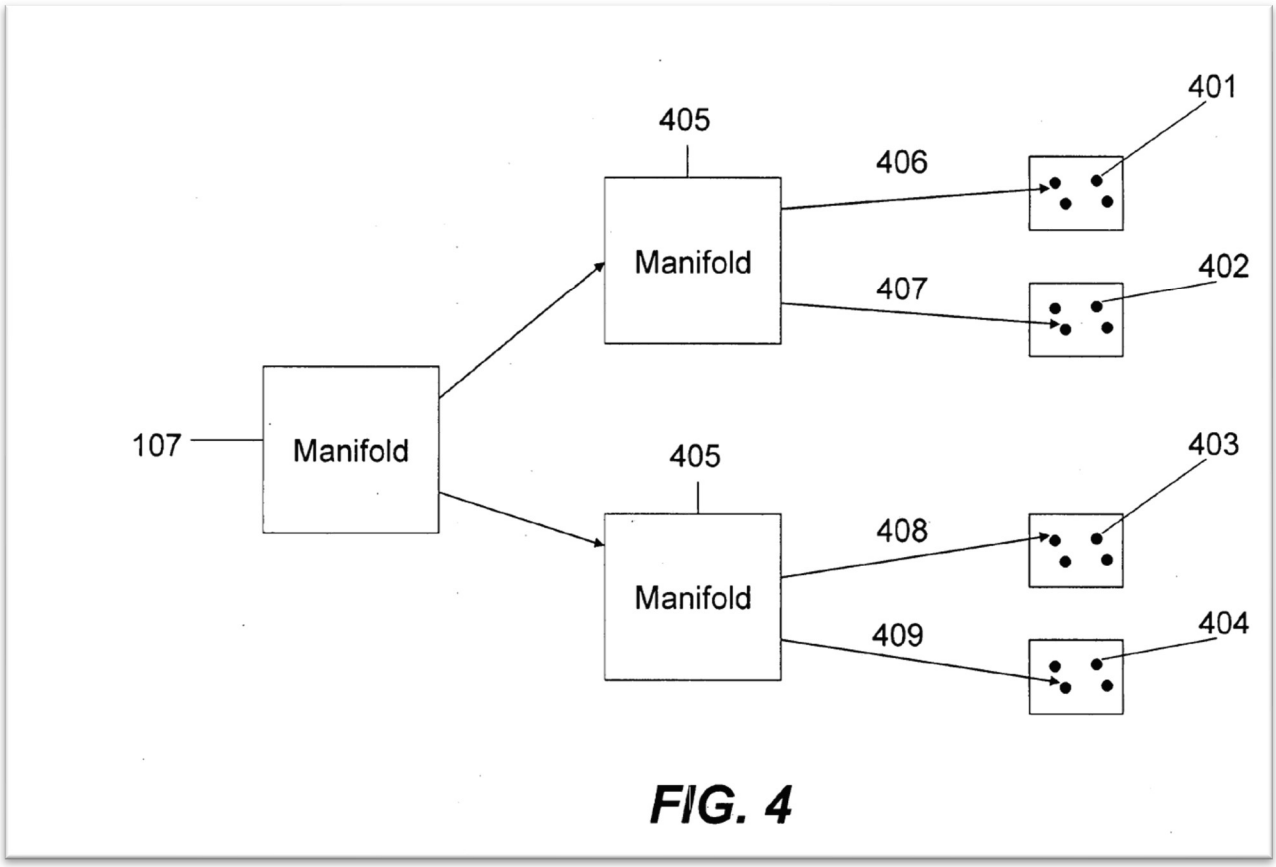


FIG. 4

McNeel,

307. *McNeel* further explicitly discloses that, like *Ciezobka*, fracturing fluid is pumped to the wells (*e.g.*, via a "pumping grid" as shown in Fig. 2) and that "each

[220] Ex. 1038 at [0024]

line can further include a pressure sensor and an additional valve."[221] *McNeel* teaches that the operations of the fracturing system "are controlled, coordinated, and monitored by a central control system. The central control system may use all of the sensor data from all unit and the drive signals from their individual subcontrollers."[222]

308. A POSITA would have been motivated to include *McNeel*'s teachings of third and fourth wells to improve the system of *Ciezobka* by gaining the benefits of *Ciezobka* at more than one location. For example *Ciezobka* teaches its system "increase[s] hydrocarbon production, enhance[s] operation efficiency…, open[s] perforations that are either unopened or not effective, as well as reducing entry friction … during multi stage hydraulic fracturing."[223] *McNeel* has similar goals of efficiency such as "to conserve labor, infrastructure and environmental impact."[224] The combination of the teachings of both *Ciezobka* and *McNeel* allow a system that gains the efficiency benefits of both disclosures. To the extent that *Ciezobka* does not already teach applying its pulse technique to a third and fourth well, a POSITA would be motivated to use connections to the third and fourth wells of *McNeel* into

[221] Ex. 1038 at [0008].

[222] Ex. 1038 at [0029].

[223] Ex. 1037 at Abstract.

[224] Ex. 1038 at [0001].

the fracturing system of *Ciezobka* at least for the reasons described above. A POSITA would recognize that combining the teachings of *Ciezobka* and *McNeel* is simply applying the teachings of *McNeel* regarding a third and fourth well to the disclosure of *Ciezobka* which is ready for improvement (e.g., applying teachings to a third and fourth well.) Further, a POSITA would recognize that the combination of *Ciezobka* and *McNeel* is the use of a known technique (fracture flow to a third and fourth well) to the known method of *Ciezobka* and used in the same way to improve fracturing efficiencies. A POSITA would, therefore, have had a reasonable expectation of success in combining *Ciezobka* with *McNeel* for the same reasons.

B. CLAIMS 6, 8-10, AND 13

309. As discussed in Grounds 1 and 2, *Ciezobka* discloses, or at least renders obvious, the methods/apparatuses of Independent Claims 1 and 8. To the extent *Ciezobka* does not disclose or render obvious the computer elements of Independent Claim 8, they are disclosed, or at least rendered obvious by, *McNeel* for the reasons discussed below. As discussed in Grounds 1 and 2, *Ciezobka* also discloses, or renders obvious the limitations in the claims depending from Independent Claim 8, including Claims 9, 10, and 13. Thus, Claims 9, 10, and 13 would have been obvious over *Ciezobka* and *McNeel* for at least the same reasons. Further, Claim 6 (depending from Independent Claim 1) and Claim 13 (depending from Independent Claim 8) are identical and each recite that the first and second valves are "zipper

valves." To the extent that the Board determines that a "zipper valve" is not explicitly disclosed by *Ciezobka,* then it would have been obvious to a POSITA with general engineering knowledge regarding such operations that the valves associated with McNeel's manifolds would have been "zipper valves," as discussed below. Because of these claims' relationships, they are discussed together below.

a. Independent Claim 8 and Claim 10:

8.1.1: "An apparatus comprising:"

8.1.2: "a non-transitory computer readable medium; and"

8.2.1: "a plurality of instructions stored on the non-transitory computer readable medium and executable by one or more processors,"

8.2.2: "wherein, when the instructions are executed by the one or more processors, the following steps are executed:"

310. As discussed above regarding Grounds 1 and 2, *Ciezobka* discloses, or at least renders obvious, the use of a generic computer to control the switching of valves. *Ciezobka* discloses using "a software toolbox which incorporates all of the data handling and data analysis elements for real time application in the field during hydraulic fracturing operations."[225] A POSITA would have understood that the description of using the software toolbox "real time in the field" to necessitate a

[225] Ex. 1037 at 27:26-28.

generic computing device, such as described in 8.1.1 – 8.2.2, to be "in the field" at the location of the hydraulic fracturing. Further, A POSITA would have also recognized that using the computer for "all of the data handling and data analysis elements" requires the computer to be connected to the system of *Ciezobka* in such a way that all flow rate measurements, pressure measurements, proppant concentrations, etc. are fed into the computer for "real time application in the field."

311. To the extent that *Ciezobka* does not explicitly disclose using the computer used for "data handing and data analysis elements" for "real time in the field" control of the valves, *McNeel* teaches such an arrangement. *McNeel* teaches the use of valves, along with sensors to control the fracturing operations. Further, *McNeel* teaches that "[t]hese valves may be either plug valves or check valves and can be manually or electronically monitored and controlled."[226] *McNeel* further teaches that the operations of the fracturing system "are controlled, coordinated, and monitored by a central control system. The central control system may use all of the sensor data from all unit and the drive signals from their individual subcontrollers."[227] A POSITA would have understood that, based on the teaching of "electronically controlled" valves, and a "central control system," it would have been obvious to use a computing device to control the valves, particularly at the time

[226] Ex. 1038 at [0025]; *see also* [0026].

[227] Ex. 1038 at [0029].

of the ’779 Patent (2021). Such computer control systems had been used in fracturing operations for decades by the time of the ’779 Patent. To the extent that using a computer, as claimed in Claim 8, to control the valve switching is not explicitly disclosed by *McNeel* or *Ciezobka,* it would have been obvious to a POSITA at the time of the ’779 Patent application to use a computer control system for valve control to execute steps 8.3-8.10 (as discussed with respect to Limitations 1.1.2-1.8). Accordingly, the combination of *Ciezobka* and *McNeel* renders obvious Limitations 8.1.2 – 8.2.2.

> **8.3: “(a) permitting performance of a first hydraulic fracturing operation on a first well, which first hydraulic fracturing operation comprises pumping fluid into the first well via a first valve associated with the first well, and**
>
> **8.4: measuring a flow rate of the fluid being pumped into the first well; and**
>
> **8.5: (b) determining that the flow rate of the fluid being pumped into the first well is below a flow rate threshold and**
>
> **8.6: has been below the flow rate threshold for a threshold amount of time;**
>
> **8.7: (c) during pumping of the fluid into the first well via the first valve, opening a second valve associated with a second well;**
>
> **8.8: (d) permitting performance of a second hydraulic fracturing operation on the second well, which second hydraulic fracturing operation comprises pumping fluid into the second well via the second valve; and**

8.9: (e) during pumping of the fluid into the second well via the second valve, closing the first valve associated with the first well;

8.10: wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped to the first valve, the second valve, or both the first valve and the second valve.

312. With the exception of being rewritten as an apparatus claim, the language in Claim Limitations 8.3 through 8.10 is identical to that of Limitations 1.1 through 1.8. *Ciezobka* discloses or at least renders obvious Limitations 8.3 through 8.10 for the same reasons as those discussed regarding Limitations 1.1 through 1.8 in Section XI.A(a)-(i).

313. It would have been obvious for *Ciezobka*'s software toolbox in *McNeel's* control system to execute the steps disclosed by *Ciezobka* in Limitations 8.3 through 8.10 to provide "real time application in the field" of "all of the data handling and data analysis elements" and operation of the system based on the data. In view of the above, *Ciezobka* and *McNeel* disclose or render obvious each and every element of Claim 8. Accordingly, *Ciezobka* and *McNeel* render obvious Claim 8 for the reasons discussed above. As discussed in Sections XI.C and XI.G, *Ciezobka* also discloses the limitations in Claim 10, which depends from Independent Claim 8. Accordingly, *Ciezobka* and *McNeel* render obvious Claim 10 for the same reasons discussed above.

b. Claim 6, 9, and 13

Claims 6 and 13: "wherein each of the first and second valves is a zipper valve."

Claim 9: "wherein each of the first and second valves is in fluid communication with a hydraulic manifold from which fluid is pumped to the first valve and/or the second valve; and wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped from the hydraulic manifold to the first valve, the second valve, or both the first valve and the second valve."

314. As discussed in Grounds 1 and 2, *Ciezobka* teaches using a manifold that receives fracturing "fluids at a high pressure from the high-pressure fracturing pumps and directs the fluid to a ground iron leading to the wellhead and the wellbore."[228] Further still, "the flow line comprises a plurality of pipes which connect the high-pressure fracturing pumps, through a single or multiple common manifolds, to a wellhead of the wellbore," and the flow lines include a valve "that can be opened and closed to restrict a flow of fluid to the wellbore."[229] A POSITA would have understood, based on the teachings of *Ciezobka*, that the flow lines and their valves are supplied fluid "through a single or multiple common manifolds." A POSITA would also have understood that *Ciezobka*'s manifold connected to multiple wells is a "zipper manifold," as it is used to distribute fluid from one of the "common manifolds" to the multiple wells, and the associated valves to be "zipper

[228] Ex. 1037 at 3:10-14.

[229] Ex. 1036 at 3:16-20; 11:21-22.

valves," as they are "operably coupled to, and adapted [to] communicate fluid between the zipper manifold … and the well," as described in the '779 Patent.[230] To the extent that the Board determines *Ciezobka* does not disclose a zipper manifold and associated zipper valves, it would have been obvious to a POSITA to use the manifold/valve systems of *McNeel*, which are used as zipper manifolds and associated zipper valves to selectively distribute fracturing fluid from a central location to multiple wells.

315. As shown in Figs. 2 and 4 of *McNeel*, reproduced below, *McNeel* teaches a "central manifold **107** can be connected to one or more additional manifolds **405**. The additional manifolds are operable to connect to multiple well locations **401**-**404** and deliver well treatment fluids" "for simultaneously treating multiple wells from a centralized location."[231] The multiple manifolds of Fig. 4 (*i.e.*, 107 and 405) are used for the same purpose as manifold 107 in Fig. 2, that is, to treat multiple wells simultaneously.[232] In the case of Fig. 4, at least four wells are explicitly represented. Thus, *McNeel's* manifolds would have been considered to function in the same way and for the same purpose as a "zipper manifold." Further, lines connecting *McNeel's* manifolds to the multiple wells each have at least one

[230] Ex. 1001 at 7:58-61.

[231] Ex. 1038 at [0001] and [0024].

[232] Ex. 1038 at [0023].

valve that are opened and closed to communicate fluid between the manifold and each well.[233] As fracturing fluid is (continuously) pumped to the manifold and associated valves, selected valve(s) may be opened or closed to allow or restrict the fluid flow to the associated well from the manifold.[234] Thus, *McNeel's* valves would have been considered to function in the same way and for the same purpose as "zipper valves" and in the same way and purpose as *Ciezobka's* first and second

[233] Ex. 1038 at [0025].

[234] Ex. 1038 at [0026].

valves.

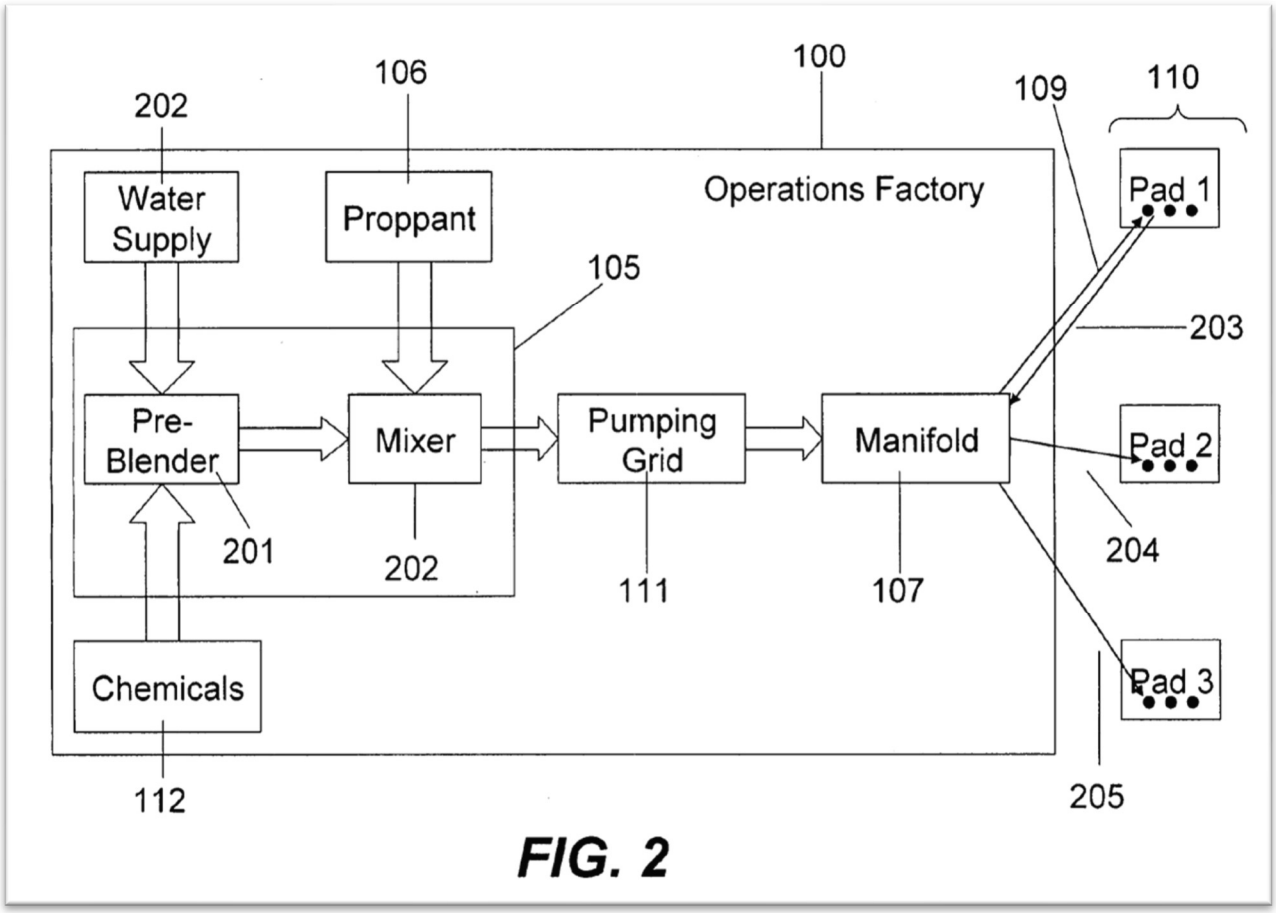

100
106
202
109
110
Operations Factory
Water Supply
Proppant
Pad 1
105
203
Pre-Blender
Mixer
Pumping Grid
Manifold
Pad 2
201
202
204
111
107
Chemicals
Pad 3
112
205

FIG. 2

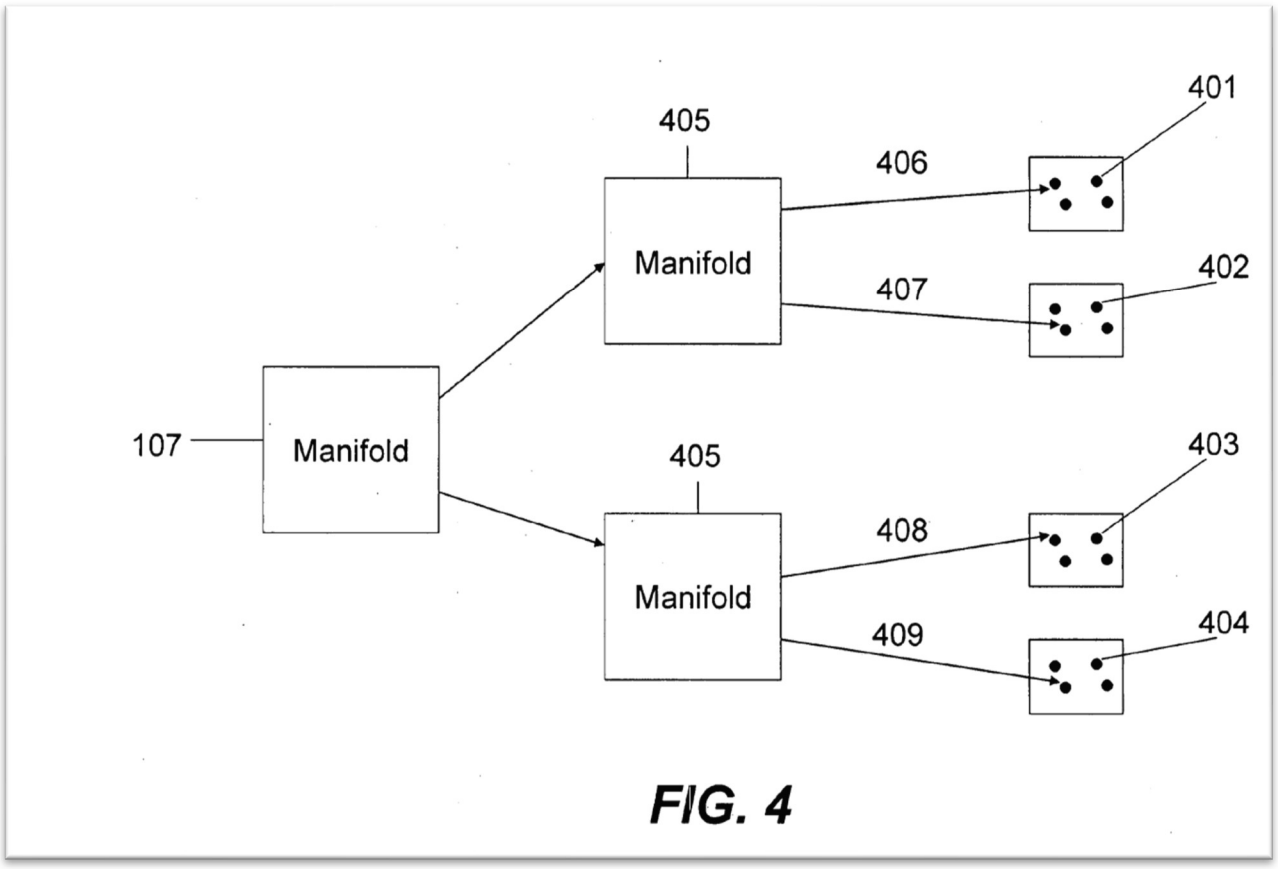


FIG. 4

316. A POSITA would have found it obvious to use *McNeel*'s manifolds in *Ciezobka*'s systems and methods as a simple substitution of one known element for another with the predictable results of efficiently distributing fluid from a central location to multiple wells, where one or more associated zipper valves are operated to distribute the pumped fluid to selected well(s). A POSITA would have also considered it obvious to use *McNeel*'s manifolds and associated valves in *Ciezobka*'s multi-well systems to predictably improve control of fluid flow to selected wells while fracturing fluid is continuously pumped via the manifold to valves associated with each of the connected wells, including more than two wells, such as third and

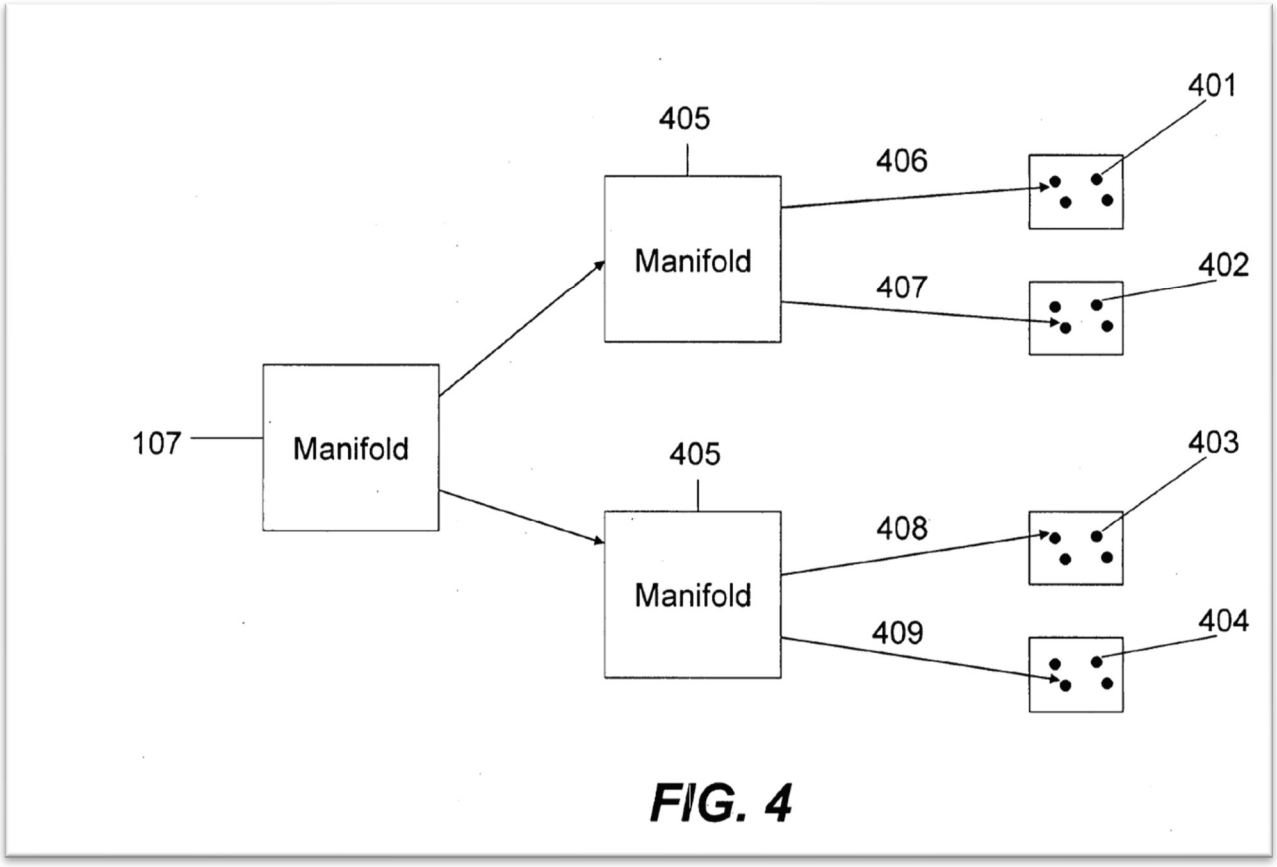
fourth wells. Thus, the combination of *Ciezobka* and *McNeel* renders the Limitations of Claims 6, 9, and 13 obvious. Therefore, Claims 6, 9, and 13 are obvious over the combination of *Ciezobka* and *McNeel*.

C. DEPENDENT CLAIM 16

317. Dependent Claim 16 depends from Claim 15. Further, Claim 16's claim limitations are like those limitations that are already analyzed as part of Claim 15 (*e.g.*, valves associated with first and second wells), but are applied to a third and fourth well, as opposed to the first and second wells of Claim 15. As discussed above regarding Grounds 1 and 2, *Ciezobka* discloses, or at least suggests, applying its pulsed hydraulic fracturing system to "multiple wells," including a third and fourth well.

318. To the extent that *Ciezobka* does not explicitly disclose a third and fourth well, *McNeel* provides in its fracturing operation "the central manifold 107 can be connected to one or more additional manifolds **405**. The additional manifolds are operable to connect to multiple well locations **401**-**404** and deliver well treatment fluids and receive production fluids via connections **406**-**409**, respectively, in the same way as the central manifold **107** described above."[235]

[235] Ex. 1038 at [0024].



McNeel, Fig. 4

319. Manifold 107 is taught by *McNeel* as being used to "treat simultaneously two separate wells, for example, as shown in FIG. 2 via connections 204 and 205."[236]

[236] Ex. 1038 at [0023].

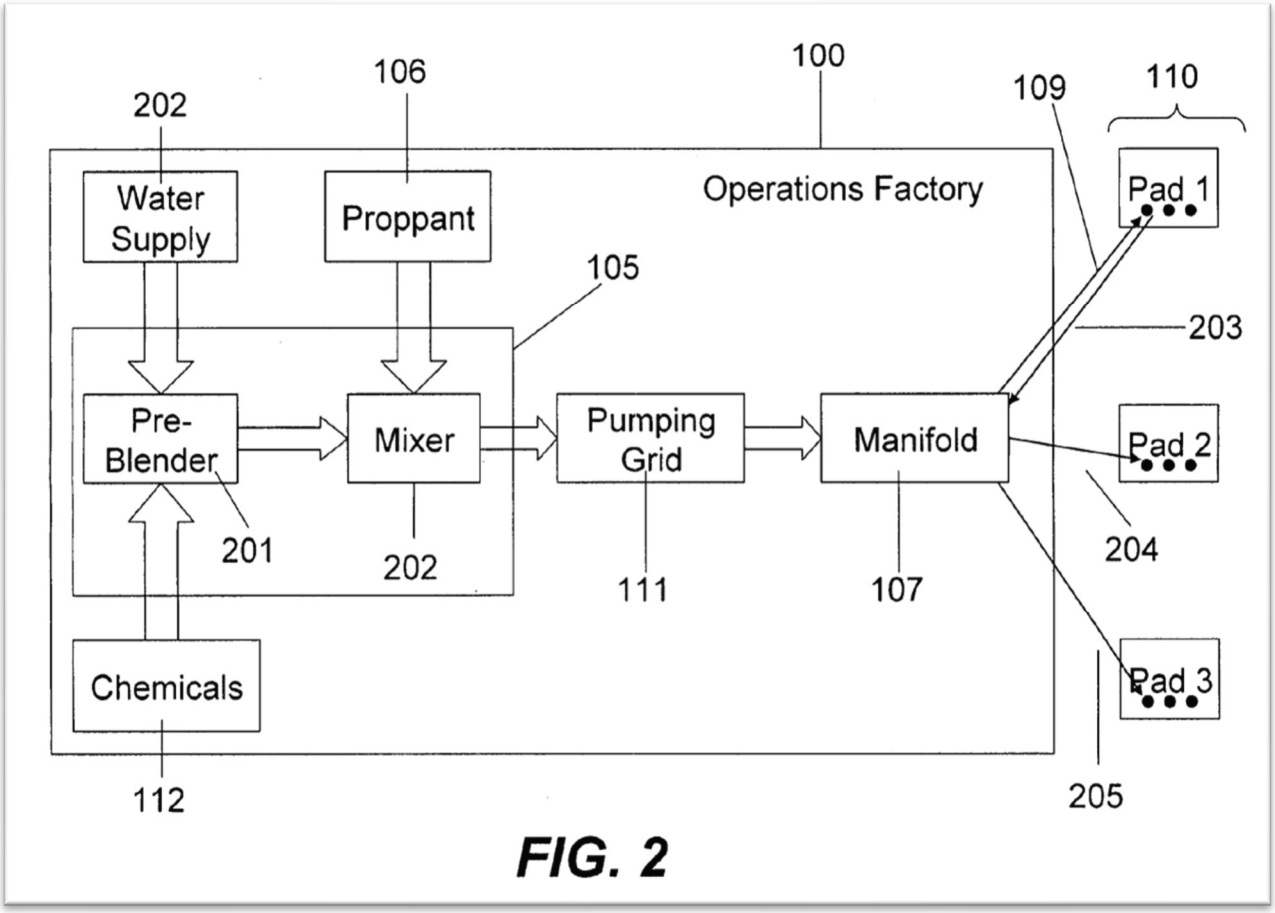


FIG. 2

McNeel, Fig. 2

320. Accordingly, the multiple manifolds of Fig. 4 (*i.e.*, 107 and 405) are used for the same purpose as manifold 107 in Fig. 2, that is, to treat multiple wells simultaneously. In the case of Fig. 4, at least four wells are explicitly represented.

a. 16.1: "16. The method of claim 15, wherein the plurality of wells further comprises third and fourth wells, the third and fourth wells being associated with third and fourth valves, respectively; and wherein the method further comprises:"

321. As discussed above regarding Grounds 1 and 2, *Ciezobka* discloses valves associated with wells, which are operated to allow fluid to pump into the well and conduct hydraulic fracturing. Further, as discussed above, *McNeel* explicitly discloses applying hydraulic fracturing techniques to a third and fourth well. A POSITA would have been motivated to apply *Ciezobka*'s valve switching to the third and fourth wells of *McNeel*. Accordingly, a POSITA would have understood that the combination of *McNeel* and *Ciezobka* teaches a third and fourth well, and third and fourth valves associated with the third and fourth wells that yields predictable results. Thus, the combination of *Ciezobka* and *McNeel* renders Limitation 16.1 obvious.

b. 16.2: "(c) permitting hydraulic fracturing of the fourth well; and"

322. As discussed above regarding Grounds 1 and 2, *Ciezobka* discloses hydraulic fracturing of, for example, a second well. Further, as discussed above, *McNeel* explicitly discloses applying hydraulic fracturing techniques to a third and fourth well. Accordingly, a POSITA would have understood that the combination of *McNeel* and *Ciezobka* teaches permitting hydraulic fracturing of a fourth well in the same manner that *Ciezobka* teaches permitting hydraulic fracturing of the second

well. Thus, the combination of *Ciezobka* and *McNeel* renders Limitation 16.2 obvious.

c. 16.3: "(c) swapping from permitting hydraulic fracturing of the fourth well to permitting hydraulic fracturing of the third well."

323. As discussed above regarding Grounds 1 and 2, *Ciezobka* discloses swapping from permitting hydraulic fracturing of the second well to permitting hydraulic fracturing of the third well. Further, as discussed above, *McNeel* explicitly discloses applying hydraulic fracturing techniques to a third and fourth well. Accordingly, a POSITA would have understood that the combination of *McNeel* and *Ciezobka* teaches swapping between hydraulic fracturing of a fourth well and the third well in the same manner that *Ciezobka* teaches swapping between hydraulic fracturing of the second well and the first well. Thus, the combination of *Ciezobka* and *McNeel* renders Limitation 16.3 obvious.

324. Accordingly, the combination of *Ciezobka* and *McNeel* renders obvious Claim 16.

D. DEPENDENT CLAIM 17

325. Dependent Claim 17 depends from Claim 16. In addition to the disclosure of the limitations of Claim 16 discussed above, *Ciezobka* combined with *McNeel* discloses the additional limitations of Claim 17:

a. <u>"17. The method of claim 16, wherein steps (a) and (c) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold; and wherein steps (b) and (d) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold."</u>

326. As discussed above regarding Grounds 1 & 2, *Ciezobka* teaches directing fluid between wells continuously by operating the valves associated with individual wells.

327. *McNeel* similarly teaches "a well operations factory which manufactures and pumps a well treatment fluid, a first connection between a first well location and the factory, and a second connection between a second well location and the factory. The "well treatment operations factory comprises a means for simultaneously flowing a first stimulation fluid to the first well location via the first connection and a second stimulation fluid to the second well location via the second connection."[237] The well treatment fluid is a hydraulic fluid and may include, *e.g.*, water, proppant, dry powder, chemical additives or modifiers.[238] Further, *McNeel* discloses that its system "can be used to stimulate wells simultaneously or singly."[239]

[237] Ex. 1038 at [0006].

[238] Ex. 1038 at [0022].

[239] Ex. 1038 at [0025].

328. As discussed above regarding Claim 17, *McNeel* explicitly discloses simultaneous flow to a third and fourth well "[i]n reference to FIG. 4, in one embodiment, the central manifold **107** can be connected to one or more additional manifolds **405**. The additional manifolds are operable to connect to multiple well locations **401-404** and deliver well treatment fluids and receive production fluids via connections **406-409**, respectively, in the same way as the central manifold **107** described above."[240]

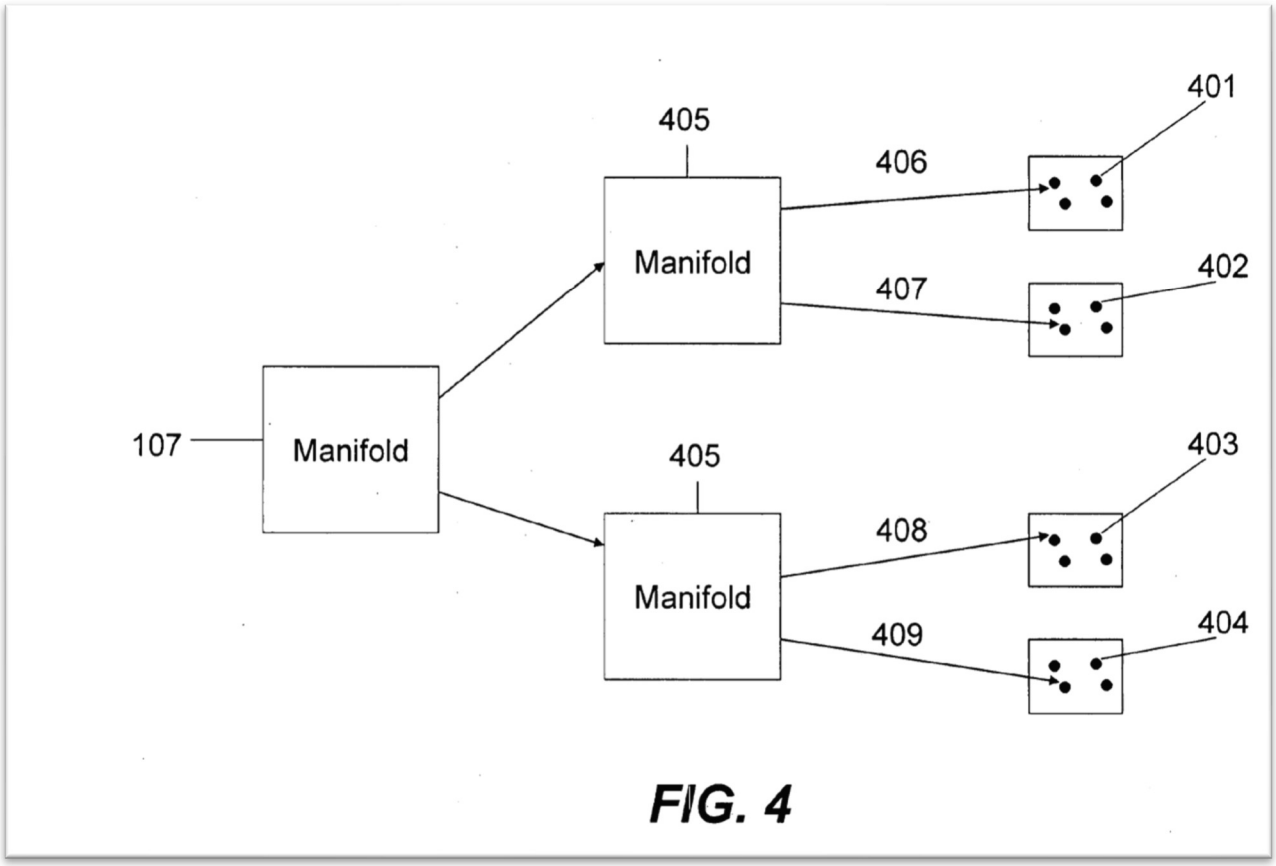


FIG. 4

McNeel, Fig. 4

[240] Ex. 1038 at [0024].

329. Accordingly, a POSITA would have understood that *McNeel* teaches the multiple manifolds of Fig. 4 are used for the same purpose as manifold **107** in Fig. 2, that is, to simultaneously treat multiple wells. In the case of Fig. 4, at least four wells are explicitly represented. Thus, it would have been obvious to a POSITA to flow fluid to a first and third well simultaneously via, for example, connections 406 and 408 from Fig. 4. Further, it would have been obvious to a POSITA to flow fluid to a second and fourth well simultaneously via, for example, connections 407 and 409 from Fig. 4. In combination with *Ciezobka,* a POSITA would have been motivated to apply the teachings of flowing to multiple wells simultaneously (from *McNeel)* with *Ciezobka*'s teaching of pulsing with "one or more" pumps to further *Ciezobka*'s goal of increasing efficiency.

330. Thus, the combination of *Ciezobka* and *McNeel* renders the Limitations of Claim 17 obvious. Therefore, Claim 17 is obvious over the combination of *Ciezobka* and *McNeel* for the reasons discussed above.

E. DEPENDENT CLAIM 18

331. Dependent Claim 18 depends from Claim 16. In addition to the disclosure of the limitations of Claim 16 discussed above, *McNeel* discloses the additional limitations of Claim 18:

a. 18.1: "18. The method of claim 16, wherein, during step (d), hydraulic fracturing fluid is continuously pumped to the third and fourth valves via the hydraulic manifold;"

332. As discussed above regarding Grounds 1 and 2, *Ciezobka* teaches simultaneous pumping of hydraulic fracturing fluid to the first and second valves associated with the first and second wells. *McNeel* similarly teaches a well operations factory that manufactures and pumps a well treatment fluid, a first connection between a first well location and the factory, and a second connection between a second well location and the factory. *McNeel*'s "well treatment operations factory comprises a means for simultaneously flowing a first stimulation fluid to the first well location via the first connection and a second stimulation fluid to the second well location via the second connection."[241] Further, *McNeel* discloses that its system "can be used to stimulate wells simultaneously or singly."[242] *McNeel* further teaches hydraulic fracturing operations at a third and fourth well, as discussed above regarding Claim 16. *McNeel* further discloses that, like *Ciezobka*, fracturing fluid is pumped to the wells (e.g. via a "pumping grid" as shown in Fig. 2) and that "each line can further include a pressure sensor and an additional valve"[243] Accordingly, each well has at least an associated valve and pressure sensor. Further,

[241] Ex. 1038 at [0006].

[242] Ex. . 1038at [0025].

[243] Ex. 1038 at [0008].

like *Ciezobka*, *McNeel* discloses with regard to Fig. 2 that its system "allows wells **101** and **102** to be stimulated individually and at a higher rate, by opening the valves along the line to the well to be treated while the valves along the other line are closed, or simultaneously at a lower rate, by opening the valves on both lines at the same time."[244] Based on the teaching of *McNeel* that the manifolds in Fig. 4 operate in the same manner as Fig. 2, a POSITA would have understood *McNeel* to additionally teach simultaneous, continuous pumping of fluid to the third and fourth valves in lines to (associated with) the third and fourth wells.

333. The combination of *Ciezobka* and *McNeel,* therefore, renders Limitation 18.1 obvious.

b. <u>18.2: "wherein step (c) comprises opening the fourth valve associated with the fourth well to permit pumping of fluid into the fourth well via the fourth valve; and"</u>

334. As discussed above regarding Limitation 18.1, *McNeel* teaches opening valves "along the line to the well to be treated" to allow simultaneous or individual fracturing fluid flow to the well(s). Further, as discussed above, *McNeel* teaches that fluid moves via a "pumping grid." Still further, as discussed above, *McNeel* discloses valves associated with a third and fourth well. *McNeel*, accordingly, discloses opening the fourth valve associated with the fourth well to permit the pumping of fluid into the fourth well via the fourth valve.

[244] Ex. 1038 at [0025].

335. Further, *McNeel* discloses pumping fracturing fluid from a manifold to multiple wells, including at least four wells, at higher and lower rates by opening/closing valves associated with the wells.[245] Additionally, *McNeel's* Fig. 6 shows the manifold of *McNeel*, where flowlines are fluidly connected to each well, including first-fourth wells. Fig. 6 shows valves along each flowline may be opened/closed to provide fluid flow from a first input, additional fluid flow from a second input, and/or no fluid flow to each well.

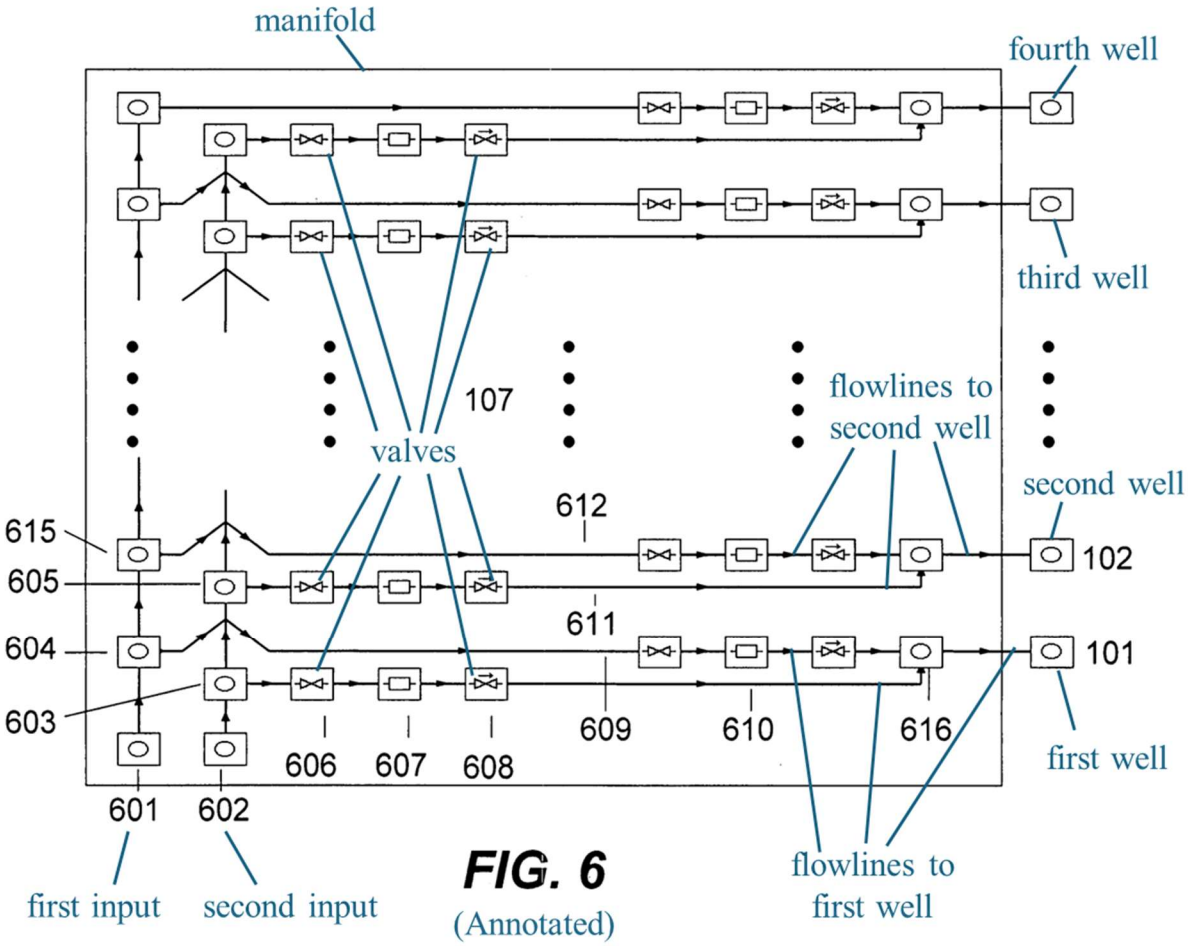


FIG. 6
(Annotated)

[245] See, e.g. Ex. 1038 at ¶¶ [0025]-[0026].

McNeel, Fig. 6

336. When combined with the techniques of Ciezobka regarding switching valves to swap hydraulic fracturing of wells, a POSITA would understand the combination to teach opening a fourth valve associated with a fourth well to permit fluid pumping into the fourth well. Accordingly, the combination of *Ciezobka* and *McNeel* renders obvious Limitation 18.2.

c. 18.3.1: "wherein step (d) comprises opening the third valve associated with the third well to permit pumping of fluid into the third well via the third valve; and"

337. As discussed above regarding Grounds 1 and 2, *Ciezobka* discloses opening and closing valves to control fluid flow into the wells. Further, as discussed above regarding Limitations 18.1 and 18.2, *McNeel* teaches opening valves "along the line to the well to be treated" to allow for simultaneous or individual fracturing fluid flow to the well(s). Further, as discussed above, *McNeel* teaches that fluid moves via a "pumping grid." Still further, as discussed above, *McNeel* discloses valves associated with a third and fourth well. *McNeel*, accordingly, discloses opening the fourth valve associated with the third well to permit the pumping of fluid into the third well via the third valve.

338. Accordingly, the combination of *Ciezobka* and *McNeel* renders obvious Limitation 18.3.1.

d. 18.3.2: "closing the fourth valve associated with the fourth well."

339. *McNeel* teaches wells to be treated (allow pumping of fracturing fluid into the well) "by opening the valves along the line to the well to be treated while the valves along the other line are closed."[246] As discussed above regarding Limitations 18.1 – 18.3.2, this applies equally to the fourth well and all other wells.

340. Accordingly, the combination of *Ciezobka* and *McNeel* renders Limitation 18.3.2 obvious.

341. In view of the above, the combination of *Ciezobka* and *McNeel* renders Claim 18 obvious.

F. INDEPENDENT CLAIM 25

342. It is my opinion that *Ciezobka* discloses Claim 25 or at least renders obvious Claim 25 of the '779 Patent, and the combination of *Ciezobka* and *McNeel* renders Claim 25 obvious. With the exception of this being an "apparatus" claim, and the claim further containing a description of the structure of the apparatus, namely known computer elements for executing instructions, Claim 25 is essentially similar to Claim 15. It would have been obvious to perform Claim 15's method with a computer, such that the method steps may be performed more safely and

[246] Ex. 1038 at [0025].

efficiently. As discussed below, *Ciezobka* contains disclosure of the structure of an apparatus that is equivalent to that of Claim 25 of the '779 Patent.

a. 25.1: "An apparatus adapted to hydraulically fracture first and second wells, the first and second wells being associated with first and second valves, respectively, the apparatus comprising:"

343. For the same reasons discussed above regarding Limitation 15.1, *Ciezobka* discloses a system for hydraulically fracturing first and second wells, the first and second wells being associated with first and second valves. Additionally, for the same reasons discussed above regarding Limitations 8.1.1-8.2.2, *Ciezobka* discloses, or renders obvious, using an apparatus having a non-transitory computer readable medium and a plurality of instructions stored on the non-transitory computer readable medium and executable by one or more processors, wherein, when the instructions are executed by the one or more processors, the claimed steps are executed.

b. 25.2: "a non-transitory computer readable medium; and"

25.3: "a plurality of instructions stored on the non-transitory computer readable medium and executable by one or more processors, wherein, when the instructions are executed by the one or more processors, the following steps are executed:"

344. Limitations 25.2 and 25.3 are identical to Limitations 8.1.2-8.2.2 and are disclosed or rendered obvious by *Ciezobka* and *McNeel* for the same reasons as those described above regarding Claim 8 in Section XII.B(a).

c. **25.4: "(a) permitting hydraulic fracturing of the second well, comprising: opening the second valve associated with the second well to permit pumping of fluid into the second well via the second valve; and**

25.5: "measuring a flow rate of the fluid being pumped into the second well;"

25.6.1: "(b) swapping from permitting hydraulic fracturing of the second well to permitting hydraulic fracturing of the first well, comprising:"

25.6.2: "opening the first valve associated with the first well to permit pumping of fluid into the first well via the first valve; and"

25.6.3: "closing the second valve associated with the second well;"

25.7: "wherein, during step (b), hydraulic fracturing fluid is continuously pumped to the first and second valves via a hydraulic manifold; and"

25.8: "wherein in response to determining that the flow rate measured at step (a) has satisfied one or more flow rate conditions, the first valve associated with the first well is opened at step (b) before the second valve associated with the second well is closed at step (b);"

25.9: "or in response to determining that the flow rate measured at step (a) has not satisfied one or more flow rate conditions, the first valve associated with the first well is opened at step (b) during or after the second valve associated with the second well is closed at step (b)."

345. The language in Claim Limitations 25.4 through 25.9 is identical to that of Limitations 15.2 through 15.7. *Ciezobka* discloses Limitations 25.4 through 25.9 for the same reasons as those discussed regarding Limitations 15.2 through 15.7 in

Section XI.I(b)-(h). In view of the above, the combination of *Ciezobka* and *McNeel* discloses each and every element of Claim 25, and renders Claim 25 obvious. A POSITA would have been motivated to incorporate the teachings of *McNeel* with *Ciezobka* for the reasons discussed above. Therefore, Claim 25 as a whole is obvious over *Ciezobka* and *McNeel*.

G. DEPENDENT CLAIM 26

a. 26.1: "26. The apparatus of claim 25, wherein the apparatus is further adapted to hydraulically fracture third and fourth wells, the third and fourth wells being associated with third and fourth valves, respectively; and wherein, when the instructions are executed by the one or more processors, the following steps are also executed"

346. Other than depending from Claim 25 and being an apparatus claim with computer language to execute the steps (which is already discussed concerning Claim 25), this limitation is substantially similar to Limitation 16.1 and is disclosed or rendered obvious by the combination of *Ciezobka* and *McNeel* for the same reasons as those discussed regarding Limitation 16.1 in Section XII.C(a).

b. 26.2: "(c) permitting hydraulic fracturing of the fourth well;"

347. Other than depending from Claim 25 and being an apparatus claim, this limitation is substantially similar to 16.2 and is rendered obvious by the combination of *Ciezobka* and *McNeel* for the same reasons as those discussed regarding Limitation 16.2 in Section XII.C(b).

c. 26.3: "(d) swapping from permitting hydraulic fracturing of the fourth well to permitting hydraulic fracturing of the third well.

348. Other than depending from Claim 25 and being an apparatus claim, this limitation is substantially similar to Limitation 16.3 and is rendered obvious by the combination of *Ciezobka* and *McNeel* for the same reasons as those discussed regarding Limitation 16.3 in Section XII.C(c). In view of the above, the combination of *Ciezobka* and *McNeel* renders Claim 26 obvious.

H. DEPENDENT CLAIM 27

349. The combination of *Ciezobka* and *Jackson* renders Claim 27 of the '779 Patent obvious. Further detail is provided below.

a. "27. The apparatus of claim 26, wherein steps (a) and (c) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold; and wherein steps (b) and (d) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold."

350. Other than depending from Claim 26 and being an apparatus claim, this limitation is substantially similar to Claim 17 and is rendered obvious by the combination of *Ciezobka* and *McNeel* for the same reasons as those discussed regarding Claim 17 in Section XII.D. In view of the above, the combination of *Ciezobka* and *McNeel* renders Claim 27 obvious.

I. DEPENDENT CLAIM 28

351. The combination of *Ciezobka* and *McNeel* renders Claim 28 of the '779 Patent obvious. Further detail is provided below.

a. 28.1: "28. The apparatus of claim 26, wherein, during step (d), hydraulic fracturing fluid is continuously pumped to the third and fourth valves via the hydraulic manifold;"

352. Other than depending from Claim 26 and being an apparatus claim, this limitation is substantially similar to Claim 18.1 and is rendered obvious by the combination of *Ciezobka* and *McNeel* for the same reasons as those discussed regarding Limitation 18.1 in Section XII.E(a).

b. 28.2: "wherein step (c) comprises opening the fourth valve associated with the fourth well to permit pumping of fluid into the fourth well via the fourth valve; and"

353. Other than depending from Claim 26 and being an apparatus claim, this limitation is substantially similar to Claim 18.2 and is rendered obvious by the combination of *Ciezobka* and *McNeel* for the same reasons as those discussed regarding Limitation 18.2 in Section XII.E(b).

c. 28.3.1: "wherein step (d) comprises: opening the third valve associated with the third well to permit pumping of fluid into the third well via the third valve; and"

28.3.2: "closing the fourth valve associated with the fourth well."

354. The language in Limitations 28.3.1 and 28.3.2 is identical to Limitations 18.3.1 and 18.3.2 in Claim 18 and is rendered obvious by the

combination of *Ciezobka* and *McNeel* for the same reasons as those discussed regarding Limitation 18.3 in Section XII.E(c)-(d). In view of the above, the combination of *Ciezobka* and *McNeel* renders Claim 28 obvious.

J. DEPENDENT CLAIM 31

355. Dependent Claim 31 depends from Claim 25. In addition to the disclosure of the limitations of Claim 25 discussed above, the combination of *Ciezobka* and *McNeel* discloses the additional limitations of Claim 31:

a. 31.1: "31. The method of claim 25, wherein the flow rate measured at step (a) has satisfied the one or more flow rate conditions when the flow rate measured at step (a) is below an upper flow rate threshold, above a lower flow rate threshold, or both; and"

356. This claim limitation merely sets forth optional flowrate measurements, including flowrates below an upper flowrate threshold, above a lower flowrate threshold, or both, and thus only one needs to be shown in the prior art.

357. As discussed above regarding Limitation 1.2, *Ciezobka* discloses and/or renders obvious to a POSITA measuring a flow rate. *Ciezobka* teaches a total flow rate pumped to each well. Further, *Ciezobka* teaches several specific thresholds, such as, "90 bpm," "45 bpm," and "20 bpm." Further, *Ciezobka* teaches several percentage flowrate thresholds for the pulses, including "from 10% to nearly 100% lower," "25% to 75% lower," and "50% lower" than the primary flowrate. [247] A

[247] *See*, Ex. 1037, *e.g.*, pages 3-4, generally.

POSITA would understand that a flow rate that is between 25% to 75% lower than the primary flowrate to be both above a lower flowrate threshold (75% lower) and below an upper threshold (25% lower). Similarly, a flowrate between 10% to nearly 100% lower would be both above a lower flowrate threshold (10% lower) and below an upper threshold (100% lower).

358. To the extent *Ciezobka* does not explicitly call the identified flowrates thresholds, it would have been obvious to apply the various flowrates, such as percentages or explicit flowrates, as thresholds to determine that the pulse is performing as desired. A flowrate that is between 25% lower and 75% lower than the primary flowrate would be both below an upper threshold (*e.g.*, 25%) and above a lower threshold (*e.g.*, 75%).

359. Further, it would have been obvious to a POSITA to apply the various flowrates, such as percentages or explicit flowrates, as thresholds to determine that the pulse is performing as desired.

360. Accordingly, *Ciezobka* discloses, or at least renders obvious, Limitation 31.1 and the combination of *Ciezobka* and *McNeel* also renders the entire claim obvious.

b. <u>31.2: "wherein the flow rate measured at step (a) has not satisfied the one or more flow rate conditions when the flow rate measured at step (a) is above the upper flow rate threshold or below the lower flow rate threshold.</u>

361. Claim Limitation 31.2 essentially defines the portion excluded by Claim Limitation 31.1. In other words, Claim Limitation 31.2 merely says that if the flow rate conditions in Claim Limitation 31.1 are not met, then the flowrate measured at step (a) "has not been satisfied." Thus, this limitation does not add anything more technically to Claim 31 other than the use of the phrase "not met." Because *Ciezobka* and *McNeel* disclose meeting certain flow rate thresholds, as discussed above, *Ciezobka* and *McNeel* also disclose that when the flow rate does not meet the desired threshold, whether it is above an upper threshold or lower than a lower threshold, the measured flow rate "has not satisfied the one or more flow rate conditions." Moreover, this is standard practice for any flow system—if a measured flowrate is outside the required flowrate, then a flowrate condition is not met.

362. The combination of *Ciezobka* and *McNeel* discloses each and every limitation of Claim 31. Accordingly, Claim 31 would have been obvious to a POSITA in light of the disclosures of *Ciezobka* and *McNeel*, for the reasons discussed above.

K. CLAIMS 1-3, 15, AND 36

363. Independent Claims 1 and 15 and dependent Claims 2, 3, and 36 have been discussed above as being anticipated by and/or obvious over *Ciezobka*.

364. For all the reasons and rationale discussed above that a POSITA would find Claims 6, 8-10, 13, 16-18, 25-28, and 31 obvious over *Ciezobka* in view of *McNeel*, a POSITA would also find Claims 1-3, 15, and 36 obvious over the same combination.

XIII. GROUND 4: CLAIMS 1-3, 6, 8-10, 13, 15-18, 25-28, 31, AND 36 ARE OBVIOUS OVER THE COMBINATION OF BEUTERBAUGH AND JACKSON

365. It is my opinion that the combination of *Beuterbaugh* and *Jackson* discloses and/or suggests all limitations of Claims 1-3, 6, 8-10, 13, 15-18, 25-28, 31, and 36, thereby rendering these claims obvious. The sections below outline the disclosure and teachings of *Beuterbaugh* and *Jackson* as they relate to individual claims as a whole.

A. RATIONALE AND MOTIVATION FOR COMBINING *BEUTERBAUGH* WITH *JACKSON*

366. A POSITA would have been motivated to combine *Jackson* with *Beuterbaugh. Jackson* is in the same field of endeavor of oil and gas well systems as *Beuterbaugh* (as well as the '779 Patent) and is directed to solving the same problem – controlling well operations, and more specifically, both *Beuterbaugh* and *Jackson*, like the '779 Patent, are directed to controlling fracturing fluid to a plurality

of wells. *Beuterbaugh* is directed to methods and systems for "pulsed fractured treatment of subterranean formations of a plurality of wells."[248] *Jackson* is directed to "[a] process for fracturing a selected region of a formation including: introducing a supply of fracturing fluid to the region of the formation until a first threshold is reached."[249]

367. A POSITA would have been motivated to combine *Jackson* with *Beuterbaugh. Jackson* is in the same field of endeavor as *Beuterbaugh* (as well as the '779 Patent) and is directed to solving the same problem – controlling well operations, and more specifically of controlling fracturing operations and improving operational efficiencies. The title of *Beuterbaugh* is "Simulfrac Pulsed Treatment."[250] A POSITA would have understood "Simulfrac" to indicate the "simultaneous fracturing" of multiple wells.[251] *Beuterbaugh* discloses "[a] method and system pulse for treating a plurality of wells simultaneously includes applying a high pressure of fracturing fluid."[252] *Jackson* discloses "[a] process for fracturing a

[248] Ex. 1036 at ¶ [0015].

[249] Ex. 1005 at Abstract.

[250] Ex. 1036 at Abstract.

[251] *See* Section IX.C.

[252] Ex. 1036 at Abstract.

selected region of a formation including: introducing a supply of fracturing fluid to the region of the formation until a first threshold is reached."[253]

368. Both *Beuterbaugh* and *Jackson* teach increases in pressure, followed by a relaxation state (*i.e.*, a pressure "pulse"). *Beuterbaugh* teaches switching valve positions "to create[e] a pulse wave into the plurality of wells for fracturing subterranean formations."[254] *Jackson* teaches "a first pressurizing step… [and] a pressure relaxation step thereafter and a second pressurizing step."[255] Further, both references teach a time-based process where the decision to move to the next step of the fracturing process is determined, at least in part, by reaching a time limit or threshold. *Beuterbaugh* teaches "sequencing control of the one or more switching valves **150a, 150b**…such that the flow rate of the fracturing fluid **151** from the one or more high pressure pumps **135a-135e** is directed to the first wellhead **115a**" and then "directed to the second wellhead 115b."[256] *Beuterbaugh* teaches that "the first switching valve **150a** [associated with first well] is closed at the end of a first predetermined time period" and "[a] second time period is started to time a duration of a created pulse in the second well."[257] *Jackson* discloses "introducing a supply of

[253] Ex. 1005 at Abstract.

[254] Ex. 1036 at Abstract.

[255] Ex. 1005 at [0008].

[256] Ex. 1036 at [0021].

[257] Ex. 1036 at [0027].

fracturing fluid to the region of the formation until a first threshold is reached, adjusting the flow of the fracturing fluid … to reach a second threshold, adjusting the flow of the fracturing fluid … to reach a third threshold and ceasing flow of the fracturing fluid to the region of the formation."[258] *Jackson* further teaches that the thresholds "may be defined by at least one criterion selected from a set of criteria consisting of: (a) *a time period threshold*; (b) a non-participating gas [fracturing fluid] flow rate threshold; (c) a well bore surface or bottom hole pressure threshold; (d) a well bore surface or bottom hole rate of pressure change threshold (e) a gas quantity threshold and (f) a formation condition threshold."[259]

369. A POSITA would have been motivated to include *Jackson's* teachings of measuring flowrate, determining a stage(s) of a fracturing operation, and using a flowrate threshold as part of the control of the pressure valves to improve the system of *Beuterbaugh*. For example, the inclusion of a flowrate and time-based threshold would help *Beuterbaugh* ensure that the proper volume of fracturing fluid is pumped down the wells to initiate the pressure pulse. Further, measuring the flowrate and combining it with the time threshold would allow the operator to determine whether equipment failure, such as leaks or failed pumps, would prevent proper operation of the pulsed treatment of *Beuterbaugh.* Further still, measuring the flowrate of each

[258] Ex. 1005 at Abstract.

[259] Ex. 1005 at [0017] (emphasis added); *see also* Claim 20.

well and using the flowrate as part of the threshold during the valve switching would allow the user to compare the effectiveness of treatment between the two wells. As would have been known to a POSITA, a different pressure response with a comparable flow rate, or a similar pressure response with varying flowrates, provides information about the quality of the fractures in the different wells. This is particularly true considering *Beuterbaugh*'s teachings of "water hammer" and a POSITA's knowledge of measuring water hammer as an indicator of fracture quality.[260]

370. To the extent that *Beuterbaugh* does not already teach using flowrate and time thresholds as the trigger to move to the next stage (*e.g.*, flow rate above or below a threshold for a threshold period of time), a POSITA would be motivated to use the threshold levels from *Jackson,* or otherwise incorporate the teachings of flowrate and time thresholds from *Jackson* into the pulsed treatment of *Beuterbaugh* at least for the reasons described above. Both *Beuterbaugh* and *Jackson* disclose similar functions of thresholds being used to trigger the control system to move to the next stage of the fracturing operation. A POSITA, therefore, would recognize that combining the teachings of *Beuterbaugh* and *Jackson* is a simple substitution of one known element (*e.g.*, specific thresholds, such as time) for another (*e.g.*, different specific thresholds and combinations of thresholds, such as flow rate and/or

[260] See, e.g. Section IX.F.

time) to obtain predictable results. A POSITA would have had a reasonable expectation of success in combining *Beuterbaugh* with *Jackson* for the same reason. To the extent *Jackson* gives examples using a gas fracturing fluid, *Jackson* also contemplates hydraulic fracturing fluids (*e.g.*, liquid based), and a POSITA would understand that including fracturing thresholds for the operation of valves, as taught by *Jackson*, would equally apply for hydraulic and/or gas fracturing systems.

B. INDEPENDENT CLAIM 1

371. It is my opinion that *Beuterbaugh* combined with *Jackson* renders obvious Claim 1 of the '779 Patent. *Beuterbaugh* and *Jackson*, either alone or in combination, disclose, or at least render obvious, each and every limitation of Claim 1. Details regarding the specific disclosures of *Beuterbaugh* and *Jackson* are contained in the following subsections.

a. 1.1.1: "1. A method, comprising:"

372. To the extent the preamble is limiting, *Beuterbaugh* discloses a method of hydraulically fracturing a plurality of wells. [261] The title of *Beuterbaugh* is "Simulfrac Pulsed Treatment."[262] A POSITA would have understood "Simulfrac" to indicate "simultaneous fracturing" of multiple wells.[263] *Beuterbaugh* further

[261] I understand that the preambles may not be limiting. However, I include analysis of the preamble for Claim 1 out of an abundance of caution.

[262] Ex. 1036 at Title.

[263] *See* Section IX.C.

describes "applying a high pressure of fracturing fluid to one or more switching valves and repeatedly opening and closing the one or more switching valves … to create[e] a pulse wave into the plurality of wells for fracturing subterranean formations."[264] Further, *Beuterbaugh* discloses "[t]he one or more pressure pumps **135a-135e** run at a constant rate to provide a substantially constant pressure of the blended fracturing fluid to the one or more switching valves."[265] A POSITA would have recognized this to mean that the fluid is pumped continuously to the switching valves.

373. Accordingly, *Beuterbaugh* discloses the preamble to Claim 1.

b. 1.1.2: "(a) permitting performance of a first hydraulic fracturing operation on a first well, which first hydraulic fracturing operation comprises pumping fluid into the first well via a first valve associated with the first well, and"

374. *Beuterbaugh* discloses "permitting performance of a first hydraulic fracturing operation on a first well." *Beuterbaugh* teaches a pulse system/method "for treating a plurality of wells simultaneously includes applying a high pressure of fracturing fluid to one or more switching valves and repeatedly opening and closing the one or more switching valves to divert the fracturing fluid near instantaneously from one well to the other well ... for fracturing subterranean formations."[266]

[264] Ex. 1036 at Abstract.

[265] Ex. 1036 at [0018].

[266] Ex. 1036 at Abstract.

Beuterbaugh further discloses "pulsed fractured treatment of subterranean formations of a plurality of wells."[267]

375. Still further, *Beuterbaugh* discloses "a first state, opening switching valve **150a** and plug valve **155a** such that the flow rate of the fracturing fluid **151** from the one or more high pressure pumps **135a-135e** is directed to the first wellhead **115a,**"[268] and that the "first wellhead **115a** [is] associated with a first well **120a**."[269] Additionally, in describing the process in more detail, *Beuterbaugh* discloses "a first switching valve **150a** is opened or opening while a second valve **150b** is at least partially closed, or closing, permitting fracturing fluid to flow to a first wellhead **115a** associated with a first well **120a**." [270] Pumping fracturing fluid to a first well, as disclosed by *Beuterbaugh,* is a first fracturing operation.

376. A POSITA would, therefore, have understood *Beuterbaugh* to disclose "permitting performance of a first hydraulic operation on a first well" as claimed.

377. With reference to Fig. 2 of *Beuterbaugh* (reproduced and annotated below), *Beuterbaugh* discloses "opening switching valve **150a** [annotated in red] and plug valve **155a** [annotated in blue] such that the flow rate of the fracturing fluid

[267] Ex. 1036 at [0015].

[268] Ex. 1036 at [0021].

[269] Ex. 1036 at [0026].

[270] Ex. at 1036 [0026].

151 … is directed to the first wellhead **115a** [annotated in green]."[271] Fig. 2 of *Beuterbaugh* shows the configuration of equipment from the disclosure. A POSITA would have understood from the figure and description that valves **150a** and **155a** are associated with the first wellhead **115a** (associated with first well **120a**.) Further, valves **150b** and **155b** are associated with the second wellhead **115b (**associated with second well **120b**).

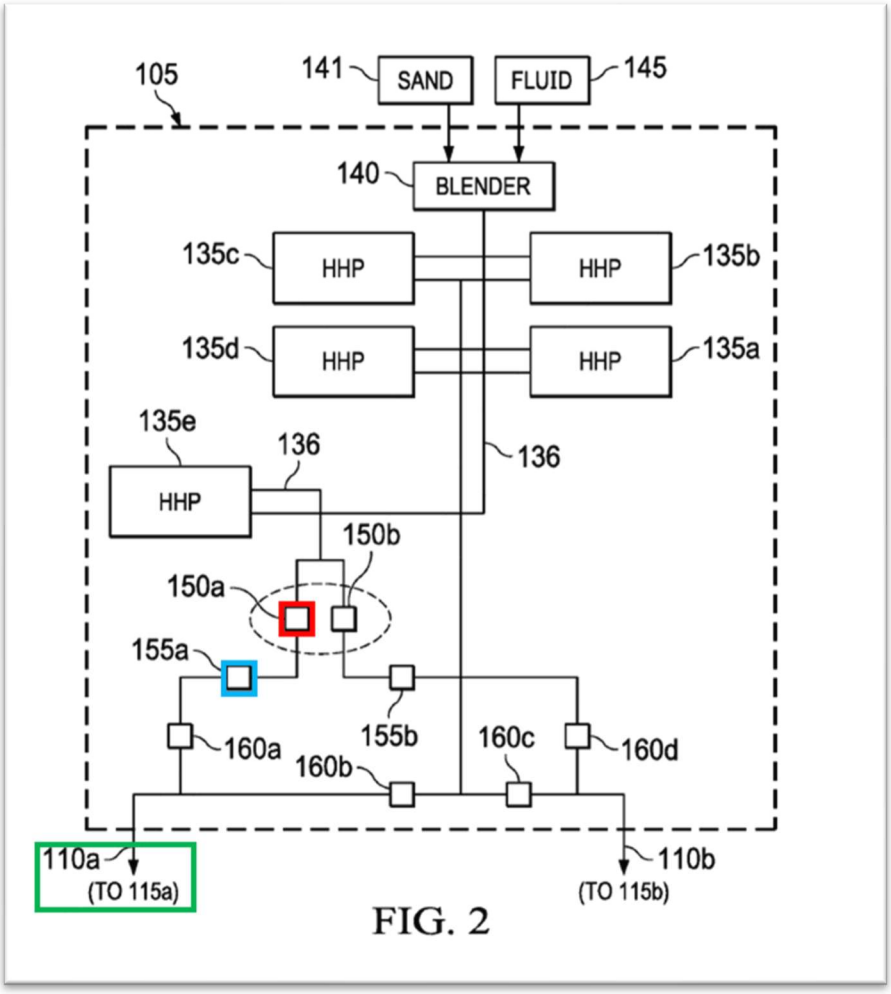


FIG. 2

[271] Ex. at 1036 [0021].

Beuterbaugh, Fig. 2, annotated

378. A POSITA would, therefore, have understood *Beuterbaugh* to disclose a "hydraulic operation comprises pumping fluid into the first well via a first valve associated with the first well" as claimed. Accordingly, *Beuterbaugh* discloses and anticipates claim Limitation 1.1.2.

c. 1.2: "measuring a flow rate of the fluid being pumped into the first well;"

379. The combination of *Beuterbaugh* and *Jackson* renders measuring the flowrate as claimed in Limitation 1.2 obvious. *Beuterbaugh* anticipates knowledge of flow rate, *e.g*., "[t]he number of high pressure pumps and total flow rate from the one or more high pressure pumps **135a**-**135e** determine the pulse size of the fracturing fluid."[272] Further, *Beuterbaugh* teaches "the flow rate of the fracturing fluid **151** from the one or more high pressure pumps **135a**-**135e** is directed to the first wellhead **115a**."[273] *Beuterbaugh* also describes changes in flow rate to different wells due to opening and closing of the switching valves.[274] Specifically, *Beuterbaugh* explains "[w]hen a flow starts to flow into a first well, a positive waterhammer wave going to that first well is created while a rarefaction wave is created in the second well due to the sudden drop in the flow rate to the second well.

[272] Ex. 1036 at [0018].

[273] Ex. 1036 at [0021].

[274] Ex. 1036 at [0024].

The overlap of fluid flows to each well **120a**, **120b** can be controlled to optimize the downhole pressure waves and minimize the surface impacts."[275] It would have been obvious to a POSITA to measure the flow rate of the fluid being pumped into the second well (and/or first well) in order to control the fluid flow to each well to "optimize the downhole pressure waves and minimize the surface impacts," as taught by *Beuterbaugh*.[276]

380. To the extent that *Beuterbaugh* does not explicitly disclose measuring a flow rate of fluid being pumped into the first well, *Jackson* provides such a disclosure. It would have been obvious to a POSITA to combine the teachings of *Beuterbaugh* regarding flowrate with those of *Jackson* regarding flowrate as a threshold to move to the next step of fracturing. *Jackson* teaches, throughout the disclosure, the use of flow rate of fluid into the well as a threshold. For example, *Jackson* discloses that thresholds "may be defined by at least one criterion selected from a set of criteria consisting of: (a) *a time period threshold*; (b) a non-participating gas [fracturing fluid] flow rate threshold; (c) a well bore surface or bottom hole pressure threshold; (d) a well bore surface or bottom hole rate of pressure change threshold (e) a gas quantity threshold and (f) a formation condition

[275] *Id*.

[276] *Id*.

threshold."[277] Further, *Jackson* further discloses "[a]s will be appreciated, however, generally other process parameters such as *flow rate*, pressure, volume, formation condition, etc. *are observed* to assess a formation fracturing process."[278] Further, *Jackson* discloses several specific flowrate thresholds as examples including at least "300 scm", "0 scm" amd"1000 scm." In order to "observe" flow rate, as disclosed by *Jackson*, it would at least have been obvious to measure the flowrate being pumped into the well as claimed in Limitaton 1.2.

381. A POSITA having general engineering knowledge would have found it obvious to combine *Jackson* and *Beuterbaugh* to measure flowrate of fluid being pumped into a well to monitor/control the fracturing process in view of *Jackson*'s teaching that process parameters including flowrate were commonly observed to assess a formation fracturing process. Further, a POSITA would have used the flowrates of *Jackson* to ensure the proper volume of fracturing fluid is pumped down the wells to initiate the pressure pulse, and to monitor for leaks. Accordingly, the combination of *Beuterbaugh* and *Jackson* render claim Limitation 1.2 obvious. Additionally, this element would have been obvious to a POSITA having general engineering knowledge as measuring flowrate into a well was well-known long before the '779 Patent. (*See* Sections IX.E-F).

[277] Ex. 1005 at [0017] (emphasis added); *see also* Claim 20.

[278] Ex. 1005 at [0019] (emphasis added).

d. 1.3: "(b) determining that the flow rate of the fluid being pumped into the first well is below a flow rate threshold and"

382. The combination of *Beuterbaugh* and *Jackson* renders obvious, "determining the flow rate of the fluid being pumped into the first well is below a flow rate threshold" as claimed. As discussed above regarding Limitation 1.2, the combination of *Beuterbaugh* and *Jackson* discloses and/or renders obvious to a POSITA measuring a flowrate. *Beuterbaugh* teaches a time-based threshold along with measuring flowrate. *Jackson* provides further teaching regarding the use of flowrate as a threshold for taking action (*i.e.*, moving the fracturing process to the next step).

383. *Jackson* teaches that the thresholds "may be defined by at least one criterion selected from a set of criteria consisting of: (a) *a time period threshold*; (b) a non-participating gas [fracturing fluid] *flow rate threshold*; (c) a well bore surface or bottom hole pressure threshold; (d) a well bore surface or bottom hole rate of pressure change threshold (e) a gas quantity threshold and (f) a formation condition threshold."[279] Further, *Jackson* specifically discloses a combination of flowrate and time. *Jackson* teaches "the first threshold may be reached by introduction of a fracturing fluid over a period of time. As will be appreciated, however, other process parameters such as flow rate, pressure, volume, formation condition etc. are

[279] Ex. 1005 at [0017] emphasis added; *see also* Claim 20.

observed to asses a formation fracturing process."[280] Further, as an example of a combined flowrate / time threshold, *Jackson* teaches "the second threshold may be defined as a time period of more than 1 minute and less than 24 hours of a flow rate of dilation fluid of less than 300 scm."[281] In this example, the fracturing fluid flowrate must have been below a flowrate threshold of 300 scm (standard cubic feet per minute) for a time threshold of at least one minute, up to 24 hours.

384. Accordingly, *Jackson* discloses "determining that the flow rate of the fluid being pumped into the first well is below a flow rate threshold" as claimed by Limitation 1.3. It would have been obvious to a POSITA to include the flow rate thresholds of *Jackson* in the method of *Beuterbaugh* to ensure sufficient flow change to initiate *Beuterbaugh*'s pressure pulse, indicate that the flow change for the pressure pulse has ended, and to monitor for leaks. When this occurs (appropriate flowrate thresholds are met), the process would move the fracturing process to the next step, as explained by *Jackson*. The combination of *Beuterbaugh* and *Jackson*, therefore, renders Limitation 1.3 obvious.

385. Further, this element would have been obvious to a POSITA having general engineering knowledge, particularly as it relates to RST and water hammer tests. (*See* Sections IX.D-IX.F).

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[280] Ex. 1005 at [0019].

[281] Ex. 1005 at [0021], *see also* Claim 22.

e. 1.4: "has been below the flow rate threshold for a threshold amount of time;"

386. The combination of *Beuterbaugh* and *Jackson* renders obvious this claim limitation. As discussed above regarding Limitation 1.3, *Jackson* specifically teaches a threshold of a flowrate for a threshold amount of time. In one embodiment of *Jackson*, "the second threshold may be defined as a time period of more than 1 minute and less than 24 hours of a flow rate of dilation fluid of less than 300 scm."[282] Accordingly, the flow rate threshold disclosed by *Jackson* in that example, is 300 scm and the threshold amount of time is 1 minute up to 24 hours.

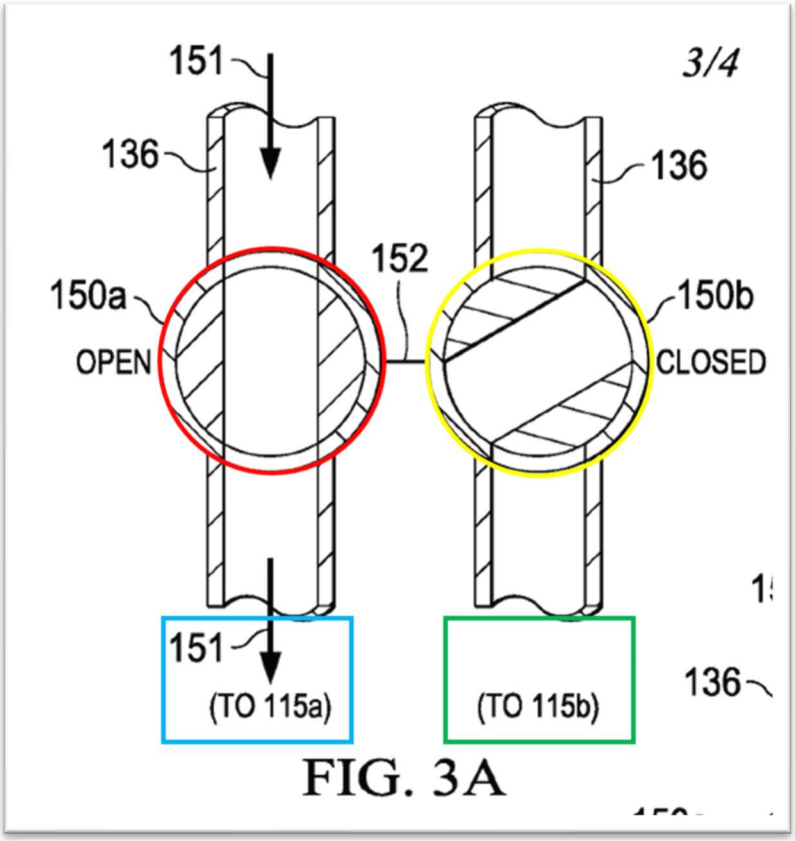
387. Accordingly, *Jackson* discloses the flow rate "has been below the flow rate threshold for a threshold amount of time" as claimed by Limitation 1.4. It would be obvious to a POSITA to include the flowrate and time thresholds of *Jackson* in the method of *Beuterbaugh* to ensure the proper volume of fracturing fluid is pumped down the wells to initiate the pressure pulse, indicate that the flow change for the pressure pulse has ended, and to monitor for leaks. When this occurs (appropriate flowrate thresholds are met), the process would move the fracturing process to the next step, as explained by *Jackson*. Therefore, the combination of *Beuterbaugh* and *Jackson* renders Limitation 1.4 obvious.

[282] Ex. 1005 at [0021].

f. 1.5: "(c) during pumping of the fluid into the first well via the first valve, opening a second valve associated with a second well;"

388. *Beuterbaugh* discloses this limitation. *Beuterbaugh* teaches pumping fluid into the first well via the first valve as a 1st state of the process discussed above regarding Limitation 1.1.2, by "opening switching valve **150a** and plug valve **155a** such that the flow rate of the fracturing fluid **151** … is directed to the first wellhead **115a**."[283] This state is illustrated in Fig. 3A, which shows valve **150a** [annotated in red] open and fluid **151** flowing to wellhead **115a** [annotated in blue] (and subsequently to well **120a**). In contrast, there is no fluid flowing to wellhead 115b [annotated in green] (and subsequently to well 120b) as valve 150b is closed. [annotated in yellow].

[283] Ex. 1036 at [0021].



Beuterbaugh, Fig. 3A

389. *Beuterbaugh* further discloses, placing the system into the 2nd state: "Next, as shown in FIG. 3B, a pulse of fluid flow **151** is directed to the second wellhead **115b** [annotated in green] by first opening the plug valve **155b** downstream of switching valve **150b**, then switching valve **150b** [annotated in yellow] is opened as switching valve **150a** is being closed."[284] By opening valve **150b** "as switching valve **150a** [annotated in red] is being closed," the second valve (**150b**) is opened while fluid is still being pumped to wellhead **115a** (and well **120a)** through valve

[284] Ex. 1036 at [0021].

150a. Note that in Fig. 3B, fluid flow **151** is flowing to both wellhead 115a and 115b simultaneously.

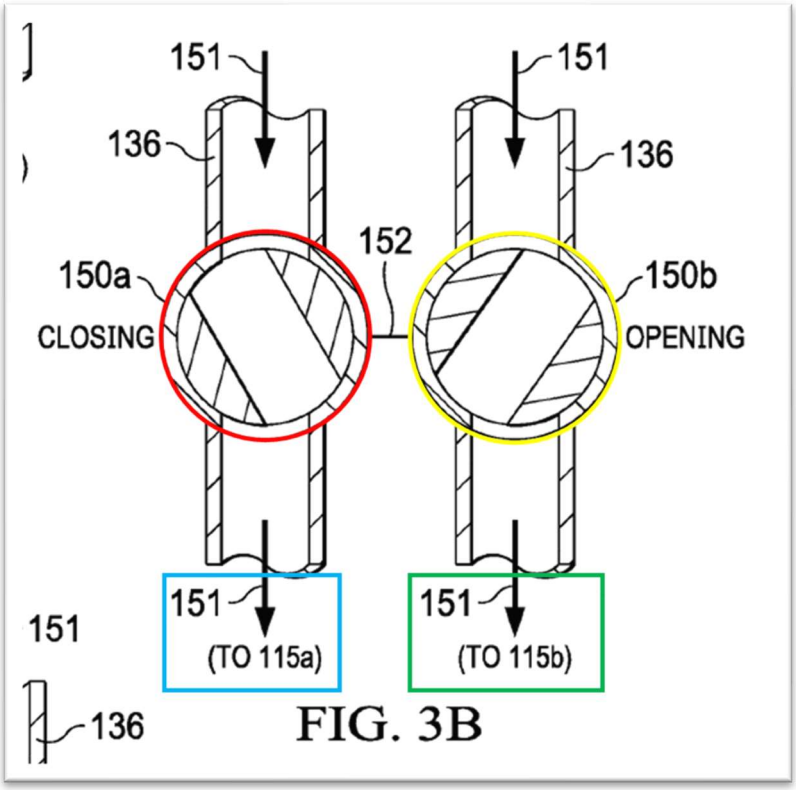


FIG. 3B

Beuterbaugh, Fig. 3B

390. Accordingly, *Beuterbaugh* discloses, or at least renders obvious, claim Limitation 1.5, and the combination of *Beuterbaugh* and *Jackson* (discussed above) renders Claim 1 as a whole obvious.

g. 1.6: "(d) permitting performance of a second hydraulic fracturing operation on the second well, which second hydraulic fracturing operation comprises pumping fluid into the second well via the second valve; and"

391. *Beuterbaugh* discloses this limitation. *Beuterbaugh* teaches "treating a plurality of wells simultaneously includes applying a high pressure of fracturing fluid to one or more switching valves and repeatedly opening and closing the one or more switching valves to divert the fracturing fluid near instantaneously from one well to the other well to creat[e] a pulse wave into the plurality of wells for fracturing subterranean formations."[285] The switching of the valves, as described above regarding Limitations 1.2 and 1.5, "alternatively redirect[s] the fracturing fluid received via high pressure conduit **136** [annotated in red] from the one or more high pressure pumps **135a**-**135e** [annotated in yellow] from one wellhead **115a** [annotated in blue] to another wellhead **115b** [annotated in green]."[286] Pumping fracturing fluid to a second well, as disclosed by *Beuterbaugh* is a second fracturing operation.

[285] Ex. 1036 at Abstract.

[286] Ex. 1036 at [0019].

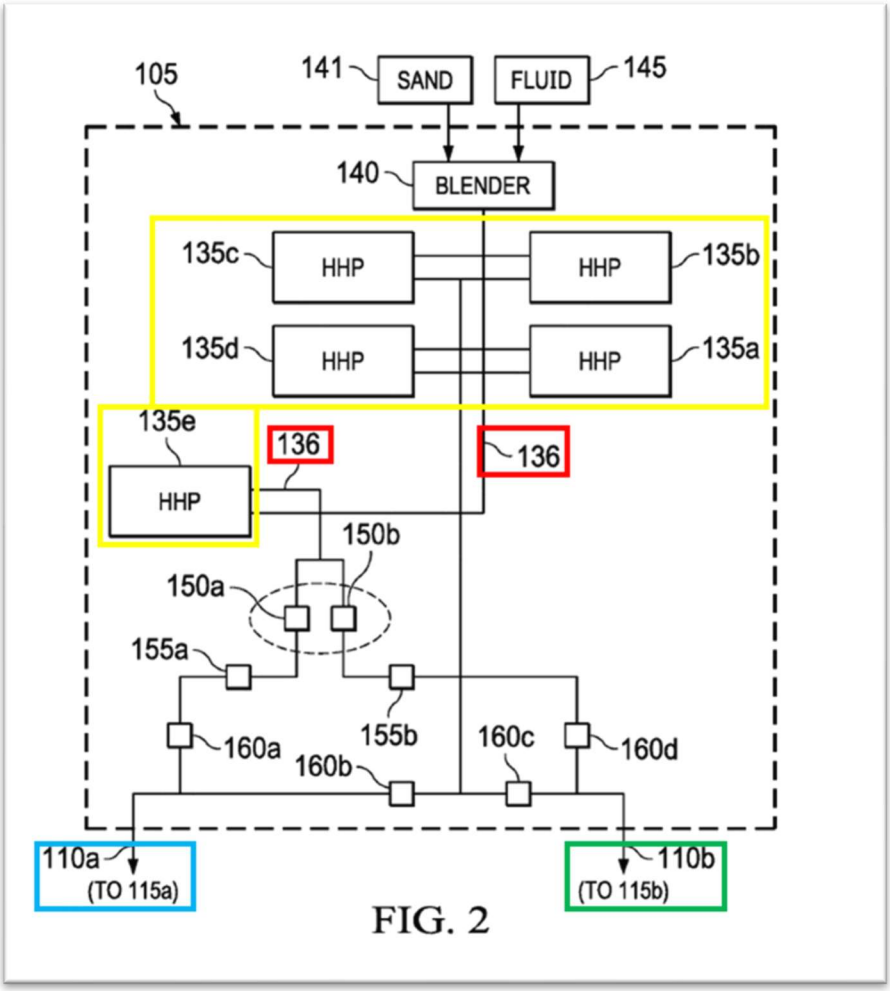


FIG. 2

Beuterbaugh, Fig. 2

392. A POSITA would have understood that flowing fracturing fluid to wellhead **115b** (associated with well **120b**) would be permitting performance of a second hydraulic fracturing operation on a second well (**120b**) by pumping fluid into the second well via the second valve (**150b**).

393. Accordingly, *Beuterbaugh* discloses, or at least renders obvious Claim Limitation 1.6, and the combination of *Beuterbaugh* and *Jackson* (discussed above) renders Claim 1 obvious as a whole.

h. 1.7: "(e) during pumping of the fluid into the second well via the second valve, closing the first valve associated with the first well;"

394. *Beuterbaugh* discloses this limitation. As described above regarding Limitation 1.5, during the 2nd state of the fracturing operation, valve **150b** is opened to allow fracturing fluid to flow to wellhead **115b** and associated well **120b** while valve **150a** is still at least partially open. *Beuterbaugh* describes closing valve **150a** as the next step. The transition to the second stage involves "switching valve **150b** [annotated in yellow] is opened as switching valve **150a** [annotated in red] is being closed. … After switching valve **150b** is fully opened and switching valve **150a** is fully closed, as shown in Fig. 3C … the plug valve **155a** downstream of switching valve **155a** is closed."[287] In this state, fracturing fluid flows to wellhead **115b** [annotated in green] but not to wellhead **115a** [annotated in blue].

[287] Ex. 1036 at [0021].

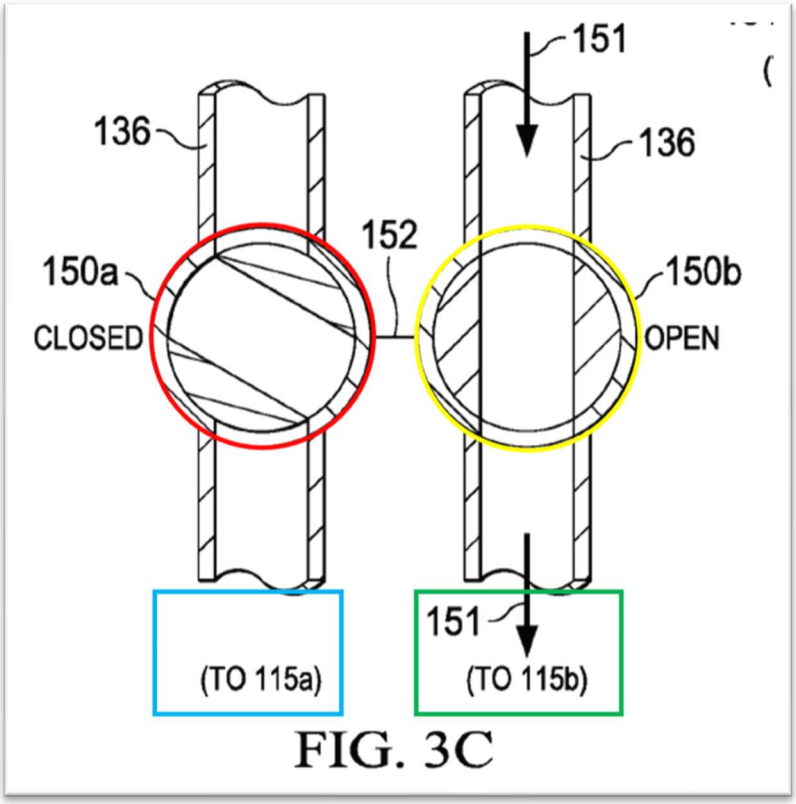


FIG. 3C

Beuterbaugh, Fig. 3C

395. Accordingly, *Beuterbaugh* discloses, or at least renders obvious, Claim Limitation 1.7. The combination of *Beuterbaugh* and *Jackson* (discussed above) renders obvious Claim 1 as a whole.

i. <u>1.8: "wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped to the first valve, the second valve, or both the first valve and the second valve."</u>

396. *Beuterbaugh* discloses this limitation. *Beuterbaugh* describes "applying a high pressure of fracturing fluid to one or more switching valves and repeatedly opening and closing the one or more switching valves … to creat[e] a

pulse wave into the plurality of wells for fracturing subterranean formations"[288]. Further, *Beuterbaugh* discloses, "[t]he one or more pressure pumps **135a-135e** run at a constant rate to provide a substantially constant pressure of the blended fracturing fluid to the one or more switching valves."[289] A POSITA would have recognized that the fluid is pumped continuously to the switching valves. Fig. 2 of *Beuterbaugh* displays this graphically. In Fig. 2, the pressure pumps are annotated in yellow, valve **150a** (first valve) is annotated in red, and valve **150b** (second valve) is annotated in blue. A switching scenario, where a constant flow rate is established and valves are switched between exposing the first and second well to fracturing fluid, would require fluid to be pumped continuously to each of valves **150a** and **150b**.

[288] Ex. 1036 at Abstract.

[289] Ex. 1036 at [0018].

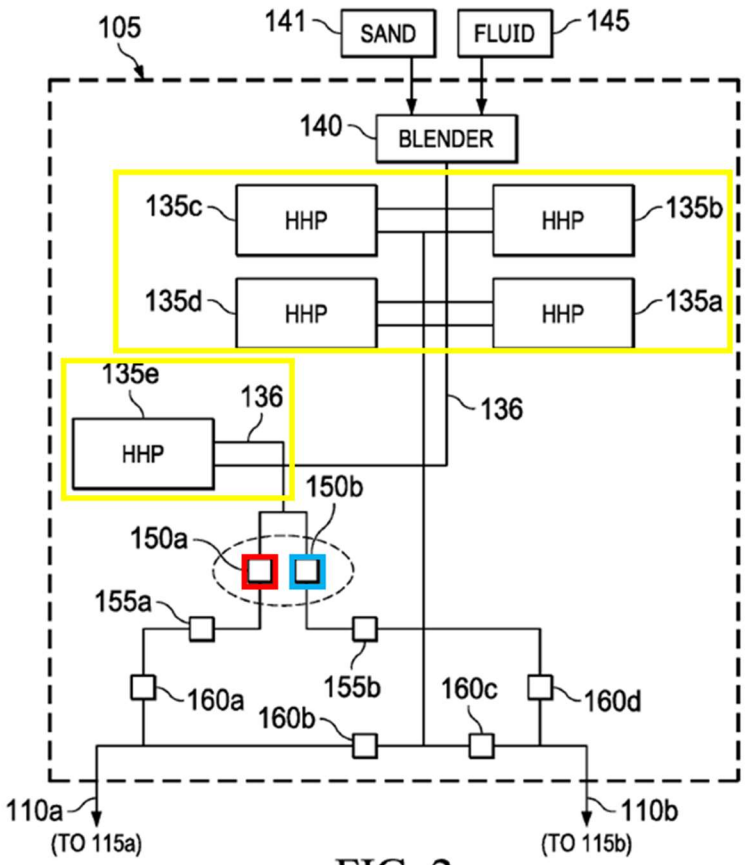


FIG. 2

Beuterbaugh, Fig. 2

397. Accordingly, *Beuterbaugh* discloses, or at least renders obvious, Claim Limitation 1.8.

398. In view of the above, the combination of *Beuterbaugh* and *Jackson* discloses each and every element of Claim 1. A POSITA would have been motivated to incorporate the teachings of *Jackson* with *Beuterbaugh* for the reasons discussed above, and therefore Claim 1 as a whole is obvious over *Beuterbaugh* and *Jackson*.

C. DEPENDENT CLAIM 2

399. Dependent Claim 2 depends from Claim 1. In addition to the disclosure of Claim 1 discussed above, *Beuterbaugh* discloses Claim 2.

a. "2. The method of claim 1, wherein each of the first and second valves is in fluid communication with a hydraulic manifold from which fluid is pumped to the first valve and/or the second valve; and wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped from the hydraulic manifold to the first valve, the second valve, or both the first valve and the second valve."

400. *Beuterbaugh* discloses this limitation. As discussed above regarding the preamble, *Beuterbaugh* teaches hydraulic fracturing operations at a multi-well fracturing site.

401. Further still, *Beuterbaugh* discloses a manifold in communication with the first and second valves used to pump fluid to the first and second valves. When discussing the background of hydraulic fracturing, *Beuterbaugh* discloses "surface equipment such as, for example, the high pressure pumps, blender, manifolds and valves."[290] In Fig. 2, *Beuterbaugh* discloses two manifolds in fluid communication with the first valve (**150a** annotated in green) and the second valve (**150b** annotated in pink). The manifold annotated in blue is the intake manifold for the pressure pumps **135a** – **135e**. This manifold is in fluid communication with the valves through pump **135e**. Secondly, the manifold annotated in red is the discharge manifold for

[290] Ex. 1036 at [0004].

pump **135e** and is in direct fluid communication with both first valve **150a** and second valve **150b**.

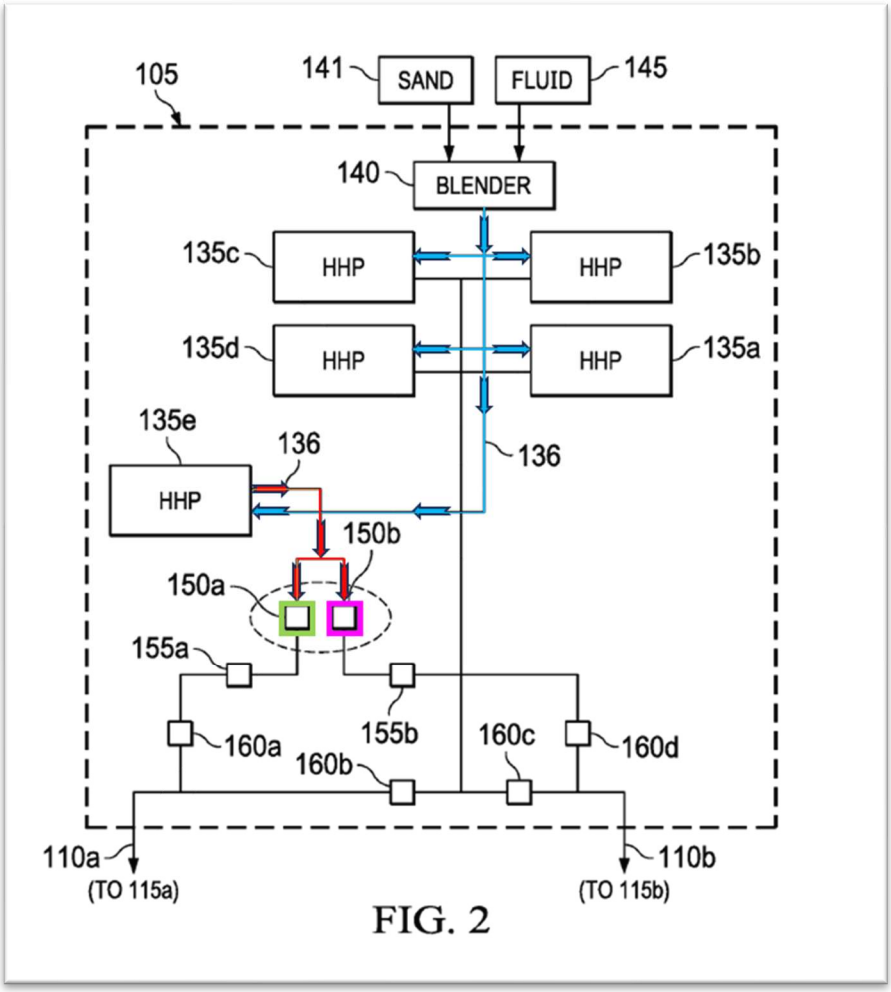


FIG. 2

Beuterbaugh, Fig. 2

402. As discussed above regarding Limitation 1.8, fluid is continuously pumped to the first and second valves via both the red and blue annotated manifolds. Accordingly, *Beuterbaugh* discloses a manifold in fluid communication with both the first valve and the second valve, through which fluid is continuously pumped to

both the first and second valves. The combination of *Beuterbaugh* and *Jackson*, therefore, renders obvious Claim 2.

D. DEPENDENT CLAIM 3

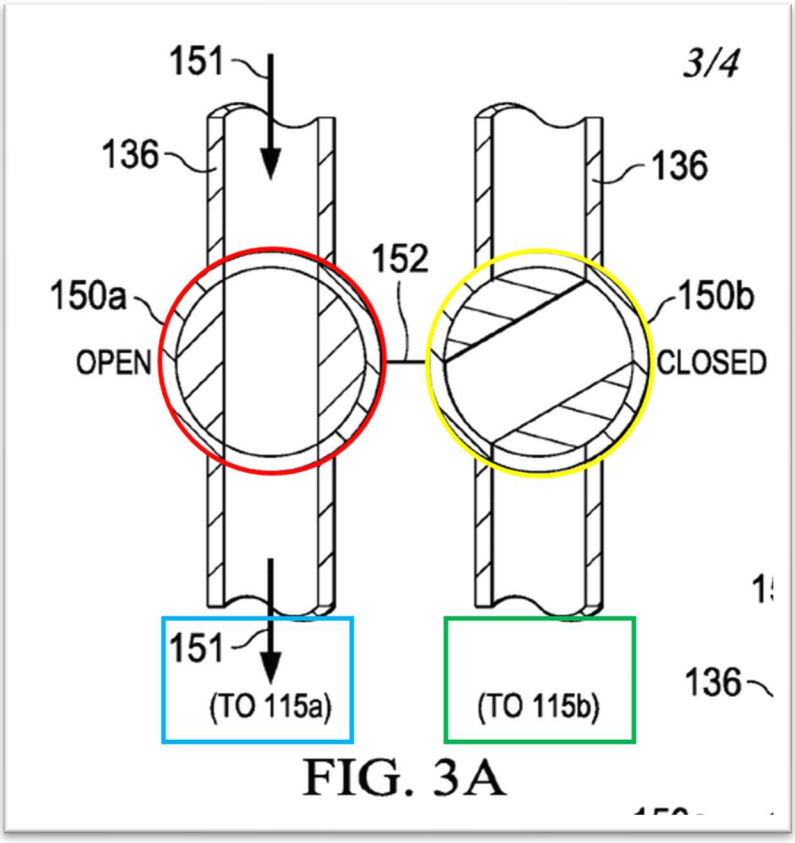
403. Dependent Claim 3 depends from Claim 1. In addition to *Beuterbaugh*'s disclosure of Claim 1 discussed above, *Beuterbaugh* discloses Claim 3:

a. "3. The method of claim 1, wherein the second valve is opened after step (b)."

404. The limitation in Claim 3 is substantially similar to the limitation discussed regarding Limitation 1.5, but missing the limitation that the second valve is opened "during pumping of the fluid into the first well via the first valve." Accordingly, Claim 3 is disclosed for the same reasons as those discussed regarding Limitation 1.5 above in Section XIII.B.(f). For example, *Beuterbaugh* teaches pumping fluid into the first well via the first valve as a 1st state of *Beuterbaugh*'s process by "opening switching valve **150a** and plug valve **155a** such that the flow rate of the fracturing fluid **151** … is directed to the first wellhead **115a**."[291] This state is illustrated in Fig. 3A, which shows valve **150a** [annotated in red] open and fluid **151** flowing to wellhead **115a** [annotated in blue] (and subsequently to well

[291] Ex. 1036 at [0021].

120a). In contrast, no fluid flows to wellhead **115b** [annotated in green] (and subsequently to well **120b**) as valve **150b** is closed [annotated in yellow].



Beuterbaugh, Fig. 3A

405. *Beuterbaugh* further discloses placing the system into the 2nd state: "[n]ext, as shown in FIG. 3B, a pulse of fluid flow **151** is directed to the second wellhead **115b** [annotated in green] by first opening the plug valve **155b** downstream of switching valve **150b**, then switching valve **150b** [annotated in yellow] is opened as switching valve **150a** is being closed."[292] By opening valve **150b** "as switching

[292] Ex. 1036 at [0021].

valve **150a** [annotated in red] is being closed", the second valve (**150b**) is opened while fluid is still being pumped to wellhead **115a** (and well **120a)** through valve **150a**. In Fig. 3B, fluid flow **151** is flowing to both wellhead 115a and 115b simultaneously.

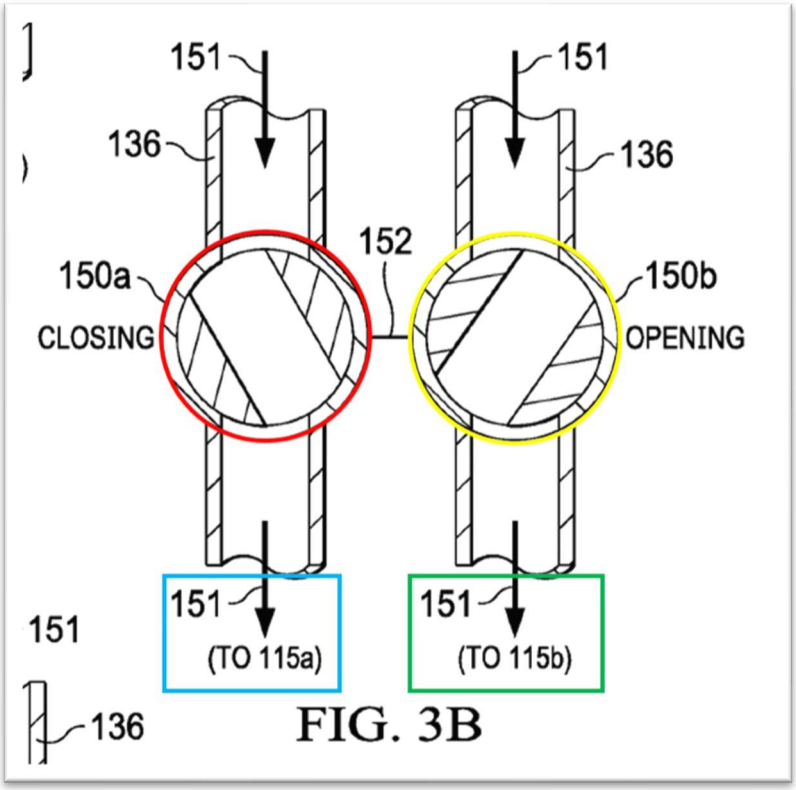


FIG. 3B

Beuterbaugh, Fig. 3B

406. Further, *Jackson* specifically discloses a combination of flow rate and time thresholds as a signal to move to the next stage of fracturing operations. For example, *Jackson* teaches "the second threshold may be defined as a time period of more than 1 minute and less than 24 hours of a flow rate of dilation fluid of less than

300 scm."[293] In this example, the fracturing fluid flow rate must be below a flowrate threshold of 300 scm (standard cubic feet per minute) for a time threshold of at least one minute, up to 24 hours, to move to the next step in the fracturing process.

407. It would be obvious to a POSITA to include the flowrate and amount of time thresholds of *Jackson* in the method of *Beuterbaugh* to move to the next step of fracturing operations. Further, a POSITA would have used the flowrate thresholds of Jackson, along with the time thresholds of *Beuterbaugh* to ensure the proper flow and volume of fracturing fluid is pumped down the wells to initiate the pressure pulse, to indicate that the flow change for the pressure pulse has ended, and to monitor for leaks. Once the flowrate and time thresholds are met, *Jackson* (and *Beuterbaugh*) teaches moving the fracturing process to the next step, which includes opening a second valve to a second well while fluid is "continuously" being pumped into a first well via a first associated valve, as suggested by *Beuterbaugh*. Using *Jackson*'s flow rate monitoring techniques in *Beuterbaugh*'s methods would have involved a simple substitution of one known technique (use of time and flowrate thresholds) for another (use of time thresholds and measuring flowrate) to achieve predictable control of the fracturing operation.

408. Therefore, the combination of *Beuterbaugh* and *Jackson* renders Claim 3 obvious for the reasons discussed above.

[293] Ex. 1005 at [0021], *see also* Claim 22.

E. DEPENDENT CLAIM 6

409. Dependent Claim 6 depends from Claim 1. In addition to *Beuterbaugh*'s disclosure of Claim 1 discussed above, *Beuterbaugh* discloses Claim 6.

a. "6. The method of claim 1, wherein each of the first and second valves is a zipper valve."

410. *Beuterbaugh* discloses this limitation. The '779 Patent describes a zipper valve **170a**-**170b** [annotated in red] as "operably coupled to, and adapted [to] communicate fluid between the zipper manifold **145** [annotated in blue] and the well **105a** [annotated in green]."[294] The configuration of the zipper valves is shown in Figs 2A – 2G of the '779 Patent, of which Fig. 2A is duplicated below.

[294] Ex. 1001 at 7:59-61.

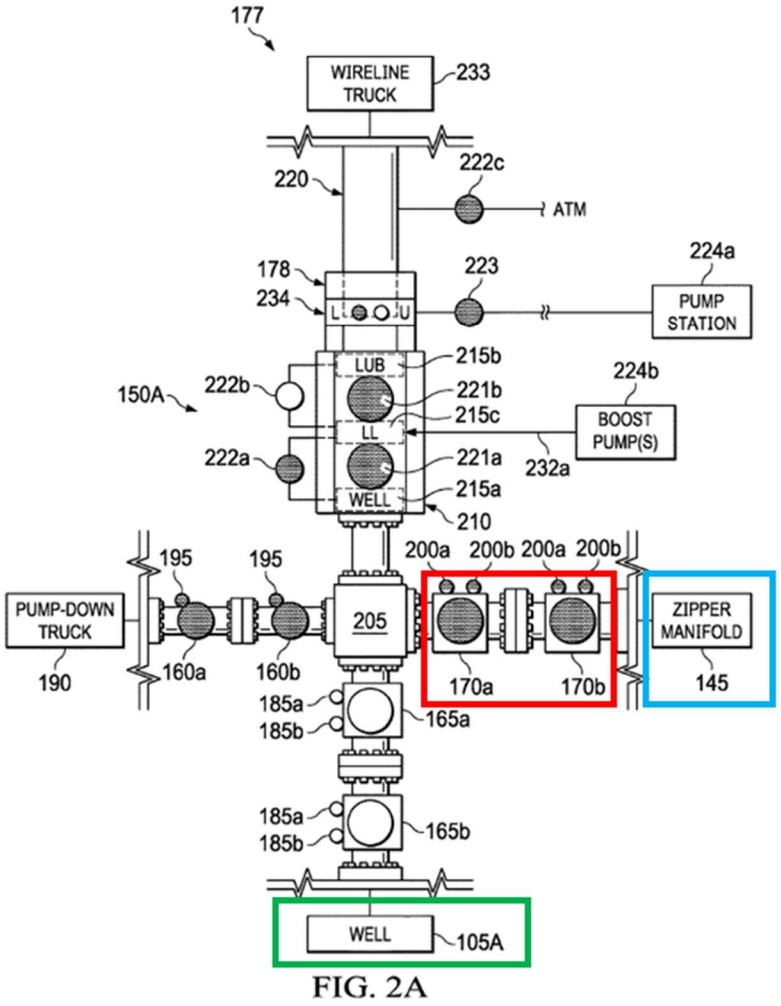


FIG. 2A

’779 Patent, Fig. 2A

411. The ’779 Patent does not specifically define or limit the “zipper valve” as any particular valve type or configuration, but rather, merely identifies one example: “such as, for example, gate valves.”[295] The ’779 Patent similarly describes other valves as being any type of valve (“such as, for example, gate valves”),

[295] Ex. 1001 at 7:59-61.

including master valves and pump down valves.[296] A gate valve is a well-known valve commonly used in the oil and gas industry, including in fracturing.[297] Thus, a POSITA would have understood a "zipper valve" to be any valve that is "operably coupled to, and adapted [to] communicate fluid between the zipper manifold … and the well."[298] Additionally, the '779 Patent does not specifically define a "zipper manifold" but explains "a zipper manifold" is "adapted to communicate the pressurized hydraulic fracturing fluid from the discharge manifold **130** to a plurality of hydraulic fracturing legs (or "frac legs") **150A** through **150C+n**, each of which is adapted to communicate the pressurized hydraulic fracturing fluid from the zipper manifold **145** to a corresponding one of the wells **105A** through **105C+n**."[299]

412. *Beuterbaugh* discloses precisely this configuration. As discussed above regarding Claim 2, in Fig. 2 (reproduced below), *Beuterbaugh* discloses two manifolds in fluid communication with the first valve (**150a** annotated in green) and the second valve (**150b** annotated in pink). The manifold annotated in blue is the

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[296] *Id*. at 7:49-55.

[297] *See*, *e.g.*, API 6A 20th Edition, *Specification for Wellhead and Christmas Tree Equipment,* October 2010

3.1.51
gate valve
valve assembly with a gate operating within the body, 90° to the conduit, to effect a closure

[298] *Id*. at 7:58-61.

[299] *Id.* at 7:55-61.

intake manifold for the pressure pumps **135a** – **135e**. This manifold is in fluid communication with the valves through pump **135e**. Secondly, the manifold annotated in red is the discharge manifold for pump **135e** and is in direct fluid communication with both first valve **150a** and second valve **150b**. A POSITA would have understood that *Beuterbaugh*'s manifold (annotated in red) is a "zipper manifold" because it is used to distribute fluid from the pumps to multiple wells through valves 150a and 150b.

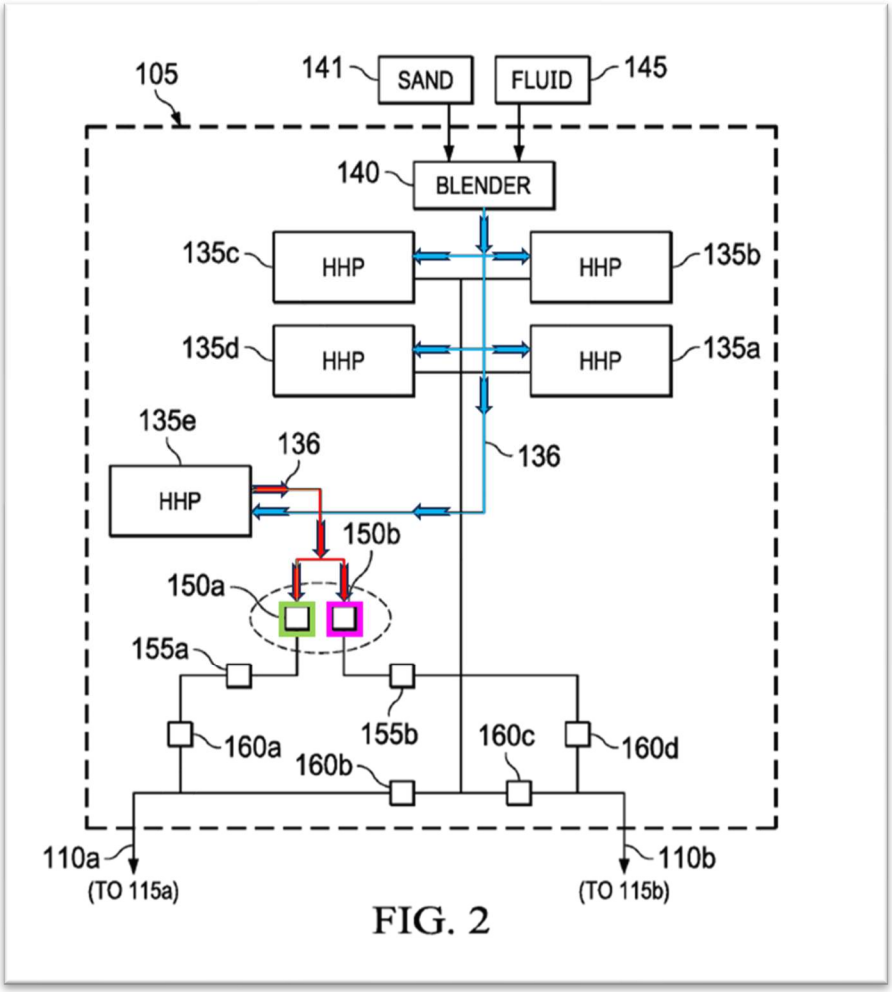


FIG. 2

Beuterbaugh, Fig. 2

413. A POSITA would have understood that a "gate valve" is a common type of valve used widely throughout the Oil and Gas industry, including in fracturing operations. A POSITA would have understood a "zipper valve" to be any valve that is "operably coupled to, and adapted [to] communicate fluid between the zipper manifold … and the well."[300] Thus, a POSITA would also have understood that the "switching valves **150a**, **150b**" would have been zipper valves. As seen in Fig. 2 of *Beuterbaugh*, these valves are associated both with the intake manifold (blue) and discharge manifold (red arrows) and communicate fluid between the zipper manifold (red) and the well (115a,115b).

414. Accordingly, *Beuterbaugh* discloses this limitation, and the combination of *Beuterbaugh* and *Jackson* renders obvious Claim 6 for the reasons discussed above. To the extent that the Board determines that a "zipper valve" is not explicitly disclosed by *Beuterbaugh,* then it would have been obvious to a POSITA with general engineering knowledge regarding such operations that the valves associated with a zipper manifold would have been "zipper valves," based on the teachings of *Beuterbaugh* regarding sequential or simultaneous (*i.e.*, zipper) fracturing operations.[301]

[300] Ex. 1001 at 7:58-61.

[301] *See*, *e.g.*, Sections IX.C-IX.D.

F. INDEPENDENT CLAIM 8

415. It is my opinion that Claim 8 of the '779 Patent would have been obvious based on the teachings of *Beuterbaugh* and *Jackson*. With the exception of Claim 8 being an "apparatus" claim, and the claim further containing a description of structure of the apparatus, namely known computer elements for executing instructions, Claim 8 is substantially similar to Claim 1. As discussed below, the combination of *Beuterbaugh* and *Jackson* discloses and renders obvious the apparatus claimed in Claim 8 of the '779 Patent.

a. 8.1.1: "An apparatus comprising:"

416. To the extent the preamble is limiting, *Beuterbaugh* discloses the preamble.[302] The title of *Beuterbaugh* is "Simulfrac Pulsed Treatment."[303] A POSITA would have understood "Simulfrac" to indicate "simultaneous fracturing" of multiple wells.[304] *Beuterbaugh* further describes "applying a high pressure of fracturing fluid to one or more switching valves and repeatedly opening and closing the one or more switching valves … to create[e] a pulse wave into the plurality of wells for fracturing subterranean formations."[305]

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[302] I understand that the preambles may not be limiting. However, I include analysis of the preamble for Claim 8 out of an abundance of caution.

[303] Ex. 1036 at Title.

[304] *See* Section IX.C.

[305] Ex. 1036 at Abstract.

417. *Beuterbaugh* discloses a "controller 158 may also control any of the switching valves 150a, 150b."[306] Specifically, *Beuterbaugh* discloses a computerized controller may be used to control the switching valves 150a, 150b.[307] Further, "[t]he controller 158 may comprise a computer processor connected by a bus to a memory. The memory may include a software program for performing the control and operational sequencing of the components, including the sequencing of opening and closing the switching valves **150a**, **150b**, **156**, plug valves **155a**, **155b**, and flapper checks **160a-160d**."[308]

418. Accordingly, *Beuterbaugh* discloses a computing system which is an example of the apparatus as described in Claim 8.

8.1.2: "a non-transitory computer readable medium; and"

419. *Beuterbaugh* discloses this limitation. *Beuterbaugh* discloses "[t]he controller 158 may comprise a computer processor connected by a bus to a memory. The memory may include a software program for performing the control and operational sequencing of the components, including the sequencing of opening and closing the switching valves **150a**, **150b**, **156**, plug valves **155a**, **155b**, and flapper checks **160a-160d**." A POSITA would thus understand the generic term "memory"

[306] Ex. 1036 [0025].

[307] Ex. 1036 at [0022].

[308] Ex. 1036 [0025].

connected by a bus to a computer and which contains a software program described in *Beuterbaugh* to be a "non-transitory computer readable medium," as claimed.

420. Accordingly, *Beuterbaugh* discloses "a non-transitory computer readable medium" as claimed in Limitation 8.1.2.

8.2.1: "a plurality of instructions stored on the non-transitory computer readable medium and executable by one or more processors,"

421. *Beuterbaugh* discloses the Limitations of Claim 8.2.1. When describing its' controller, *Beuterbaugh* discloses "[t]he controller **158** may comprise a computer processor connected by a bus to a memory. The memory may include a software program for performing the control and operational sequencing of the components, including the sequencing of opening and closing the switching valves **150a**, **150b**, **156**, plug valves **155a**, **155b**, and flapper checks **160a-160d**."[309]

422. A POSITA would have immediately equated the "software program" of *Beuterbaugh* to the claimed "plurality of instructions." A POSITA would have also immediately recognized the software program on the memory connected by bus to the processor would equate to the program being "executable by one or more processors."

[309] Ex. 1036 at [0025].

423. Accordingly, *Beuterbaugh* discloses "a plurality of instructions stored on the non-transitory computer readable medium and executable by one or more processors" as claimed in Limitation 8.2.1.

8.2.2: "wherein, when the instructions are executed by the one or more processors, the following steps are executed:"

424. *Beuterbaugh* discloses this limitation. *Beuterbaugh* teaches "[t]he controller 158 may comprise a computer processor connected by a bus to a memory. The memory may include *a software program for performing the control and operational sequencing of the components, including the sequencing of opening and closing the switching valves **150a**, **150b**,* **156**, plug valves **155a**, **155b**, and flapper checks **160a**-**160d**."[310] A POSITA would have immediately equated the disclosure of "program for performing the control and operational sequencing of the components, including the sequencing of opening and closing the switching valves **150a**, **150b**" to the claimed "when the instructions are executed by the one or more processors, the following steps are executed" as claimed.

425. Furthermore, during prosecution of the '779 Patent, the examiner understood that the "control vehicle **40** [of another reference] would have computer readable medium to allow [an] operator to control the valves for the fracturing

[310] Ex. 1036 at [0025] (emphasis added).

process."[311] The Applicant did not disagree, but in response, the Applicant incorporated allowable subject matter into the independent claims. In other words, during prosecution of the '779 Patent, Downing acknowledged that it was well known for control devices that allow an operator to control valves on the fracturing process to include a computer readable medium and to include instructions executed by one or more processors to perform the steps of the instructions.

426. Whether or not *Beuterbaugh*'s disclosure of a software program inherently included non-transitory computer readable medium, it was well known in the art to use computer systems having non-transitory computer readable medium to control valves and other equipment in hydraulic fracturing operations.[312]

427. Thus, it would have been obvious that the computerized controller of *Beuterbaugh* include a processor that executes instructions stored on the memory component to control valves in a well system in order "to allow the operator to control different parameters of the fracturing operation."[313]

428. Accordingly, *Beuterbaugh* discloses, or at least renders obvious, a computerized controller which is an example of the apparatus as described in Claim 8.

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[311] Ex. 1010 at p. 4 (Office Action dated 1/5/2022).

[312] *See*, *e.g.*, Ex. 1020 at [0030]; Ex. 1021 at [0072]; Ex. 1036 at [0022], [0025].

[313] Ex. 1010 at p. 4.

b. **8.3: "(a) permitting performance of a first hydraulic fracturing operation on a first well, which first hydraulic fracturing operation comprises pumping fluid into the first well via a first valve associated with the first well, and**

8.4: measuring a flow rate of the fluid being pumped into the first well; and

8.5: (b) determining that the flow rate of the fluid being pumped into the first well is below a flow rate threshold and

8.6: has been below the flow rate threshold for a threshold amount of time;

8.7: (c) during pumping of the fluid into the first well via the first valve, opening a second valve associated with a second well;

8.8: (d) permitting performance of a second hydraulic fracturing operation on the second well, which second hydraulic fracturing operation comprises pumping fluid into the second well via the second valve; and

8.9: (e) during pumping of the fluid into the second well via the second valve, closing the first valve associated with the first well;

8.10: wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped to the first valve, the second valve, or both the first valve and the second valve.

429. With the exception of being rewritten as an apparatus claim, the language in claim Limitations 8.3 through 8.10 is identical to that of Limitations 1.1 through 1.8. The combination of *Beuterbaugh* and *Jackson* discloses or at least renders obvious Limitations 8.3 through 8.10 for the same reasons as those discussed regarding Limitations 1.1 through 1.8 in Section XIII.B(a)-(i). In view of the above,

the combination of *Beuterbaugh* and *Jackson* discloses each and every element of Claim 8. A POSITA would have been motivated to incorporate the teachings of *Jackson* with *Beuterbaugh* for the reasons discussed above.

430. As discussed in Sections XIII.F(a) above, *Beuterbaugh* discloses an apparatus as claimed for executing steps, and the steps executed by *Beuterbaugh*'s computerized controller and software program in view of *Jackson*'s disclosure include the steps recited in Limitations 8.3 through 8.10 (*see also* Section XIII.B). Therefore, Claim 8, as a whole, is obvious over *Beuterbaugh* and *Jackson*.

G. DEPENDENT CLAIM 9

a. "9. The apparatus of claim 8,wherein each of the first and second valves is in fluid communication with a hydraulic manifold from which fluid is pumped to the first valve and/or the second valve; wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped from the hydraulic manifold to the first valve, the second valve, or both the first valve and the second valve."

431. Except for depending from Claim 8 and being an apparatus claim, Claim 9 is identical to Claim 2 and is disclosed by *Beuterbaugh* for the same reasons as those described above regarding Claim 2 in Section XIII.C. Accordingly, Claim 9 is rendered obvious by *Beuterbaugh* in view of *Jackson* for the reasons provided above.

H. DEPENDENT CLAIM 10

a. "10. The apparatus of claim 8, wherein the second valve is opened after step (b)."

432. Except for depending from Claim 8 and being an apparatus claim, Claim 10 is identical to Claim 3 and is disclosed by *Beuterbaugh* for the same reasons as those described above regarding Claim 3 in Section XIII.D. Accordingly, Claim 10 is obvious over the combination of *Beuterbaugh* and *Jackson* for the reasons discussed above.

I. DEPENDENT CLAIM 13

a. "13. The apparatus of claim 8, wherein each of the first and second valves is a zipper valve."

433. Except for depending from Claim 8 and being an apparatus claim, Claim 13 is identical to Claim 6 and is disclosed by *Beuterbaugh* for the same reasons as those described above regarding Claim 6 in Section XIII.E. Accordingly, Claim 13 is obvious over the combination of *Beuterbaugh* and *Jackson* for the reasons discussed above.

J. INDEPENDENT CLAIM 15

434. It is my opinion that the combination of *Beuterbaugh* and *Jackson* renders obvious Claim 15 of the '779 Patent. Details regarding the specific disclosures of *Beuterbaugh* and *Jackson* are contained in the following subsections.

a. 15.1: "15. A method of hydraulically fracturing at least first and second wells of a plurality of wells, the first and second wells being associated with first and second valves, respectively, the method comprising:"

435. To the extent the preamble is limiting, *Beuterbaugh* discloses a method of hydraulically fracturing a plurality of wells, including a first and second well, each well with associated valves.[314] *Beuterbaugh* discloses "[a] method and system pulse for treating a plurality of wells simultaneously includes applying a high pressure of fracturing fluid to one or more switching valves and repeatedly opening and closing the one or more switching valves to divert the fracturing fluid near instantaneously from one well to the other well."[315]

436. *Beuterbaugh* further discloses individual valves for switching fracturing fluid to the wells. "Referring to FIG. 2, the surface fracturing equipment **105** is shown in more detail. The surface fracturing equipment **105** in this example includes … one or more switching valves **150a**, **150b**."[316] Further, *Beuterbaugh* teaches these valves are associated with a plurality of wells, for introduction of fracturing fluid such that "the fracturing fluid [is] selectively diverted to the plurality of wells **120a**, **120b** by one or more switching valves **150a**, **150b**."[317]

[314] I understand that the preambles may not be limiting. However, I include analysis of the preamble for Claim 15 out of an abundance of caution.

[315] Ex. 1036 at Abstract.

[316] Ex. 1036 [0018].

[317] *Id*.

437. Accordingly, *Beuterbaugh* discloses, or at least renders obvious in light of the general engineering knowledge of a POSITA, the preamble.

b. <u>15.2: "(a) permitting hydraulic fracturing of the second well, comprising: opening the second valve associated with the second well to permit pumping of fluid into the second well via the second valve; and"</u>

438. As discussed above regarding the preamble, *Beuterbaugh* discloses hydraulic fracturing operations of multiple wells, including a second well **120b**. Also as discussed above, associated with second well **120b** is second valve **150b**, "[t]he second switching valve **150b** is connected to the second wellhead **115b** associated with a second well **120b** for treating the plurality of wells simultaneously."[318] *Beuterbaugh* teaches "a pulse of [fracturing] fluid flow **151** is directed to the second wellhead **115b** by first opening the plug valve **155b** downstream of switching valve **150b**, then switching valve **150b** is opened as switching valve **150a** is being closed."[319] A POSITA would understand that by opening the plug valve **155b** and switching valve **150b** to allow fracturing fluid to flow to well **120b** (via wellhead **115b**), the system of *Beuterbaugh* is permitting hydraulic fracturing of a second well. Further, although Claim 15 refers to permitting hydraulic fracturing of a "second well" and/or a "first well," there is no

[318] Ex. 1036 [0026].

[319] Ex. 1036 [0021].

technical distinction between "first" and "second" wells and no specific sequence tied to the use of "first" and "second" with respect to the "well." Rather, the terms "first" and "second" in the claims merely distinguish between two different wells.

439. In view of the above, *Beuterbaugh* discloses permitting hydraulic fracturing of multiple wells including a second well where hydraulic fracturing of the second well includes opening the second valve associated with the second well to allow fluid to be pumped into the second well. Thus, *Beuterbaugh* discloses, and the combination of *Beuterbaugh* and *Jackson* renders obvious Limitation 15.2.

c. <u>15.3: "measuring a flow rate of the fluid being pumped into the second well;"</u>

440. The combination of *Beuterbaugh* and *Jackson* renders measuring the flow rate as claimed in Limitation 15.3 obvious. *Beuterbaugh* anticipates knowledge of flow rate, by explaining, *e.g*, "[t]he number of high pressure pumps and total flow rate from the one or more high pressure pumps **135a**-**135e** determine the pulse size of the fracturing fluid."[320] Further, *Beuterbaugh* teaches that "the flow rate of the fracturing fluid **151** from the one or more high pressure pumps **135a**-**135e** is directed to the first wellhead **115a**."[321] *Beuterbaugh* also describes changes in flow rate to different wells due to opening and closing of the switching valves.[322] Specifically,

[320] Ex. 1036 [0018].

[321] Ex. 1036 [0021].

[322] Ex. 1036 at [0024].

Beuterbaugh explains "[w]hen a flow starts to flow into a first well, a positive waterhammer wave going to that first well is created while a rarefaction wave is created in the second well due to the sudden drop in the flow rate to the second well. The overlap of fluid flows to each well **120a**, **120b** can be controlled to optimize the downhole pressure waves and minimize the surface impacts."[323] It would have been obvious to a POSITA to measure the flow rate of the fluid being pumped into the second well (and/or first well) in order to control the fluid flow to each well to "optimize the downhole pressure waves and minimize the surface impacts," as taught by *Beuterbaugh*.[324]

441. To the extent that *Beuterbaugh* does not explicitly disclose or alone render obvious measuring a flowrate of fluid being pumped into the first well, *Jackson* provides such a specific disclosure. It would have been obvious to a POSITA to combine the teachings of *Beuterbaugh* regarding flowrate with those of *Jackson* regarding flowrate as a threshold to move to the next step of fracturing. *Jackson* teaches, throughout the disclosure, the use of flowrate of fluid into the well as a threshold. For example, *Jackson* discloses that thresholds "may be defined by at least one criterion selected from a set of criteria consisting of: (a) *a time period threshold*; (b) a non-participating gas [fracturing fluid] *flow rate threshold;* (c) a well

[323] Ex. 1036 at [0024].

[324] *Id*.

bore surface or bottom hole pressure threshold; (d) a well bore surface or bottom hole rate of pressure change threshold (e) a gas quantity threshold and (f) a formation condition threshold."[325] Further, *Jackson* discloses "[a]s will be appreciated, however, generally other process parameters such as *flow rate*, pressure, volume, formation condition, etc. *are observed* to assess a formation fracturing process."[326] Further, *Jackson* discloses several specific flowrate thresholds as examples including at least "300 scm", "0 scm" and "1000 scm." A POSITA would understand that to "observe" flowrate, as disclosed by *Jackson*, the flowrate being pumped into the well would be measured, as claimed in Limitation 15.3.

442. Although *Jackson* discusses "the fracturing fluid may include a non-participating gas and, if it is advantageous for the formation or the seam, may be substantially free of liquid water,"[327] a POSITA would understand that the teachings of a flowrate threshold for a gaseous fluid would equally apply to a liquid (*i.e.*, hydraulic) fluid. *Jackson* recognizes, "Aqueous liquids, or aqueous liquid based flows, may tend to be common frac fluids,"[328] particularly when there are not clays which may tend to swell in the presence of water. Further still, *Jackson* discloses

[325] Ex. 1005 at [0017]; *see also* Claim 20.

[326] Ex. 1005 at [0019] (emphasis added).

[327] Ex. 1005 2:63-67

[328] Ex. 1005 at7:43-44

that "if it is advantageous," the fluid may be substantially free of liquid water, which indicates that if it is not advantageous to be liquid-free, the fluid would contain water.

443. Further, a POSITA having general engineering knowledge would have known that measuring flowrate into a well was well-known long before the '779 Patent.[329]

444. Accordingly, the combination of *Beuterbaugh* and *Jackson* render Claim Limitation 15.3 obvious.

d. <u>15.4.1: "(b) swapping from permitting hydraulic fracturing of the second well to permitting hydraulic fracturing of the first well, comprising:"</u>

445. *Beuterbaugh* discloses this limitation. In describing the sequence of steps of the hydraulic fracturing system, *Beuterbaugh* teaches, initially, opening valve **150a** to allow fracturing fluid to flow into wellhead **115a** (and associated well **120a**), followed by a swap from the well **115a** to the well **115b** by opening valve **150b** and allowing fracturing fluid to flow into wellhead **115b** (and associated well **120b**). This is the process discussed in Claim 1 and Claim 8 above.[330]

446. As discussed above, although Claim 15 refers to permitting hydraulic fracturing of a "second well" and then "first well," there is no technical distinction

[329] *See* Sections IX.E-IX.F.

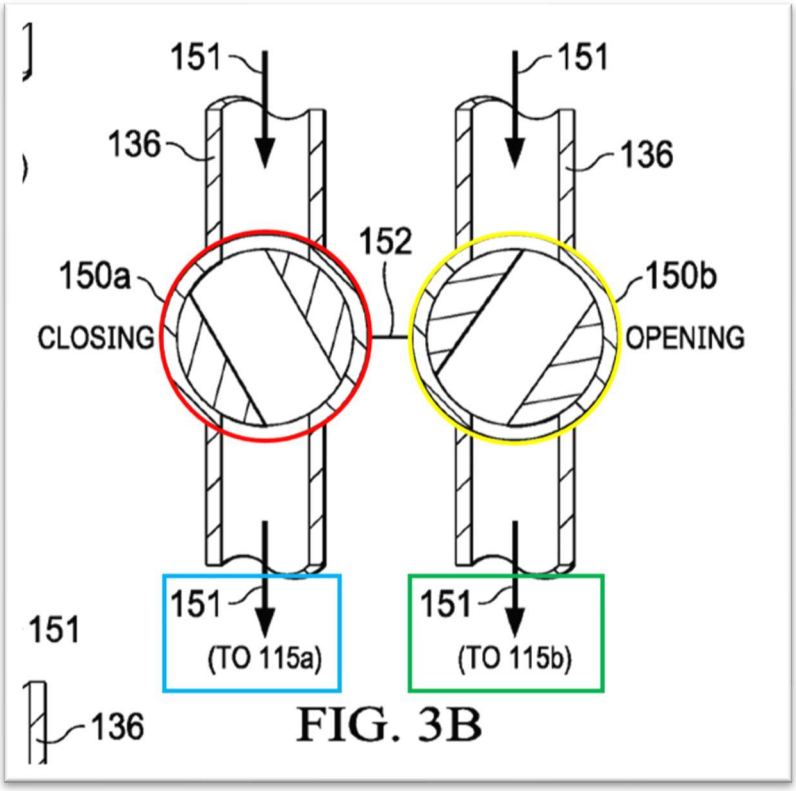
[330] *See* Ex. 1036 at [0022].

between "first" and "second" wells and no specific sequence tied to the use of "first" and "second" with respect to the "well," other than that recited in Limitation 15.4.1 (*i.e.*, swapping from …second well to … first well"). Rather, the terms "first" and "second" in the claims merely distinguish between two different wells.

447. *Beuterbaugh* discloses "swapping from permitting hydraulic fracturing of the second well to permitting hydraulic fracturing of the first well." For example, *Beuterbaugh* teaches swapping from "second wellhead **115b**" of the "second well **120b**" to the "first wellhead **115a**" of the "first well **120a**."

448. *Beuterbaugh* teaches, as shown in FIG. 3B, "a pulse of fluid flow **151** is directed to the second wellhead **115b** by first opening the plug valve **155b** downstream of switching valve **150b**, then switching valve 150b is opened as switching valve **150a** is being closed."[331]

[331] Ex. 1036 [0021].



Beuterbaugh, Fig. 3B

449. When describing the system, *Beuterbaugh* discusses a 3rd state of the system, illustrated by Fig. 3C as "**150b** is fully opened and switching valve **150a** is fully closed, as shown in FIG. 3C, initiating a pulse down well **120b**, the plug valve **155a** downstream of switching valve **155a** is closed. The process is then reversed to send a pulse towards wellhead **115a** and to well **120a**."[332]

[332] Ex. 1036 at [0021] (emphasis added).

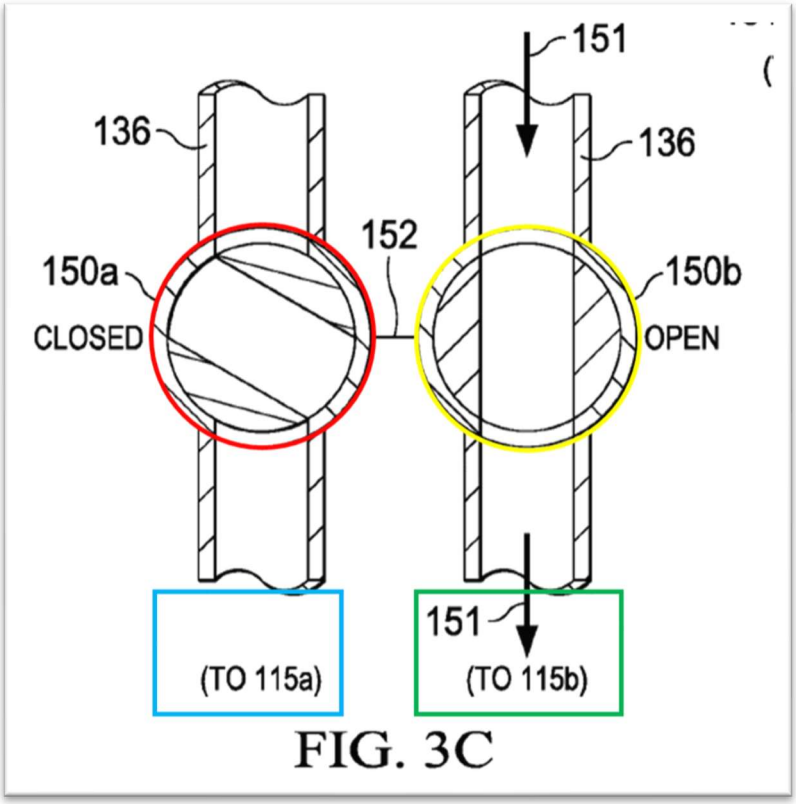


FIG. 3C

Beuterbaugh, Fig. 3C

450. A POSITA would have also recognized that "reversing the process" to allow fluid to flow (send a pulse) towards wellhead **115a** and to well **120a** as "swapping from permitting hydraulic fracturing of the second well to permitting hydraulic fracturing of the first well" as claimed.

451. Accordingly, *Beuterbaugh* discloses, and the combination of *Beuterbaugh* and *Jackson* renders obvious, Limitation 15.4.1.

e. 15.4.2: "opening the first valve associated with the first well to permit pumping of fluid into the first well via the first valve; and"

452. *Beuterbaugh* discloses this limitation. As discussed above regarding Limitation 15.4.1, *Beuterbaugh* teaches hydraulic fracturing of the first well by opening the first valve associated with the first well. *Beuterbaugh* teaches "as a first state, opening switching valve **150a** and plug valve **155a** such that the flow rate of the fracturing fluid 151 from the one or more high pressure pumps **135a-135e** is directed to the first wellhead **115a**,"[333] and associated well **120a**. Through its teaching of reversing the process, *Beuterbaugh* teaches this opening after fracturing fluid has flowed into well **120b** via valve **150b**.

453. Accordingly, *Beuterbaugh* discloses Limitation 15.4.2.

f. 15.4.3: "closing the second valve associated with the second well;"

454. As discussed above regarding 15.4.3, *Beuterbaugh* teaches the sequence of opening valve **150a**; [first valve] allowing fluid to flow into well **120a** [first well]; then while fluid is still flowing into well **120a** "a pulse of fluid flow **151** is directed to the second wellhead **115b** by first opening the plug valve **155b** downstream of switching valve **150b**, then switching valve **150b** is opened *as switching valve **150a** is being closed,*" which directly teaches closing the first valve

[333] Ex. 1036 [0021] emphasis added.

at the end of a swap between hydraulically fracturing the first well and hydraulically fracturing the second well. *Beuterbaugh* then teaches, after hydraulically fracturing the second well "[t]he process is then reversed to send a pulse towards wellhead **l15a** and to well **120a**."[334] A POSITA would have understood that in order to "reverse the process" according to the teachings of *Beuterbaugh*, valve **150a** [first valve] would be opened as valve **150b** [second valve] is being closed." Thus, Beuterbaugh discloses, and the combination of *Beuterbaugh* and *Jackson* renders obvious, Limitation 15.4.3.

g. 15.5: "wherein, during step (b), hydraulic fracturing fluid is continuously pumped to the first and second valves via a hydraulic manifold; and"

455. *Beuterbaugh* discloses this limitation. *Beuterbaugh* describes "applying a high pressure of fracturing fluid to one or more switching valves and repeatedly opening and closing the one or more switching valves … to create[e] a pulse wave into the plurality of wells for fracturing subterranean formations"[335]. Further, *Beuterbaugh* discloses "[t]he one or more high pressure pumps **135a-135e** run at a constant rate to provide a substantially constant pressure of the blended fracturing fluid to the one or more switching valves."[336] Accordingly, a POSITA

[334] Ex. 1036 at [0021].

[335] Ex. 1036 at Abstract.

[336] Ex. 1036 at [0018].

would have recognized that the fluid is pumped continuously to the switching valves. Fig. 2 of *Beuterbaugh* displays this graphically. In Fig. 2, the pressure pumps are annotated in yellow, valve **150a** (first valve) is annotated in red and valve **150b** (second valve) is annotated in blue. A switching scenario, where a constant flow rate is established, and valves are switched between exposing the first well and the second well to fracturing fluid would require fluid to be pumped continuously to each of valves **150a** and **150b**.

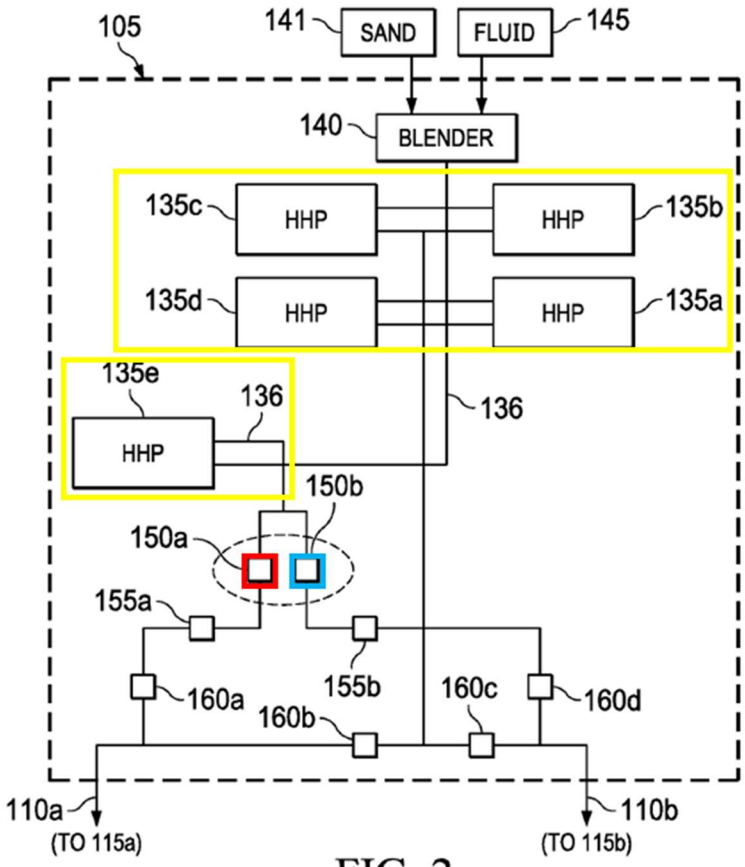


FIG. 2

Beuterbaugh, Fig. 2

456. Furthermore, *Beuterbaugh* repeatedly refers to methods of "*hydraulic* fracturing a plurality of wells" and describes the hydraulic fracturing fluid as, "for example, water or another liquid mixed with sand or other proppants."[337]

457. Accordingly, *Beuterbaugh* discloses that during step (b), hydraulic fracturing fluid is continuously pumped to the first and second valves via a hydraulic manifold as claimed in Limitation 15.5.

h. 15.6: "wherein in response to determining that the flow rate measured at step (a) has satisfied one or more flow rate conditions, the first valve associated with the first well is opened at step (b) before the second valve associated with the second well is closed at step (b);"

458. As discussed above, *Beuterbaugh* discloses a multi-well fracturing system that applies "a high pressure of fracturing fluid to one or more switching valves and repeatedly opening and closing the one or more switching valves … to create[e] a pulse wave into the plurality of wells for fracturing subterranean formations."[338] As described above regarding Limitation 1.5, *Beuterbaugh* teaches pumping fluid into the first well via the first valve as a 1st state of *Beuterbaugh*'s process by "opening switching valve **150a** and plug valve **155a** such that the flow rate of the fracturing fluid **151** … is directed to the first wellhead **115a.**"[339]

[337] Ex. 1036 at [0017].

[338] Ex. 1036 at Abstract.

[339] Ex. 1036 [0021].

Beuterbaugh further discloses, placing the system into the 2nd state, "[n]ext, as shown in FIG. 3B, a pulse of fluid flow **151** is directed to the second wellhead **115b** [annotated in green] by first opening the plug valve **155b** downstream of switching valve **150b**, then switching valve **150b** [annotated in yellow] *is opened as switching valve **150a** is being closed*."[340] Accordingly, *Beuterbaugh* teaches that two "second valves" are opened after the first valve is opened and before the first valve is closed, both plug valve 155b and switching valve 150b. *Beuterbaugh* discloses the use of a time threshold for determining when the change from a first state to a second state occurs. *Beuterbaugh* teaches that "the first switching valve **150a** [associated with first well] is closed at the end of a first predetermined time period" and "a second time period is started to time a duration of a created pulse in the second well."[341]

Beuterbaugh discusses a 3rd state of the system, illustrated by Fig. 3C as "150b is fully opened and switching valve **150a** is fully closed, as shown in FIG. 3C, initiating a pulse down well **120b**, the plug valve **155a** downstream of switching valve **155a** is closed. The process is then reversed to send a pulse towards wellhead **115a** and to well **120a**."[342] *Beuterbaugh* discloses that the "time duration that a switching valve **150a**, **150b** is opened can vary, or can be maintained of a constant

[340] Ex. 1036 [0021] (emphasis added).

[341] Ex. 1036 at [0027].

[342] Ex. 1036 at [0021] (emphasis added).

duration from cycle to cycle. The time may be selected from a range of about 100ms to about 10 secs. Moreover, the time duration of a pulse created may be equal for each well **120a**, **120b**, or the time duration of a pulse may be unequal for one well **120a**, **120b** compared to the other well." Thus, *Beuterbaugh* discloses opening a first valve associated with the first well at step (b) before the second valve associated with the second well is closed at step (b) based on at least a time condition in both going from the 1st state to the 2nd state and in going from the 2nd state to the 3rd state.

459. As described above regarding Limitation 1.3, *Jackson* teaches using of a combined flowrate and time threshold, or using of a flowrate threshold alone for determining when switching occurs. *Jackson* teaches that the thresholds "may be defined by at least one criterion selected from a set of criteria consisting of: (a) *a time period threshold*; (b) a non-participating gas [fracturing fluid] *flow rate threshold*; (c) a well bore surface or bottom hole pressure threshold; (d) a well bore surface or bottom hole rate of pressure change threshold (e) a gas quantity threshold and (f) a formation condition threshold."[343] Although Jackson discusses "the fracturing fluid may include a non-participating gas and, if it is advantageous for the formation or the seam, may be substantially free of liquid water,"[344] a POSITA would understand that the teachings of a flowrate threshold for a gaseous fluid would

[343] Ex. 1005 at [0017]; *see also* Claim 20.

[344] Ex. 1005 2:63-67

equally apply to a liquid (*i.e.*, hydraulic) fluid. Jackson recognizes, "[a]queous liquids, or aqueous liquid based flows, may tend to be common frac fluids,"[345] particularly when there are not clays which may tend to swell in the presence of water. Further still, Jackson discloses that "if it is advantageous," the fluid may be substantially free of liquid water, which indicates that if it is not advantageous to be liquid-free, the fluid would contain water.

460. It would have been obvious to a POSITA to use the process of *Jackson* regarding using flowrate conditions to determine when to move a fracturing process to the next step in the method of *Beuterbaugh* in order to allow for additional control of the fracturing operation of *Beuterbaugh*, which may include opening a first valve to a first well before closing a second valve to a second well (or opening a second valve to a second well before closing a first valve to a first well) to "continuously" pump fluid to the first and second wells, as taught by *Beuterbaugh*.

461. A POSITA would have understood that *Beuterbaugh*'s disclosure of switching from the 1st state (first valve open, second valve closed) to the third state (second valve open, first valve closed) via a 2nd state (both first valve and second valve open), and a reversed process switching from the 3rd state (second valve open, first valve closed) to 1st state (first valve open, second valve closed) through the intermediate second state where both first and second valves are open combined with

[345] Ex. 1005 at7:43-44

Jackson's teaching of the use of flowrate thresholds (*i.e.*, flowrate conditions) for switching to teach changing from first state to the third state in response to the flowrate meeting the flowrate conditions.

462. The combination of *Beuterbaugh* and *Jackson*, therefore, renders obvious Limitation 15.6.

i. 15.7: "or, in response to determining that the flow rate measured at step (a) has not satisfied one or more flow rate conditions, the first valve associated with the first well is opened at step (b) during or after the second valve associated with the second well is closed at step (b)."

463. Claim Limitation 15.7 is the second prong of an "OR" statement in claim 15. As discussed above regarding 15.6, the first prong of the "OR" is satisfied by the disclosures of *Beuterbaugh* and *Jackson*, and as a result, *Beuterbaugh* and *Jackson* render obvious, the entire "OR" statement.

464. Nevertheless, it would have been obvious to a POSITA that if the flow and/or time conditions of the *Beuterbaugh* and *Jackson* system/method are not met (*e.g.*, where the flow does not meet a minimum flow threshold or exceeds a maximum flow threshold) to close one valve before opening another to avoid generating a pressure pulse when it is not desired, or to reduce any risk of damage to the equipment or formation. Such a valve sequence (which the '779 Patent admits is a "regular swap") would have been obvious to a POSITA as an ordinary valve sequence for controlling or responding to unexpected or undesired flow.

465. For the reasons described above, the combination of *Beuterbaugh* and *Jackson* renders Claim 15 as a whole obvious.

K. DEPENDENT CLAIM 16

466. Dependent Claim 16 depends from Claim 15. In addition to the disclosure of the limitations of Claim 15 discussed above, *Beuterbaugh* discloses, or at least renders obvious the additional limitations of Claim 16:

a. 16.1: "16. The method of claim 15, wherein the plurality of wells further comprises third and fourth wells, the third and fourth wells being associated with third and fourth valves, respectively; and wherein the method further comprises:"

467. *Beuterbaugh* renders obvious the use of its valve-switching process on a third and fourth well. *Beuterbaugh* explicitly discloses switching a third well in the same manner described above in Claim 15 regarding switching a first and second well. *Beuterbaugh* teaches that the process demonstrated in Claim 15, including communicating fluid via manifolds and valves to the wells and closing a second valve after opening a first valve, applies equally to a "third well." *Beuterbaugh* discloses, referring to the switching operations "a third switching valve and associated third plug valve operatively connected to a third well head may be included in the process as separate steps that operates in similar sequential fashion"[346] to the sequence of first and second switching valves **150a** and **150b**

[346] Ex. 1036 at [0028].

described above. Further, *Beuterbaugh* discloses "a third wellhead associated with a third well for simultaneously treating the plurality of wells including the first well, the second well and the third well; … opening the third switching valve while the second switching valve is a least partially closed permitting the fracturing fluid to flow to the third wellhead and third well for a third time period."[347]

468. Additionally, *Beuterbaugh* discloses that its method of hydraulic fracturing a *plurality of wells* includes "alternating application of a constant pressure of fracturing fluid to a plurality of wellheads by opening and closing at least one switching valve to create a pulsed pressure wave in each well associated with the plurality of wellheads for fracturing a subterranean formation associated with each well… wherein the pulse pressure wave is created by opening and closing the at least one switching valve to re-direct the constant pressure of fracturing fluid after a first application period from a first well of the plurality of wells to at least one other subsequent well."[348] *Beuterbaugh* also discloses "a system for hydraulic fracturing a plurality of wells" that includes "at least one pump to supply a constant pressure of fracturing fluid *to a plurality of wells* each having a wellhead; and *at least one switching valve connected between the at least one pump and each of the plurality of wellheads*, the at least one valve operable to alternate application of the constant

[347] Ex. 1036 at [0041].

[348] Ex. 1036 at [0043]-[0044].

pressure of fracturing fluid to the plurality of wellheads by opening and closing the at least one switching valve to create a pulsed pressure wave in each well associated with the plurality of wellheads for fracturing a subterranean formation associated with each well… wherein the at least one switching valve is *a plurality of switching valves with one of the plurality of switching valves connected to each wellhead*, the plurality of switching valves synchronized to permit alternating flow of the constant pressure of fracturing fluid in each of the plurality of wells for a predetermined time period causing the pulsed pressure wave in each well."[349] Thus, *Beuterbaugh* discloses a system and method that includes a plurality of wells each with an associated wellhead and valve, and therefore discloses third and fourth wells, the third and fourth wells being associated with third and fourth valves.

469. Further, given that *Beuterbaugh* explicitly describes first, second and third wells, it would have been obvious to a POSITA to perform the same method or sequence of the first and second and third wells on a fourth well, and any additional wells. *Beuterbaugh* explicitly discloses the use of its method on "two or more" wells with no limitation on the "more," and would therefore include at least a third and fourth well. *Beuterbaugh* discloses "switching of a single-mode high-pressure fracturing fluid to allow *two or more* wells to be pulsed simultaneously by

[349] Ex. 1036 at [0048]-[0049] (emphasis added).

a single source of high pressure fracturing fluid."[350] Moreover, the mere repetition of elements has no patentable significance unless a new and unexpected result is produced. Here, performing the method of the Independent Claims on additional wells in the same environment (*i.e.*, fourth well and fourth valve) would be performed in the same way and produce the same expected results as the first, second, and third wells and therefore would have been obvious to a POSITA.

470. Thus, *Beuterbaugh* discloses, or at least renders obvious, applying the method of Claim 15 to third and fourth valves associated the third and fourth wells as claimed.

471. Accordingly, *Beuterbaugh* discloses, or at least renders obvious, Limitation 16.1.

b. <u>16.2: "(c) permitting hydraulic fracturing of the fourth well; and"</u>

472. *Beuterbaugh* discloses, or at least renders obvious, this limitation. As discussed above regarding Claim 15, *Beuterbaugh* teaches permitting hydraulic fracturing of a plurality of wells. *Beuterbaugh* discloses "[a] method and system pulse for treating a plurality of wells simultaneously includes applying a high pressure of fracturing fluid to one or more switching valves and repeatedly opening

[350] Ex. 1036 at [0015].

and closing the one or more switching valves to divert the fracturing fluid near instantaneously from one well to the other well."[351]

473. As further described above regarding Limitation 16.2, the teachings of *Beuterbaugh* extend to the third and fourth wells in the same manner as the first and second wells.

474. Therefore, *Beuterbaugh* discloses permitting hydraulic fracturing of the fourth well as claimed in Limitation 16.2.

c. 16.3: "(d) swapping from permitting hydraulic fracturing of the fourth well to permitting hydraulic fracturing of the third well."

475. As discussed above regarding Limitation 16.2, *Beuterbaugh* discloses hydraulic fracturing operations of multiple wells, including a fourth well and a third well. Further, as discussed above regarding the preamble, each well has associated valves. As discussed above regarding 15.4.1, *Beuterbaugh* discloses swapping between hydraulic fracturing of wells. As discussed above regarding 16.1, the teachings of *Beuterbaugh* extend to third wells and fourth wells.

476. Accordingly, *Beuterbaugh* discloses, or at least renders obvious, Limitation 16.3.

477. For the reasons discussed above, Claim 16 is obvious over the combination of *Beuterbaugh* and *Jackson.*

[351] Ex. 1036 at Abstract.

L. DEPENDENT CLAIM 17

478. Dependent Claim 17 depends from Claim 16. In addition to the disclosure of the limitations of Claim 16 discussed above, *Beuterbaugh* discloses the additional limitations of Claim 17:

a. "17. The method of claim 16, wherein steps (a) and (c) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold; and wherein steps (b) and (d) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold."

479. As discussed above, *Beuterbaugh* teaches directing hydraulic fluid between wells continuously by operating the valves associated with individual wells.[352] *Beuterbaugh* discloses "[a] method and system pulse for treating a plurality of wells simultaneously."[353] Further, *Beuterbaugh* discloses "switching of a single-mode high-pressure fracturing fluid to allow *two or more* wells to be pulsed simultaneously by a single source of high-pressure fracturing fluid."[354]

480. Further still, *Beuterbaugh* discloses a manifold in communication with the valves and used to pump fluid to the valves and associated wells. When discussing the background of hydraulic fracturing, *Beuterbaugh* discloses "surface equipment, such as, for example, the high pressure pumps, blender, manifolds and

[352] Ex. 1036 at Abstract.

[353] Ex. 1036 at Abstract.

[354] Ex. 1036 at [0015] (emphasis added).

valves."[355] In Fig. 2, *Beuterbaugh* discloses two manifolds in fluid communication with both the first valve (**150a** annotated in green) and the second valve (**150b** annotated in pink). The manifold annotated in blue is the intake manifold for the pressure pumps **135a** – **135e**. This manifold is in fluid communication with the valves through pump **135e**. Secondly, the manifold annotated in red is the discharge manifold for pump **135e** and is in direct fluid communication with both first valve **150a** and second valve **150b**.

[355] Ex. 1036 at [0004].

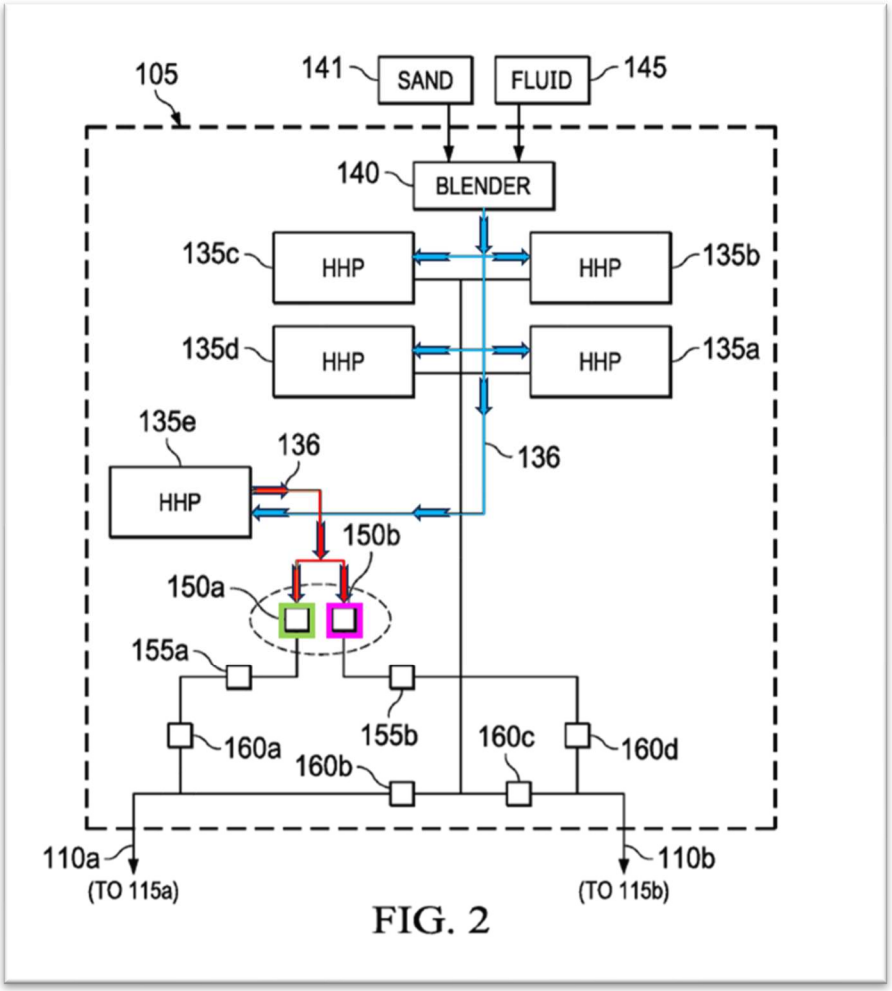


FIG. 2

Beuterbaugh, Fig. 2

481. As discussed above regarding Limitation 1.8, fluid is continuously pumped to the first and second valves via both the red and blue annotated manifolds. Accordingly, *Beuterbaugh* discloses a manifold in fluid communication with the switching valves, through which fluid is continuously pumped to the switching valves and the wells.

482. As discussed above regarding Limitations 16.1 and 16.2, the processes of *Beuterbaugh* extend explicitly to "two or more wells" and would include the third

and fourth wells. Accordingly, a POSITA would have found it obvious to combine *Beuterbaugh*'s teaching of simultaneously pumping fluid to multiple valves and wells with the understanding that the teaching applies to a third and fourth well to simultaneously pump hydraulic fracturing fluid to the second and fourth well (steps (a) and (c)). Similarly, a POSITA would have found it obvious to pump hydraulic fracturing fluid simultaneously to the first and third wells (steps (b) and (d)).

483. Thus, *Beuterbaugh* discloses, or at least renders obvious, the limitations of Claim 17. Therefore, Claim 17 is obvious over the combination of *Beuterbaugh* and *Jackson* for the reasons discussed above.

M. DEPENDENT CLAIM 18

484. Dependent Claim 18 depends from Claim 16. In addition to the disclosure of the limitations of Claim 16 discussed above, *Beuterbaugh* discloses the additional limitations of Claim 18:

a. 18.1: "18. The method of claim 16, wherein, during step (d), hydraulic fracturing fluid is continuously pumped to the third and fourth valves via the hydraulic manifold;"

485. For the same reasons as those discussed above regarding Claim 17, a POSITA would have found it obvious, based on the teachings of *Beuterbaugh* regarding simultaneous pumping and applicability to "two or more wells" to continuously pump hydraulic fracturing fluid to the third and fourth wells.

486. Thus, *Beuterbaugh* renders obvious the Limitations of 18.1.

b. 18.2: "wherein step (c) comprises opening the fourth valve associated with the fourth well to permit pumping of fluid into the fourth well via the fourth valve; and"

487. As discussed above regarding 15.2.1, *Beuterbaugh* teaches hydraulic fracturing of the second well by opening the second valve associated with the second well to allow fluid to be pumped into the second well. *Beuterbaugh* also discloses a method and system for hydraulic fracturing a plurality of wells that includes "at least one pump to supply a constant pressure of fracturing fluid to a plurality of wells each having a wellhead; and at least one switching valve connected between the at least one pump and each of the plurality of wellheads, the at least one valve operable to alternate application of the constant pressure of fracturing fluid to the plurality of wellheads by opening and closing the at least one switching valve to create a pulsed pressure wave in each well associated with the plurality of wellheads for fracturing a subterranean formation associated with each well… wherein the at least one switching valve is a plurality of switching valves with one of the plurality of switching valves connected to each wellhead, the plurality of switching valves synchronized to permit alternating flow of the constant pressure of fracturing fluid in each of the plurality of wells for a predetermined time period causing the pulsed pressure wave in each well."[356] Further, as discussed above regarding Limitation 16.2, *Beuterbaugh* discloses, or at least suggests, permitting fracturing operations of

[356] Ex. 1036 at [0048]-[0049].

a fourth well. Thus, *Beuterbaugh* discloses "wherein step (c) [permitting hydraulic fracturing of the fourth well] comprises opening the fourth valve associated with the fourth well to permit pumping of fluid into the fourth well via the fourth valve."

488. Even if the Board finds this limitation is not explicitly disclosed by *Beuterbaugh*, based on the disclosure of *Beuterbaugh* it would at least have been obvious to a POSITA to open the fourth valve associated with the fourth well to permit pumping fluid into the fourth well. Further, it would be a necessary part of fracturing operations of the fourth well to open the fourth valve associated with the fourth well to pump fluid into the fourth well.

489. Accordingly, *Beuterbaugh* discloses, or at least renders obvious, Limitation 18.2.

c. <u>18.3.1: "wherein step (d) comprises opening the third valve associated with the third well to permit pumping of fluid into the third well via the third valve; and"</u>

490. *Beuterbaugh* discloses this limitation. As discussed above regarding 16.1, *Beuterbaugh* explicitly discloses switching a third well in the same manner described above in Claim 15 regarding switching a first and second well. Further, *Beuterbaugh* discloses "a third wellhead associated with a third well for simultaneously treating the plurality of wells including the first well, the second well and the third well; … opening the third switching valve while the second switching

valve is a least partially closed permitting the fracturing fluid to flow to the third wellhead and third well for a third time period"[357]

491. Accordingly, *Beuterbaugh* discloses Limitation 18.3.1.

d. <u>18.3.2: "closing the fourth valve associated with the fourth well."</u>

492. *Beuterbaugh* discloses this limitation, or at least renders it obvious. A discussed above regarding Limitation 15.4.3, *Beuterbaugh* discloses closing the second valve associated with the second well. Further, as discussed above regarding Claim 16 and Limitation 18.2, the teaching of *Beuterbaugh* extends to "two or more wells" or a "plurality of wells" which would include a fourth well. *Beuterbaugh* also explicitly discloses that a plurality of switching valves with one of the plurality of switching valves connected to each wellhead and synchronized to permit alternating flow to each of the plurality of wells for a predetermined time period.[358] Thus, *Beuterbaugh* discloses closing the fourth valve associated with the fourth well as part of the process of switching fracturing from one well to the other (*i.e.*, swapping). Even if the Board finds *Beuterbaugh* does not explicitly disclose this limitation, it would have been obvious to a POSITA to apply *Beuterbaugh*'s teachings of closing a second valve associated with a second well to the fourth valve and fourth well

[357] Ex. 1036 at [0041].

[358] Ex. 1036 at [0048]-[0049].

respectively. Based on the disclosure of *Beuterbaugh* it would at least have been obvious to a POSITA to close the fourth valve associated with the fourth well.

493. Accordingly, *Beuterbaugh* discloses, or at least renders obvious, Limitations 18.3.2.

494. In view of the above, the combination of *Beuterbaugh* and *Jackson* renders Claim 18 obvious.

N. INDEPENDENT CLAIM 25

495. It is my opinion the combination of *Beuterbaugh* and *Jackson* renders Claim 25 obvious. With the exception of this being an "apparatus" claim, and the claim further containing a description of the structure of the apparatus, namely known computer elements for executing instructions, Claim 25 is essentially similar to Claim 15. It would have been obvious to perform Claim 15's method (and therefore, Claim 25's method steps) with a computer, such that the method steps may be performed more safely and efficiently. As discussed below, *Beuterbaugh* contains disclosure of the structure of the apparatus that is equivalent to that of Claim 25 of the '779 Patent.

a. 25.1: "An apparatus adapted to hydraulically fracture first and second wells, the first and second wells being associated with first and second valves, respectively, the apparatus comprising:"

496. For the same reasons discussed above regarding Limitation 15.1, *Beuterbaugh* discloses a system for hydraulically fracturing first and second wells,

the first and second wells associated with first and second valves. Additionally, for the same reasons discussed above regarding Limitations 8.1.1-8.2.2, *Beuterbaugh* discloses, or renders obvious, using an apparatus having a non-transitory computer readable medium and a plurality of instructions stored on the non-transitory computer readable medium and executable by one or more processors, wherein, when the instructions are executed by the one or more processors, the claimed steps are executed.

b. 25.2: "a non-transitory computer readable medium; and"

25.3: "a plurality of instructions stored on the non-transitory computer readable medium and executable by one or more processors, wherein, when the instructions are executed by the one or more processors, the following steps are executed:"

497. Limitations 25.2 and 25.3 are identical to Limitations 8.1.2-8.2.2 and are disclosed or rendered obvious by *Beuterbaugh* for the same reasons as those described above regarding Claim 8 in Section XIII.F(a).

c. **25.4: "(a) permitting hydraulic fracturing of the second well, comprising: opening the second valve associated with the second well to permit pumping of fluid into the second well via the second valve; and**

25.5: "measuring a flow rate of the fluid being pumped into the second well;"

25.6.1: "(b) swapping from permitting hydraulic fracturing of the second well to permitting hydraulic fracturing of the first well, comprising:"

25.6.2: "opening the first valve associated with the first well to permit pumping of fluid into the first well via the first valve; and"

25.6.3: "closing the second valve associated with the second well;"

25.7: "wherein, during step (b), hydraulic fracturing fluid is continuously pumped to the first and second valves via a hydraulic manifold; and"

25.8: "wherein in response to determining that the flow rate measured at step (a) has satisfied one or more flow rate conditions, the first valve associated with the first well is opened at step (b) before the second valve associated with the second well is closed at step (b); or"

25.9: "in response to determining that the flow rate measured at step (a) has not satisfied one or more flow rate conditions, the first valve associated with the first well is opened at step (b) during or after the second valve associated with the second well is closed at step (b)."

498. The language in claim Limitations 25.4 through 25.9 is identical to that of Limitations 15.2 through 15.7. *Beuterbaugh* discloses Limitations 25.4 through 25.9 for the same reasons as those discussed regarding Limitations 15.2 through 15.7

in Section XIII.J(b)-(i). In view of the above, the combination of *Beuterbaugh* and *Jackson* discloses each and every element of Claim 25, and renders Claim 25 obvious. A POSITA would have been motivated to incorporate the teachings of *Jackson* with *Beuterbaugh* for the reasons discussed above.

499. As discussed in Sections XIII.F(a) above, *Beuterbaugh* discloses an apparatus as claimed in Limitations 25.1-25.3 for executing steps, and the steps executed by *Beuterbaugh*'s computerized controller and software program in view of *Jackson*'s disclosure include the steps recited in Limitations 25.4 through 25.9 (*see* Section XII.J(b)-(i)). Therefore, Claim 25 as a whole is obvious over *Beuterbaugh* and *Jackson*.

O. DEPENDENT CLAIM 26

a. 26.1: "26. The apparatus of claim 25, wherein the apparatus is further adapted to hydraulically fracture third and fourth wells, the third and fourth wells being associated with third and fourth valves, respectively; and wherein, when the instructions are executed by the one or more processors, the following steps are also executed"

500. Other than depending from Claim 25 and being an apparatus claim with computer language to execute the steps (which is already discussed with respect to Claim 25), this limitation is substantially similar to 16.1 and is rendered obvious by the combination of *Beuterbaugh* and *Jackson* for the same reasons as those discussed regarding Limitation 16.1 in Section XIII.K(a).

b. 26.2: "(c) permitting hydraulic fracturing of the fourth well;"

501. Other than depending from Claim 25 and being an apparatus claim, this limitation is substantially similar to Limitation 16.2 and is rendered obvious by the combination of *Beuterbaugh* and *Jackson* for the same reasons as those discussed regarding Limitation 16.2 in Section XIII.K(b).

c. 26.3: "(d) swapping from permitting hydraulic fracturing of the fourth well to permitting hydraulic fracturing of the third well.

502. Other than depending from Claim 25 and being an apparatus claim, this limitation is substantially similar to Limitation 16.3 and is rendered obvious by the combination of *Beuterbaugh* and *Jackson* for the same reasons as those discussed regarding Limitation 16.3 in Section XIII.K(c). In view of the above, the combination of *Beuterbaugh* and *Jackson* renders Claim 26 obvious.

P. DEPENDENT CLAIM 27

503. The combination of *Beuterbaugh* and *Jackson* renders obvious Claim 27 of the '779 Patent. Further detail is provided below.

a. "27. The apparatus of claim 26, wherein steps (a) and (c) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold; and wherein steps (b) and (d) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold."

504. Other than depending from Claim 26 and being an apparatus claim, this limitation is substantially similar to Claim 17 and is rendered obvious by the

combination of *Beuterbaugh* and *Jackson* for the same reasons as those discussed regarding Claim 17 in Section XIII.L. In view of the above, the combination of *Beuterbaugh* and *Jackson* renders Claim 27 obvious.

Q. DEPENDENT CLAIM 28

505. The combination of *Beuterbaugh* and *Jackson* renders obvious Claim 28 of the '779 Patent. Further detail is provided below.

a. 28.1: "28. The apparatus of claim 26, wherein, during step (d), hydraulic fracturing fluid is continuously pumped to the third and fourth valves via the hydraulic manifold;"

506. Other than depending from Claim 26 and being an apparatus claim, this limitation is substantially similar to Limitation 18.1 and is rendered obvious by the combination of *Beuterbaugh* and *Jackson* for the same reasons as those discussed regarding Limitation 18.1 in Section XIII.M(a).

b. 28.2: "wherein step (c) comprises opening the fourth valve associated with the fourth well to permit pumping of fluid into the fourth well via the fourth valve; and"

507. Other than depending from Claim 26 and being an apparatus claim, this limitation is substantially similar to Limitation 18.2 and is rendered obvious by the combination of *Beuterbaugh* and *Jackson* for the same reasons as those discussed regarding Limitation 18.2 in Section XIII.M(b).

c. 28.3.1: "wherein step (d) comprises: opening the third valve associated with the third well to permit pumping of fluid into the third well via the third valve; and"

28.3.2: "closing the fourth valve associated with the fourth well."

508. The language in Limitations 28.3.1 and 28.3.2 is identical to that in Limitations 18.3.1 and 18.3.2 in Claim 18 and is rendered obvious by the combination of *Beuterbaugh* and *Jackson* for the same reasons as those discussed regarding Limitation 18.3 in Section XIII.M(c). In view of the above, the combination of *Beuterbaugh* and *Jackson* renders Claim 28 obvious.

R. DEPENDENT CLAIM 31

509. Dependent Claim 31 depends from Claim 25. In addition to the disclosure of the limitations of Claim 25 discussed above, the combination of *Beuterbaugh* and *Jackson* discloses the additional limitations of Claim 31:

a. 31.1: "31. The method of claim 25, wherein the flow rate measured at step (a) has satisfied the one or more flow rate conditions when the flow rate measured at step (a) is below an upper flow rate threshold, above a lower flow rate threshold, or both; and"

510. This claim limitation merely sets forth optional flowrate measurements, including flowrates below an upper flowrate threshold, or above a lower flowrate threshold, or both. Thus, only one needs to be shown in the prior art. As discussed above regarding the motivation to combine, *Jackson* discloses using various thresholds as a trigger for moving the fracturing operation to the next stage.

As an example, *Jackson* discloses "there is a process for fracturing a formation including: introducing a supply of fracturing fluid to the formation until a first threshold is reached, adjusting the flow of the fracturing fluid to reach a second threshold, adjusting the flow to reach a third threshold, and ceasing flow of the fracturing fluid to the formation, the fracturing fluid being a non-participating gas" and including a proppant in at least one of the stages.[359]

511. *Jackson* further teaches specifically that the thresholds "may be defined by at least one criterion selected from a set of criteria consisting of: (a) a time period threshold; (b) a non-participating gas [fracturing fluid] flow rate threshold; (c) a well bore surface or bottom hole pressure threshold; (d) a well bore surface or bottom hole rate of pressure change threshold (e) a gas quantity threshold and (f) a formation condition threshold."[360] *Jackson* teaches "the first threshold may be reached by introduction of a fracturing fluid over a period of time. As will be appreciated, however, other process parameters such as flow rate, pressure, volume, formation condition etc. are observed to asses a formation fracturing process."[361] *Jackson* teaches, "[i]n one embodiment, the first threshold is defined as an introduction of fluid for a time period in the range of 1 to 10 minutes and a flow rate of dilation fluid

[359] Ex. 1005 at [0003]-[0004].

[360] Ex. 1005 at [0017]; *see also* Claim 20.

[361] Ex. 1005 at [0019].

of at least 1000 scm," which a POSITA would have understood to be "above a lower threshold" as claimed. Further, as an example of a combined flowrate/time threshold, *Jackson* teaches "the second threshold may be defined as a time period of more than 1 minute and less than 24 hours of a flow rate of dilation fluid of less than 300 scm."[362] In this example, the fracturing fluid flowrate must be below a flowrate threshold of 300 scm (standard cubic feet per minute) for a time threshold of at least one minute, up to 24 hours. Thus, *Jackson* discloses wherein the flow rate measured at step (a) has satisfied the one or more flow rate conditions when the flow rate measured at step (a) is below an upper flow rate threshold or above a lower flow rate threshold, as claimed. Although Jackson discusses "the fracturing fluid may include a non-participating gas and, if it is advantageous for the formation or the seam, may be substantially free of liquid water,"[363] a POSITA would understand that the teachings of a flowrate threshold for a gaseous fluid would equally apply to a liquid (*i.e.*, hydraulic) fluid. Jackson recognizes, "[a]queous liquids, or aqueous liquid based flows, may tend to be common frac fluids,"[364] particularly when there are not clays which may tend to swell in the presence of water. Further still, Jackson discloses that "if it is advantageous," the fluid may be substantially free of liquid

[362] Ex. 1005 at [0020]; *see also* Claim 22.

[363] Ex. 1005 2:63-67

[364] Ex. 1005 at7:43-44

water, which indicates that if it is not advantageous to be liquid-free, the fluid would contain water.

512. It would have been obvious to a POSITA to include Jackson's fluid flow rate thresholds in the hydraulic fracturing plan of *Beuterbaugh* so that the determined flow rate triggers moving the fracturing operation to the next stage. This combination of *Beuterbaugh and Jackson* would render obvious wherein the flow rate measured at step (a) has satisfied the one or more flow rate conditions when the flow rate measured at step (a) is below an upper flow rate threshold or above a lower flow rate threshold or both. Accordingly, the combination of *Beuterbaugh* and *Jackson* renders Claim Limitation 31.1 obvious.

b. 31.2: "wherein the flow rate measured at step (a) has not satisfied the one or more flow rate conditions when the flow rate measured at step (a) is above the upper flow rate threshold or below the lower flow rate threshold.

513. Claim Limitation 31.2 essentially defines the portion excluded by Claim Limitation 31.1. In other words, Claim Limitation 31.2 merely says that if the flowrate conditions in Claim Limitation 31.1 are not met, then the flowrate measured at step (a) "has not been satisfied." Thus, this limitation does not add anything more technically to Claim 31 other than using the phrase "not met." Because *Beuterbaugh* and *Jackson* disclose meeting certain flow rate thresholds, as discussed above, *Beuterbaugh* and *Jackson* also disclose that when the flow rate does not meet the desired threshold, whether it is above an upper threshold or lower

than a lower threshold, the measured flow rate "has not satisfied the one or more flow rate conditions." Moreover, this is standard practice for any flow system—if a measured flow rate is outside the required flowrate, then a flowrate condition is not met.

514. The combination of *Beuterbaugh* and *Jackson* discloses each and every limitation of Claim 31. Accordingly, Claim 31 would have been obvious to a POSITA in light of the disclosures of *Beuterbaugh* and *Jackson*, for the reasons discussed above.

S. DEPENDENT CLAIM 36

515. Dependent Claim 36 depends from Claim 15. In addition to the disclosure of the limitations of Claim 15 discussed above, the combination of *Beuterbaugh* and *Jackson* discloses the additional limitations of Claim 36:

a. 36.1: "36. The method of claim 15, wherein the flow rate measured at step (a) has satisfied the one or more flow rate conditions when the flow rate measured at step (a) is below an upper flow rate threshold, above a lower flow rate threshold or both and"

36.2: "wherein the flow rate measured at step (a) has not satisfied the one or more flow rate conditions when the flow rate measured at step (a) is above the upper flow rate threshold or below the lower flow rate threshold."

516. With the exception of depending from Claim 15, Limitations 36.1-36.2 are identical to Limitations 31.1-31.2 and are disclosed and/or rendered obvious by *Beuterbaugh* in view of *Jackson* for the same reasons as those discussed above

regarding Limitations 31.1-31.2 in Section XIII.R. In view of the above, the combination of *Beuterbaugh* and *Jackson* renders Claim 36 obvious.

XIV. SECONDARY CONSIDERATIONS

517. I have not seen any evidence of secondary considerations related to the '779 Patent. Should the Patent Owner put forth any alleged evidence of secondary considerations in this proceeding or any related proceeding, I reserve the right to consider such evidence, to consider whether any such evidence has a nexus to any claims of the Challenged Patent, and to update my analysis.

XV. CONCLUSION

518. Based on my education, experience, and expertise, it is my opinion that all of the Challenged claims are anticipated and/or obvious in view of *Ciezobka*, *Beuterbaugh*, *Jackson*, and/or *McNeel* for the reasons discussed above.

All statements made herein of my own knowledge are true, and all statements made on information and belief are believed to be true. I further understand that willful false statements and the like are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code. I declare under penalty of perjury that the foregoing is true and correct.

Executed on March 1, 2024. 

Dr. Robert A. Durham

APPENDIX A

Dr. ROBERT A DURHAM, PhD, FIEEE

Resume
Specialization
Honors & Awards
Publications

Dr ROBERT A DURHAM, PhD, FIEEE

Robert A Durham is the Principal of D^2 Tech Solutions, a technology related firm concentrating on Mechanical and Electrical systems and energy conversions. He also serves as a Principal Scientist of THEWAY LABs, Tulsa, OK, an engineering and energy consulting firm that provides design and failure analysis of facilities and system installations.

Dr. Durham's work experience is broad and encompasses all areas of the energy industry. Dr. Durham spent 11 years with AEP/CSW, at the time the country's largest utility, in electrical engineering positions in the power generation and transmission planning departments. He then accepted a position as Manager of Electric Infrastructure for New Dominion, LLC., a major independent energy producer in Oklahoma. Dr. Durham then moved on to hold the position of Vice President of Engineering and Project Management for EDG Power Group, an Engineering Procurement and Construction company specializing in design and construction of small to medium size power generating facilities. Dr. Durham left EDG Power Group to accept his current positions. Dr. Durham has been accepted as an expert and offered testimony in several jurisdictions.

Dr. Durham's extensive client list includes the development of a broad spectrum of forensic, electrical and facilities projects for many companies. He has also taught University offered courses in electrical engineering review for board licensure. He has published five books, six magazine articles and over 40 other technical papers and articles. Dr. Durham's extensive work on standards and electrical systems has resulted in his elevation to Fellow of the IEEE, the highest grade of recognition in the electrical technology industry.

Dr. Durham received the B.S. in electrical engineering from the University of Tulsa in 1992 and the M.E. in Technology Management from The University of Tulsa in 1997. Tulsa, OK. In 2004, Dr. Durham received a PhD in Engineering Management from Kennedy Western University.

Degrees Earned

BSEE, with Honors, The University of Tulsa
Master of Engineering, The University of Tulsa
PhD , Kennedy Western University

Area of Specialization

lightning & grounding
failure analysis & forensic engineering
electrical power systems & safety
power generation
utility industry competition
economics & management
petroleum & chemical industry
electrical / mechanical energy conversion

Registration

Professional Engineer - Oklahoma
Professional Engineer – Texas
Professional Engineer – California
Professional Engineer – New Hampshire (Inactive)
Professional Engineer – Kansas
Professional Engineer – North Carolina (Inactive)
Professional Engineer – Missouri
Professional Engineer – Arkansas
Professional Engineer – Virginia (Inactive)
Professional Engineer – Illinois (Inactive)
Electrical Contractor - Oklahoma

Work History

D^2 Tech Solutions, Inc. 2002 - 2022
Principal

THEWAY Corp. 2004 - 2022
Principal Scientist

EDG Power Group, Inc. 2002 - 2004
Vice President Engineering & Project Management

New Dominion, LLC 2000 - 2002
Mgr Electric Infrastructure

Central & Southwest, Inc 1989 - 2000
Electrical Engineer

Professional Memberships

Fellow	Institute of Electrical and Electronic Engineers
Diplomate	American College of Forensic Examiners, International
Member	National Association of Fire Investigators
Voting Member	National Fire Protection Institute, Electrical Section
Executive Member	Petroleum and Chemical Industry Committee, IEEE
Diplomate, Past Board Member	American Board of Forensic Engineering and Technology
Member	IEEE Standards Association
Past Chair	Production Subcommittee, IEEE IAS/PCIC
CFC	American College of Forensic Examiners
Member	International Association of Arson Investigators
CFEI, CVFEI	National Association of Fire Investigators
Past Chair	Tulsa Section IEEE
Chair	IEEE RP1017.1 Working Group
Chair	IEEE RP1017.2 Working Group
Chair	IEEE RP1017.3 Working Group
Chair	IEEE RP1017.4 Working Group
Past Chair	IEEE PCIC Standards Subcommittee
Secretary	IEEE Petroleum and Chemical Industry Committee

Honors and Awards

Fellow of the IEEE

For contributions to submersible electrical equipment analysis and multi-point ground method in hazardous petroleum and chemical environments.

Honor Societies

Tau Beta Pi, national engineering honors
Eta Kappa Nu, national electrical engineering honors

Dr. Durham's publications have often successfully competed for outstanding paper awards from journals of the Institute of Electrical and Electronic Engineers (PCIC and IAS). This is an

international competitive peer review and evaluation of papers that provide a significant contribution to the advancement and understanding of electrical applications.

IEEE Industry Applications Society, New Orleans, LA: Prize Article for "Data Quality and Grounding: Considerations in a Mixed Use Facility"

PCIC, Cincinnati, OK: Prize Paper for "Grounding and Bonding Conductors: Solid, Stranded, Bare or Insulated"

PCIC, New Orleans, LA: Prize paper for "Industrial Design Application for Power Distribution over Extra-Long Distances"

PCIC, Philadelphia, PA: Prize paper for "Paradigm Shifts and Impact on Engineers and Industry"

Transactions on Industry Applications, Orlando, FL: Prize Paper for "Lightning, Grounding, and Protection for Control Systems".

PCIC, Denver, CO: Prize Paper for "Grounding System Design for Isolated Locations and Plant Systems"

PCIC, St. Louis, MO: First place for "Lightning, Grounding, and Protection for Distributed Control and Communications Systems: A Retrofit".

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Robert A Durham, PhD, PE
Expert Witness
Previous Four Years from February 14, 2023

Attorney	Case	Location	Issue	
Carr & Carr	Bales v. Amp Electric et al	Delaware County, OK	Fire	Depo
Denton Law	Robbins v. Madewell	Mayes County, OK	Fire / injury	Trial
Baker Botts	IPR 2023-00558	USPTA PTAB	Intellectual Property	Depo
Haynes Boone	Nabors v. Helmerich & Payne et al	Northern District, TX	Intellectual Property	Trial
McDermott Will & Emery LLP	Halliburton V. U.S. Well Services	Western District, TX	Intellectual Property	Trial
Jones, Oten & Jewell	Davis v. Tapp	Garfield County, OK	Fire / Injury	Trial
Haynes & Boone	Nabors Driling v. Helmerich & Payne et al	Northern District, TX	Intellectual Property	Depo
Mattingly Law	Fulton v. Aviagen et al	Muskogee County, OK	Building Codes	Trial
Baker Botts	US Well Services v. Halliburton	Western District, TX	Intellectual Property	Depo
Kelly, Morgan	Montanez v. Deepwell Energy Svcs	Ector County, TX	Flash Fire / Injury	Depo
Baker Botts	IPR 2021-01316	USPTO PTAB	Intellectual Property	Depo
Baker Botts	IPR 2021-01238	USPTO PTAB	Intellectual Property	Depo
Baker Botts	IPR 2021-01315	USPTO PTAB	Intellectual Property	Depo
Baker Botts	IPR 2021-01065	USPTO PTAB	Intellectual Property	Depo
Clancy & Thompson	Borth v. Phillips & Sons Trucking et al	Canadian County, OK	Injury	Depo
Baker Botts	IPR 2021-01034	USPTO PTAB	Intellectual Property	Depo
Baker Botts	IPR 2021-01033	USPTO PTAB	Intellectual Property	Depo
Baker Botts	IPR 2021-01032	USPTO PTAB	Intellectual Property	Depo

Stephen Jones	Davis v. Tapp	Garfield County	Fire / Injury	Depo
Kelly, Morgan	Calvillo v. On Point	Travis County, TX	Flash Fire / Injury	Depo
Hartline Barger	Ramirez v. Home Depot	Southern District, TX	Electrical Failure / Fire	Depo
Mcafee & Taft	Hale v. Southeast Colorado Power Association	Baca County, CO	Electrical Failure / Fire	Depo
Hartline Barger	Siqueros v. Templo Monte Horeb et al	El Paso County, TX	Injury	Depo
Naman, Howell	Lentz v Brenntag Pacific et al	Upton County, TX	Flash Fire / Injury	Depo
Craft Law Firm	Cason v. Cimarex et al	Victoria County, TX	Flash Fire / Injury	Depo
Naman, Howell	Lentz v Brenntag Pacific et al	Upton County, TX	Flash Fire / Injury	Depo