

IPR2024-00583
Patent No. 11,401,779

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTELLIGENT WELLHEAD SYSTEMS, INC.,
Petitioner,

v.

DOWNING WELLHEAD EQUIPMENT, LLC
Patent Owner

IPR2024-00583
Patent No. 11,401,779

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 11,401,779**

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Exhibit 1008	Jacobs, Trent. “The Shale Evolution: Zipper Fracture Takes Hold,” <i>J Pet Technol</i> 66 (2014): 60–67. doi: https://doi.org/10.2118/1014-0060-JPT
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Exhibit 1017	Carl T. Montgomery and Michael B. Smith, “Hydraulic Fracturing: History of an Enduring Technology,” <i>Journal of Petroleum Technology</i> , Vol. 62, Issue 12 (Dec. 2010).
Exhibit 1018	Bourgoyne, A. T., Jr., K. K. Millheim, M. E. Chenevert and F. S. Young, Jr. (1986). <u>Applied Drilling Engineering</u> , Society of Petroleum Engineers.
Exhibit 1019	Vassiliou, M. S. (2018), <u>Historical dictionary of the petroleum industry</u> , Rowman & Littlefield
Exhibit 1020	U.S. Patent Application Publication No. 2013/0306322 to Sanborn <i>et al.</i> entitled “System and Process for Extracting Oil and Gas by Hydraulic Fracturing” (“ <i>Sanborn</i> ”)
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Exhibit 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." <i>J Pet Technol</i> 44 (1992): 10–18. doi: https://doi.org/10.2118/22836-PA
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Exhibit 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 (“Roussel”)
Exhibit 1027	K. R. Webster, W. C. Goins, Jr., and S. C. Berry, "A Continuous Multistage Tracing Technique," <i>Journal of Petroleum Technology</i> , vol. 17, no. 06, pp. 619-625, 1965, doi: 10.2118/977-pa. (“Webster”)
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Exhibit 1031	Tolman, R. C., et al. (2009). <u>Method and Apparatus for Simultaneous Stimulation of Multi-Well Pads</u> . SPE Hydraulic Fracturing Technology Conference (“ <i>Tolman</i> ”).
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Exhibit 1033	R. W. Paige, L. R. Murray, and J. D. M. Roberts, "Field Application of Hydraulic Impedance Testing for Fracture Measurement," <i>SPE Production & Facilities</i> , vol. 10, no. 01, pp. 7-12, 1995, doi: 10.2118/26525-pa (“ <i>Paige</i> ”).
Exhibit 1034	L. V. Massaras, A. Dragomir, and D. Chiriac, “Enhanced Fracture Entry Friction Analysis of the Rate Step-Down Test,” in <i>SPE Hydraulic Fracturing Technology Conference</i> , 2007, vol. All Days, SPE-106058-MS, doi: 10.2118/106058-ms. [Online]. Available: https://doi.org/10.2118/106058-MS (“ <i>Massaras</i> ”).
Exhibit 1035	S. Mondal, "Pressure transients in wellbores: Water hammer effects and implications for fracture diagnostics," 2010 (“ <i>Mondal</i> ”).
Exhibit 1036	PCT International Patent Application Publication WO2020/145978 A1 by Beuterbaugh et al. entitled “Simulfrac Pulsed Treatment” (“ <i>Beuterbaugh</i> ”).
Exhibit 1037	PCT International Patent Application Publication WO2017/201526 A1 by Ciezobka et al. entitled “Hydraulic Fracturing System and Method” (“ <i>Ciezobka</i> ”).

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Exhibit 1040	Downing’s Supplemental Objections and Responses to IWS’s First Set of Interrogatories in the Litigation
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Exhibit 1043	<i>Intelligent Wellhead Systems, Inc. v. Downing Wellhead Equipment, LLC</i> , IPR2024-00300, Petition for <i>Inter Partes</i> Review of U.S. Patent No. 11,560,770 (Paper 1)
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TABLE OF CLAIMS

CLAIM / LIMITATION	CLAIM LANGUAGE
CLAIM 1	
1.1	1. A method, comprising: (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;
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.
CLAIM 2	
2.1	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

CLAIM / LIMITATION	CLAIM LANGUAGE
2.2	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.
CLAIM 3	
	3. The method of claim 1, wherein the second valve is opened after step (b).
CLAIM 6	
	6. The method of claim 1, wherein each of the first and second valves is a zipper valve.
CLAIM 8	
8.1	8. An apparatus, comprising: a non-transitory computer readable medium; and
8.2	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:
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;
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;

CLAIM / LIMITATION	CLAIM LANGUAGE
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.
CLAIM 9	
9.1	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;
9.2	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.
CLAIM 10	
	10. The apparatus of claim 8, wherein the second valve is opened after step (b).
CLAIM 13	
	13. The apparatus of claim 8, wherein each of the first and second valves is a zipper valve.
CLAIM 15	
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:

CLAIM / LIMITATION	CLAIM LANGUAGE
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	(b) swapping from permitting hydraulic fracturing of the second well to permitting hydraulic fracturing of the first well, comprising: opening the first valve associated with the first well to permit pumping of fluid into the first well via the first valve; and 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).
CLAIM 16	
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 / LIMITATION	CLAIM LANGUAGE
16.3	(d) swapping from permitting hydraulic fracturing of the fourth well to permitting hydraulic fracturing of the third well.
CLAIM 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.
CLAIM 18	
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	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 closing the fourth valve associated with the fourth well.
CLAIM 25	
25.1	25. 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:

CLAIM / LIMITATION	CLAIM LANGUAGE
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	(b) swapping from permitting hydraulic fracturing of the second well to permitting hydraulic fracturing of the first well, comprising: opening the first valve associated with the first well to permit pumping of fluid into the first well via the first valve; and 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).
CLAIM 26	
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:

CLAIM / LIMITATION	CLAIM LANGUAGE
26.2	(c) permitting hydraulic fracturing of the fourth well; and
26.3	(d) swapping from permitting hydraulic fracturing of the fourth well to permitting hydraulic fracturing of the third well.
CLAIM 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.
CLAIM 28	
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	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 closing the fourth valve associated with the fourth well.
CLAIM 31	
	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 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.

CLAIM / LIMITATION	CLAIM LANGUAGE
CLAIM 36	
	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 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.

I. INTRODUCTION

Intelligent Wellhead Systems, Inc. (“IWS”/“Petitioner”) requests *inter partes* review (IPR) of claims 1-3, 6, 8-10, 13, 15-18, 25-28, 31, and 36 (“Challenged Claims”) of Downing Wellhead Equipment, LLC’s (“Downing’s”) U.S. Patent No. 11,401,779 (“’779 Patent”/“’779”) (Ex. 1001).

The Challenged Claims are unpatentable and should be cancelled because they merely cover the well-known abstract idea of determining fluid flowrate conditions to decide which valves to open/close in multi-well hydraulic fracturing operations, and prior art anticipates and/or renders them all obvious.

II. MANDATORY NOTICES

A. REAL PARTIES-IN-INTEREST

Intelligent Wellhead Systems, Corp., IWS USA Corp., and Pason Systems Corp. are real parties-in-interest.

B. RELATED MATTERS

1. Downing asserted the Challenged Claims against IWS, Intelligent Wellhead Systems, Corp. and IWS USA Corp., in *Downing Wellhead Equipment, LLC v. Intelligent Wellhead Systems, Inc., et al.*, No. 1:23-cv-01180-RMR-SP (D. Colo.) (“the Litigation”). Exs. 1007, 1046. The Litigation is in its early stages. Claim construction has not occurred, a claim construction hearing has not been set, and, as of February 14, 2024, all claim construction briefing deadlines have been

stayed. A trial date has not been set. On February 14, 2024, the Litigation was stayed pending institution decisions by the Patent Trial and Appeal Board (the “Board”) in related IPR2024-00256 and IPR2024-00300 (“related IPRs”). Ex. 1045, 1042, 1043. The stay affects all deadlines and litigation activities with the exception of allowing either side to conduct third-party discovery relating to *Krupa* (U.S. 2022/0268141, Ex. 1003) as prior art. *Id.*, 22. The parties shall submit a status report to the court within five business days of the Board’s institution decisions in the related IPRs, and either party may seek a further stay if either of the related IPRs is instituted. *Id.* IWS has not yet filed an answer in the Litigation as IWS’s Motion to Dismiss under 35 U.S.C. § 101 (ECF No. 34) was pending at the time the stay was granted.

2. *Intelligent Wellhead Systems, Inc. v. Downing Wellhead Equipment, LLC*, Case No. IPR2024-00256, before the Board, involving U.S. Patent No. 11,401,779, which is the parent to the ’770 Patent. This IPR is pending institution with Downing’s preliminary response due March 11, 2024. Ex. 1042, 1001-1035.

3. *Intelligent Wellhead Systems, Inc. v. Downing Wellhead Equipment, LLC*, Case No. IPR2024-00300, before the Board, involving U.S. Patent No. 11,560,770, which is a continuation of the ’779 Patent. This IPR is pending institution with Downing’s preliminary response due March 28, 2024. Ex. 1043.

4. *Intelligent Wellhead Systems, Inc. v. Downing Wellhead Equipment, LLC*, Case No. IPR2024-00584, before the Board, involving the '770 Patent.

C. LEAD AND BACKUP COUNSEL

Lead Counsel:	Backup Counsel:
Tammy J. Terry (Reg. No. 69,167) OSHA BERGMAN WATANABE & BURTON LLP 1100 Louisiana Street, Suite 4900 Houston, TX 77002 Telephone: 713.228.8600 Email: terry@obwb.com	Lisa E. Margonis (Reg. No. 57,123) Califf T. Cooper (<i>Pro Hac Vice</i> to be requested) Laura J. Witbeck (Reg. No. 59,766) Peter C. Schechter (Reg. No. 31,662) OSHA BERGMAN WATANABE & BURTON LLP 1100 Louisiana Street, Suite 4900 Houston, TX 77002 Tel. Fax: 713.228.8600 713.228.8778 Emails: margonis@obwb.com ; cooper@obwb.com ; witbeck@obwb.com ; schechter@obwb.com ; and, OBWB-IWS-Downing@obwb.com

D. SERVICE INFORMATION

Papers concerning this matter should be served on Lead and Back-up counsel.

Petitioner consents to service by email.

III. PAYMENT OF FEES

Charge all IPR-associated fees to Deposit Account 50-0591.

IV. GROUND FOR STANDING

Petitioner certifies that '779 is available for IPR and Petitioner is not barred/estopped from requesting IPR on the identified grounds.

V. IDENTIFICATION OF CHALLENGE

The Challenged Claims should be cancelled as unpatentable under post-AIA¹ 35 U.S.C. §§ 102/103 on these grounds:

GROUND(S)	CHALLENGED CLAIMS (1-3, 6, 8-10, 13, 15-18, 25-28, 31, 36)	35 U.S.C. §	REFERENCE(S)
1	1-3, 6, 15, 16, 18, 36	102	<i>Ciezobka</i>
2	All	103	<i>Ciezobka</i>
3	6, 8-10, 13, 16-18, 25-28, 31	103	<i>Ciezobka</i> and <i>McNeel</i>
4	All	103	<i>Beuterbaugh</i> and <i>Jackson</i>

Grounds are explained below, including where prior art discloses/teaches/suggests each limitation.

Dr. Robert Durham’s Declaration (Ex. 1041) provides additional explanation and support. 37 C.F.R. §§ 42.104(b)(1).

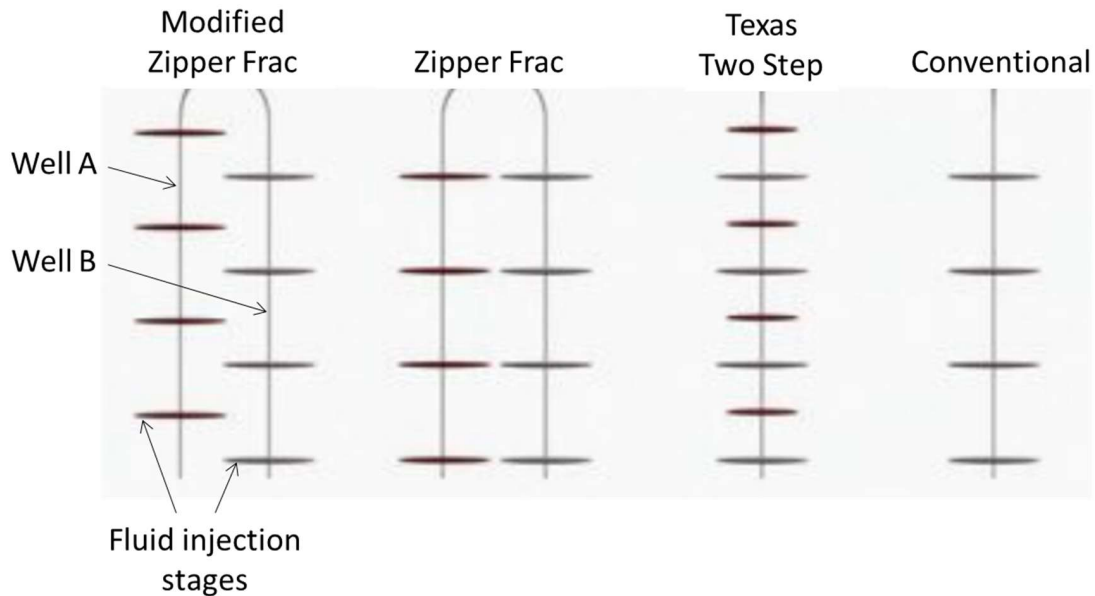
VI. TECHNOLOGY BACKGROUND AND PRIOR ART

For decades, hydraulic fracturing has used pumps and valve sequences to control and direct high-pressure fracturing fluid into wells to fracture and increase hydrocarbon recovery. Ex. 1041, ¶¶ 66-77; *see also*, Exs. 1015-1035.

Operators began “zipper fracturing” (simultaneously/sequentially fracturing multiple wells) in the mid-2000s. Ex. 1041, ¶¶ 78-80. By 2014, zipper fracturing

¹ The earliest effective filing date of ’779 is after 2013.

was widespread, as shown in this annotated article illustrating well completion plans for multiple techniques/variations of alternating fluid into wells:



Id., ¶¶ 81-90; Ex. 1008, 61.

“Continuous pumping” (“CP”) refers to pumping fluid to treat multiple stages and/or wells simultaneously or sequentially without stopping the pumps. Ex. 1041, ¶¶ 91-93. It has long been used to meet overall goals of reducing non-productive time at the wellsite and reducing wear/damage to high-pressure pumps and valves. *Id.*, ¶ 91. Closing valves during high-flow conditions creates extreme pressure increases, which could damage equipment and/or cause catastrophic system failure. *Id.*, ¶¶ 76, 94-99. Responsive and preventative measures, such as reducing flowrate between fracturing stages, have been commonly used to allow frac job execution. *Id.* For years, operators have also known to open a second well for CP only if there

is sufficient flow to support two-well operation, but not so much flow to blow a valve or damage the system. *Id.*, *see also*, ¶¶ 100-105.

Reducing flowrate and alternating valve sequencing during hydraulic fracturing operations, including zipper and continuous fracturing operations, was well known long before the '779 Patent, as shown in at least the following prior art.

A. CIEZOBKA

WO2017/201526 (“*Ciezobka*,” Ex. 1037), published November 23, 2017—before the '779’s effective filing date (May 17, 2021)—is § 102(a)(1)-prior art.

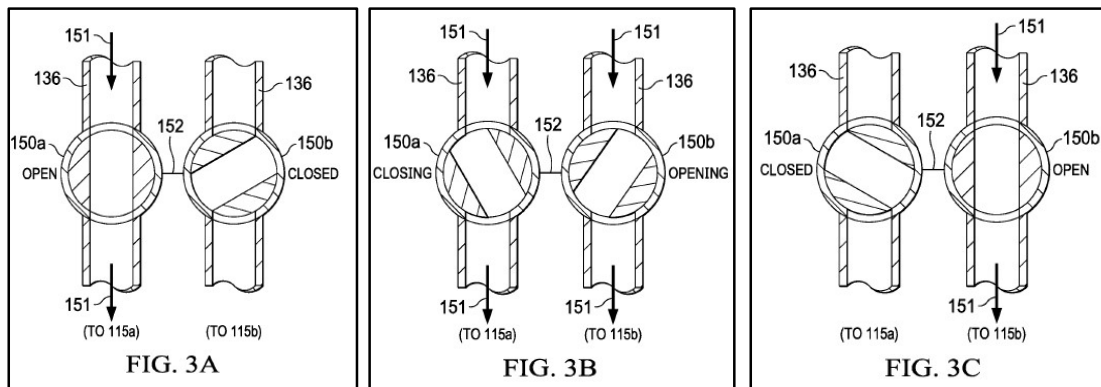
Ciezobka discloses hydraulic-fracturing systems/methods that include controlling flowrate to multiple wells to deliver pressure pulses to improve well fracturing. *Ciezobka*, Abstract, 2:24-28. Flowrate may be varied by alternatingly opening and closing valves along flowlines to the wells to divert fluid flow from one well to another. *Id.*, 11:21-12:15.

Ciezobka also discloses fracturing evaluation methods “implemented in a software toolbox which incorporates all of the data...for real time application in the field during hydraulic fracturing operations” and post-completion, “using the data collected during field activities” ultimately “to decide on further rate fluctuations” in hydraulic fracturing operations. *Id.*, 27:26-28:2; *see also* Ex. 1041, ¶¶ 106-110.

B. BEUTERBAUGH

WO2020145978 (“*Beuterbaugh*,” Ex. 1036), published July 16, 2020—before the ’779’s effective filing date—is § 102(a)(1)-prior art.

Beuterbaugh discloses fracking multiple wells by alternatingly opening and closing valves to the wells using switching and plug valves to divert high-pressure “fracturing fluid near instantaneously from one well to the other well.” *Beuterbaugh*, Abstract, [0018], [0022], [0027].



Figs. 3A-3C show sequencing control of two switching valves including a pulse of fluid flow 151 directed to the second wellhead 115b by first opening the plug valve 155b downstream of switching valve 150b, and then opening switching valve 150b as switching valve 150a is being closed. *Beuterbaugh*, ¶ [0021]; see also Ex. 1041, ¶¶ 111-113.

C. JACKSON

U.S. Publication No. 2007/0023184 (“*Jackson*,” Ex. 1005), published February 1, 2007—years before ’779’s effective filing date—is § 102(a)(1)-prior art.

Jackson discloses fracturing processes using gas (fluid) injections at different flowrates within set thresholds for set durations. *Jackson*, Abstract, ¶¶ [0012], [0017], [0045]-[0046], [0053], [0056]-[0059]; *see also* Ex. 1041, ¶¶ 114-117.

D. McNEEL

U.S. 2007/0125543 (“*McNeel*,” Ex. 1038), published June 7, 2007—before the ’779’s effective filing date—is § 102(a)(1)-prior art.

McNeel discloses stimulating multiple wells simultaneously or singly from a centralized location, including a manifold. *McNeel*, Abstract, ¶¶ [0021], [0024], [0025]; *see also* Ex. 1041, ¶¶ 118-122.

VII. PERSON OF ORDINARY SKILL IN THE ART (“POSITA”)

A POSITA as of ’779’s priority date would have had an engineering degree and two or more years’ well-related operations experience, or equivalent education/experience. Ex. 1041, ¶ 63.

VIII. ’779 PATENT OVERVIEW

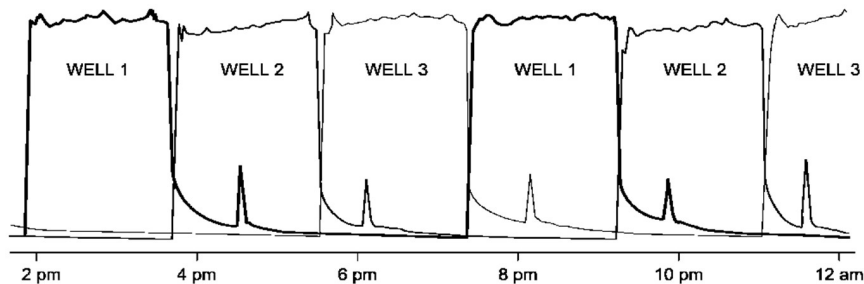
A. SUMMARY

’779 describes multiple-well hydraulic fracturing systems/methods. Ex.

1001², 2:7-10. In FIGs. 1A and 1B, hydraulic fracturing fluid is pumped through a zipper manifold (145, FIG. 1A) to a plurality of fracturing (“frac”) legs (150A-150C+n, FIG. 1A) adapted to communicate fluid from the manifold to a corresponding well. *Id.*, 5:53-61.

FIG. 13 shows the process for performing a regular swap from a first well to a second well, where one closes the first well before opening the second well. FIG. 15 shows the process for performing a CP swap from the first to the second well, where one opens the second well while the first well is also open, and then closes the first well.

FIG. 16D shows an example pumping schedule executing between multiple wells:



'779 Fig. 16D

These CP swaps are described as “instantaneous” with total time between

² Citations to '779/prior art are in [column]:[line] or [internal page #]:[line] or [paragraph] format.

stages measured at treatment pressure at “less than 20 seconds (as fast as 19 seconds in some instances).” ’779, 14:41-49.

B. ’779 PROSECUTION SUMMARY

’779 issued on August 2, 2022, from Application No. 17/388,716, filed July 29, 2021, as a continuation application of Application No. 17/319,854.

During prosecution one office action issued. Ex. 1009. Some claims were allowed as written, some were noted as allowable if rewritten, and some, namely those that did not recite flowrate thresholds, were rejected as anticipated by U.S. Pub. 2017/0275980 (“*Kajaria*” (Ex. 1004)) or obvious over *Kajaria* in view of U.S. Pub. 2014/0352968.

Downing maintained allowed claims, amended rejected claims, and added dependent claims. After prosecution on the merits closed, Downing changed identification of the application from continuation to continuation-in-part.

C. ’779 PRIORITY

The Parties do not dispute that ’779 claims priority to Provisional Application No. 63/189,663, filed May 17, 2021, or that ’779’s earliest effective filing date is May 17, 2021. Downing initially refused to identify a priority date until after it had seen IWS’s invalidity contentions in the Litigation. Ex. 1014. After receiving those contentions and the IPR2024-00256 petition, Downing acknowledged May 17, 2021 as the Challenged Claims’ earliest effective filing date, but alleged having publicly

disclosed the subject matter of '779 on September 1, 2020, arguing that one or more exceptions under 35 U.S.C. § 102(b) applies to “remove” any prior art with an effective filing date after September 1, 2020. Exs. 1039, 1040.

This Petition presents only prior art published prior to September 1, 2020, rendering disputes regarding alleged prior disclosure(s) irrelevant to this IPR.

D. CLAIM CONSTRUCTION

The Board only construes claims when necessary to resolve the underlying controversy. *Toyota Motor Corp. v. Cellport Sys., Inc.*, IPR2015-00633, Paper No. 11 at 16 (P.T.A.B. Aug. 14, 2015). Claim construction is not necessary in this IPR.³ If necessary, however, the *Phillips* standard applies. 37 C.F.R. § 42.100(b); *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-16 (Fed. Cir. 2005).

IX. DETAILED EXPLANATION OF GROUNDS

Petitioner explains all grounds showing unpatentability of all Challenged Claims below. Each claim is considered as a whole, separated into discrete subparts for ease of discussion only. Dependent claim discussions incorporate their respective independent/intervening claim discussions. As shown below, it was well

³ Claim construction may nonetheless be necessary in the Litigation for invalidity, noninfringement, and/or unenforceability purposes.

known to continuously direct flow between wells simply by opening or closing valves in response to flow conditions.

A. GROUNDS 1 AND 2-*CIEZOBKA* ANTICIPATES/RENDERS OBVIOUS ALL CHALLENGED CLAIMS

1. Independent Claims 1, 8, 15, and 25

Claims 1 and 8 are nearly identical, as are Claims 15 and 25 to each other, but a person/computer may execute Claims 1 and 15, while only a computer executes Claims 8 and 25. Because Claims 8 and 25 merely add standard computer language to Claims 1 and 15, they are discussed together. *Ciezobka* discloses/teaches/suggests all limitations in all these claims.⁴

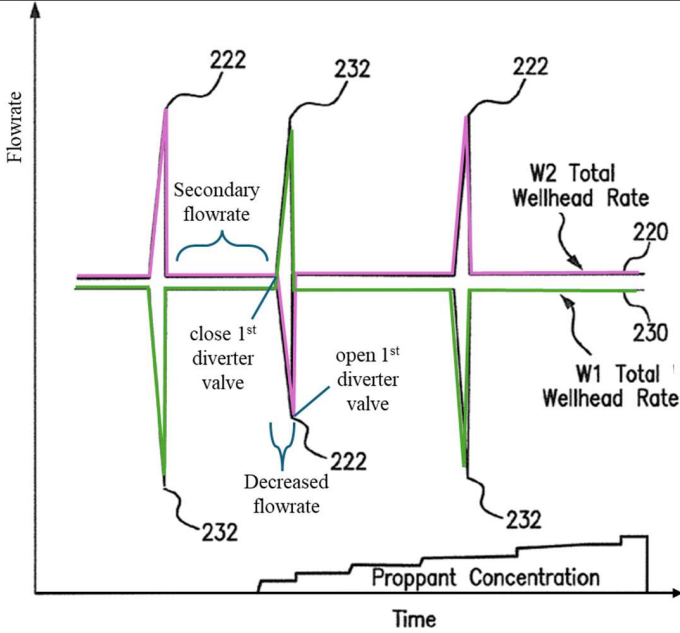
Claim	<i>Ciezobka</i>
[8.1] –“An apparatus, comprising: a non-transitory computer readable medium; and” [8.2] –“a plurality of instructions stored on the non-transitory computer readable medium and executable by one or more processors, wherein, when the instructions are executed by the one	<i>Ciezobka</i> discloses using a diagnostic approach for evaluating hydraulic fracturing 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.” 27:26-29. The diagnostics may be “used to decide on further rate fluctuations as envisioned to be part of subject hydraulic fracturing method.” 28:1-2. <i>Ciezobka</i> also discloses artificial intelligence (AI) tools “can be used to identify the efficacy of said rate pulses in the subject processing.” 27:11-15. <i>Ciezobka</i> ’s “(AI) tools” or “software toolbox” would necessarily include a typical computer system with

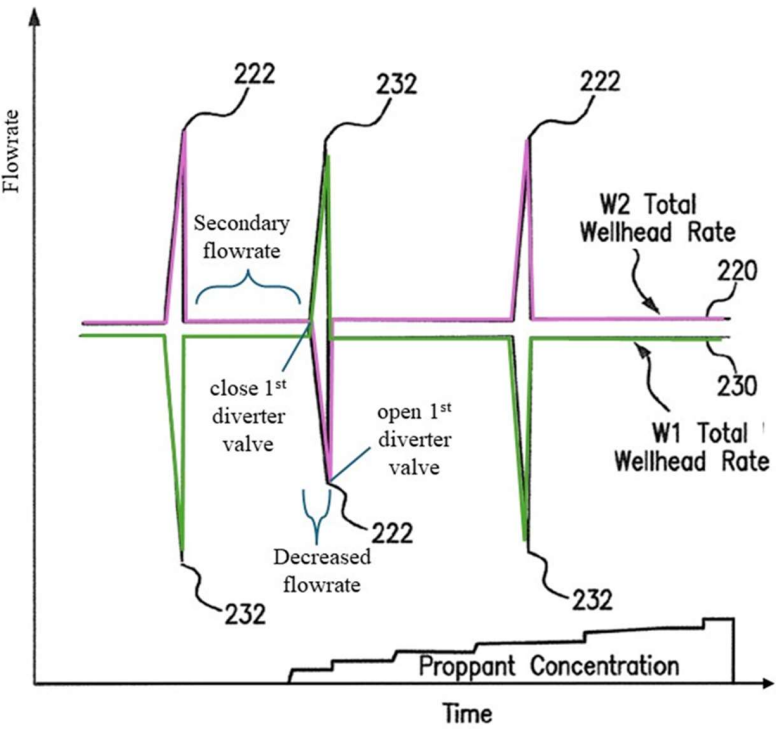
⁴ *Ciezobka*-citations in claim charts refer to *Ciezobka*/Ex. 1037.

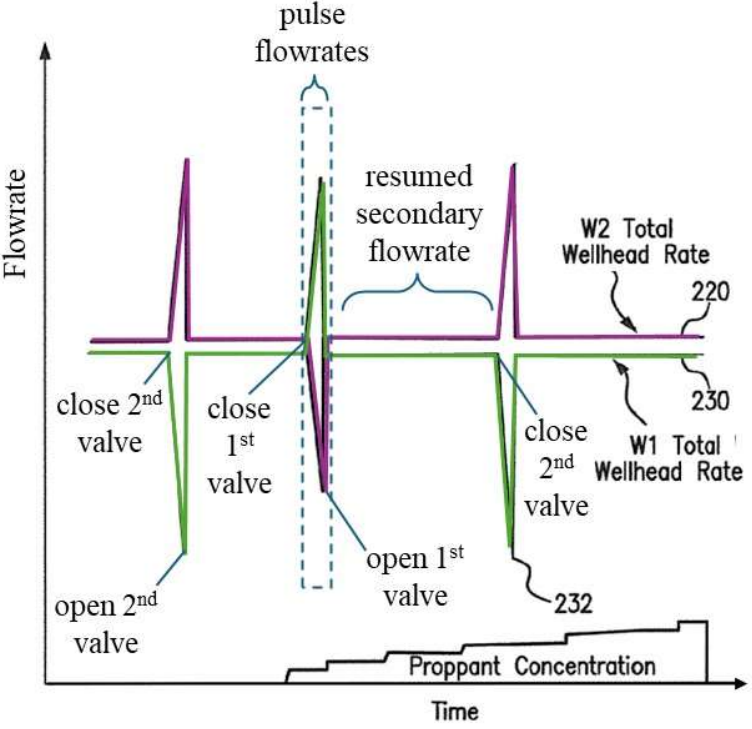
Claim	<i>Ciezobka</i>
or more processors, the following steps are executed:”	processor(s) executing instructions stored on non-transitory computer readable medium. Ex. 1041, ¶¶ 186-187.
<u>[1.1]/[8.3]</u> –“A method, comprising: (a) permitting performance of a first hydraulic fracturing operation on 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”	<i>Ciezobka</i> discloses hydraulic fracturing systems/methods, including “pumping the fracturing fluid...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.” 3:29-32. “As the system moves towards an equilibrium pressure with few or no new fractures being created,” the flowrate of fracturing fluid into the well is changed to introduce “a pressure pulse into the wellbore for a pulse period of time causing a temporary increase of pressure leading to opening new fractures.” 3:32-4:3. <i>Ciezobka</i> discloses pumping fluid into a first well via a first valve (diverter valve 218 along the first diverter flowline and/or a valve along the first constant rate flowline 212) associated with the first well to permit hydraulic fracturing on the first well. <i>See</i> 3:17-18; 10:10-1211:21-33; 12:4-10, Fig. 6; Ex. 1041, ¶¶ 124-132, 190.
<u>[1.2]/[8.4]</u> –“measuring a flow rate of the fluid being pumped into the first well”	In <i>Ciezobka</i>, flowrate of a fluid pumped into a well is measured and controlled to provide pressure pulses in a fracturing process. 3:29-4:8. For example, <i>Ciezobka</i>’s fracturing treatment plan includes pumping a first percentage of total fluid flow “at a constant flow rate” through a first constant rate flowline to a first well, and the total flowrate to the first well may be changed by a selected amount from an initial total flowrate into the well to deliver a pulse. 11:32-34; 12:19-20. To provide the selected flowrates to the wells according to the fracturing treatment plan, the flowrates would be measured or otherwise determined. Ex. 1041, ¶¶ 133-136, 190. In examples, “a total flow rate of 90 barrels per minute (bpm)” is pumped to a well (10:30-31), and a graph

Claim	<i>Ciezobka</i>
	shows “a first total flow rate to a first wellhead and a second total flow rate to a second wellhead,” which are measured over time (Fig. 7). 6:22-23; <i>see also</i> , 13:20-21; 14:2; 14:13-15:2; 14:23-25; 16:7-9; Fig. 8 (disclosing using field-collected measured flowrates for fracturing performance evaluations).
[1.3]/[8.5] –“(b) determining that the flow rate of the fluid being pumped into the first well is below a flow rate threshold and”	<i>Ciezobka</i> discloses “redirecting the flow” of fluid into wells for a “short amount of time” “to impart a pressure pulse that can open unopened perforations.” 8:11-13; 11:5-7. “The pressure pulse comprises changing the initial flow rate to a pulse flow rate and then to a secondary flow rate.” 4:2-3. In some embodiments, the “pulse flow rate is less than the initial flow rate” for a pulse period of time. 4:4-15. In this case, the pulse flowrate of fluid pumped into the well is below a flowrate threshold equal to the initial flowrate. Ex. 1041, ¶ 139. <i>Ciezobka</i> ’s Figures 6-7 demonstrate a fracturing system/method for two wells, where diverter valves are opened/closed to redirect fluid flow according to a flowrate schedule into each well. 12:4-11. <i>Ciezobka</i> determines the flowrate increases and decreases into the first and second wells. <i>See</i> Fig. 7 (annotated) ⁵ below; 4:2-3; 12:13-15.

⁵ All annotated figures use pink lines for flow to first well and green lines for flow to second well.

Claim	<i>Ciezobka</i>
	 FIG. 7 (Annotated)
	<i>Ciezobka</i> discloses that the parameters of variable rate fracturing are “select[ed] and design[ed]...including... parameters such as flow rate (e.g., magnitude of change and duration) as well as frequency (for example... measured...period[s] of time between the endings of successive flow rate variations).” 15:18-21. A “pulse flow rate may be greater than the initial flow rate and/or the secondary flow rate may ... be greater than or less than the initial flow rate.” 4:11-13. Optionally, the initial flowrate is increased “to a pre-pulse flow rate,” dropped to “a pulse flow rate,” returned “to the pre-pulse flow rate” and this cycle is repeated “before returning the flow rate to the initial flow rate.” 4:26-31. Thus, <i>Ciezobka</i> discloses determining the flowrate of the fluid and comparing the determined flowrate to certain thresholds (e.g., initial, pre-pulse, pulse, and secondary flowrates), and therefore discloses determining that the flowrate of the fluid being pumped into the first well is below a flowrate threshold. Ex. 1041, ¶¶ 139, 190.

Claim	Ciezobka
[1.4]/[8.6]-“has been below the flow rate threshold for a threshold amount of time”	Figures 6-7 show the total flowrate of fluid being pumped to the first well during a pulse is decreased (below a secondary flowrate threshold) “for a short period of time,” e.g., ranging “from 1 minute to 1 second” or “any period of time.” 12:8-15; Ex. 1041, ¶¶ 141, 190.  FIG. 7 (Annotated) As Figure 7 shows, after the decreased flowrate has been provided for a pulse period of time, the valves are operated to resume flow through both diverter lines to both wells. 12:5-15.

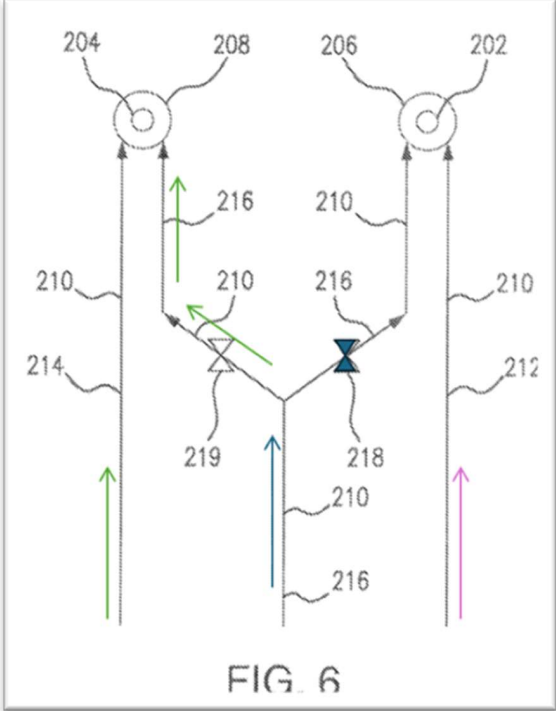
Claim	Ciezobka
	 FIG. 7 (Annotated)
[1.5]/[8.7]–“(c) during pumping of the fluid into the first well via the first valve, opening a second valve associated with a second well;”	Figures 6-7 (annotated below) show fracturing fluid pumped through a first diverter valve 218 to a first well, while a second diverter valve 219 to a second well is closed to prevent fluid flow through the second diverter line 216 to the second well (12:8-11), and, as fluid is continuously pumped through valve 218 to the first well, the second valve 219 to the second well is <i>opened</i> to allow fluid flow to the second well (12:5-16):

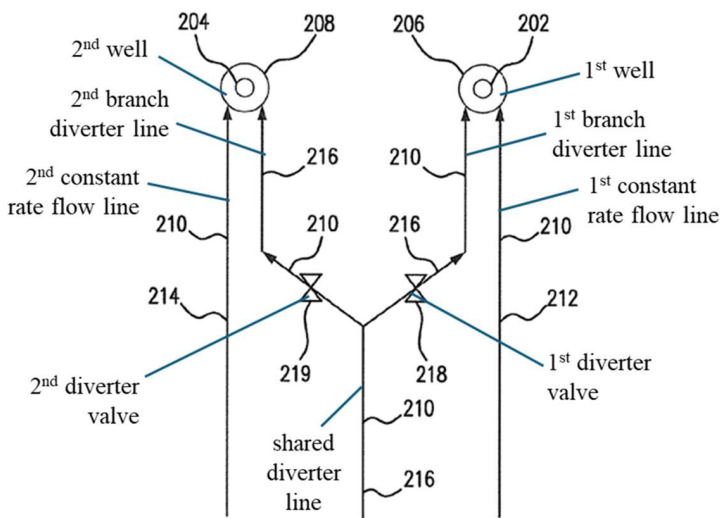
Claim	Ciezobka
	FIG. 7 (Annotated) FIG. 6 (Annotated)

Claim	Ciezobka
	FIG. 7 (Annotated) FIG. 6 (Annotated) <i>See also Ex. 1041, ¶¶ 144-150, 190.</i>

Claim	<i>Ciezobka</i>
[1.6]/[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”	<i>Ciezobka</i> discloses pumping fracturing fluid “at a pump rate and injecting [the fluid] under pressure into [a] wellhead” at a flowrate to create “small fractures” in the wellbore formation. 3:29-32. The flowrate is varied to introduce “a pressure pulse into the wellbore for a pulse period of time...to open[] new fractures.” 4:1-2. In Figure 6 (annotated below), fracturing fluid is pumped into two wells 206, 208 through separate constant rate flowlines 212, 214 and diverter lines 216 to each well. 11:25-32. “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 [through] the diverter line 216.” 11:34-4:2. The “third percentage of flow rate” may be diverted to a selected well during a pressure pulse. 12:4-5. Thus, when the second diverter valve 219 to associated second well 208 is open, fracturing fluid is pumped into the second well 208 via the second diverter line 216. 11:24-30; 12:5-15.

Claim	Ciezobka
	FIG. 6 (Annotated) <i>Ciezobka</i> also discloses that “one or more of the flow lines” to a well “may include a valve, not shown, that can be opened and closed to restrict a flow of fluid to the wellbore” (11:21-23; Fig. 4), which would allow constant flowrate to the second well during fracturing operations. <i>Id.</i>; Ex. 1041, ¶¶ 151-154, 190.
[1.7]/[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;”	<i>Ciezobka</i> discloses “[t]he process is then repeated” for the first well, where fluid is pumped through the open second diverter valve 219 to the second well 204 while the first diverter valve 218 to the first well 202 is closed, thereby “increasing the total flow rate 230 to the second wellhead 204 and decreasing the total flow rate 220 to the first wellhead 202” (12:8-15, FIG. 6):

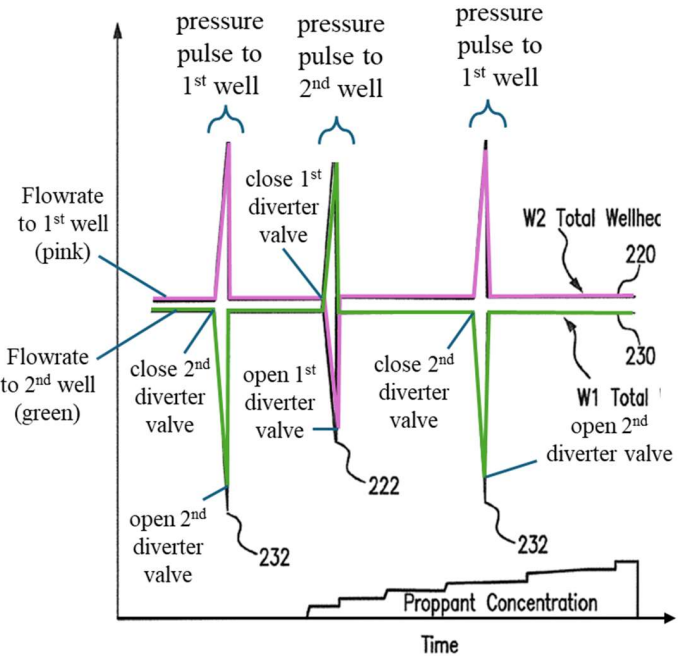
Claim	Ciezobka
	 FIG. 6 See also Ex. 1041, ¶¶ 155-159, 190.
[1.8]/[8.10]- “wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped to the first valve, the second valve, or both the first valve and the second valve.”	Figures 6-7 show first and second wells 206, 208 are connected to a fracturing system via constant rate flowlines 212, 214 and diverter lines 216 (collectively, “flow lines 210”), where each well is connected to a separate constant rate flowline 212, 214 and to a shared diverter line 216 via associated branch diverter lines (as shown in Fig. 6) (11:25-32):

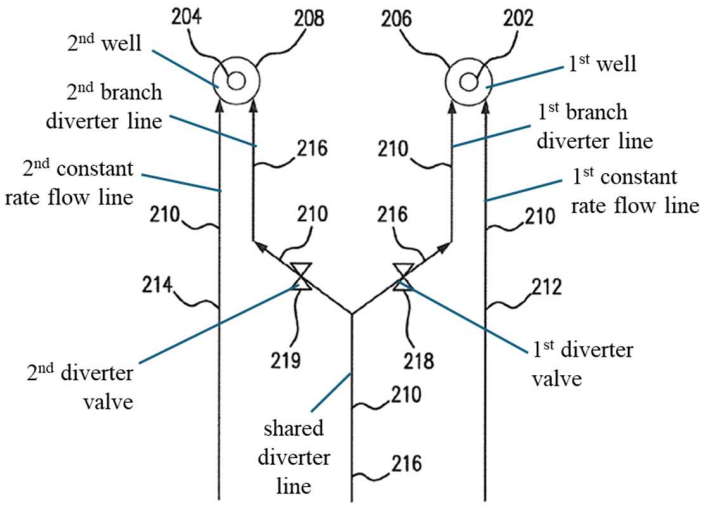
Claim	Ciezobka
	 The diagram illustrates a well system with two wells, labeled '1st well' (202) and '2nd well' (204). Each well has a 'diverter line' (210) and a 'constant rate flow line' (212 for the 1st well, 214 for the 2nd well). These lines converge into a 'shared diverter line' (216) which leads to a 'diverter valve' (218 for the 1st well, 219 for the 2nd well). The diagram also shows a 'diverter valve' (212) and a 'diverter line' (210) for the 1st well, and a 'diverter valve' (214) and a 'diverter line' (210) for the 2nd well. The diagram is annotated with various numerical labels: 202, 204, 206, 208, 210, 212, 214, 216, 218, 219, 220, 222, 224, 226, 228, 230, 232, 234, 236, 238, 240, 242, 244, 246, 248, 250, 252, 254, 256, 258, 260, 262, 264, 266, 268, 270, 272, 274, 276, 278, 280, 282, 284, 286, 288, 290, 292, 294, 296, 298, 300, 302, 304, 306, 308, 310, 312, 314, 316, 318, 320, 322, 324, 326, 328, 330, 332, 334, 336, 338, 340, 342, 344, 346, 348, 350, 352, 354, 356, 358, 360, 362, 364, 366, 368, 370, 372, 374, 376, 378, 380, 382, 384, 386, 388, 390, 392, 394, 396, 398, 400, 402, 404, 406, 408, 410, 412, 414, 416, 418, 420, 422, 424, 426, 428, 430, 432, 434, 436, 438, 440, 442, 444, 446, 448, 450, 452, 454, 456, 458, 460, 462, 464, 466, 468, 470, 472, 474, 476, 478, 480, 482, 484, 486, 488, 490, 492, 494, 496, 498, 500, 502, 504, 506, 508, 510, 512, 514, 516, 518, 520, 522, 524, 526, 528, 530, 532, 534, 536, 538, 540, 542, 544, 546, 548, 550, 552, 554, 556, 558, 560, 562, 564, 566, 568, 570, 572, 574, 576, 578, 580, 582, 584, 586, 588, 590, 592, 594, 596, 598, 600, 602, 604, 606, 608, 610, 612, 614, 616, 618, 620, 622, 624, 626, 628, 630, 632, 634, 636, 638, 640, 642, 644, 646, 648, 650, 652, 654, 656, 658, 660, 662, 664, 666, 668, 670, 672, 674, 676, 678, 680, 682, 684, 686, 688, 690, 692, 694, 696, 698, 700, 702, 704, 706, 708, 710, 712, 714, 716, 718, 720, 722, 724, 726, 728, 730, 732, 734, 736, 738, 740, 742, 744, 746, 748, 750, 752, 754, 756, 758, 760, 762, 764, 766, 768, 770, 772, 774, 776, 778, 780, 782, 784, 786, 788, 790, 792, 794, 796, 798, 800, 802, 804, 806, 808, 810, 812, 814, 816, 818, 820, 822, 824, 826, 828, 830, 832, 834, 836, 838, 840, 842, 844, 846, 848, 850, 852, 854, 856, 858, 860, 862, 864, 866, 868, 870, 872, 874, 876, 878, 880, 882, 884, 886, 888, 890, 892, 894, 896, 898, 900, 902, 904, 906, 908, 910, 912, 914, 916, 918, 920, 922, 924, 926, 928, 930, 932, 934, 936, 938, 940, 942, 944, 946, 948, 950, 952, 954, 956, 958, 960, 962, 964, 966, 968, 970, 972, 974, 976, 978, 980, 982, 984, 986, 988, 990, 992, 994, 996, 998, 1000. FIG. 6 (Annotated) A connected fracturing pump pumps fracturing fluid to all “the flow lines 210 at a constant flow rate.” 11:32-33. “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.” 11:34-12:2. Fracturing fluid is thereby continuously pumped to first and second diverter valves 218, 219 via the shared portion of the diverter line while valve-switching to selectively deliver pulses of fracturing fluid to associated wells. 11:30-12:15; Ex. 1041, ¶¶ 160-164, 190.

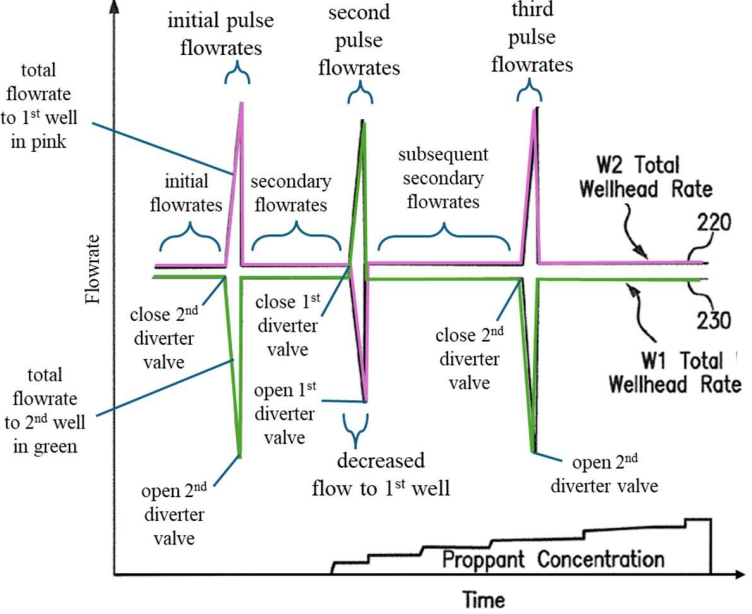
Claim	<i>Ciezobka</i>
[25.1]-“An apparatus adapted to hydraulically fracture first and second wells, the first and second wells being associated with first and second valves, respectively, the apparatus comprising:”	25.1 is the same as 15.1, except 25.1 recites an apparatus adapted to perform the method of 15.1. As discussed below, <i>Ciezobka</i> discloses 15.1. <i>Ciezobka</i> also discloses a typical computer system with processor(s) executing instructions stored on non-transitory computer readable medium. 27:26-29; 28:1-2; 27:11-15; Ex. 1041, ¶¶ 272-273.
[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:”	These limitations are identical to 8.1-8.2. <i>Ciezobka</i> discloses them as shown above. Ex. 1041, ¶ 274.

Claim	<i>Ciezobka</i>
[15.1]-“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.”	15.1 combines 1.1 and 1.6. <i>Ciezobka</i> discloses 15.1 for the same reasons discussed above. Ex. 1041, ¶¶ 196-201.
[15.2]/[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”	15.2 combines 1.5 and 1.6. <i>Ciezobka</i> discloses this limitation for the same reasons discussed above. Ex. 1041, ¶¶ 202-205, 275-277.
[15.3]/[25.5]-“measuring a flow rate of the fluid being pumped into the second well;”	15.3 is identical to 1.2. Accordingly, <i>Ciezobka</i> discloses this limitation as shown above. Ex. 1041, ¶¶ 206-210, 275-277.
[15.4]/[25.6]-“ (b) swapping from permitting hydraulic fracturing of the second well to permitting hydraulic fracturing of the	<i>Ciezobka</i> discloses hydraulic fracturing systems/methods as discussed above regarding Claim 1. <i>See, e.g.</i> , 3:29-4:2. Figures 6-7 further disclose switching pulse fracturing between a first well 206 and a second well 208. 11:24-12:15.

Claim	<i>Ciezobka</i>
first well, comprising: opening the first valve associated with the first well to permit pumping of fluid into the first well via the first valve; and closing the second valve associated with the second well;	<i>Ciezobka</i>'s pulse hydraulic fracturing is swapped between the first and second wells 206, 208 by opening and closing associated diverter valves. <i>Id.</i> For example, <i>Ciezobka</i> discloses that a pressure pulse is induced by closing a second diverter valve associated with the second well to "increase[e] the total flow rate 220 to the first well[] and decreas[e] the total flow rate 230 to the second well[]" for a short period of time," after which, the second diverter valve is opened to resume fluid flow (at a secondary flowrate) through both the first and second diverter valves to first and second wells. 4:1-3; 12:7-11. After pulse fracturing is conducted on the first well, the first diverter valve is closed, "increasing the total flow rate 230 to the second well[] and decreasing the total flow rate 220 to the first well[]" for a short period of time" to deliver a pressure pulse to the second well. 12:13-15. After the pressure pulse to the second well, the first diverter valve is opened to resume fluid flow (at another secondary flowrate) through both the first and second diverter valves to first and second wells. 4:1-3; 12:7-11. The process can be repeated, as shown in Figure 7 (12:13):

Claim	Ciezobka
	 FIG. 7 (Annotated) <i>See also Ex. 1041, ¶¶ 211-222, 275-277.</i>
[15.5]/[25.7]–“wherein, during step (b), hydraulic fracturing fluid is continuously pumped to the first and second valves via a hydraulic manifold; and”	<i>Ciezobka</i> discloses “a single or multiple common manifolds” may connect fracturing pumps to a well via multiple flowlines, where the flowlines may include a valve “that can be opened and closed to restrict a flow of fluid to the wellbore.” 3:15-20; 11:21-22. <i>Ciezobka</i> further discloses that multiple wells can be connected to such a pumping system. 11:28-30. In <i>Ciezobka</i> fracturing fluid is continuously pumped to first and second valves via this hydraulic manifold as discussed above with Limitation 1.8/8.10 (disclosing constant rate flowlines 212, 214 and diverter lines 216 (collectively referred to as “flow lines 210”) connected to wells 206, 208 (11:25-12:15)). <i>See above.</i>

Claim	Ciezobka
	 FIG. 6 (Annotated) Fracturing fluid is thereby continuously pumped to first and second diverter valves 218, 219 via the shared portion of the diverter line (or “single or multiple common manifolds”) while valve-switching to deliver pressure pulses to and hydraulically fracture the first and second wells. 3:15-20; 11:30-12:15. <i>See also</i> Ex. 1041, ¶¶ 223-226, 275-277.
[15.6]/[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	<i>Ciezobka</i> discloses “variable rate fracturing” methods for fracturing multiple wells by varying flowrate “parameters” into each well. 15:16-21. Flowrate parameters/conditions include the “magnitude of change” in a pulse flowrate and the “duration” of the flowrate change. 8:11-12; 11:5-7; 15:19-20; Fig. 8. After determining a pulse flowrate (greater than, less than and/or within a range of an initial flowrate) has been directed into a well for a certain time, a subsequent valve sequence is performed in response to the determination based on a flowrate condition to redirect flow between the two wells, including opening a first valve to a first well before closing a second valve to a second well. 12:17-20; <i>see also</i> 4:11-13; 4:26-31.

Claim	Ciezobka
(b);”	A pulse is delivered to either well by closing the other well’s diverter valve. In Figures 6-7, after a pulse has been delivered to the second well, the first valve 218 is opened to resume secondary flowrates to the first and second wells. After secondary flowrates have been met, the second valve is then closed, after opening the first valve 218. 4:1-3; 12:7-15:  FIG. 7 (Annotated) See Ex. 1041, ¶¶ 227-232, 275-277.
[15.7]/[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	This limitation is a second option in an “or” clause of claim 15/25 (therefore, not required), and merely requires opening a valve to a next well during or after closing a valve to another well. Ex. 1041, ¶ 233, 275-277.

Claim	<i>Ciezobka</i>
opened at step (b) during or after the second valve associated with the second well is closed at step (b).”	

Ciezobka thus discloses/teaches/suggests every limitation of Claims 1, 8, 15, and 25 as arranged in the claims, anticipating Claims 1 and 15 while at least rendering obvious Claims 8 and 25.

If it is argued that *Ciezobka*’s AI tool/software toolbox disclosures do not expressly execute Claims 8 and 15’s steps, *Ciezobka*’s AI tool/software toolbox would obviously be used to operate *Ciezobka*’s fracturing systems/methods. Ex. 1041, ¶¶ 187-189, 191-192, 273-277. For example, for the “software toolbox” to implement diagnostics “using data collected during field activities,” the computer system would need to be connected to *Ciezobka*’s fracturing systems “in such a way that all flow rate measurements, pressure measurements, proppant concentrations, etc. are fed into the computer.” *Id.*

Ciezobka discloses that the collected data diagnostics are further used to generate parameter optimization outputs, which “are then used to decide on further rate fluctuations as envisioned to be part of subject hydraulic fracturing method.” *Ciezobka*, 27:30-28:2. *Ciezobka*’s “rate fluctuations” include “increasing and/or

decreasing the pump rate” and/or opening/closing valves to multiple wells to “redirect[] the flow of fracturing fluid” between the wells. *Id.*, 4:30-31; 9:28-31; 28:22-26. Thus, a POSITA would have understood that using the computer system’s generated optimized rate fluctuations “for real time application in the field during hydraulic fracturing operations” would have included software instructions for opening/closing valves according to the determined optimized rate fluctuation schedules, including 1.1-1.8 and 8.3-8.10’s steps, which would have been executed in *Ciezobka*’s fracturing systems. Ex. 1041, ¶¶ 137-138, 140, 142-143, 187-189, 190-192, 274-277. *Ciezobka* therefore also renders obvious Claims 1 and 8.

Further, if it is argued that *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. Ex. 1041, ¶¶ 234-236, 275-277.

If any differences exist between *Ciezobka* and Claims 1 and 8’s or Claims 15 and 25’s limitations, they are insubstantial, and *Ciezobka* would still render obvious these claims’ subject matter “as a whole.”

2. Claims 2 and 9

Dependent Claims 2(1)⁶ and 9(8) are identical. *Ciezobka* discloses their limitations:

Claim	<i>Ciezobka</i>
[2.1]/[9.1]- “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”	Flowlines connect “high-pressure fracturing pumps, through a single or multiple common manifolds, to a wellhead.” 3:16-18; Ex. 1041, ¶¶ 165-170, 193. Figure 4 shows an example where high-pressure fracturing pumps direct fracturing fluid to a manifold at a high-pressure and then through the flowlines to a wellhead connected to the wellbore. 10:10-13. <i>Ciezobka</i> discloses that the pump/manifold system may likewise be connected via flowlines and first and second diverter valves 218, 219 to two wells, such as in Figure 6. 11:28-33.
[2.2]/[9.2]- “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.”	Fracturing pumps supply fracturing fluid through the manifold to each of the flowlines 210 in the system “at a constant flow rate,” where first, second, and third percentages of the flow rate passes through first, second, and third constant rate flow lines 212/214/216. 3:16-18; 11:28-12:2. As the third percentage of the flowrate is flowed “at a constant flow rate” to diverter line 216, the fluid may be diverted from being pumped into both wells 202, 204, to being pumped into a single well by opening and closing diverter valves associated with each well. 12:4-19. <i>See also</i> Ex. 1041, ¶ 169.

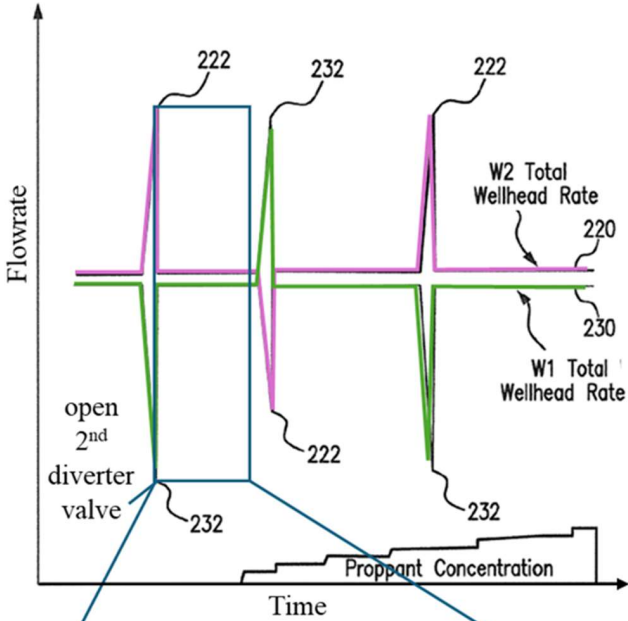
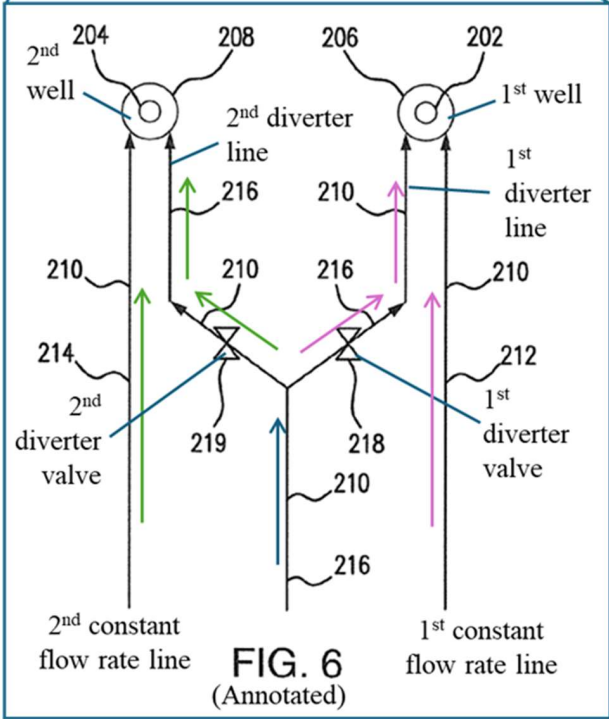
⁶ Dependent claims are identified in the format “[dependent claim #]([independent claim #])” or “[dependent]([independent],[intervening dependent claim])”.

Because *Ciezobka* discloses each limitation of Claims 2/9 (in addition to disclosing/rendering obvious Claims 1/8), *Ciezobka* also anticipates/renderers obvious Claims 2 and 9. *See* Ex. 1041, ¶¶ 170, 193.

3. Claims 3 and 10

Ciezobka discloses all Claims 3(1) and 10(8)’s limitations:

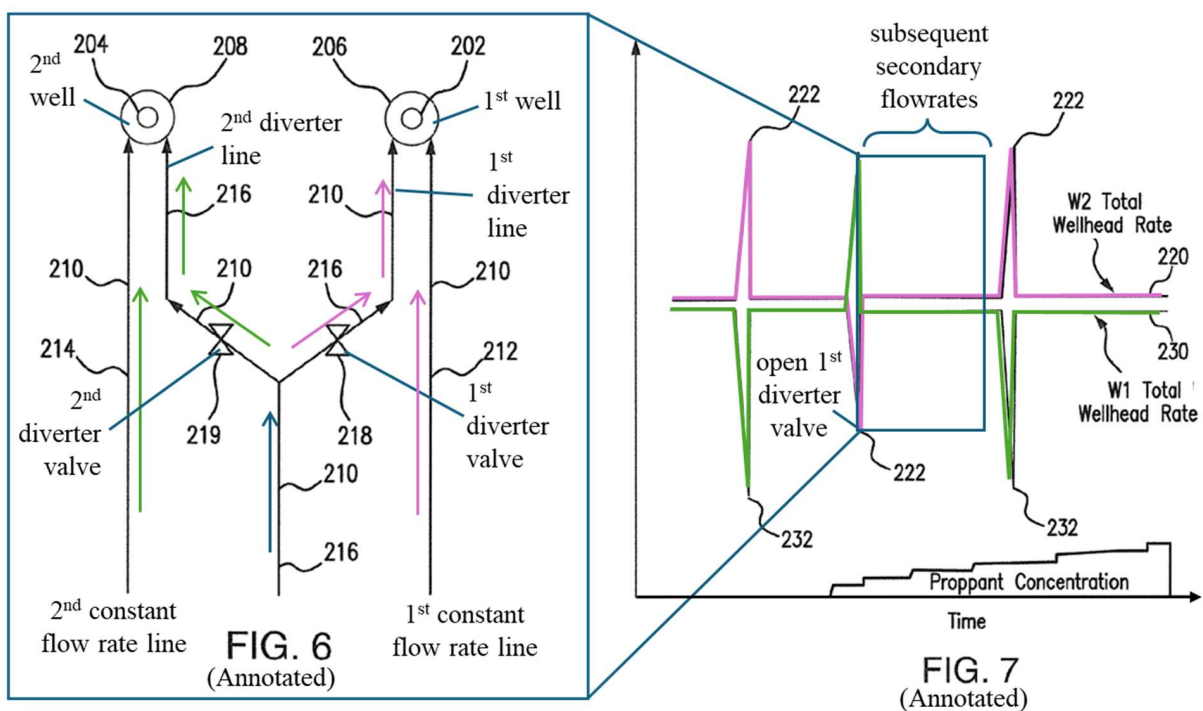
Claim	<i>Ciezobka</i>
[3]/[10]-“wherein the second valve is opened after step (b).”	<i>Ciezobka</i> discloses step (b) as discussed in Section IX.A.1, and discloses that after determining the fluid rate into the well is below a flowrate threshold (<i>e.g.</i>, pulse flowrate is less than the initial flowrate) for the pulse period (<i>e.g.</i>, threshold amount of time), the second diverter valve 219 is opened to return total flowrate to each well to a secondary flowrate. 12:2-8; 15:29-31. In Figures 6-7’s repeated pulsing process, once the third pulse is performed, the second diverter valve 219 is opened after the decreased flowrate has been pumped to the first well for the threshold pulse period of time (during the second pulse in Figure 7). Fig. 7; 11:21-12:15.

Claim	Ciezobka
	 FIG. 7 (Annotated)  FIG. 6 (Annotated) See also, 11:21-12:15 (disclosing another repeated

Claim	<i>Ciezobka</i>
	alternating valve opening/closing process); and 4:11-13; 4:26-31 (disclosing other combinations of flowrate pulse schedules); Ex. 1041, ¶¶ 171-177, 194.

Ciezobka thus discloses Claims 3 and 10's limitations (in addition to Claims 1/8's limitations), and therefore anticipates these claims. *See also* Ex. 1041, ¶¶ 177, 194.

Alternatively, *Ciezobka* renders these claims obvious. *Id.*, ¶¶ 177, 194. A POSITA would understand *Ciezobka's* decreased pulse flowrate to the first well for a pulse period of time as equivalent to pumping into the first well a flowrate that is below a flowrate threshold of the secondary flowrate for a threshold amount of time (pulse period). Ex. 1041, ¶ 174-176.



Figures 8-9 disclose other flowrate schedule examples (20:25-33):

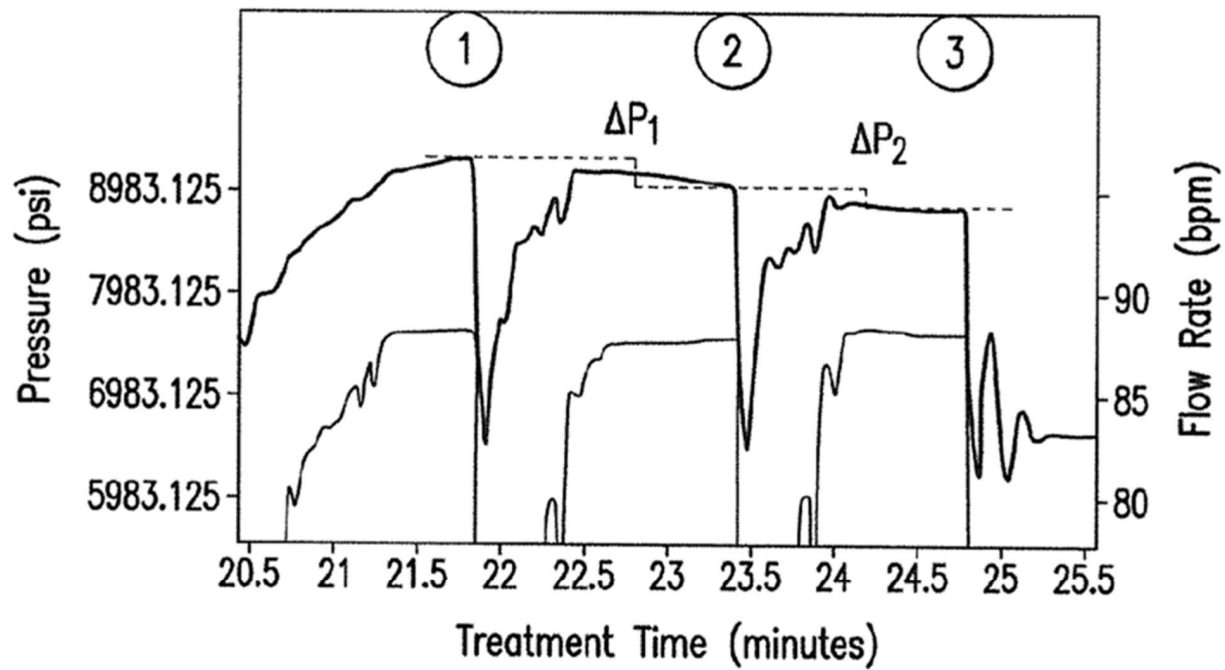


Figure 8: Rate fluctuations introduced in rapid succession at 21st minute and 23rd minute of treatment and corresponding pressure profile for a representative completion.

FIG. 8

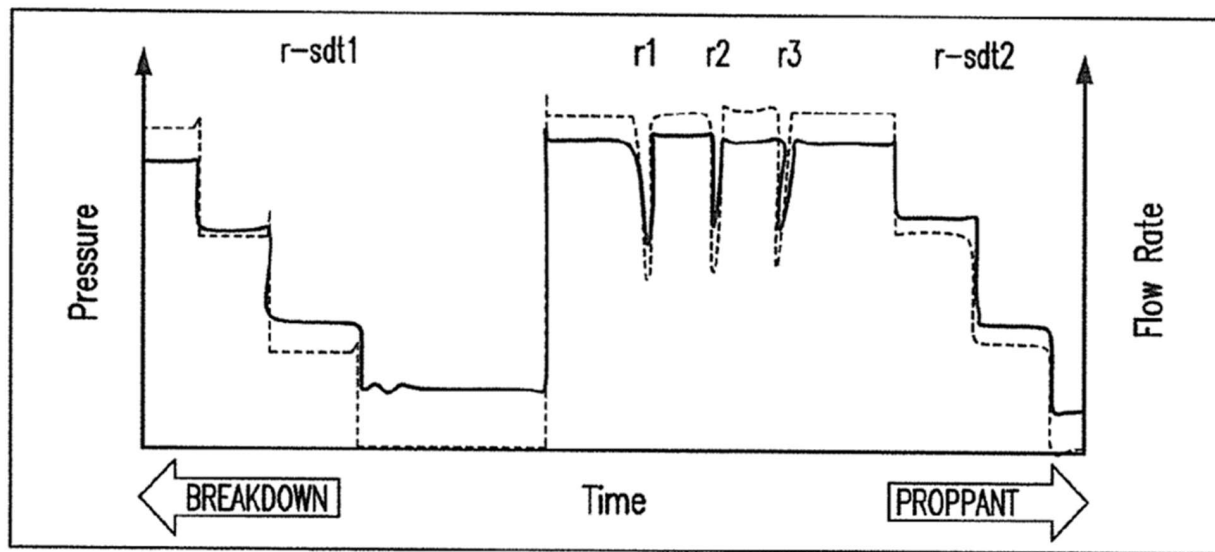


Figure 9: Schematic showing proposed experimental design for variable rate fluctuations workflow outlined in the discussion.

FIG. 9

Ciezobka discloses that total flowrates into wells can be varied “by increasing and decreasing the pump rate and/or by redirecting the flow of fracturing fluid” via opening/closing valves. 4:30-31; 9:28-31.

A POSITA would have understood from *Ciezobka*’s disclosure that different flowrate pulse schedules can be applied to wells (e.g., first and second wells 206, 208 in Figure 6) “by increasing and decreasing the pump rate and/or by redirecting the flow of fracturing fluid” via opening/closing valves (*see e.g.*, 4:30-31; 9:28-31; 11:21-12:15; 12:23-24) and would include opening a second valve to a second well after determining the flowrate of fluid being pumped into a first well is below a flowrate threshold for a threshold amount of time. Ex. 1041, ¶¶ 172-174.

Ciezobka therefore anticipates/renderers obvious Claims 3 and 10.

4. Claims 6 and 13

Ciezobka discloses Claims 6(1) and 13(8). '779 neither defines nor describes “zipper” valves as having any distinguishable feature from any other valve capable of allowing fluid flow into a well. Ex. 1041, ¶ 180. Instead, '779 merely describes “zipper valves 170a-b (such as, for example, gate valves)” based on their function “[to] communicate fluid between” a zipper manifold and a well, and a “zipper manifold” is merely described as being a manifold “adapted to communicate” pressurized fracturing fluid from high-pressure pumps (via a discharge manifold) to multiple wells. '779, 5:52-61; 7:58-61, 7:63-66, 14:7-9, 14:20-23, 14:27-31, 14:41-46, and associated figures. *Id.*

Claim	<i>Ciezobka</i>
[6]/[13]-“wherein each of the first and second valves is a zipper valve.”	<i>Ciezobka</i> discloses “zipper valves” for the same reasons <i>Ciezobka</i> discloses the claimed first and second valves discussed in Sections IX.A.1. Further, “a single or multiple common manifolds” may connect high-pressure fracturing pumps to a well via multiple flowlines, which may include valves “that can be opened and closed to restrict a flow of fluid to the wellbore.” 3:15-20; 11:21-22. A POSITA would have considered <i>Ciezobka</i>’s “common manifold(s)” (Figure 4. 11:28-30) to be equivalent to/interchangeable with a “zipper manifold,” and any associated valves that “can be opened and closed to restrict a flow of fluid to the wellbore” to be effectively equivalent to “zipper valves,” as described in '779. <i>See</i> Ex. 1041, ¶ 178-182, 195.

Ciezobka thus discloses the claimed “zipper valves.”

Alternatively, *Ciezobka* at least renders this limitation obvious as a POSITA would have understood *Ciezobka*’s above-identified disclosures as including valves effectively equivalent to “zipper valves,” as described in ’779. Ex. 1041, ¶¶ 182-185, 195; Ex. 1044.

Accordingly, *Ciezobka* anticipates and/or renders obvious Claims 6 and 13.

5. Claims 16 and 26

Dependent claims 16(15) and 26(25) are substantially identical and recite already-analyzed limitations (15/25), but applied to third and fourth wells. *Ciezobka* discloses and/or renders obvious these claims. Given their similarity, the claims are discussed together.

Claim	<i>Ciezobka</i>
[16.1] –“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” [26.1] –“wherein	<i>Ciezobka</i> discloses opening/closing valves to associated first/second wells to alternate delivering pulses of increased and decreased flowrates into the wells, the pulses of increased flowrate opening new fractures in the well. 3:29-4:2; 11:24-12:15. Thus, <i>Ciezobka</i> discloses swapping from permitting hydraulic fracturing of one well to another. Although <i>Ciezobka</i> ’s examples use two wells, <i>Ciezobka</i> discloses the methods and apparatuses may include “[s]imilar variations...utiliz[ing] multiple wells.” 28:22-23; Ex. 1041, ¶¶ 237-238, 279.

Claim	<i>Ciezobka</i>
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”	
[16.2]/[26.2]–“(c) permitting hydraulic fracturing of the fourth well; and” [16.3]/[26.3]–“(d) swapping from permitting hydraulic fracturing of the fourth well to permitting hydraulic fracturing of the third well.”	<i>Ciezobka</i> discloses “[s]imilar variations may utilize multiple wells....Fluid can be diverted from one wellhead to another in situations where two wells are simultaneously stimulated.” 28:22-25; Ex. 1041, ¶¶ 241-242, 245-247, 279.

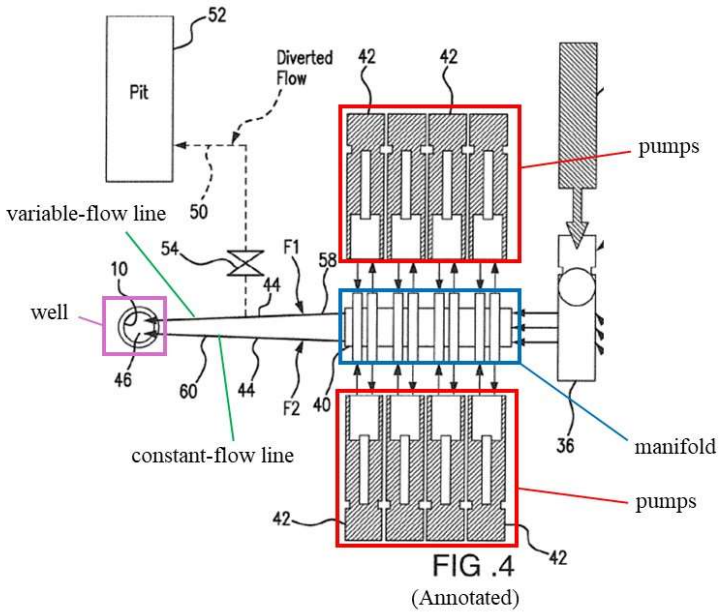
As discussed, *Ciezobka* discloses that the methods and apparatuses may use “multiple wells.” 28:22-23. Application of *Ciezobka*’s teachings to third and fourth wells and associated third and fourth valves in a multi-well system would have involved performing the same function in the same manner with predictable results. Ex. 1041, ¶¶ 239-40, 243-244, 248-250, 278-282. Moreover, mere repetition of elements has no patentable significance unless a new and unexpected result is produced. *See, e.g., In re Harza*, 274 F.2d 669 (CCPA 1960); and *Perfect Web Techs., Inc. v. InfoUSA, Inc.*, 587 F.3d 1324, 1330 (Fed. Cir. 2009).

Thus, Claim 16 is anticipated by and 16 and 26 are obvious over *Ciezobka*.

6. Claims 17 and 27

Dependent Claims 17(15,16) and 27(25,26) are identical. *Ciezobka* discloses and/or renders obvious their limitations. Claims 17/27 recite already-analyzed limitations (Claims 15/16/25/26) that are likewise applied to the third valve/well and fourth valve/well.

Claim	<i>Ciezobka</i>
[17]/[27]-“wherein steps (a) and (c) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold; and wherein steps (b)	<i>Ciezobka</i> discloses “a single or multiple common manifolds” that connect high-pressure fracturing pumps to a wellhead of a wellbore via multiple flowlines. 3:16-18. Figure 4 shows such a system where multiple flowlines (including a variable- and a constant-rate flowline) connect fracturing pumps through a manifold to a well, where “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” (10:10-13, 21-22):

Claim	Ciezobka
and (d) are executed simultaneously using hydraulic fracturing fluid from the hydraulic manifold.”	 Further, <i>Ciezobka</i> discloses that “[s]imilar variations [in flow rate or pulses] may utilize multiple wells” (28:22-23) and that “the flow rate...can be varied by diverting a portion of the fracturing fluid via [a] valve to...another wellhead and wellbore.” 3:25-26; <i>see also</i> 3:29-32; 11:24-12:8; 28:23-26, Figs. 6-7. “Fluid can be diverted from one wellhead to another...where two wells are simultaneously stimulated.” 28:23-25.

It would have been at least obvious to a POSITA to use “similar variations” with “multiple wells,” including a third and fourth well, where the second and fourth wells may be fractured simultaneously using fracturing fluid pumped via a manifold, and where swapping between hydraulically fracturing the second/first wells and fourth/third wells (*e.g.*, via *Ciezobka*’s pulses) may be executed simultaneously

using the fracturing fluid from the manifold. Ex. 1041, ¶¶ 251-258, 283-285. Doing so would have involved performing the same function in the same manner as disclosed with *Ciezobka*'s first and second wells with predictable results. Ex. 1041, ¶ 257. Thus, the repeated elements in Claims 17/27 have no patentable significance. *See, e.g., Perfect Web*, 587 F.3d at 1330.

Claims 17 and 27 are obvious over *Ciezobka*.

7. Claims 18 and 28

Dependent Claims 18(15) and 28(25) are identical. *Ciezobka* discloses their limitations. Claims 18/28 recite already-analyzed limitations (Claims 15/25) that are likewise applied to the third valve/well and fourth valve/well.

Claim	<i>Ciezobka</i>
[18.1]/[28.1]- “wherein, during step (d), hydraulic fracturing fluid is continuously pumped to the third and fourth valves via the hydraulic manifold;”	<i>Ciezobka</i> discloses opening/closing valves to associated wells to alternate delivering pulses of increased and decreased flowrates into the wells for fracturing, as discussed with Limitations 15.4/25.6 and 15.5/25.7 in Section IX.A.1. <i>See also</i> , 3:29-4:2; 11:24-12:15. Thus, <i>Ciezobka</i> discloses swapping from permitting hydraulic fracturing of one well, <i>e.g.</i> , a second well, to another well, <i>e.g.</i> , a first well, via a hydraulic manifold. Although <i>Ciezobka</i> 's examples use two wells, <i>Ciezobka</i> discloses its methods/apparatuses may include “[s]imilar variations...utiliz[ing] multiple wells.” 28:22-23.
[18.2]/[28.2]- “wherein step (c) comprises opening the fourth valve associated with the fourth well to	<i>Ciezobka</i> 's “high-pressure fracturing pump provides a first total flow rate 220 to the first wellhead 202 and a second total flow rate 230 to the second wellhead 204.” “[B]oth valves 218 [and 219] are open allowing the third percentage of the flow rate to be provided to both of the wellheads.” 12:5-8. <i>Ciezobka</i> includes “variations [that] may utilize multiple

Claim	<i>Ciezobka</i>
permit pumping of fluid into the fourth well via the fourth valve; and”	wells.” 28:22-23.
[18.3]/[28.3]-“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 closing the fourth valve associated with the fourth well.”	<i>Ciezobka</i> discloses pumping fluid to multiple wellheads as part of a hydraulic fracturing operation and that valves associated with the wells, <i>e.g.</i> , valves 218, 219, can be opened and closed to allow or restrict a flow of fluid to one or more wellbore(s). 11:21-22; 12:7-8; 28:22-23.

Applying *Ciezobka*’s teachings to swapping fracturing between third and fourth wells using associated third and fourth valves in a multi-well system would have involved performing the same function in the same manner with predictable results. Ex. 1041, ¶¶ 259-271, 286-290. Thus, Claims 15/25’s limitations repeated with third and fourth wells/valves in Claims 18/28 have no patentable significance. *See, e.g., Perfect Web*, 587 F.3d at 1330.

Claim 18 is anticipated by and 18 and 28 are obvious over *Ciezobka*.

8. Claims 31 and 36

Claims 31(25) and 36(15) are identical. *Ciezobka* discloses these limitations.

Claim	<i>Ciezobka</i>
[31]/[36]-“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 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.”	<i>Ciezobka</i> discloses the measured flowrate from Limitation 15.3/25.5 having satisfied flowrate condition(s) of Limitations 15.6/25.8 when the measured flowrate is below an upper flowrate, above a lower flowrate, or both (Limitation 31.1/36.1) for at least the same reasons discussed for Limitation 1.3. Ex. 1041, ¶¶ 291-293. <i>Ciezobka</i> discloses the parameters of variable rate fracturing are “select[ed] and design[ed]...including, for example... parameters such as flow rate (e.g., magnitude of change and duration) as well as frequency (for example, such as measured...period of time between the endings of successive flow rate variations).” 15:18-21; <i>see also</i> 4:2-13; 4:26-31;12:13-20, Fig. 7. This limitation also merely recites that the measured flowrate from Limitation 15.3/25.5 has not satisfied Limitation 15.6/25.8’s flowrate condition(s) when the measured flowrate is above the upper flowrate threshold or below the lower flowrate threshold, <i>i.e.</i>, when the flowrate conditions of Limitation 31.1/36.1 are not met. For the same reasons <i>Ciezobka</i> discloses meeting the flowrate conditions of Limitations 31.1/36.1, the flowrate conditions in <i>Ciezobka</i> would not be met when the measured flowrate is outside the thresholds. Ex. 1041, ¶¶ 295-300.

Furthermore, a POSITA would have found it “obvious to apply the various flowrates, such as percentages or explicit flowrates, as thresholds [of *Ciezobka*]...to

determine that the pulse is performing as desired” when opening/closing respective valves to implement the flowrate pulse schedule. Ex. 1041, ¶ 294-297. This would be “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.” Ex. 1041, ¶ 294.

Ciezobka discloses, or at least renders obvious, Claims 31/36.

In sum, *Ciezobka* anticipates/renderers obvious all Challenged Claims. *Id.*, ¶ 123.

B. GROUND 3-CIEZOBKA AND MCNEEL RENDER OBVIOUS CLAIMS 6, 8-10, 13, 16-18, 25-28, AND 31

McNeel adds additional explicit disclosure regarding third and fourth wells, manifolds, zipper valves, and computerized control. Ex. 1041, ¶ 301. Similar to *Ciezobka*, *McNeel* discloses “multiple wells can be fractured simultaneously, or a treatment fluid can be flowed simultaneously to multiple wells” with fluid pumped through the central manifold. *McNeel*, ¶¶ [0005]-[0006], [0018], [0023]. As with *Ciezobka*, *McNeel* discloses that wells may 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” line to another connected well “are closed, or simultaneously at a lower rate, by opening the valves on both lines at the same time.” *Id.*, ¶ [0025]. *McNeel*’s manifolds “are controlled, coordinated, and monitored by a central control

system,” which may use “sensor data” to control, *e.g.*, pumping, based on, *e.g.*, flowrate. *Id.*, ¶ [0029].

McNeel discloses its methods/systems “for simultaneously treating multiple wells from a centralized location and simultaneously connecting multiple wells to a single manifold,” may “conserve labor, infrastructure, and environmental impact.” *Id.*, ¶ [0001]. Thus, it would have been obvious to a POSITA to use *McNeel*’s manifolds and control systems with *Ciezobka*’s hydraulic fracturing systems/methods to improve *Ciezobka*’s similar systems/methods in the same way. Ex. 1041, ¶¶ 302-308. Further, because *McNeel* and *Ciezobka* both relate to systems/methods for hydraulically fracturing one or more wells using hydraulic fracturing fluid pumped through common manifolds, a POSITA would have had a reasonable expectation of success in combining *McNeel*’s teachings with *Ciezobka*’s systems/methods to yield the predictable results of improved control/performance of fracturing multiple wells (*e.g.*, two to four or more wells) from a common manifold. *Id.*

1. Claims 8 and 25

Claims 8 and 25 differ from Claims 1 and 15 only in that Claims 8 and 25 are apparatus claims including Limitations 8.1-8.2/25.2-25.3 (boilerplate computer language) that perform the methods of Claims 1 and 15. *See* Ex. 1041, ¶¶ 309-313, 342-345. *McNeel*’s computer system controls valves to adjust/control well-system

fluid flow (*McNeel*, [0025], [0029]) and can execute *Ciezobka*'s steps. *Id.*

As discussed in Section IX.A.1, *Ciezobka* discloses “[AI] tools”/“software toolbox,” which a POSITA would have understood to include a typical computer system with processor(s) executing instructions stored on non-transitory computer readable medium, and that a POSITA would have found obvious to use to operate *Ciezobka*'s fracturing systems/methods. *Ciezobka* 27:30-28:2; 4:30-31; 9:28-31; 28:22-26; Ex. 1041, ¶¶ 311, 344.

McNeel discloses operations of a hydraulic fracturing system “are controlled, coordinated and monitored by a central control system.” *McNeel*, ¶ [0029]. “The central control system may use all of the “sensor data” to control pumping, based on, *e.g.*, flowrate. *Id.*

A POSITA would have understood *McNeel*'s “central control system” would necessarily include conventional computer system elements such as processor(s) able to execute instructions stored on non-transitory computer readable medium to “control[], coordinate[], and monitor[]” the hydraulic fracturing system. Ex. 1041, ¶ 311. Additionally, and/or alternatively, it would have been obvious to a POSITA to use *Ciezobka*'s “software toolbox”/AI tools in *McNeel*'s “central control system” to determine and execute optimized rate fluctuation schedules in the fracturing systems/methods, as taught in *Ciezobka*. *Ciezobka*, 27:11-15, 27:26-28:2; Ex. 1041, ¶ 311. “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 of the ’779 Patent (2021).” *McNeel*, [0025]; Ex. 1041, ¶¶ 311, 344.

Ciezobka in view of *McNeel* therefore renders obvious Claims 8 and 25. Ex. 1041, ¶¶ 313, 345.

2. Claims 9(8), 10(8), 31(25)

As discussed in Section IX.A.1, *Ciezobka* discloses these claims’ limitations. Regarding Claim 9, *McNeel* also discloses a hydraulic manifold for continuously pumping. Because these claims depend from Claims 8 and 25, they are obvious over *Ciezobka* and *McNeel* for the same reasons discussed in Section IX.B.1. Ex. 1041, ¶¶ 313-316, 355-362.

3. Claims 6(1), 13(8)

Dependent Claims 6(1) and 13(8) are also obvious over *Ciezobka* in view of *McNeel*. As discussed above in Section IX.A.1, *Ciezobka* discloses “zipper valves” for the same reasons *Ciezobka* discloses the claimed first and second valves.

Additionally, similar to *Ciezobka*, *McNeel* discloses “central manifolds” that receive pressurized fluid from a pump through input(s) and selectively distribute the pressurized fluid to multiple wells (*e.g.*, first-fourth wells) via flowlines through the manifold by opening/closing valves along each line to an associated well. *McNeel*, ¶ [0026]. For example, *McNeel*’s Figure 2 shows a central manifold 107 fluidly

connects pumps to multiple wells:

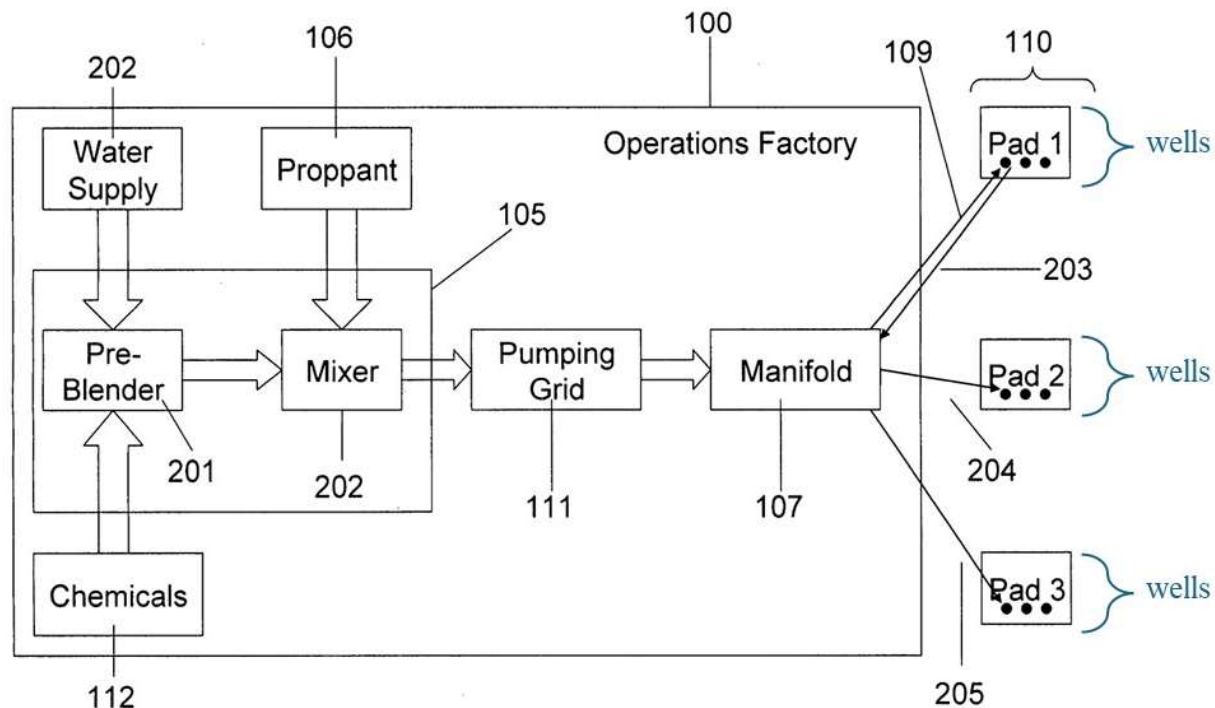
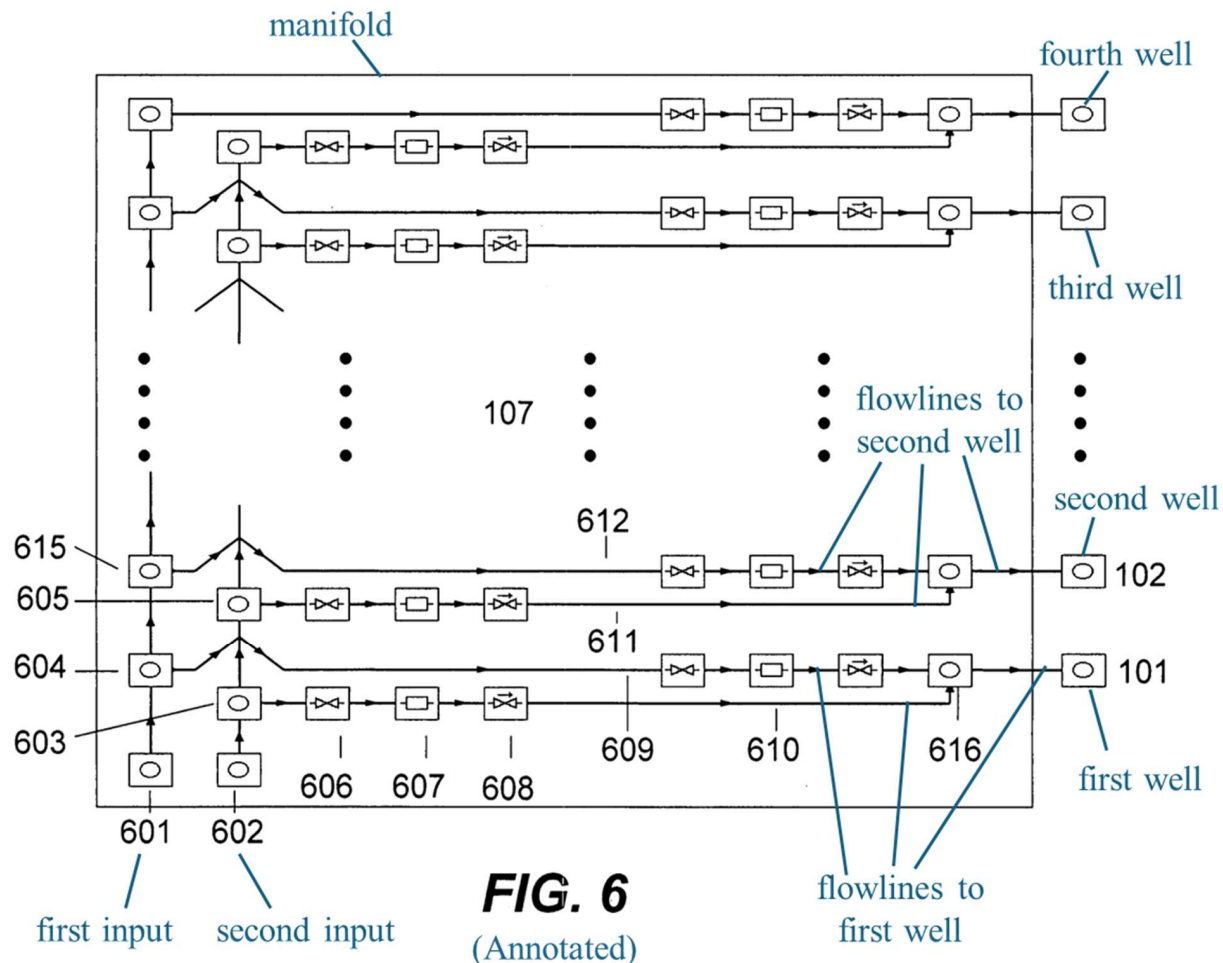


FIG. 2
(Annotated)

Figure 6 shows an example of the central manifold configuration, including lines 609-612 fluidly connecting inputs to multiple wells, where valves 606, 608 along the flowlines are opened/closed to selectively deliver fluid from one or both inputs to one or more of the wells (*McNeel*, ¶ [0026]):



Thus, *McNeel*'s manifolds and associated valves perform the same function in the same manner as the zipper manifolds/valves described in '779 and are therefore equivalent. Ex. 1041, ¶¶ 314-316.

A POSITA would have considered using *McNeel*'s manifolds in *Ciezobka*'s systems/methods as simply substituting one known element for another. Ex. 1041, ¶ 316. Additionally, a POSITA would have found it obvious to use *McNeel*'s manifolds in *Ciezobka*'s multi-well system to control and provide fluid flow to

selected wells, as doing so would merely amount to combining prior art elements according to known methods to yield predictable results. *Id.*

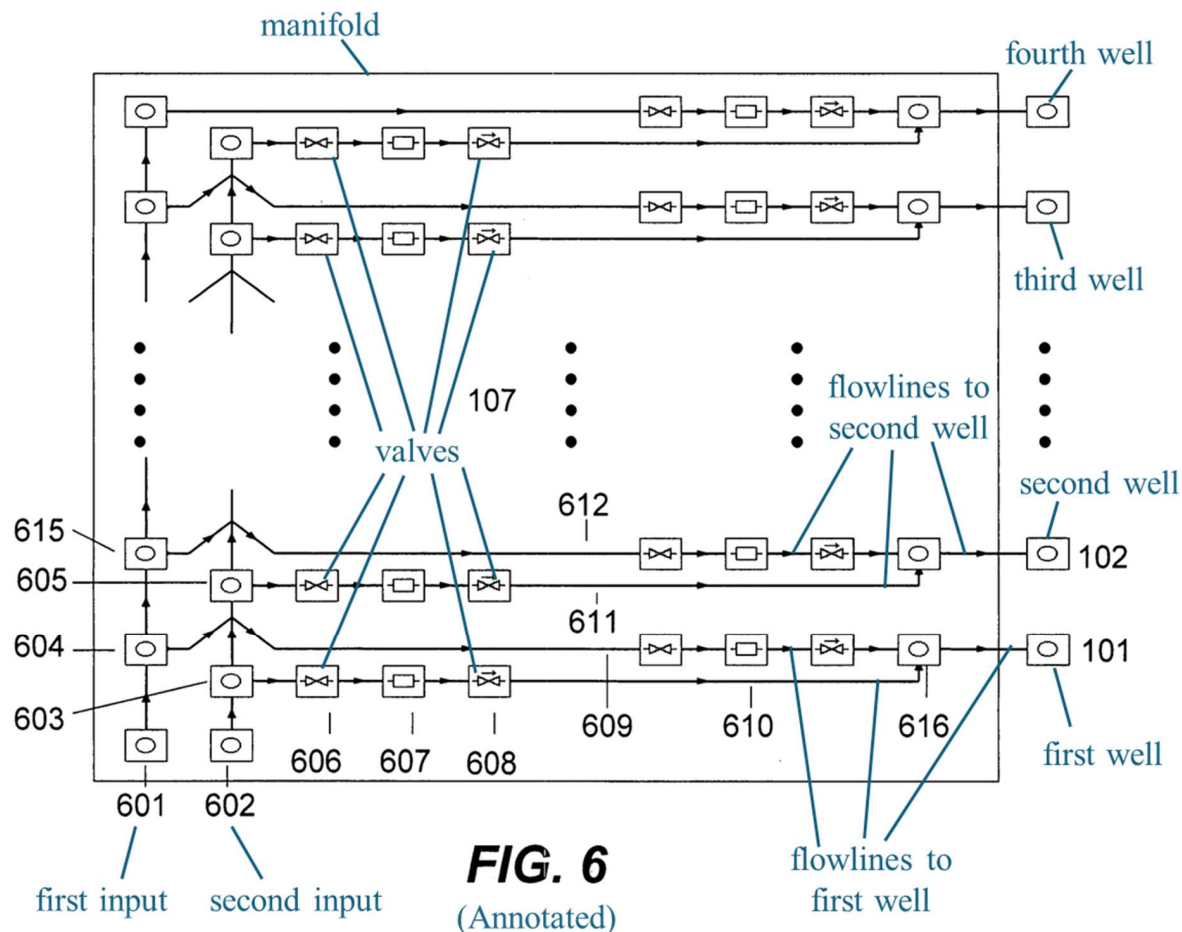
Therefore, *Ciezobka* in view of *McNeel* render Claims 6/13 obvious.

4. Claims 16-18, 26-28

These claims recite already-analyzed limitations (Claims 15 and 25) that are likewise applied to third and fourth valves/wells from a hydraulic manifold, and that are simultaneously hydraulically fractured with another well. As discussed above in Section IX.A.1, *Ciezobka* discloses/renders obvious these limitations. *Ciezobka* in view of *McNeel* also render these claims obvious, as discussed below.

Ciezobka discloses swapping from permitting hydraulic fracturing of one well to another and using similar variations on multiple wells. *See* Section IX.A.1 (Claims 15/25), *see also Ciezobka*, 3:29-4:2; 11:24-12:15; 28:22-23.

McNeel discloses pumping fracturing fluid from a manifold to multiple wells, including at least four wells, at higher and lower rates by opening/closing well-associated valves. *McNeel*, ¶¶ [0025]-[0026]. Additionally, in *McNeel*'s Figure 6 manifold, two flowlines are fluidly connected to each well, including first-fourth wells, where valves along each of the two flowlines may be opened/closed to provide fluid flow and/or no flow from multiple inputs to each well. *McNeel*, ¶ [0026].



McNeel further discloses its manifolds/systems “can be adapted for multiple uses,” e.g., “multiple well sites may be treated, produced, or treated and produced sequentially or simultaneously from a single central location.” *McNeel*, ¶ [0031]; Ex. 1041, ¶¶ 317-320. A central manifold may connect to pumps and operate to fracture multiple wells at different pads simultaneously; each pad may include multiple wells. *Id.*, ¶¶ [0018], [0023]; Ex. 1041, ¶ 320. *McNeel* also discloses that a central manifold “can be connected to one or more additional manifolds 405,”

where the “additional manifolds are operable to connect to multiple well locations 401-404.” *Id.*, ¶ [0024].

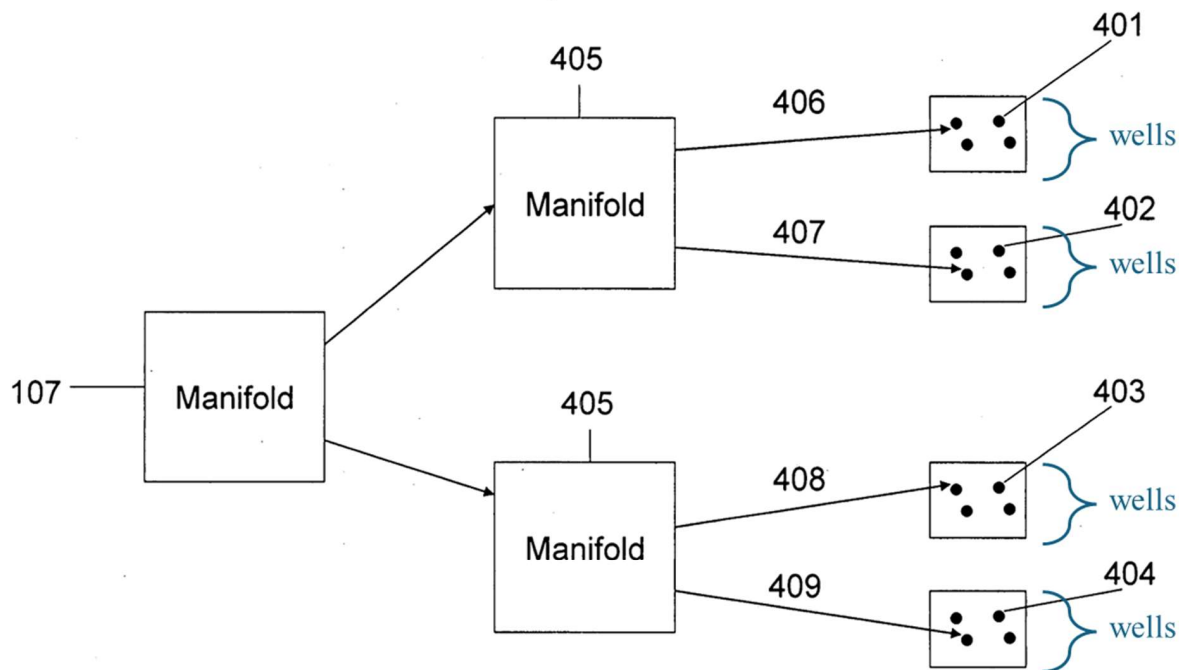


FIG. 4
(Annotated)

It would have been obvious to a POSITA to use *McNeel*’s manifold to selectively deliver higher/lower rates of fluid flow to multiple wells, including first-fourth wells in *Ciezobka*’s systems according to *Ciezobka*’s methods for delivering fluid flow pulses to and swapping between multiple wells (including four wells), as Claims 16, 18, 26, and 28 recite. Ex. 1041, ¶¶ 321-324, 331-341, 346-348, 351-354. Applying *Ciezobka*’s teachings to third and fourth wells and their associated valves in a multi-well system using *McNeel*’s systems/methods for selectively delivering

fluid to first-fourth wells would have involved performing the same function in the same manner with predictable results. *Id.* Moreover, mere repetition of elements has no patentable significance unless a new and unexpected result is produced. *See, e.g., Perfect Web*, 587 F.3d at 1330.

Further, it would have been obvious to a POSITA to merely combine known elements according to known methods to yield predictable results by connecting *McNeel*'s central manifold to *Ciezobka*'s systems/methods (*e.g.*, replacing *Ciezobka*'s manifolds (*Ciezobka*, 3:16-18, 11:28-30)) to provide pressurized fluid flow to simultaneously fracture multiple connected wells, as taught in *McNeel*. Ex. 1041, ¶¶ 317-324.

It also would have been obvious to a POSITA, in view of *Ciezobka*'s disclosure that its fracturing processes can have “similar variations” using “multiple wells” (28:22-23), to fracture third and fourth wells simultaneously using fracturing fluid pumped via a central manifold, as *McNeel* discloses, and to swap between hydraulically fracturing the second/first wells and fourth/third wells (*e.g.*, via *Ciezobka*'s pulses) simultaneously using the fracturing fluid from the central manifold to perform Claims 17 and 27's methods. Ex. 1041, ¶¶ 325-330, 349-350. Doing so would have involved performing the same function in the same manner as disclosed with *Ciezobka*'s first and second wells with predictable results. *Id.*

Claims 16-18 and 26-28 are therefore also obvious over *Ciezobka* in view of *McNeel*.

Claims 1-3, 15, and 36 are not addressed with respect to *McNeel* because all limitations are explicitly disclosed/rendered obvious by *Ciezobka* alone. However, these claims are also obvious over *Ciezobka* and *McNeel* for the reasons and rationale above. Ex. 1041, ¶¶ 363-364.

C. GROUND 4-BEUTERBAUGH AND JACKSON RENDER OBVIOUS ALL CHALLENGED CLAIMS

Beuterbaugh discloses fracking multiple wells by alternately opening and closing valves to the wells using switching and plug valves to divert high-pressure fracturing fluid from one well to the other. *Beuterbaugh*, Abstract, [0018], [0022], [0027]. *Beuterbaugh's* system provides control over fracturing operations and allows effective use of surface equipment to treat multiple wells. *Id.*, [0015], [0022]. For example, “[t]he overlap of fluid flows to each well” in the multi-well system “can be controlled to optimize the downhole pressure waves and minimize the surface impacts.” *Id.*, [0024]. Further, *Beuterbaugh* discloses diverting the fracturing fluid to multiple wells in “pulses” to “create or enhance fractures in a rock formation.” *Id.*, [0003]. The fluid is injected for a time to create the pulse, where the “total flow rate from the...pumps...determine the pulse size of the fracturing fluid that are selectively diverted to the...wells.” *Id.*, [0018], [0022].

Jackson also discloses controlling fracturing fluid injection into a well to provide “a greater degree of fracturing and/or connecting the fractures.” *Jackson*, [0044]-[0045]. Fracturing fluid is injected in “pulses” of varying flowrates, pressures, and/or durations, defined according to thresholds, to improve fracturing. *Id.*, [0052]-[0053], [0060], [0067].

It would have been obvious to a POSITA to combine *Jackson* and *Beuterbaugh*’s teachings, as they are in the same field of endeavor (as is ’779) and directed to solving the same problem of controlling and improving fracturing operations. Ex. 1041, ¶¶ 365-367. Further, a POSITA would have found it obvious to include *Jackson*’s measuring flowrate and using flowrate thresholds as part of *Beuterbaugh*’s systems/methods, for example, to indicate fracturing stage status and determine next operational steps. *Id.*, ¶¶ 365, 366-370.

1. Independent Claim 1

Beuterbaugh in view of *Jackson* render Claim 1 obvious.

Limitation [1.1]

Beuterbaugh discloses systems/methods “for hydraulic fracturing a plurality of wells,” including a first well. *Beuterbaugh*, [0030]. In *Beuterbaugh*’s Figure 2, a fracturing system includes high-pressure pumps connected to wells “for conveying hydraulic fracturing fluid to the wells.” *Id.*, [0016]-[0017]. “[S]witching valves

150a, 150b alternatively redirect the fracturing fluid received...from the... pumps...from one wellhead...to another wellhead.” *Id.*, [0018]-[0019].

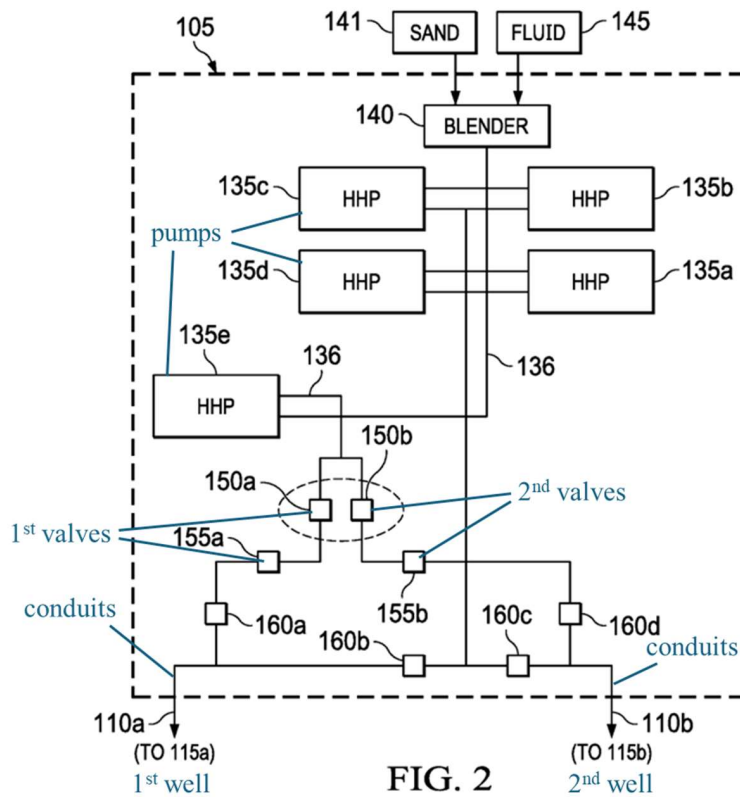


FIG. 2
(Annotated)

Beuterbaugh discloses that first plug and switching valves are “opened...permitting the fracturing fluid to flow to a first wellhead 115a associated with a first well.” *Id.*, [0021], [0026]; *see also* Ex. 1041, ¶¶ 371-378.

Thus, *Beuterbaugh* discloses Limitation 1.1.

Limitation [1.2]

In *Beuterbaugh* the pumps’ total flowrate can determine the pulse size of fracturing fluid selectively diverted to a well. *Beuterbaugh*, [0018]. Additionally,

because “a positive waterhammer wave going to [a] first well is created while a rarefaction wave is created in [a] second well” when switching from flowing fluid into the second well to flowing fluid into the first well “due to the sudden drop in the flow rate to the second well,” the “overlap of fluid flows to each well...can be controlled to optimize the downhole pressure waves and minimize the surface impacts.” *Id.*, [0024]. Thus, *Beuterbaugh* considers knowledge of flowrate. Ex. 1041, ¶ 379.

It would have been obvious to a POSITA to measure flowrate of fluid being pumped into a well, as *Jackson* discloses, to monitor and control the pulse size of fracturing fluid, as *Beuterbaugh* discloses.

Prior to '779, flowrate was a well-known parameter to measure and monitor during fracturing operations, as taught by *Jackson*. In *Jackson*, flowrate is measured to assess if thresholds are met for a fracturing process. *Jackson*, [0019]. *Jackson* discloses “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.” *Id.*, [0003]. “[A]fter reaching the third threshold and prior to ceasing flow, further thresholds may be reached by adjustment of fracturing fluid flow.” *Id.*, [0003]. *Jackson* discloses flowrate thresholds. *Id.*, [0017]. *Jackson* discloses various injection equipment and systems were known and

used to supply fracking fluid to a wellbore, including “flow meters for the frac[k]ing fluid and proppant.” *Id.*, [0048].

It would have been obvious, based on a POSITA’s general engineering knowledge, “to combine *Jackson* and *Beuterbaugh* to measure flowrate of fluid being pumped into a well to monitor/control a fracturing process because *Jackson* teaches process parameters including flowrate were commonly observed to assess a fracturing process.” Ex. 1041, ¶¶ 380-381.

Limitation [1.3]

Beuterbaugh considers knowledge of flowrate for determining fracturing fluid pulse size, optimization of downhole pressure wave, and minimization of surface impacts. *Beuterbaugh*, [0018], [0024].

Jackson discloses flowrate as a known parameter to measure/monitor during fracturing operations. *Jackson*, [0019]. *Jackson* also discloses that it was known to determine if a measured flowrate was below a flowrate threshold to determine if a condition for an operation was met so the fracturing process could move to the next step. For example, *Jackson* describes fracturing processes that include supplying fracturing fluid into a well until a first threshold is reached and performing a series of steps of adjusting the flow of the fracturing fluid to reach subsequent thresholds. *Jackson*, Abstract. *Jackson* states that thresholds “may be defined by at least one...of: (a) a time period threshold; (b) a non-participating gas [fracturing fluid]

flow rate threshold;” and/or others, where process parameters such as flowrate and volume are observed to assess fracturing processes. *Id.*, [0017], [0019]. The threshold may be defined as a flowrate of less than a selected flowrate, such as during a period of pumping relaxation. *Id.*, [0061].

Thus, while *Beuterbaugh* broadly discloses monitoring/controlling fracturing operation parameters to selectively deliver fracturing fluid pulses to wells, *Jackson* gives more detailed guidance including monitoring flowrate to control fracturing according to flowrate thresholds. A POSITA would have considered using *Jackson*’s systems/methods for measuring/monitoring flowrate according to flowrate thresholds as a simple complement to *Beuterbaugh*’s fracturing systems/methods for directing fracturing fluid pulses with a selected pulse size to wells in a multi-well system. Ex. 1041, ¶¶ 382-385.

Limitation [1.4]

Beuterbaugh and *Jackson* consider time/duration for fracturing fluid injections into a well and, therefore, disclose/render obvious Limitation 1.4.

Beuterbaugh discloses generally that a pulse’s “time duration” may be selected for each well in multi-well systems. *Beuterbaugh*, [0022]. *Jackson* uses selected flowrate thresholds with selected time thresholds to indicate different stages in a frac cycle and trigger the next fracturing operation stage. *Jackson*, [0017]-[0019]. For example, a frac cycle “relaxation stage” may be defined by flowrate

being less than 300 scm⁷ (flowrate threshold) for 1 minute to 24 hours (time period threshold). *Id.*, [0005], [0061].

A POSITA would have found obvious to include *Jackson*'s threshold teachings in *Beuterbaugh*'s methods/systems, including using *Jackson*'s disclosure of a measured flowrate below a flowrate threshold for a threshold amount of time indicating a stage of a fracturing process, to improve *Beuterbaugh*'s control of fracturing operations. Ex. 1041, ¶¶ 386-387.

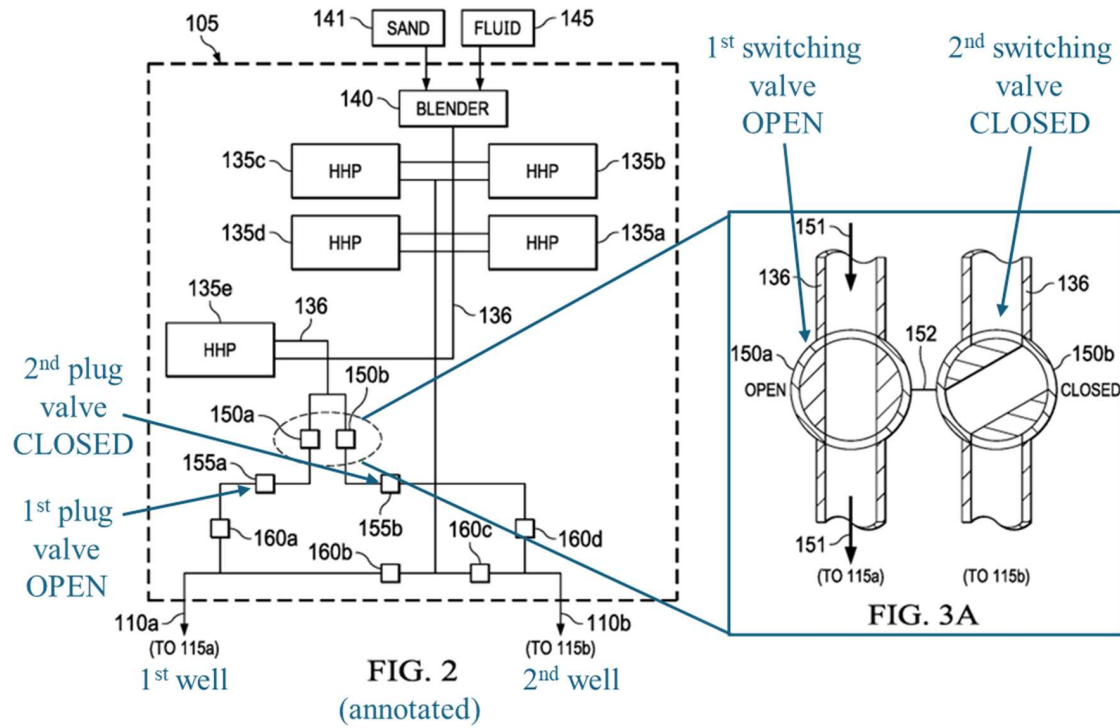
Limitation [1.5]

Beuterbaugh discloses methods for treating multiple wells that include pumping “fracturing fluid to one or more switching valves and repeatedly opening and closing the...switching valves to divert the fracturing fluid...from one well to the other well...for fracturing subterranean formations.” *Beuterbaugh*, Abstract. As shown in Figures 2-3B, while fracturing fluid is being constantly pumped to each well's associated valves, *Beuterbaugh*'s valve sequencing includes:

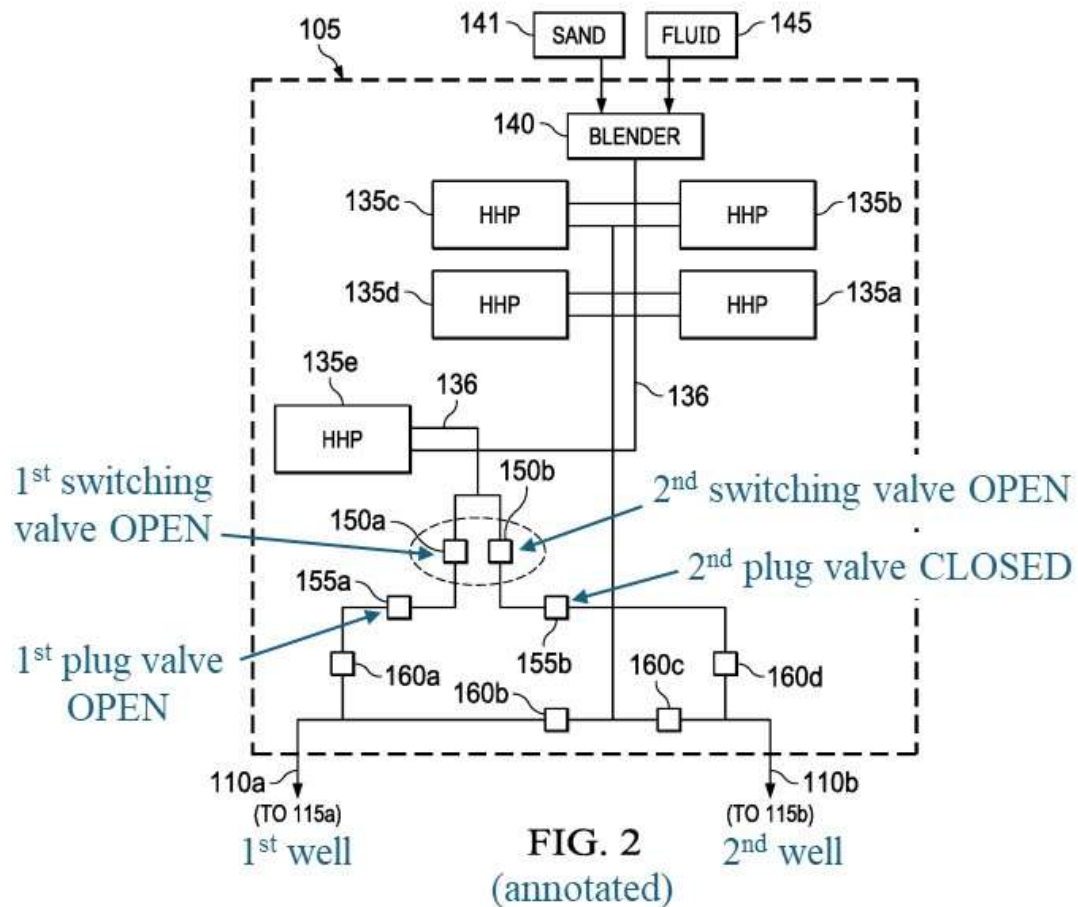
- 1) “as a first state, opening [first] switching valve 150a and [first] plug valve 155a such that the flow rate of the fracturing fluid...is directed to the first wellhead 115a, delivering a pulse, while [second] switching valve 150b

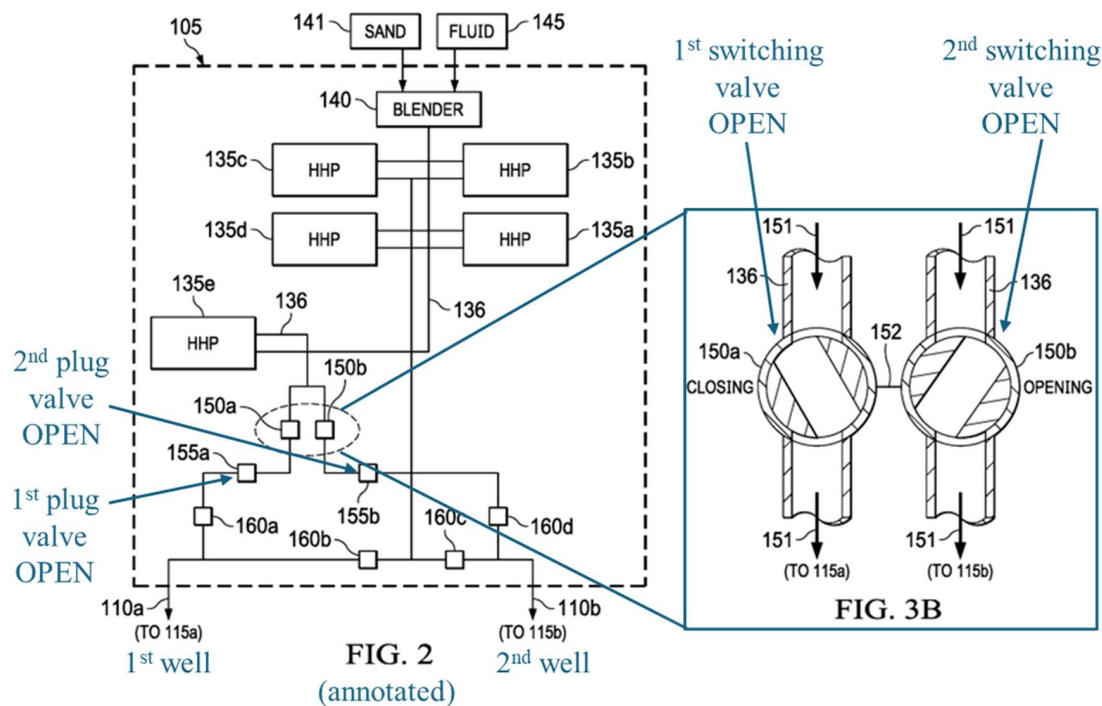
⁷ (standard cubic meters/minute)

and associated [second] plug valve [155b] are closed preventing fluid flow
 151 to the second wellhead 115b.” *Id.*, [0021], [0030].



- 2) “Next...[second] plug valve 155b downstream of the [second] switching valve 150b” is opened; then second “switching valve 150b is opened (*Id.*):





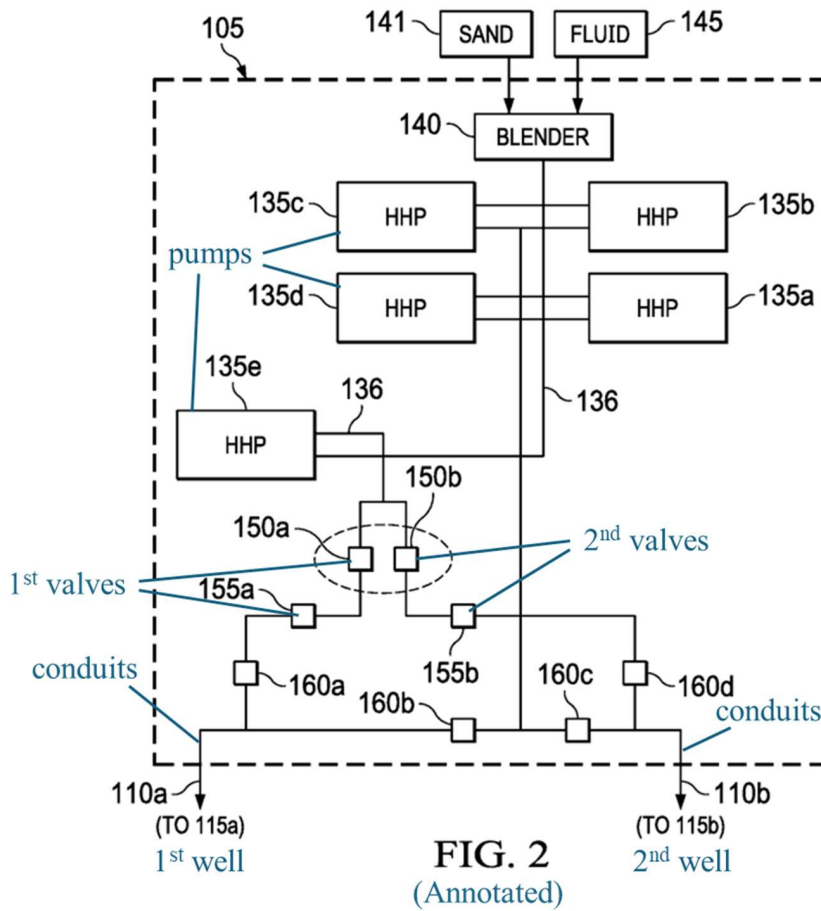
Thus, *Beuterbaugh* discloses hydraulic fracturing methods for multiple wells that include valve sequencing where a second valve to a second well (*e.g.*, second plug and/or switching valve) is open while fluid is pumped into a first well via a first valve (*e.g.*, first plug and switching valves). *See also* Ex. 1041, ¶¶ 388-390.

Beuterbaugh discloses Limitation 1.5.

Limitation [1.6]

Beuterbaugh discloses hydraulically fracturing first and second wells. *Beuterbaugh*, [0016]-[0017]. Figure 2 shows a fracturing system with pumps connected to first and second wells for “conveying hydraulic fracturing fluid to the wells.” *Id.*, [0016]-[0017]. “[S]witching valves 150a, 150b alternatively redirect

the fracturing fluid received... from the... pumps” from the first well to the second well. *Id.*, [0018]-[0019].

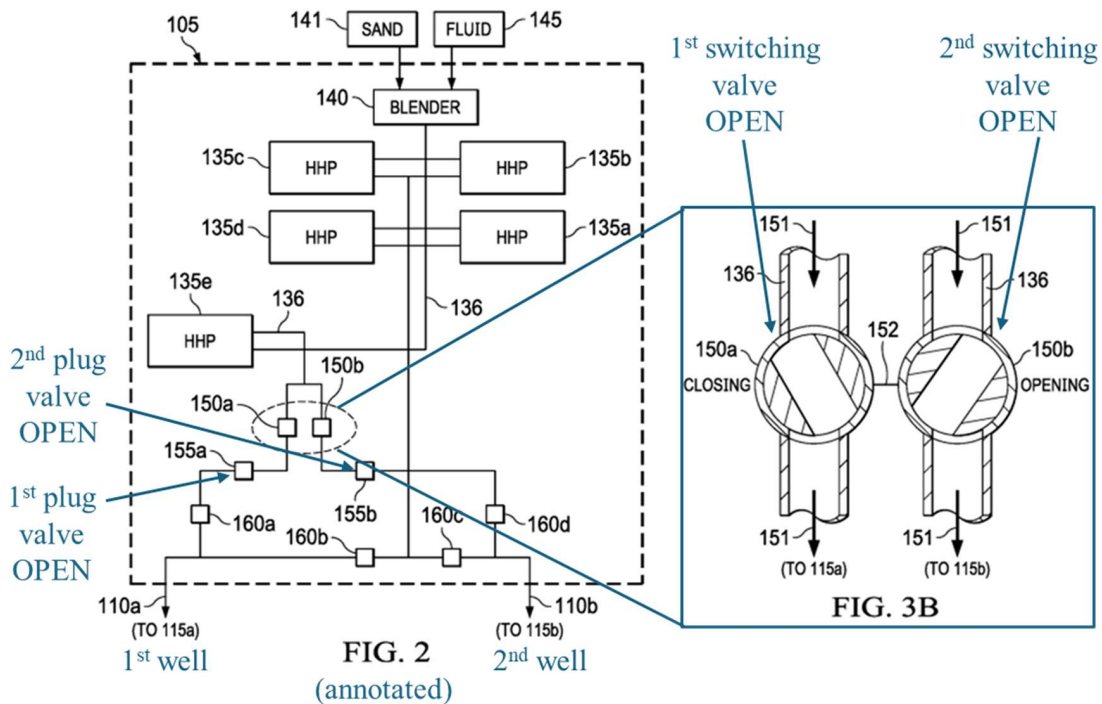


Beuterbaugh discloses “a pulse of fluid flow...is directed to the second wellhead 115b by first opening the [second] plug valve 155b downstream of [second] switching valve 150b, then [second] switching valve 150b is opened...initiating a pulse down [the second] well.” *Id.*, [0021]; *see also* Ex. 1041, ¶¶ 391-393.

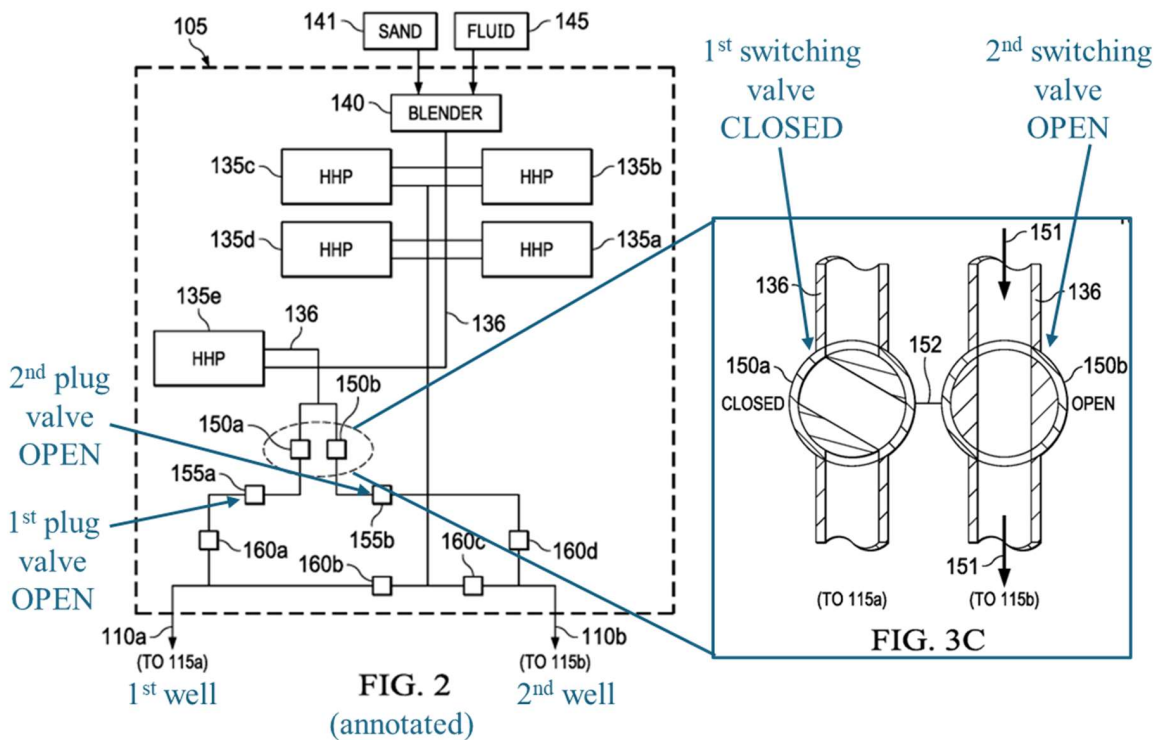
Thus, *Beuterbaugh* discloses Limitation 1.6.

Limitation [1.7]

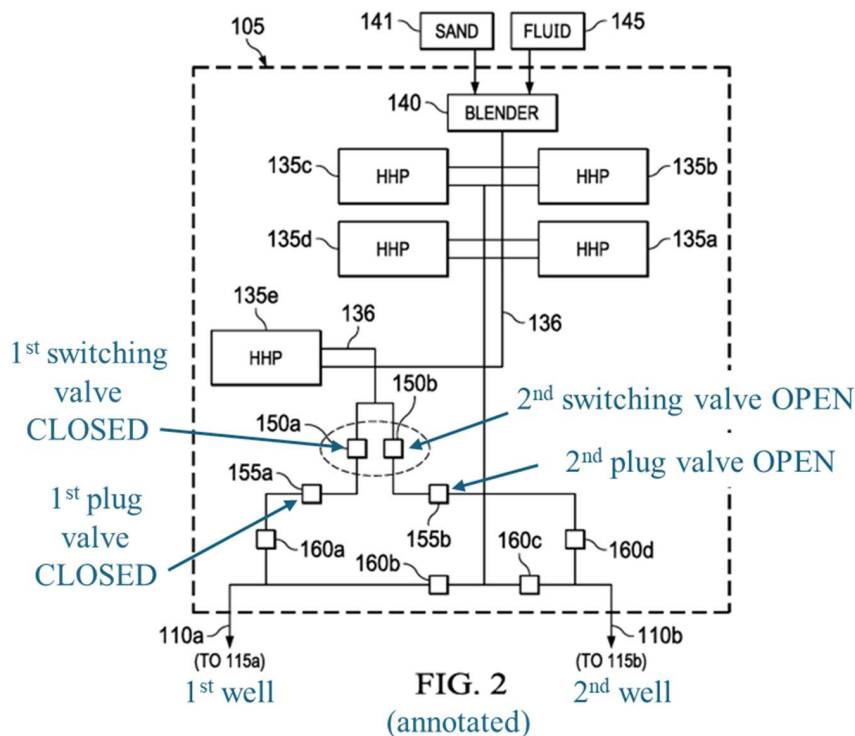
Beuterbaugh discloses “fluid flow 151 is directed to the second wellhead...by first opening the [second] plug valve” to the second well, and then opening the second switching valve to the second well while closing the first switching valve to the first well. *Beuterbaugh*, [0021].



After the second “switching valve...is fully opened and [the first] switching valve...is fully closed,” a pulse is initiated in the second well. *Id.*



While directing the fluid pulse into the second well, and after closing the first switching valve, the first plug valve, downstream of first switching valve, is also closed. *Id.*



Thus, *Beuterbaugh* discloses closing a first valve to a first well (e.g., first plug and/or switching valve) while pumping fluid into a second well via a second valve (e.g., second plug and switching valves). *See also* Ex. 1041, ¶¶ 394-395.

Beuterbaugh discloses Limitation 1.7.

Limitation [1.8]

Beuterbaugh discloses methods of “hydraulic fracturing a plurality of wells” that include “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.” *Beuterbaugh*,

[0043]. For example, pumps “run at a constant rate to provide a substantially constant pressure of...fracturing fluid to the...switching valves” as the valves are opened/closed to alternately redirect the fracturing fluid to a selected well. *Id.*, Abstract, [0018]-[0019]. “A POSITA would have recognized this to mean that the fluid is pumped continuously to the switching valves.” Ex. 1041, ¶¶ 396-397. Fig. 5 illustrates this operation:

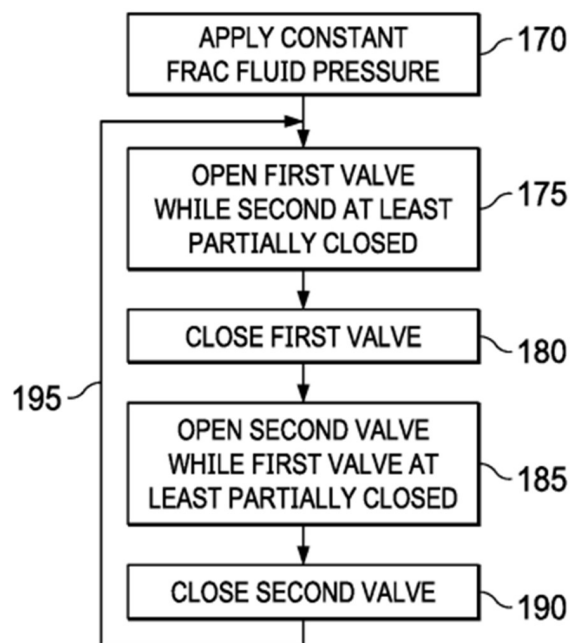


FIG. 5

Thus, *Beuterbaugh* discloses Limitation 1.8.

In sum, *Beuterbaugh* discloses every limitation in Claim 1 except for explicitly determining a measured flowrate into the first well is below a flowrate threshold for a threshold amount of time. However, *Jackson* shows monitoring and controlling fracturing operations using flowrate thresholds was not an inventive

concept. Instead, a POSITA would have found it obvious to determine whether a flowrate into a well is below a flowrate threshold for a threshold amount of time, as taught by *Jackson*, in *Beuterbaugh*'s fracturing operation, because *Beuterbaugh* considers using flowrate as a parameter for controlling fracturing operations (*e.g.*, where the flowrate may be used when determining the pulse size of fracturing fluid diverted into each well) and *Jackson* uses flowrates to determine stages of fracturing operations. Ex. 1041, ¶¶ 366-370, 380-387, 398; *Beuterbaugh*, [0018].

Beuterbaugh in view of *Jackson* renders Claim 1 obvious.

2. Independent Claim 8

Claim 8 merely adds computer system limitations (8.1-8.2) to Claim 1's limitations.

Limitations [8.1]-[8.2]

Beuterbaugh discloses Limitations 8.1-8.2.

Beuterbaugh discloses controlling valves and other components in the system using “a computerized controller:”

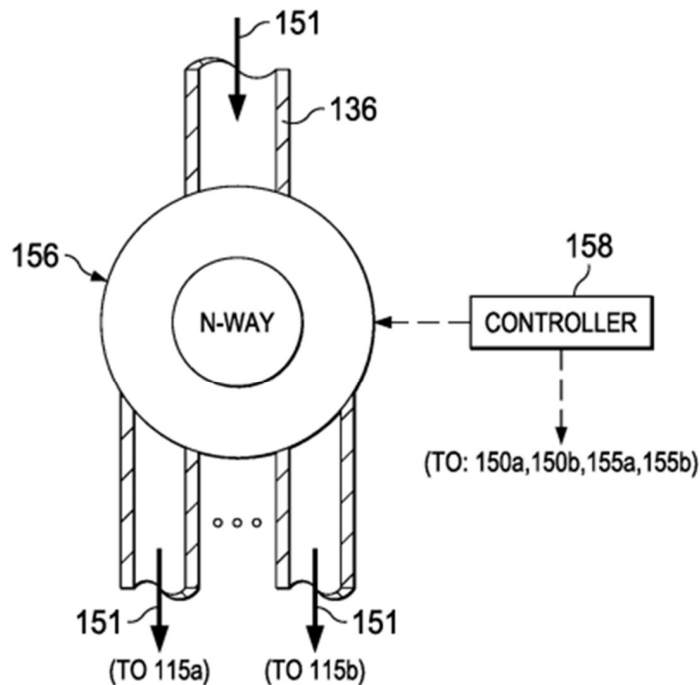


FIG. 4

Beuterbaugh, [0022], [0025].

Beuterbaugh's controller may “control any of the switching valves...and ...any...other components, including...plug valves...and the high pressure pumps.”

Id., [0025]. “The controller...may comprise a computer processor connected by a bus to a memory,” where the memory includes “a software program for performing the control and operational sequencing of the components, including the sequencing of opening and closing the...valves.” *Id.*; *see also* Ex. 1041, ¶¶ 415-418.

A POSITA would have immediately understood “the generic term ‘memory’ connected by a bus to a computer processor and which contains a software program to be a ‘non-transitory computer readable medium,’” and that the “software program” was a plurality of instructions executable by the processor to execute Claim 8’s steps. Ex. 1041, ¶¶ 419-428. Further, it was well-known to use such computer systems for controlling equipment, including fracturing system equipment, even before *Beuterbaugh*’s filing date in 2019. *Id.*

Beuterbaugh discloses Limitations 8.1-8.2.

Limitations [8.3]-[8.10]

Limitations 8.3-8.10 and 1.1-1.8 are identical and are, therefore, disclosed/taught/suggested for the same reasons discussed with 1.1-1.8, and it would have been obvious to use *Beuterbaugh*’s computerized controller to execute Claim 8’s steps to control *Beuterbaugh*’s fracturing process. Ex. 1041, ¶¶ 429-430.

Therefore, *Beuterbaugh* in view of *Jackson* render Claim 8 obvious.

3. Claims 2 and 9

Beuterbaugh discloses that manifolds were known as part of surface equipment used with hydraulic fracturing systems. *Beuterbaugh*, [0004]. Additionally, *Beuterbaugh*'s methods of "alternating operation between a plurality of wells leads to multi-well pulsed completions and more effective use of blender, pumps, manifolds and the like at the surface." *Id.*, [0015].

Figure 1 shows "a generalized schematic view of a plurality of wells...along with associated wellheads...connected to surface fracturing equipment," which would include known surface equipment manifold(s), where the "surface equipment...may be interconnected to the wellheads...using corresponding conduits...for conveying hydraulic fracturing fluid to the wells:"

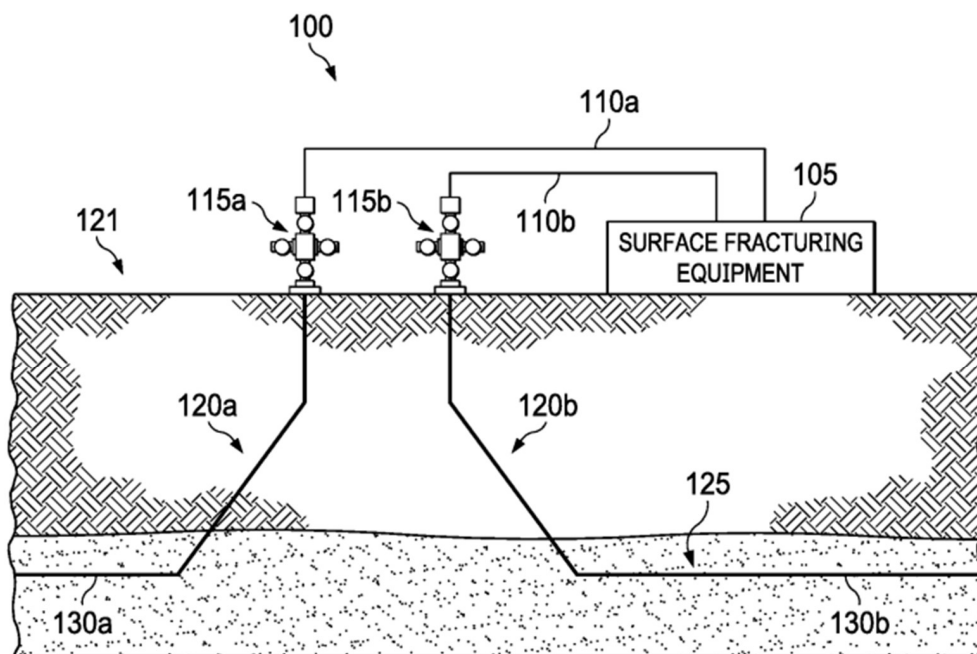
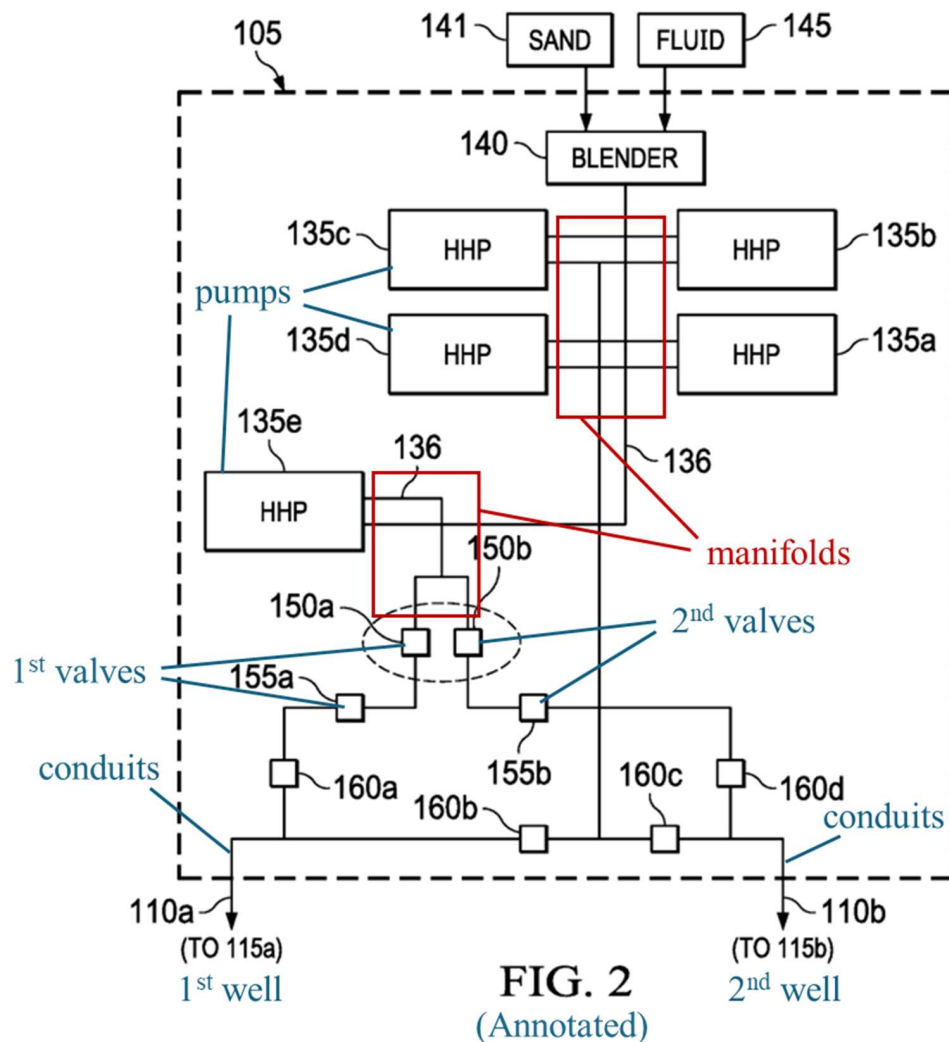


FIG. 1

Id., [0016].

Figure 2 further shows more detail of Figure 1's surface fracturing equipment
105. *Id.*, [0018].



In view of *Beuterbaugh*'s disclosure, a POSITA would have easily recognized either of the annotated groupings of conduits in Annotated Figure 2 to be

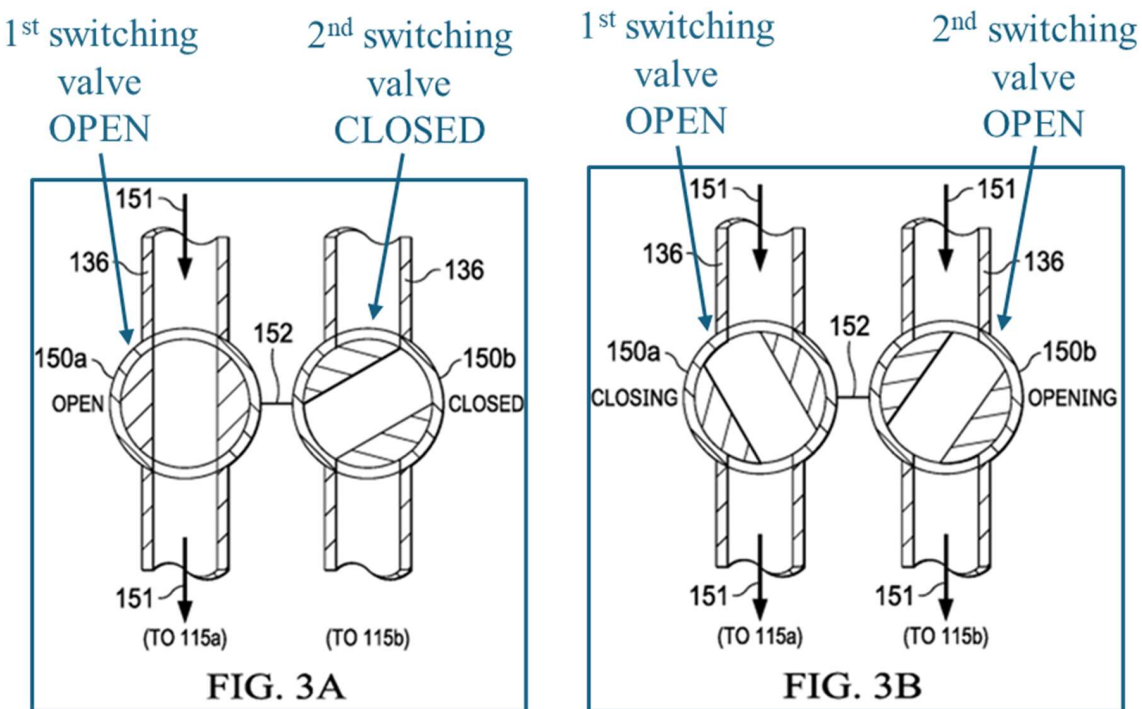
representative of the manifolds that *Beuterbaugh* discloses were common with surface fracturing equipment. Ex. 1041, ¶¶ 399-402, 431.

Thus, in addition to the limitations disclosed by *Beuterbaugh* and *Jackson* in Claims 1/8, *Beuterbaugh* discloses limitations 2.1-2.2/9.1-9.2. *Id.*

Claims 2 and 9 are therefore obvious over *Beuterbaugh* in view of *Jackson*.

4. Claims 3 and 10

Beuterbaugh discloses an alternating and overlapping valve sequence used to deliver fluid pulses with a determined pulse size (based on total flowrate from the pumps) to multiple wells. *Beuterbaugh*, [0018], [0048]. *Beuterbaugh*'s methods include opening valves to a first well "such that the flow rate of the fracturing fluid 151 from the...pumps...is directed to the first wellhead" to deliver a fluid pulse, while the valves to the second well "are closed preventing fluid flow 151 to the second wellhead...as shown in FIG. 3A." *Id.*, [0021]. "Next, as shown in FIG. 3B, a pulse of fluid flow 151 is directed to the second wellhead" by opening the valves to the second well. *Id.* Thus, *Beuterbaugh*'s Figures 3A-B show opening the second valve after a fluid pulse is delivered to the first well. *Id.*



Jackson teaches flowrate and time were known parameters operators monitored to determine next steps in fracturing operations, including time and flowrate thresholds. *Jackson*, [0017]. In an example, *Jackson* discloses a step in a fracturing operation defined by a flowrate threshold of less than 300 scm for a time threshold of 1 minute to 24 hours. *Id.*, [0061].

It would have been obvious to a POSITA to use *Jackson*'s methods of defining steps in a fracturing operation using an upper flowrate threshold and time threshold to define the fluid pulses in *Beuterbaugh* as "a simple substitution of one known technique for another to achieve predictable control of the fracturing operation." Ex. 1041, ¶¶ 403-408, 432.

Accordingly, it would have been obvious to determine, as an operational condition, that the flowrate of the fluid being pumped into the first well is below a flowrate threshold and has been below that threshold for a threshold amount of time, as taught by *Jackson*, prior to opening the second valve in a fracturing operation of *Beuterbaugh*, to provide a fluid pulse to the first well with a determined pulse size. *Beuterbaugh*, [0018]; Ex. 1041, ¶¶ 403-408, 432.

Claims 3 and 10 are therefore obvious over *Beuterbaugh* in view of *Jackson*.

5. Claims 6 and 13

Beuterbaugh discloses zipper valves. '779's claimed "zipper valves" do not require additional functionality or structure over the independent claims' first and second valves, and thus are disclosed by *Beuterbaugh* for at least the same reasons *Beuterbaugh* discloses the claimed first and second valves. Ex. 1041, ¶¶ 409-414, 433.

'779 merely describes "zipper valves" as standard valves (*e.g.*, gate valves) operably coupled to and adapted to communicate fluid to a well. '779, 7:58-61. *Beuterbaugh*'s switching valves perform the same function in the same manner, producing the same results—where *Beuterbaugh*'s switching valves are operably coupled to and adapted to communicate fluid to an associated well. *Beuterbaugh*, [0018]. Thus, *Beuterbaugh*'s switching valves are at least equivalent to the claimed zipper valves. *Id.*

Claims 6 and 13 are therefore also obvious over *Beuterbaugh* in view of *Jackson*.

6. Independent Claim 15

Limitation 15.1

Limitation 15.1 combines Limitations 1.1 and 1.6. Accordingly, *Beuterbaugh* discloses hydraulically fracturing first and second wells associated with first and second valves for the same reasons discussed above regarding Claim 1. *See* Section IX.C.1; Ex. 1041, ¶¶ 434-437.

Limitation 15.2

Limitation 15.2 combines Limitations 1.5 and 1.6. Accordingly, *Beuterbaugh* discloses opening a second valve associated with a second well to permit pumping of fluid into the second well via the second valve to permit hydraulic fracturing of the second well for the same reasons discussed above regarding Claim 1. *See* Section IX.C.1; Ex. 1041, ¶¶ 438-439.

Limitation 15.3

Limitations 15.3 and 1.2 are identical. Accordingly, *Beuterbaugh* and *Jackson* disclose/teach/suggest 15.3 for the same reasons as 1.2. *See* Section IX.C.1; Ex. 1041, ¶¶ 440-444.

Limitation 15.4

Beuterbaugh discloses swapping fracturing from a second to a first well by closing/opening their associated valves. *Beuterbaugh*, Abstract. For example, *Beuterbaugh*'s systems/methods "for treating a plurality of wells simultaneously include[] 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..." *Id.* The valves to a first well are opened to deliver a pulse of fracturing fluid into the first well while the valves to a second well are closed to prevent fluid flow to the second well. *Id.*, [0021]. The valve positions are then switched to allow a pulse of fluid flow directed into the second well for fracturing the second well and to prevent fluid flow into the first well. *Id.* "The process is then reversed" to switch from directing fracturing fluid into the second well to directing fracturing fluid into the first well. *Id.*

Thus, *Beuterbaugh* discloses Limitation 15.4. *See* Ex. 1041, ¶¶ 445-454.

Limitation 15.5

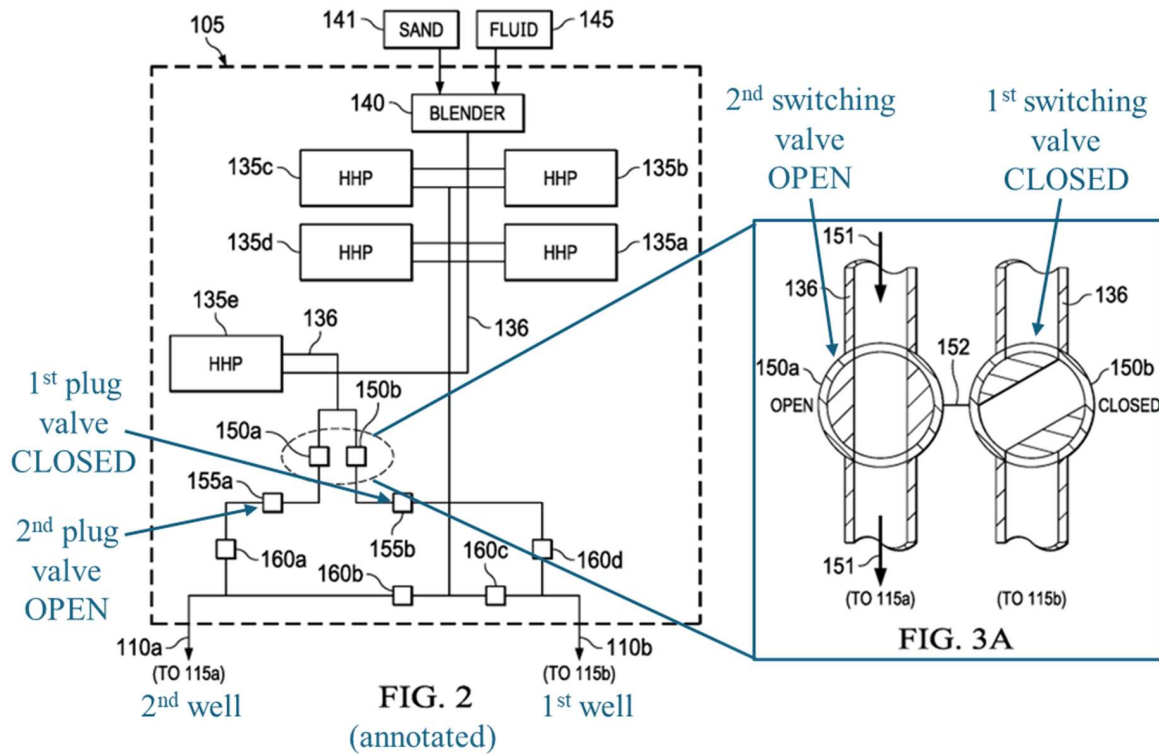
This limitation is substantially identical to Limitations 2.2/9.2 and is therefore obvious for the same reasons explained with Limitations 2.2/9.2. *See* Section IX.C.1; Ex. 1041, ¶¶ 455-457.

Limitation 15.6

Beuterbaugh discloses that selective flow to each well in a multi-well site may be controlled by opening and closing valves positioned along each well's flow conduits. *Beuterbaugh*, [0018]. Further, the fluid is directed between wells continuously by operating valves associated with wells to provide fluid to one well at a particular time/place, while simultaneously stopping the flow of fluid into another well that is in a different place in the frac cycle. *Id.*, [0021], Figs. 3A-C.

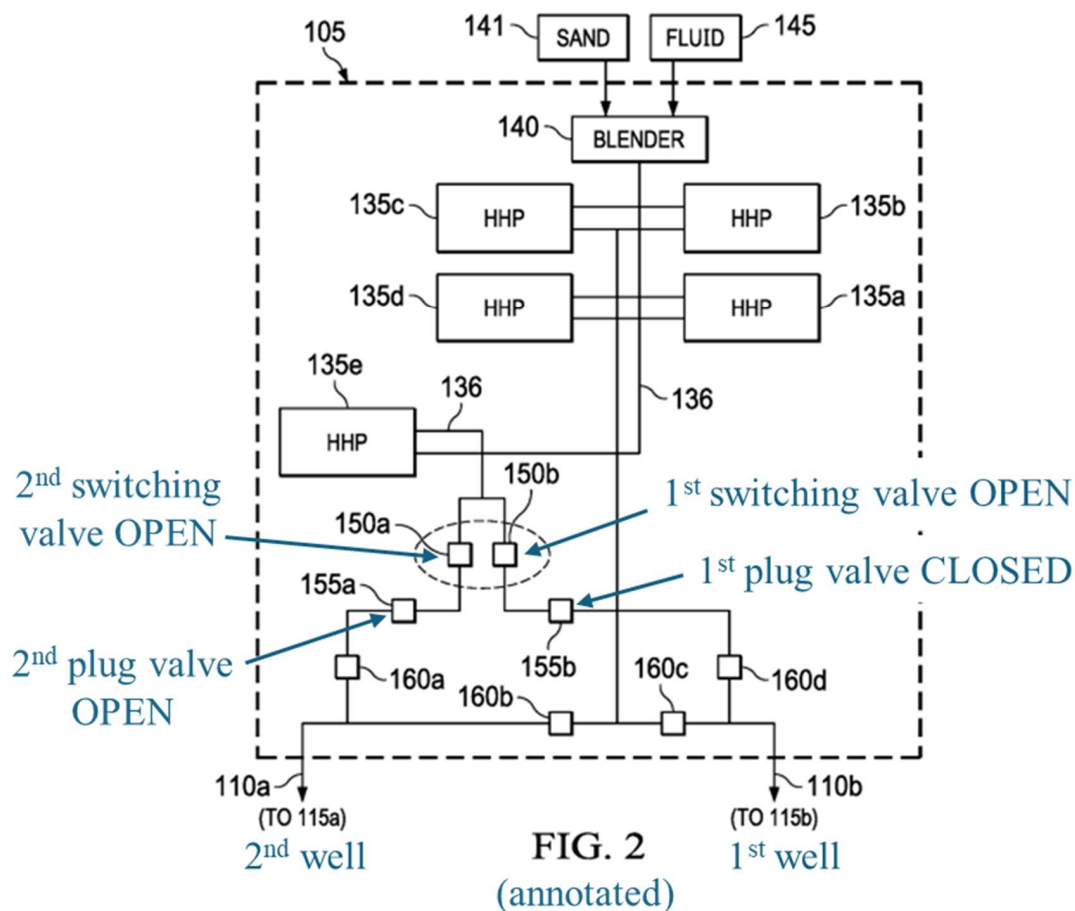
Beuterbaugh details a method for switching from fracturing a first well to fracturing a second well in Figures 3A-B, and states that this "process is then reversed" to switch from fracturing the second well to fracturing the first well. *Id.*, [0021]. Figures 2-3B of *Beuterbaugh* (annotated below) show "the process" in reverse, applying *Beuterbaugh's* instructions for switching from a first to a second well to switching from the second to the first well.

- 1) First, one opens a second well's valves to pulse fracturing fluid into the second well while closing a first well's valves, preventing fluid flow into the first well:

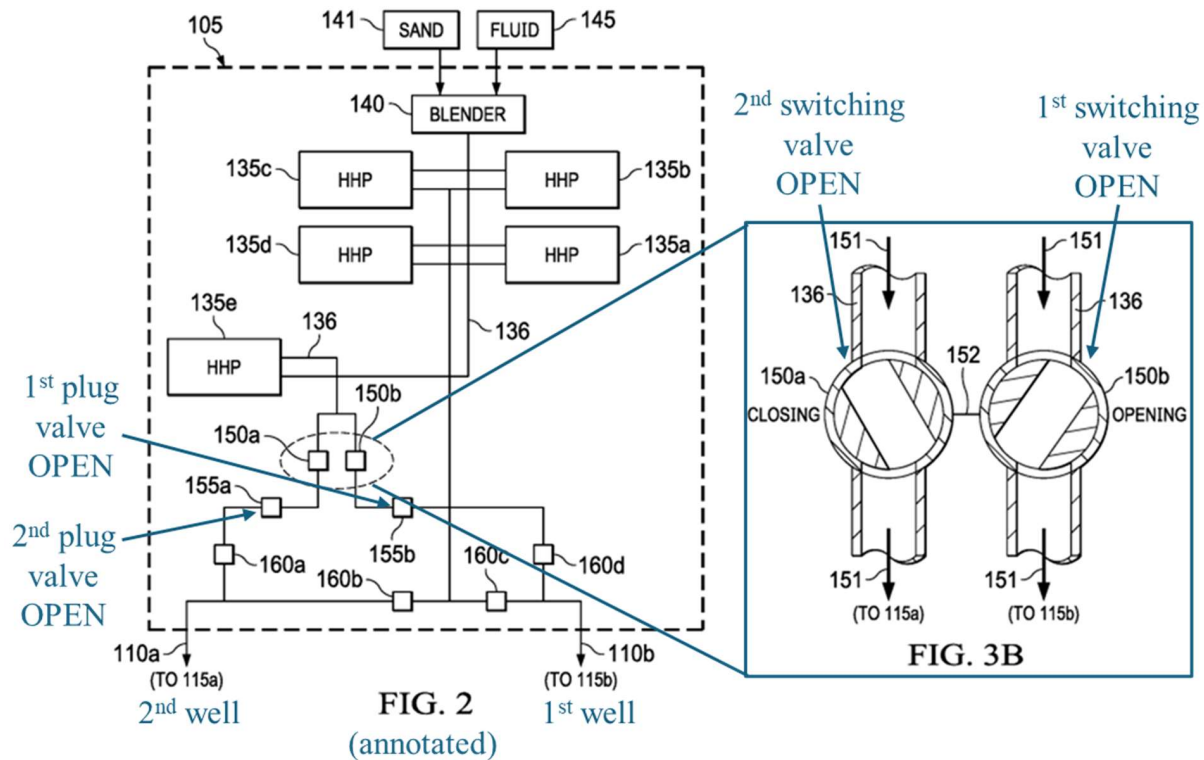


Id., [0021], [0030].

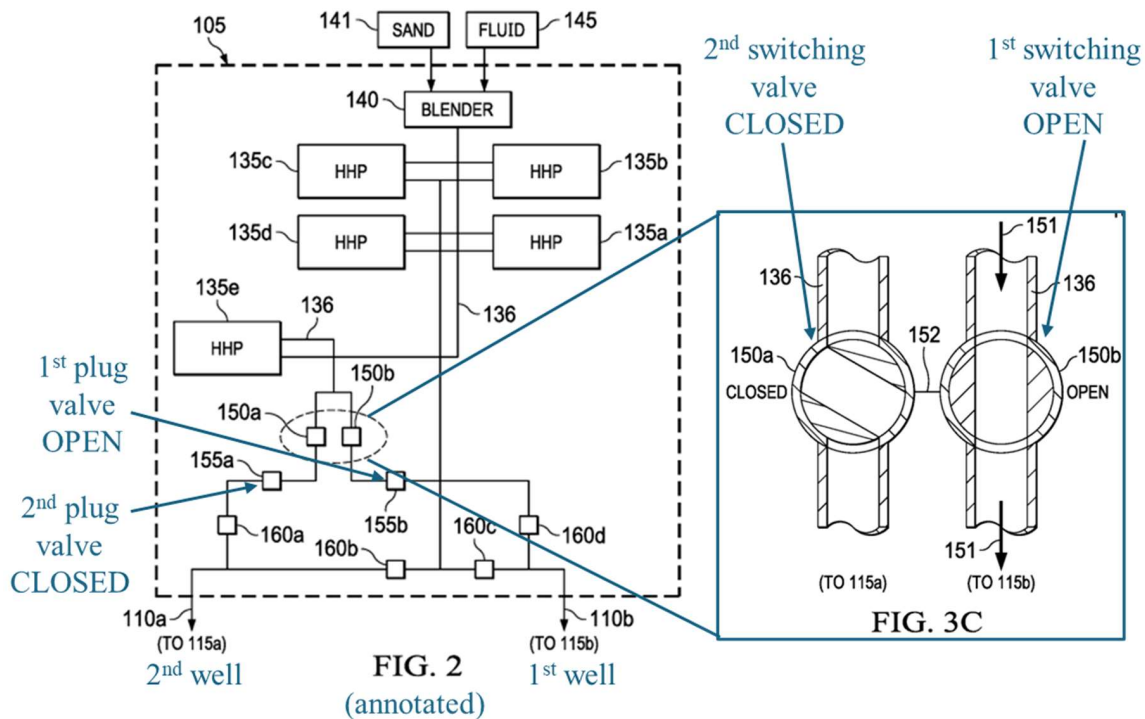
- 2) While pumping fracturing fluid into the second well, one opens “the [first] plug valve...downstream of the [first] switching valve.” *Id.*, [0021].



- 3) Then, the first “switching valve...is opened.” *Id.* As shown, at this stage, one opens the first switching valve before closing the second switching and plug valves. *Id.*



- 4) The second switching valve is then “fully closed,” while pumping a pulse of fracturing fluid into the first well. *Id.* The second plug valve is closed after closing the second switching valve, while the fluid is directed into the first well. *Id.*



Beuterbaugh discloses that the “time duration that a switching valve...is opened can vary, or can be maintained of a constant duration from cycle to cycle” and can be equal or unequal for different wells. *Id.*, [0022]. Thus, *Beuterbaugh* discloses opening a first valve associated with the first well before the second valve associated with the second well is closed in response to at least a time condition.

Beuterbaugh also considers using flowrate as a parameter for controlling fracturing operations, *e.g.*, where the flowrate may be considered when determining fracturing fluid pulse size, optimization of downhole pressure wave, and minimization of surface impacts. *Beuterbaugh*, [0018], [0024]; Ex. 1041, ¶ 440.

Jackson discloses determining if flowrate conditions were met for different stages of fracturing processes. *Jackson*, [0019]. For example, *Jackson* discloses fracturing methods include “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.” *Id.*, [0003].

It would have been obvious to determine next steps in response to flowrate conditions, as taught by *Jackson*, in *Beuterbaugh*’s systems/methods to allow for additional control of the fracturing operation. The method would include opening a first valve before closing a second valve and continuously pumping hydraulic fracturing fluid to the valves via the hydraulic manifold as taught by *Beuterbaugh* in response to meeting *Jackson*’s flowrate thresholds. Ex. 1041, ¶¶ 458-462.

Beuterbaugh in view of *Jackson* render Limitation 15.6 obvious.

Limitation 15.7

This limitation is a second option in an “or” clause of claim 15, and merely requires opening a valve to a next well during or after closing a valve to another well. As discussed above, *Beuterbaugh* and *Jackson* disclose or render obvious the first option in the “or” clause, and therefore meet this claim limitation.

Nevertheless, it would have been obvious to a POSITA to open a first valve after closing a second valve if the flow and/or time conditions of the *Beuterbaugh* and *Jackson* system/method are not met to avoid generating a pressure pulse when it is not desired, or to reduce any risk of equipment/formation damage. Such a valve sequence (which ’779 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. Ex. 1041, ¶¶ 463-465.

7. Independent Claim 25

Claims 15 and 25 are nearly identical but Claim 25 adds 8.1-8.2’s computer limitations to Claim 15’s limitations. It would have been obvious to perform Claim 15’s method with a computer. Ex. 1041, ¶¶ 495-499. *Beuterbaugh* and *Jackson* disclose every limitation of Claim 25, as discussed with Limitations 8.1-8.2 and 15.1-15.7, respectively. See Sections IX.C.2. and IX.C.6. For the same reasons, it would have been obvious to use *Jackson*’s teachings of using flowrate conditions to determine when to move a fracturing process to the next step in the method of

Beuterbaugh to allow for control of the fracturing operation, including when to switch from opening/closing valves to fracture different wells, rendering the subject matter of Claim 25 as a whole obvious. Ex. 1041, ¶¶ 495-499. Thus, Claim 25 is obvious over *Beuterbaugh* in view of *Jackson*.

8. Claims 16 and 26

Claims 16 and 26 apply similar “permitting” and “swapping” steps of the first/second wells in Limitations 15.2/25.4 and 15.4/25.6 to third and fourth wells. As discussed with Limitations 15.2/25.4 and 15.4/25.6, *Beuterbaugh*’s systems/methods include first and second wells with associated valves, operation of the valves to permit hydraulic fracturing of the second well, and swapping fracturing of the second well to fracturing of the first well. See Sections IX.C.1 and IX.C.6 (Limitations 1.5-1.6, 15.2, 15.4). Thus, by merely changing the labels of the “first” and “second” wells/valves to “third” and “fourth” wells/valves, *Beuterbaugh* likewise discloses the limitations in Claims 16 and 26. Further, Claims 16 and 26 do not have any connection requirements between the third/fourth wells/valves and the first/second wells/valves. Accordingly, by merely providing *Beuterbaugh*’s systems/methods at two well sites, whether or not they’re connected or even nearby, the limitations of Claims 16 and 26 would be met. Ex. 1041, ¶¶ 466-477, 500-502.

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 “a plurality of switching valves,” where each switching valve is “connected between the at least one pump and each of the plurality of wellheads,” and where the switching valves are “operable to alternate application of the constant pressure of fracturing fluid to the plurality of wellheads by opening and closing the...switching valve[s] to create a pulsed pressure wave in each well associated with the plurality of wellheads for fracturing a subterranean formation associated with each well.” *Beuterbaugh*, [0048]-[0049]. *Beuterbaugh*’s systems using “a plurality of wells” and “a plurality of switching valves” associated with the wells would include third and fourth wells and associated third and fourth valves functioning in the same way as *Beuterbaugh*’s first and second valves. Ex. 1041, ¶¶ 468-469.

For example, *Beuterbaugh* gives an explicit example of a system/method with a plurality of wells and associated valves in Figure 5, where first and second valves to first and second wells are alternately opened/closed to switch fracturing between the first and second wells while continuously pumping fluid to the valves:

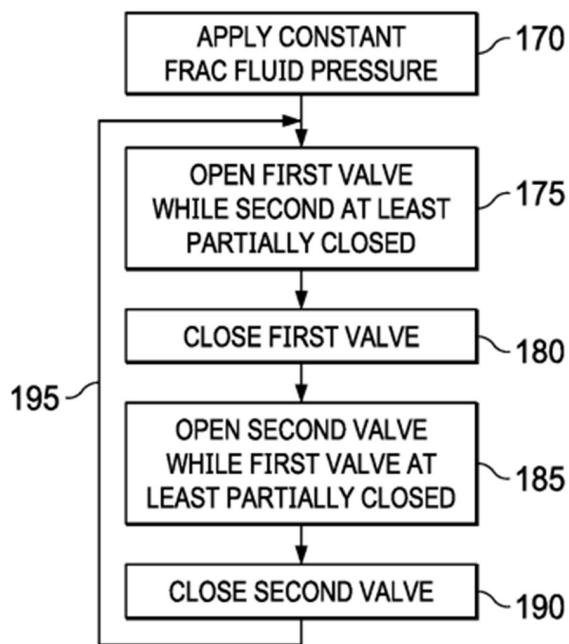


FIG. 5

Beuterbaugh, [0027].

Beuterbaugh discloses that the system/method in Figure 5 may also include a third well with third associated valves, where “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 after steps 185 and 190 and before steps 175 and 180.” *Id.*, [0028].

“[I]t 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,” as “*Beuterbaugh* explicitly discloses the use of its method on ‘two or more’ wells, which would include at least a third and fourth well.” Ex. 1041, ¶ 469; *Beuterbaugh*, [0015], [0048]. Additionally, “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,” as a mere repetition of elements with predictable results. Ex. 1041, ¶ 469.

Claims 16 and 26 are therefore also obvious over *Beuterbaugh* in view of *Jackson*.

9. Claims 17 and 27

As discussed with Claims 2/9, *Beuterbaugh* discloses pumping hydraulic fracturing fluid from “surface fracturing equipment,” which would include known manifold(s), to “a plurality of wells” by “applying a constant pressure of fracturing fluid to a plurality of switching valves” associated with the wells “to provid[e] simultaneous pulsed treatment of [the] plurality of wells.” *Beuterbaugh*, [0015]-[0016], [0030], [0050]; Ex. 1041, ¶¶ 478-481, 503-504. *Beuterbaugh* discloses that the “simultaneous pulsed fractured treatment of a plurality of wells in subterranean formations” may “reduce wear and equipment failure.” *Beuterbaugh*, [0014].

Additionally, *Beuterbaugh*’s explicit disclosure of applying the methods to “two or more wells,” would include also include third/fourth and additional wells. *Id.*, [0015], [0028]; Ex. 1041, ¶ 482, 504. “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))” and “pump[ing] hydraulic fracturing fluid simultaneously to the first and third wells (steps (b) and (d)).” Ex. 1041, ¶ 482-483, 504.

Claims 17 and 27 are therefore also obvious over *Beuterbaugh* in view of *Jackson*.

10. Claims 18 and 28

Beuterbaugh discloses pumping hydraulic fracturing fluid from “surface fracturing equipment,” which would include known surface equipment manifold(s), to “a plurality of wells” by “applying a constant pressure of fracturing fluid to a plurality of switching valves” associated with a plurality wells “to provid[e] simultaneous pulsed treatment of [the] plurality of wells.” *Beuterbaugh*, [0015]-[0016], [0030], [0048]-[0050], Fig. 5; Ex. 1041, ¶ 484-487. *Beuterbaugh*’s explicit disclosure of applying the methods to “two or more wells,” and “a plurality of wells,” having a plurality of switching valves, one associated with each well, therefore, includes third and fourth wells. *Beuterbaugh*, [0015], [0028], [0048]-[0049]; Ex. 1041, ¶ 485. Thus, a POSITA would have found it obvious, based on *Beuterbaugh*’s teachings regarding simultaneous pumping and applicability to “two or more wells” to continuously pump hydraulic fracturing fluid to the third and fourth wells, by

opening the associated third/fourth valves to permit the constantly pumped fracturing fluid into the third/fourth wells via the fourth valve. *Id.*

Additionally, in the same manner *Beuterbaugh* discloses swapping between fracturing first and second wells, as described with Claims 15/25, the third and fourth valves associated with third and fourth wells would likewise be opened and closed, respectively, to permit fluid flow into the third well via the third valve and stop pumping fluid into the fourth well. Ex. 1041, ¶¶ 484-494, 505-508.

Accordingly, *Beuterbaugh* discloses, or at least renders obvious, Limitations 18.1-18.3/28.1-28.3.

Claims 18 and 28 are therefore obvious over *Beuterbaugh* in view of *Jackson*.

11. Claims 31 and 36

Beuterbaugh considers using flowrate as a parameter for controlling fracturing operations. *Beuterbaugh*, [0018], [0024]; Ex. 1041, ¶¶ 440, 498, 509, 515.

Jackson discloses it was known to monitor/measure flowrate conditions according to their thresholds when fracturing a well to determine next steps in fracturing operations. *Jackson*, [0019]. In *Jackson* fracturing methods include adjusting flow of the fracturing fluid to the well based on various flowrate and time thresholds. *Id.*, [0002]-[0003]. In various examples, *Jackson* discloses flowrate thresholds as being less than an upper flowrate threshold, such as during a period of

pumping relaxation, and greater than a lower flowrate threshold, such as during pressurization of the formation. *Id.*, [0061].

It would have been obvious to use *Jackson*'s fracturing methods based on flowrate conditional thresholds—*e.g.*, if a measured flowrate into a well is below upper and/or above lower flowrate thresholds (or if flowrate is outside the flowrate threshold range)—in *Beuterbaugh*'s systems/methods when controlling when to move the fracturing operation to the next step (*e.g.*, when to deliver a next pulse of fracturing fluid). Ex. 1041, ¶¶ 510-512, 516. Thus, Limitations 31.1/36.1 are obvious over *Beuterbaugh* in view of *Jackson*.

Limitations 31.2/36.2 merely recite that if Limitations 31.1/36.1's flowrate conditions are not met, then the flowrate measured at step (a) "has not been satisfied." A POSITA would understand that flowrates used in the combination of *Beuterbaugh* and *Jackson* that are outside the flowrate threshold range (above upper or below lower flowrate thresholds) would not meet the conditions for moving to the next stage, and this is "standard practice for any flow system—if a measured flowrate is outside the required flowrate, then a flowrate condition is not met." Ex. 1041, ¶¶ 513-514, 516.

Thus, *Beuterbaugh* in view of *Jackson* render Limitations 31.1-31.2/36.1-36.2 obvious.

Claims 31 and 36 are therefore also obvious over *Beuterbaugh* in view of *Jackson*.

X. SECONDARY CONSIDERATIONS

There are none. *Id.*, ¶ 517.

XI. THE OFFICE HAS NOT PREVIOUSLY CONSIDERED THESE GROUNDS

No ground in this Petition was considered by the Office. Denial of institution under 35 U.S.C. § 325(d) is unwarranted.

XII. CONCLUSION

The Challenged Claims are unpatentable.

Dated: March 1, 2024

Respectfully submitted,

/s/ Tammy J. Terry

Tammy J. Terry (Reg. No. 69,167)

Lisa E. Margonis (Reg. No. 57,123)

Califf T. Cooper (*Pro Hac Vice* to be requested)

Laura J. Witbeck (Reg. No. 59,766)

Peter C. Schechter (Reg. No. 31,662)

OSHA BERGMAN WATANABE & BURTON LLP

1100 Louisiana St., Suite 4900

Houston, Texas 77002

Tel. | Fax. 713.228.8600 | 713.228.8778

Email: OBWB-IWS-Downing@obwb.com

Counsel for Petitioner Intelligent Wellhead Systems, Inc.

CERTIFICATE OF COMPLIANCE

The undersigned hereby certifies that the foregoing Petition contains 13,840 words, excluding those portions identified in 37 C.F.R. § 42.24(a), as measured by the word-processing system used to prepare this Petition.

Dated: March 1, 2024

By: /s/ Tammy J. Terry

Tammy J. Terry (Reg. No. 69,167)
OSHA BERGMAN WATANABE & BURTON LLP
1100 Louisiana St., Suite 4900
Houston, Texas 77002
Tel. | Fax. 713.228.8600 | 713.228.8778
Email: OBWB-IWS-Downing@obwb.com

***Counsel for Petitioner Intelligent Wellhead
Systems, Inc.***

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e) and 42.105(a), the undersigned hereby certifies that on March 1, 2024, a true and correct copy of the foregoing **Petition for *Inter Partes* Review of U.S. Patent No. 11,401,779** and copies of all supporting exhibits was served by Federal Express on the following correspondence address of record as listed on USPTO's Patent Center (formerly PAIR):

HAYNES AND BOONE, LLP
IP Section
2801 N. Harwood St.
Suite 2300
Dallas, TX
UNITED STATES

Pursuant to 37 C.F.R. § 42.105(a), the undersigned hereby certifies that on February, 2024, a true and correct copy of the foregoing **Petition for *Inter Partes* Review of U.S. Patent No. 11,401,779** and copies of all supporting exhibits was served by Federal Express on the Patent Owner at the following address known to the Petitioner as likely to effect service:

Scott Jarratt
scott.jarratt.ipr@haynesboone.com
Tiffany Cooke
tiffany.cooke@haynesboone.com
Caroline W. Fox
Caroline.fox.ipr@haynesboone.com
Brooke E. Cohen
Brooke.cohen.ipr@haynesboone.com
Andrew B. Drott
andrew.drott@haynesboone.com

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Patent No. 11,401,779

HAYNES AND BOONE, LLP
2801 N. Harwood St. Suite 2300
Dallas, TX 75201

Dated: March 1, 2024

Respectfully submitted,

/s/ Tammy J. Terry

Tammy J. Terry (Reg. No. 69,167)

***Counsel for Petitioner Intelligent Wellhead
Systems, Inc.***