

IPR2024-00256
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-xxxxxx
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 1016	B.A. Wells and K.L. Wells. “Shooters – A “Fracking” History.” American Oil & Gas Historical Society, (https://aoghs.org/technology/hydraulic-fracturing) (last accessed November 30, 2023)
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 1022	Waters, George, Dean, Barry, Downie, Robert, Kerrihard, Ken, Austbo, Lance, and Bruce McPherson. "Simultaneous Hydraulic Fracturing of Adjacent Horizontal Wells in the Woodford Shale." Paper presented at the SPE Hydraulic Fracturing Technology Conference, The Woodlands, Texas, January 2009. doi: https://doi.org/10.2118/119635-MS (“ <i>Waters</i> ”)
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
Exhibit 1024	Mutalik, P N, and Bob Gibson. "Case History of Sequential and Simultaneous Fracturing of the Barnett Shale in Parker County." Paper presented at the SPE Annual Technical

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

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

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;
8.8	(d) permitting performance of a second hydraulic fracturing operation on the second well, which second hydraulic

CLAIM / LIMITATION	CLAIM LANGUAGE
	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:
15.2	(a) permitting hydraulic fracturing of the second well, comprising: opening the second valve associated with the

CLAIM / LIMITATION	CLAIM LANGUAGE
	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
16.3	(d) swapping from permitting hydraulic fracturing of the fourth well to permitting hydraulic fracturing of the third well.

CLAIM / LIMITATION	CLAIM LANGUAGE
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
18.3	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:
25.4	(a) permitting hydraulic fracturing of the second well, comprising: opening the second valve associated with the second well to permit pumping of fluid into the second well via the second valve; and

CLAIM / LIMITATION	CLAIM LANGUAGE
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:
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 / LIMITATION	CLAIM LANGUAGE
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
	wherein step (d) comprises:
28.3	opening the third valve associated with the third well to permit pumping of fluid into the third well via the third valve; and
28.3	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 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

CLAIM / LIMITATION	CLAIM LANGUAGE
	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

Petitioner 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 U.S. Patent No. 11,401,779 (“’779 Patent”/“’779”) (Ex. 1001), assigned to Downing Wellhead Equipment, LLC (“Downing”/“Patent Owner”). The Challenged Claims are unpatentable and should be cancelled.

The ’779 Patent relates to continuous pumping (“CP”) operations for multi-well fracturing sites, using steps operators have long performed to hydraulically fracture wells: monitoring/determining fluid flow conditions and opening/closing valves in response to those conditions. Either a generic computer monitors/determines, or, in other instances, no computer is required at all. Thus, the Challenged Claims merely cover the well-known abstract idea of determining fluid flowrate conditions to decide which valves to open and close in multi-well hydraulic fracturing operations. Petitioner shows how well-known the claimed hydraulic fracturing operations were and how the prior art anticipates and/or renders obvious the Challenged Claims.

II. MANDATORY NOTICES

A. REAL PARTIES-IN-INTEREST

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

B. RELATED MATTERS

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”). Ex. 1007. The Litigation is in its early stages. IWS has not yet filed an answer as IWS’s Motion to Dismiss under 35 U.S.C. § 101 (ECF No. 34) is pending. Claim construction has not yet occurred and a claim construction hearing has not yet been set. Expert discovery does not close until March 28, 2025, and dispositive motions are not due until April 30, 2025. A trial date has not yet been set.

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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(S) 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	All	102	<i>Krupa</i>
2	All	103	<i>Krupa</i>
3	All	103	<i>Kajaria, Jackson</i>

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

4	All	103	<i>Krupa, Jackson</i>
5	All	103	<i>Kajaria, Jackson, Martino</i>

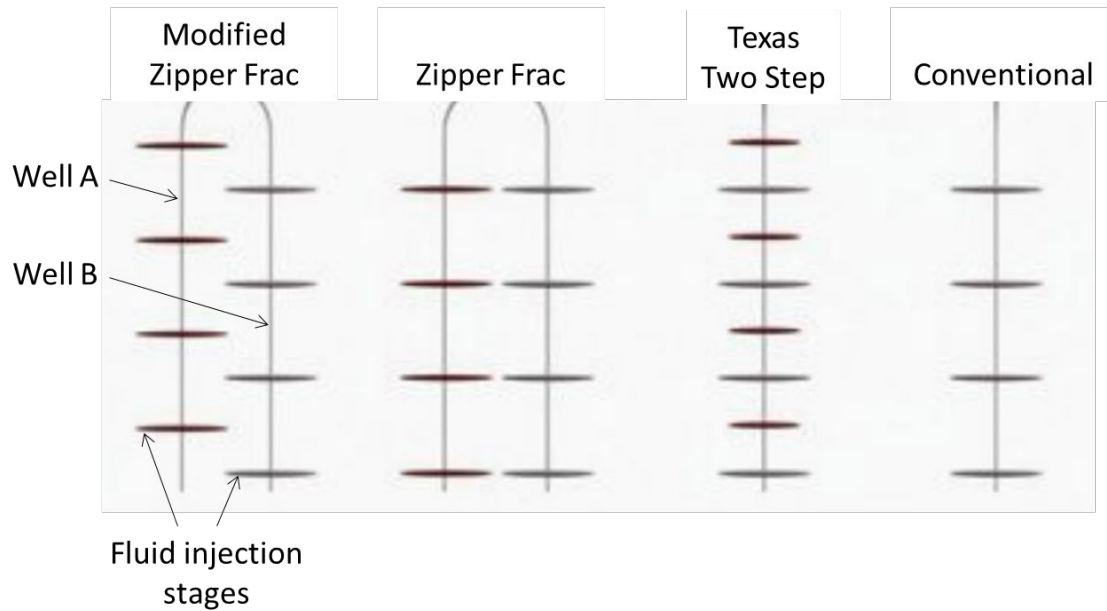
Grounds are explained below, including where prior art discloses/teaches/suggests each limitation.

Dr. Robert Durham's Declaration (Ex. 1002) provides additional explanation and support. 37 C.F.R. §§ 42.104(b)(1).

VI. TECHNOLOGY BACKGROUND AND PRIOR ART

For decades, hydraulic fracturing processes have used pumps and valve sequences to control and direct high-pressure fracturing fluid into wells to fracture and increase hydrocarbon recovery from the surrounding downhole formations. Ex. 1002, ¶¶ 62-73; *see also*, Exs. 1015-1035.

Operators began “zipper fracturing” (simultaneously/sequentially fracturing multiple wells) in the mid-2000s. Ex. 1002, ¶ 74-85. By 2014, zipper fracturing was widespread, as shown in this annotated 2014 article illustrating well completion plans for multiple techniques/variations of alternating fluid into wells using zipper fracturing:



Id., ¶ 86; Ex. 1008, 61.

“Continuous pumping” refers to pumping fluid to treat multiple stages and/or wells simultaneously or sequentially without stopping the pumps. *Id.*, ¶¶ 87-89. It has long been used to meet the overall goals of reducing non-productive time at the wellsite and reducing wear/damage to high-pressure pumps and valves. *Id.*, ¶ 87. Closing valves during high-flow conditions creates extreme pressure increases, which could damage mechanical equipment and/or cause catastrophic system failure. *Id.*, ¶¶ 90-95. Responsive and preventative measures, such as reducing flowrate between fracturing stages, have been commonly used to allow for mechanical execution of the frac job. *Id.* For years, operators have also known to open a second well for continuous pumping only if there is sufficient flow to support

operation of two wells, but not so much flow that it would blow a valve or cause damage to the system. *Id.*

For decades, hydraulic-fracturing operators have used field testing, which involves altering flowrates and sequencing valves to evaluate job performance or conditions. *Id.*, ¶¶ 96-101. For example, to determine the extent of fractures created from a fracturing operation, operators often close/open valves and/or reduce flowrate to create downhole pressure pulses to measure and correlate with fracture growth. *Id.*

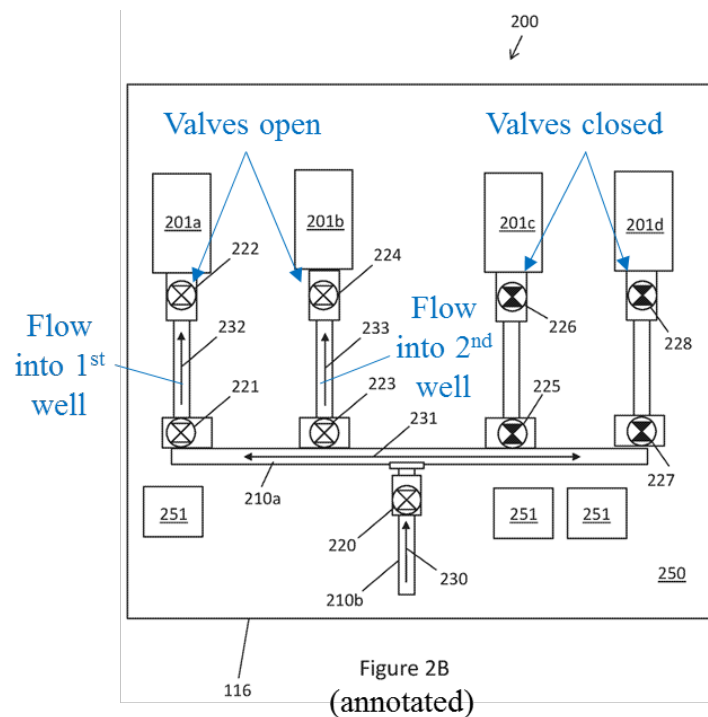
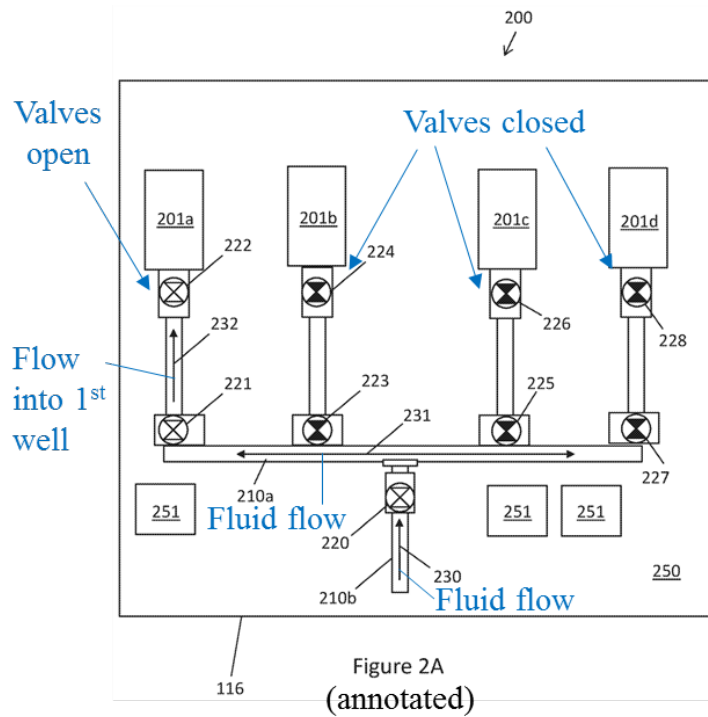
Accordingly, incorporating flowrate reductions and alternating valve sequencing during hydraulic fracturing operations, including zipper and continuous fracturing operations, was well known long before the '779 Patent, as shown in at least the following prior art.

A. *KRUPA*

U.S. Patent Pub. No. 2022/0268141 (“*Krupa*,” Ex. 1003) was filed on February 18, 2022, published on August 25, 2022, and claims priority to U.S. Provisional App. No. 63/153,607, filed February 25, 2021. Because *Krupa*’s effective filing date is February 25, 2021—before ’779’s priority date (May 17, 2021)—*Krupa* is prior art under 35 U.S.C. § 102(a)(2).

Krupa discloses CP systems and methods on multiple wells using a software application which includes instructions for a sequence of valve operations to direct

fluid flow into selected wells. *Krupa*, Abstract, ¶ [0038]. Figures 2A-E show an exemplary valve sequence/flow path through wellhead assemblies 201 (wells):



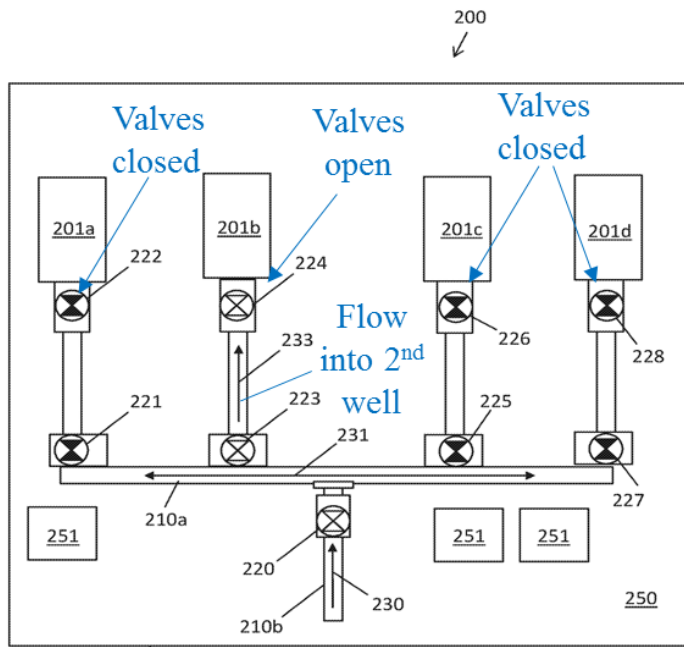


Figure 2C
(annotated)

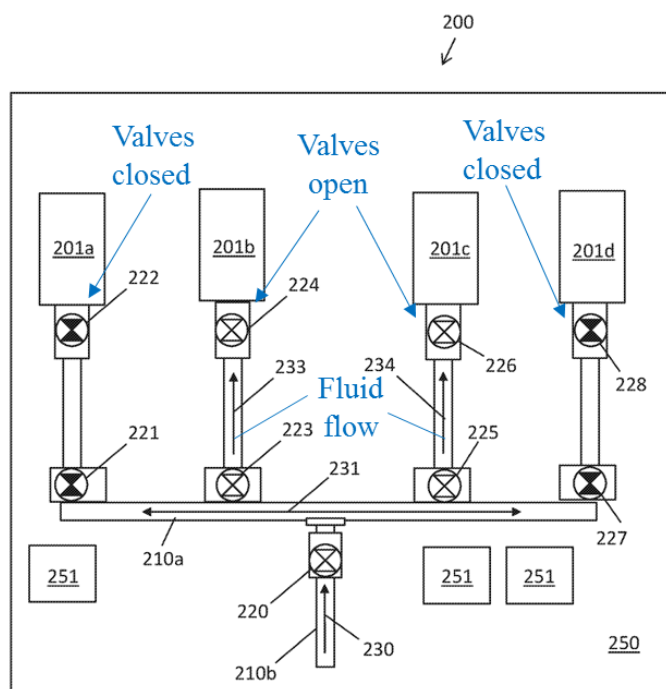
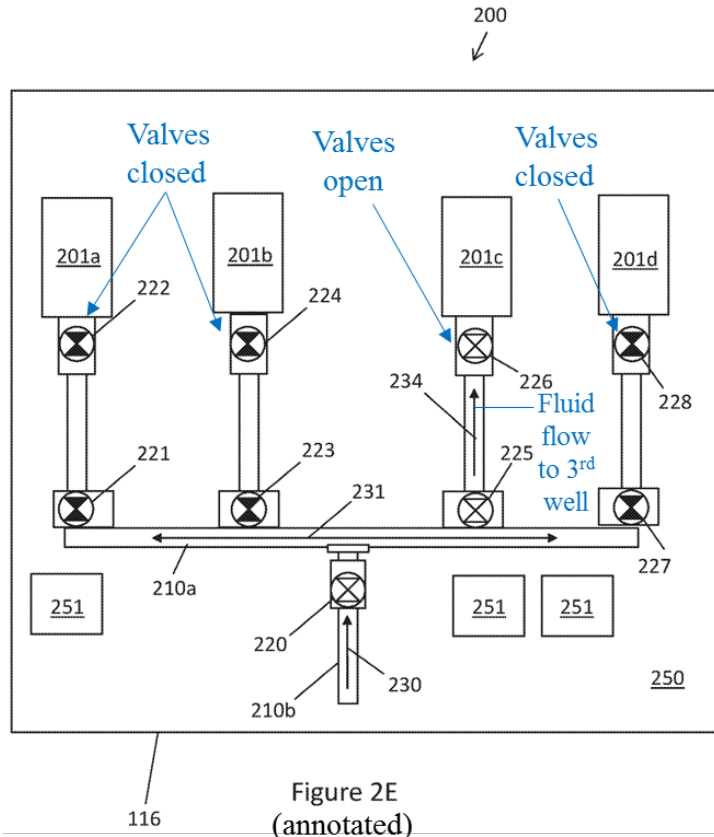


Figure 2D
(annotated)



B. *KAJARIA*

U.S. Patent Pub. No. 2017/0275980 (“*Kajaria*,” Ex. 1004) was filed March 28, 2017, and published September 28, 2017, before ’779’s priority date. *Kajaria* is § 102(a)(1) prior art.

During ’779’s prosecution, the Examiner stated that *Kajaria* disclosed most claim elements, “but does not specifically disclose measuring a flow rate of the fluid being pumped” or determining that the flowrate “is below a flow rate threshold ... for a threshold amount of time.” Ex. 1009, p. 6-7. In response, Downing amended claims to include determining if flowrate thresholds or conditions are met.

Kajaria discloses that multi-well hydraulic fracturing sites were well known

and typically included fluid supply lines connecting a manifold to the wells, where “an operator can use the hydraulic fracturing manifold to isolate wells as they complete a frac cycle, and to redirect fluid to a different well that is ready to begin a new frac cycle,” which “is known in the industry as ‘zip’ fracking.” *Kajaria*, ¶ [0006].

With *Kajaria*’s system, “it is possible [to] direct flow between wells continuously simply by opening or closing the valves ... associated with individual wells.” *Id.*

C. JACKSON

U.S. Publication No. 2007/0023184 (“*Jackson*,” Ex. 1005) was filed May 30, 2006, and published February 1, 2007—years before ’779’s priority date. *Jackson* 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].

D. MARTINO

U.S. Patent Pub. No. 2017/0315566 (“*Martino*,” Ex. 1006) was filed April 28, 2016, and published November 2, 2017, before ’779’s priority date. *Martino* is § 102(a)(1) prior art.

Martino discloses a valve that is opened or closed in response to determining whether a measured flowrate has met a flowrate threshold in a well system. *Martino*, Abstract, ¶¶ [0003], [0021]. *Martino* also discloses various wellbore applications that may need *Martino*'s valve to quickly adjust the valve position based on wellbore conditions (*e.g.*, when an abrupt change in wellbore pressure occurs"). *Id.*, ¶ [0021].

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.

VIII. '779 PATENT OVERVIEW

A. SUMMARY

'779 describes hydraulic fracturing systems and methods for multiple wells. 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 legs ("frac legs," 150A-150C+n, FIG. 1A), which are adapted to communicate pressurized hydraulic fracturing fluid from the zipper manifold to a corresponding well. *Id.*, 5:53-61.

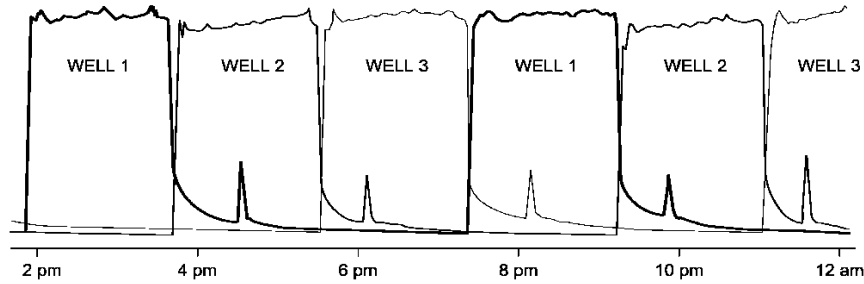
The methods include perforating and isolating, then hydraulically fracturing, a stage of each well. '779, 6:48-54. In preparing for hydraulically fracturing a first well (105B in FIG. 1A), one determines if a fracturing stage of a second well (105D

² Citations to '779/Ex. 1001 are in [column]:[line] format.

in FIG. 1A) has ended. *Id.*, 7:1-2. Then, one determines “whether to permit a regular swap or a CP swap from hydraulically fracturing [the second] well 105D to hydraulically fracturing [the first] well 105B.” *Id.*, 7:3-5. 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.

’779 FIG. 12 shows how to determine whether to permit a regular swap or a CP swap, which includes checking a frac rate (or idle rate) of a first well, and “if the frac rate of the [first] well is below the upper threshold rate (*e.g.*, 10 bbl) and above the lower threshold rate (*e.g.*, 0 bbl) for a threshold amount of time (*e.g.*, 10 s), a CP swap from hydraulically fracturing the [first] well to hydraulically fracturing the [second] well is permitted...but...if the frac rate of the [first] well is below the lower threshold rate [(*e.g.*, if the flowrate is below 0 bbl (*i.e.*, when the pump is not running))] for a threshold amount of time, only a regular swap ... is permitted.” ’779, 13:41-52.

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



'779 Fig. 16D

These CP swaps are described as “instantaneous and the total time between stages measured at treatment pressure is 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 (“’716 Application”), 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 *Kajaria* or obvious over *Kajaria* in view of U.S. Patent Pub. No. 2014/0352968 (“Pitcher”).

Downing maintained allowed claims, amended rejected claims, and added dependent claims. After prosecution on the merits closed, Downing changed identification of the '716 Application from continuation to continuation-in-part of Application No. 17/319,854.

C. 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 (Aug. 14, 2015). Petitioner asserts that claim construction is not necessary in this IPR.³ If necessary, however, the *Phillips* standard applies (37 C.F.R. § 42.100(b)) in which claim terms are typically given their ordinary and customary meanings, as understood by a POSITA at the time of the invention, having considered the claims, specification, and prosecution history. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-16 (Fed. Cir. 2005).

IX. THE CHALLENGED CLAIMS' PRIORITY DATE IS MAY 17, 2021

Despite naming new and different inventors and having a completely new specification, Downing filed the '716 Application as a continuation application. *After prosecution on the merits closed*, Downing changed the application's identification to a continuation-*in-part* ("CIP") application. When recently asked in the Litigation to state '779's priority date, Downing refused, surprisingly stating it would first need to see IWS's invalidity contentions. Ex. 1014, 5-7. Petitioner therefore addresses priority here.

'779 claims priority to Provisional Application No. 63/189,663 ("'663

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

Provisional”), filed May 17, 2021. ’779 also claims priority to seven non-provisional and nine other provisional applications, collectively referred to as “the CIP Family,” as each application is related to ’779 through at least one CIP relationship, as shown in Exhibit 1011.

Significantly, ’779’s specification is completely different from every prior application, except for a few “boilerplate” passages and generic descriptions of computing components. *See* Ex. 1012 (merge-comparisons between ’779 and related specifications). Thus, ’779’s claims must be analyzed against the ’663 Provisional and the CIP Family to determine whether ’779 is entitled to any earlier filing dates. As discussed below, May 17, 2021 is the earliest priority date to which any of ’779’s claims are entitled.⁴

For a later-filed claim to be entitled to an earlier-filed application’s filing date, the earlier-filed application must comply with § 112’s written description requirement with respect to the later-filed claim. 35 U.S.C. § 120; *Lockwood v. Am. Airlines, Inc.*, 107 F.3d 1565, 1571-72 (Fed. Cir. 1997). Specifically, the specification “must describe the invention sufficiently to convey to a [POSITA] that the patentee had possession of the claimed invention at the time of the application, *i.e.*, that the patentee invented what is claimed.” *Lizardtech, Inc. v. Earth Res.*

⁴ Even if ’779 is entitled to an earlier effective filing date, *Kajaria, Jackson, and Martino* are still § 102(a)(1) prior art.

Mapping, Inc., 424 F.3d 1336, 1345 (Fed. Cir. 2005). Put another way, “one skilled in the art, reading the original disclosure, **must immediately discern the limitation at issue** in the [later-filed] claims.” *Purdue Pharma L.P. v. Faulding Inc.*, 230 F.3d 1320, 1323 (Fed. Cir. 2000) (emphasis added).

“Entitlement to a [earlier] filing date extends only to the subject matter that is disclosed; not to that which is obvious...[t]herefore the parent application must actually or inherently disclose the elements of the later-filed claims.” *Research Corp. Techs., Inc. v. Microsoft Corp.*, 627 F.3d 859, 870 (Fed. Cir. 2010).

The CIP Family lacks written description support for each limitation in ’779’s independent claims, including those related to the following categories:

- 1) measuring flowrate of fluid being pumped into a well (all independent claims);
- 2) determining whether measured flowrate is below/above a flowrate threshold or has/has not satisfied one or more flowrate conditions (claims 1, 8 (below a flowrate threshold); 15, 25 (has/has not satisfied one or more flowrate conditions));
- 3) determining whether measured flowrate has been below the flowrate threshold for a threshold amount of time (claims 1, 8);
- 4) a specific valve sequence for opening/closing a first and second valve associated with a first and second well in response to determining the

measured flowrate claim elements (claims 15, 25);

- 5) opening a second valve associated with a second well while pumping fluid into a first well via a first valve, and closing the first valve while pumping fluid into the second well via the second valve (claims 1, 8); and,
- 6) continuous pumping (claims 1, 8, 15, and 25).

The CIP Family discloses none of the claim limitations in the six above-described categories. *See* Ex. 1013.

Priority is granted on a claim-by-claim basis; not on a limitation-by-limitation basis. Thus, a later-filed claim that includes *any* new matter (not properly supported by an earlier-filed § 112-compliant application) is not entitled to the earlier-filed application's filing date. *In re Van Lagenhoven*, 458 F.2d 132, 136-137 (CCPA 1972). Because '779's independent claims have several limitations containing new matter introduced into the chain of applications via the '663 Provisional, those claims, as a whole, can only benefit from the '663 Provisional's filing date and no other earlier-filed application.

Also, in a chain of CIPs, "each application in the chain leading back to the earlier application must comply with [§ 112's] written description requirement ... to gain the benefit of the filing date of an earlier application under 35 U.S.C. § 120." *Lockwood*, 107 F.3d at 1571. "That means each application in the chain must 'reasonably convey[] to those skilled in the art that the inventor had possession of

the [later-claimed] subject matter as of the filing date.” *Arthrex, Inc. v. Smith & Nephew, Inc.*, 35 4th 1328, 1343 (Fed. Cir. 2022), *cert. denied*, 143 S. Ct. 2493 (2023). Here, many applications of the CIP Family do *not* comply with the written description requirement as to ’779’s Challenged Claims, instead disclosing subject matter entirely different from ’779’s flow-rate thresholds or CP swaps, such as:

- 1) Remotely operating valves to control a well system (Apps. 17/319,854, 16/855,749, and Prov. App. 62/836,761, entitled “Intelligently controlled fluid systems”);
- 2) Greasing valves (App. 16/248,648, “Delivering and metering grease to process valves,” and Prov. App. 62/617,443, “Grease system for valves used in oil and gas operations”);
- 3) Launching objects into a well via a frac stack (App. 16/803,156, “Launching objects into a wellbore,” App. 16/248,633, “Object launching apparatus and related methods,” Prov. App. 62/617,438, “Object launching apparatus,” App. 16/100,741, “Subterranean formation fracking and well workover,” Prov. App. 62/638,688, “Unibody valve and methods of using the valve,” Prov. App. 62/638,681, “Method of operating a valve and extending an object through the valve and into a well,” Prov. App. 62/637,220, “Unibody valve and methods of using the valve,” Prov. App. 62/637,215, “Method of operating a valve and extending an object through

the valve and into a well,” and Prov. App. 62/598,914, “Valve apparatus”);
and,

- 4) Well stack connectors (App. 16/436,623 and Prov. App. 62/755,170,
“Subterranean formation fracking and well stack connector”).

Because ’779’s claims do not have § 112-compliant support in the CIP Family, they do not benefit from those earlier applications’ filing dates.

Therefore, ’779’s Challenged Claims’ earliest priority date is the ’663 Provisional’s filing date: May 17, 2021.

X. DETAILED EXPLANATION OF GROUNDS

Petitioner explains all grounds below, showing how the Challenged Claims are unpatentable. The Claims are considered as a whole but broken down into discrete subparts for ease of discussion.

As shown below, it was well known to continuously direct flow between wells simply by opening or closing valves in response to flow conditions.

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

The Challenged Claims relate to CP operations for a multi-well fracturing site that include overlapping valve sequences for fracturing between two or more wells

on-site. *Krupa* discloses this exactly, and therefore anticipates (Ground 1) or renders obvious⁵ (Ground 2) the Challenged Claims.

To begin, *Krupa*'s Figure 1 shows a system for hydraulically fracturing multiple wells (101):

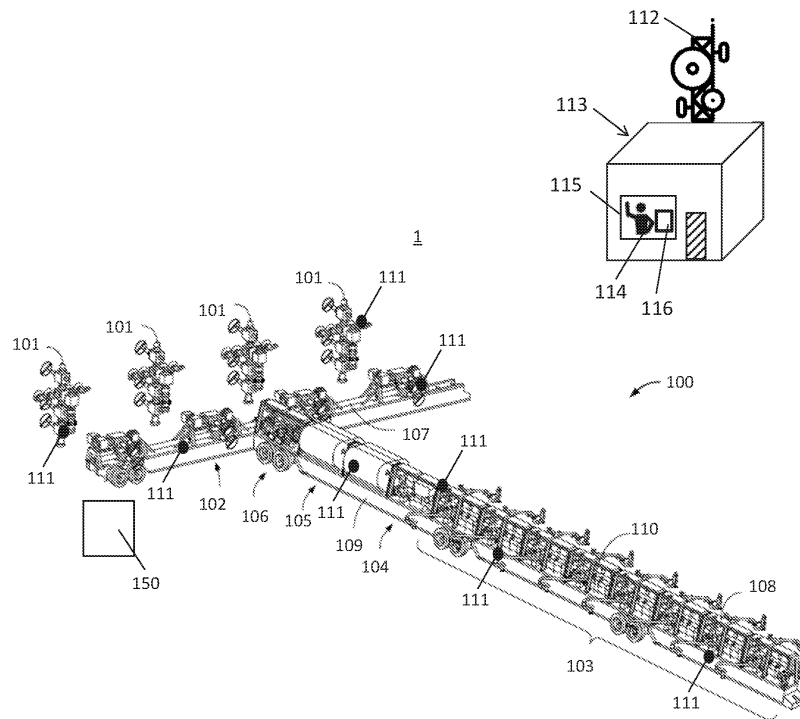
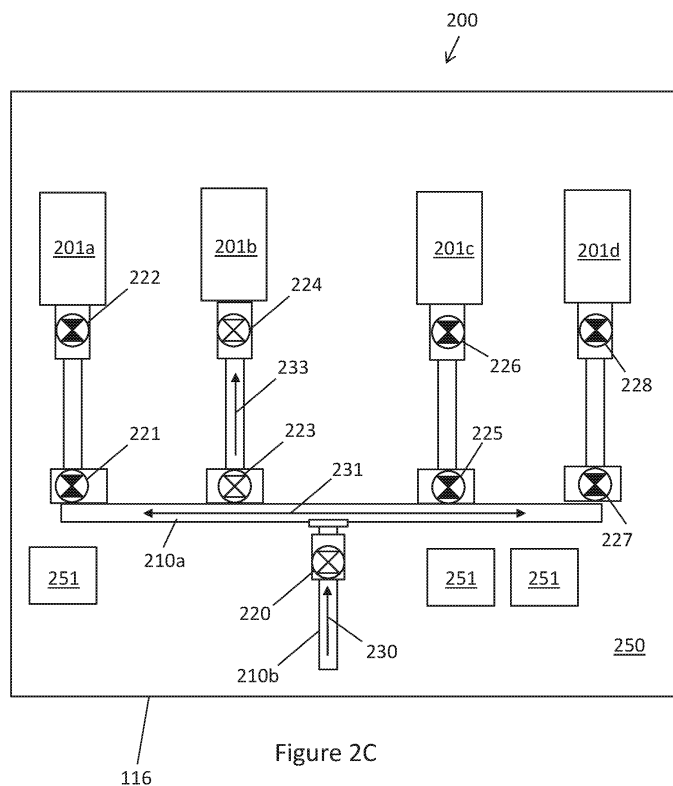
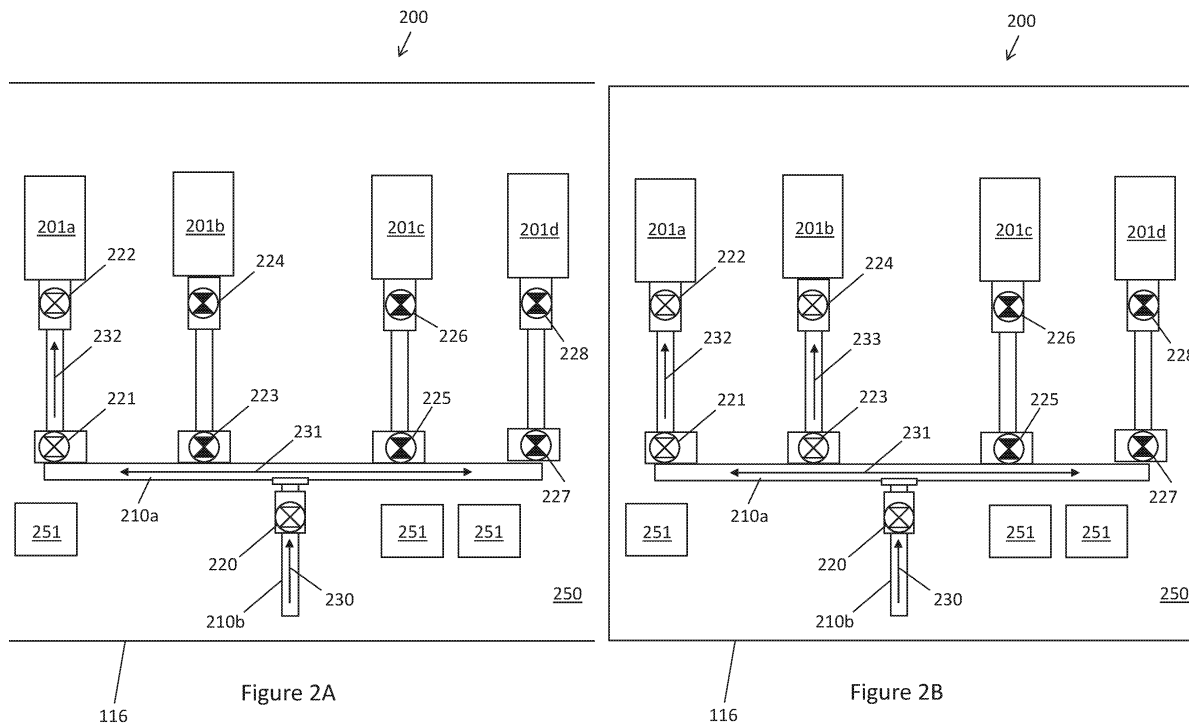


Figure 1

In Figures 2A-C, *Krupa* discloses valves (e.g., 221-224) associated with each well (e.g., 201a-d), operated in overlapping valve sequences to conduct “[CP] operations”:

⁵ A “disclosure that anticipates under § 102 also renders the claim invalid under § 103, for ‘anticipation is the epitome of obviousness.’” *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548 (Fed. Cir. 1983).



Krupa also considers various operational conditions, including flowrate, for determining when to switch between fracturing wells, as claimed in '779.

As discussed below, *Krupa* anticipates and renders obvious all Challenged Claims.

1. INDEPENDENT CLAIMS 1 AND 8

Claims 1 and 8 are nearly identical, but a person/computer may execute Claim 1, while only a computer executes Claim 8. Because Claim 8 merely adds standard computer language to Claim 1, they are discussed together. *Krupa* discloses all limitations in both claims ⁶

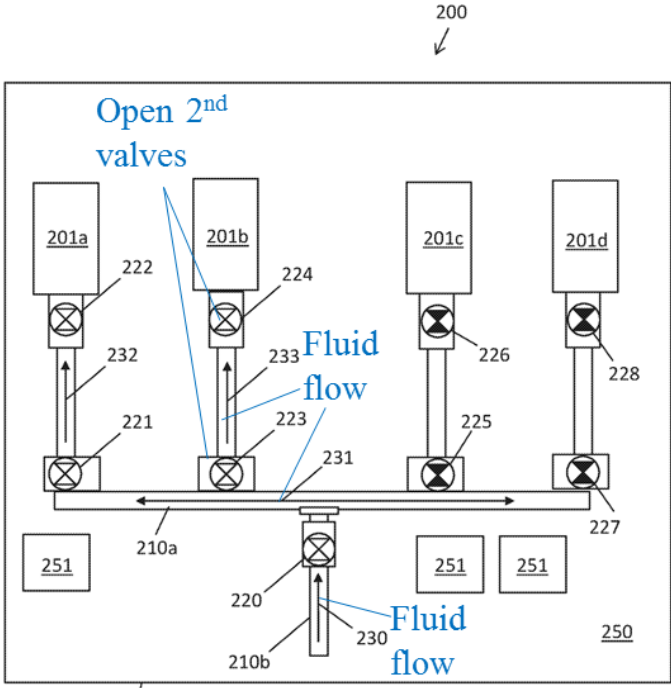
Claim	<i>Krupa</i>
[8.1] -“An apparatus, comprising: a non-transitory computer readable medium; and” [8.2] -“a plurality of instructions stored on the non-transitory computer readable medium and executable by one or more processors, wherein, when	“Software instructions in the form of computer readable program code to perform embodiments of the disclosure may be stored, in whole or in part, temporarily or permanently, on a non-transitory computer readable medium such as a CD, DVD, storage device, a diskette, a tape, flash memory, physical memory, or any other computer readable storage medium.” [0032]. The “software instructions may correspond to computer readable program code, that when executed by a processor(s), may perform one or any of the automated hydraulic fracturing systems features described [in <i>Krupa</i>], including that associated with data interpretation and automated hydraulic fracturing pumping systems.” [0032].

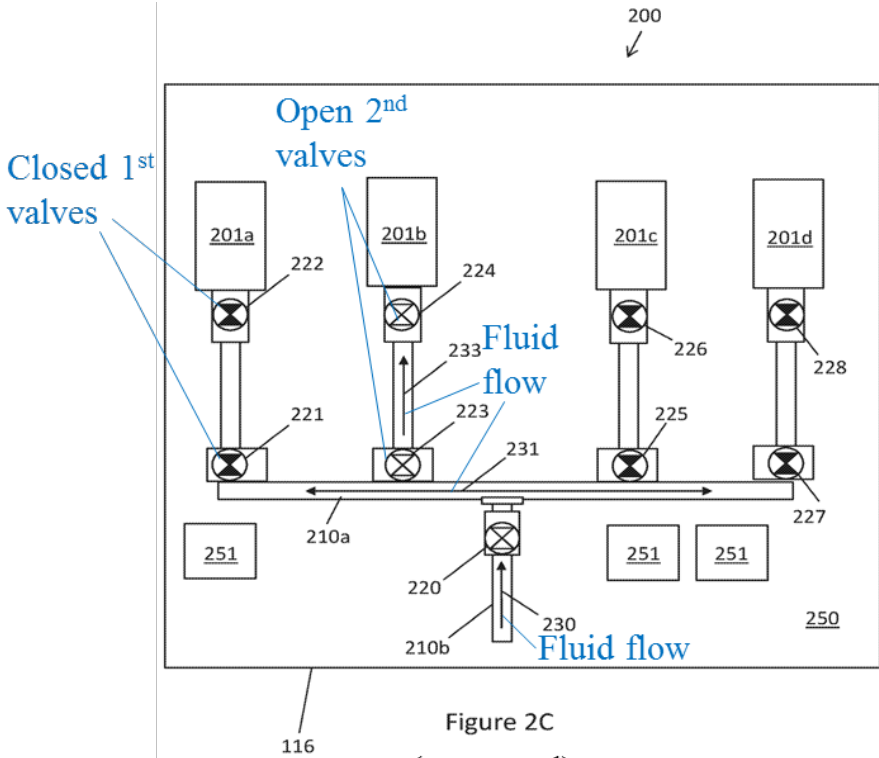
⁶ Bracketed 4-digit numbers in *Krupa* claim charts refer to *Krupa*/Ex. 1005's numbered paragraphs.

Claim	<i>Krupa</i>
the instructions are executed by the one or more processors, the following steps are executed.”	
[1.1]/[8.3] –“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”	FIGS. 2A-2G show “continuous hydraulic fracturing pumping operations between the wellhead assemblies,” where wellhead assembly 201a is a first well. [0038], [0046]. <i>Krupa</i> ’s CP methods include “pumping fluids into a first well via at least one pump manifold by opening a first set of valves” to the first well. [0005].
[1.2]/[8.4] –“measuring a flow rate of the fluid being pumped into the first well”	A “plurality of sensors 111 may be used to collect data on status, process conditions, performance, and overall quality of the device that said sensors are monitoring,” and may be used for valve, pump, and flow-line monitoring. [0024]-[0025]. <i>Krupa</i> further discloses the well site includes “a wide variety of fracturing equipment for operating the fracturing, such as ... many gauges and meters for flow rate, fluid density, treating pressure, etc.” [0002], [0014]. <i>Krupa</i> uses pump rate as a condition for moving to next steps in one fracturing plan. [0042]. A POSITA would have known monitoring the pump rate was “a common form of monitoring flow rate, as the pump rate is proportional to the

Claim	<i>Krupa</i>
	flow rate” and because using dedicated flow meters may be more costly. Ex. 1002, ¶¶ 132-134.
[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>Krupa</i> discloses flowrate sensors are commonly used in fracturing operations. [0002]. <i>Krupa</i> also discloses using sensors capable of pump monitoring and flow line monitoring, which a POSITA would understand as including flowrate monitoring. Ex. 1002, ¶¶ 132-134. The sensors aid in carrying out a fracturing plan, <i>e.g.</i>, by using collected data “to create real-time logging of operational metrics, such as duration between various stages.” [0026]. <i>Krupa</i>’s sensors provide information about the state of the automated fracturing operation and help provide choices for possible stages. [0026]. Closed-loop valve control systems using sensor data allows valve control and monitoring without visual inspection to reduce human interaction with equipment. [0026]. <i>Krupa</i>’s “operational metrics,” which include measured flowrate data, would necessarily include thresholds indicating the “current state of the hydraulic fracturing operation” and choices for possible next stages to form the “closed loop valve control system.” <i>See</i> Ex. 1002, ¶¶ 135-139. In an example of <i>Krupa</i> using flowrate: When a frac stage of the first wellhead assembly ... is at an end, a flush fluid may be pumped to flow ... at a full pump rate, such as a rate of about 50-150 bbl/min, into the first wellhead assembly.... Once a total volume of the flush fluid is pumped, a pump rate may be reduced from the full pump rate [<i>e.g.</i>] to 5-15 bbl/min. Once a pressure has stabilized at the reduced pump rate, the software application may move the fracturing pumping plan to the next step. [0042]. <i>Krupa</i> discloses flowrate limits as examples of flowrate thresholds indicating when to move to a next step in a

Claim	<i>Krupa</i>
	fracturing operation. Dr. Durham explains that a POSITA would understand <i>Krupa</i> 's disclosure as providing an example where a flowrate is determined to be below a threshold of 15 bbl/min, which would have been measured with at least one of <i>Krupa</i> 's sensors. Ex. 1002, ¶¶ 135-139.
<u>[1.4]/[8.6]</u> -"has been below the flow rate threshold for a threshold amount of time"	<i>Krupa</i>'s system reduces fluid flow into a well from a higher rate (about 50-150 bbl/min) to a lower rate (5-15 bbl/min), and when it is determined that the "pressure has stabilized at the reduced pump rate," the next step of the fracturing plan can be performed. [0042]. Making sure the "pressure has stabilized at the reduced pump rate" necessarily and thus inherently includes waiting a threshold amount of time to make sure the pressure is stable. Ex. 1002, ¶ 140. Alternatively, "a POSITA would have immediately recognized that measuring changes in flow rate over time is a common and necessary part of a zipper or [CP] fracturing operation." <i>Id.</i>, ¶¶ 141-142.
<u>[1.5]/[8.7]</u> -"(c) during pumping of the fluid into the first well via the first valve, opening a second valve associated with a second well;"	<i>Krupa</i> discloses methods of fracturing multiple wells that "allow the [CP] of fluids, connecting the initial and terminal "cleaning" portions of the frac operations of a first well and a second well, respectively." [0058]. <i>Krupa</i>'s CP methods "include pumping the fluids into a second well via the at least one pump manifold while continuously pumping the fluids into the first well by opening a second set of valves." [0005]. Figure 2B illustrates where "a second set of valves 223, 224 may be opened while the first set of valves 221, 222 remain open during the pumping of the flush fluid." [0043].
<u>[1.6]/[8.8]</u> -"(d) permitting performance of a second hydraulic fracturing operation on the	<i>Krupa</i> discloses "a second set of valves ... may be opened while the first set of valves ... remain open during the pumping of the flush fluid" in the hydraulic fracturing operation of the first well. [0043]. With the second valves opened and fluid pumped therethrough, "hydraulic fracturing operations are conducted on the second wellhead assembly

Claim	Krupa
second well, which second hydraulic fracturing operation comprises pumping fluid into the second well via the second valve; and”	201b”:  Figure 2B (annotated)
[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>Krupa</i> further discloses “closing the first set of valves to stop pumping the fluids into the first well and isolating and continuously pumping the fluids into the second well.” [0005]. “Once injection is established and pressure has stabilized in both the first wellhead assembly 201a and the second wellhead assembly 201b, the first set of valves 221, 222 may be closed remotely to shut in the first wellhead assembly 201a:”

Claim	Krupa
	 Figure 2C (annotated) [0043].
[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.”	<i>Krupa</i>’s fracturing plans “include instructions to perform at least one [CP] operation for ... one or more wells.” Abstract, [0005]-[0007]. With Figures 2A-G, <i>Krupa</i> explains, “a main valve 220 may be open to allow fluid flow (see arrow 230) from the primary manifold connection 210b to the manifold connection 210a,” where “the fluid flow (see arrow 231) may flow from one end to another.” [0040].

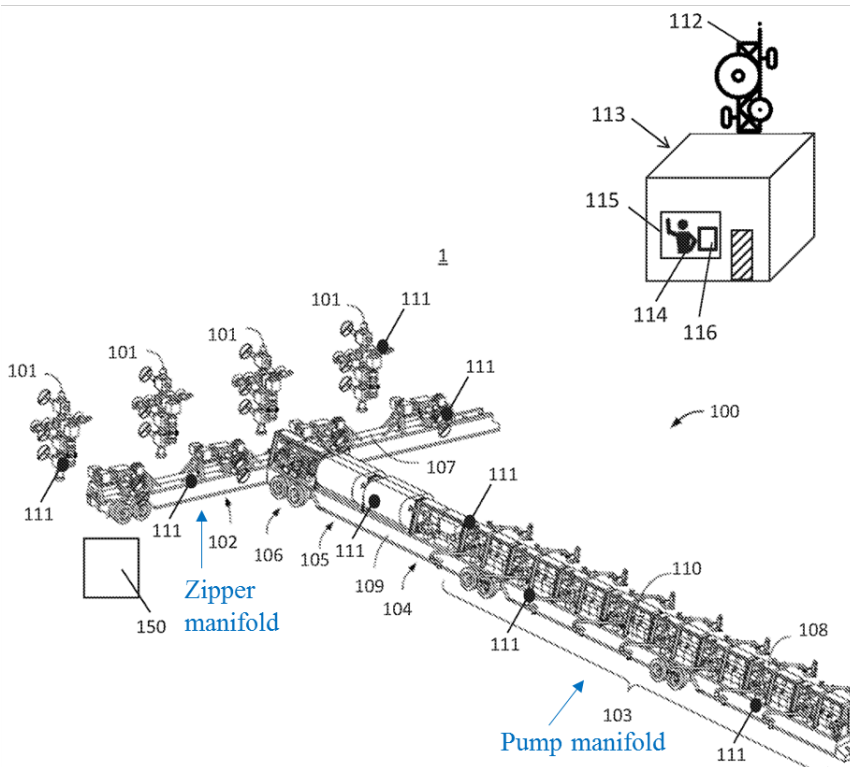
Intelligent Wellhead Systems, Inc. v. Downing Wellhead Equipment, LLC

As this claim chart demonstrates, *Krupa* actually or inherently discloses every limitation of Claims 1 and 8, as arranged in the claims. Thus, *Krupa* anticipates Challenged Claims 1 and 8.

Additionally, even if not explicitly disclosed in *Krupa*, determining whether a measured flowrate of fluid being pumped into a well is below a threshold would have been obvious in view of *Krupa*'s disclosure of "a reduction in flow indicating the end of the stage, and the subsequent 'move to the next step' executed by the software application." Ex. 1002, ¶¶ 135-141. Further, it was well-known to a POSITA at the time that reducing flowrate at the end of the fracturing stage is common, *e.g.*, to execute a mechanical operation or to perform performance tests. *Id.*, ¶¶ 137. Thus, even if any differences exist between *Krupa*'s disclosure and the limitations of Claims 1 and 8, such differences are clearly insubstantial, and *Krupa* would still render obvious these Challenged Claims' subject matter "as a whole." *Id.*, ¶ 122-152 (Claim 1), 165-176 (Claim 8).

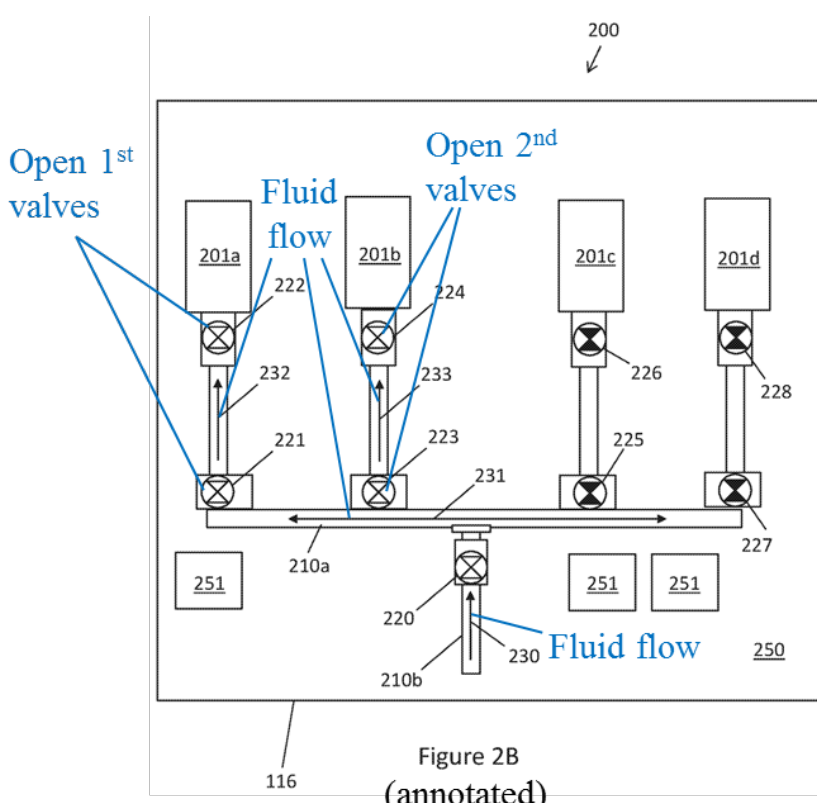
2. CLAIMS 2 AND 9

limitations:

Claim	Krupa
[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”	<i>Krupa’s “hydraulic fracturing pumping system[s]” include multiple wellhead assemblies (101) coupled to a zipper manifold (102), where a pump manifold (103) directs pressurized fracking fluid from one or more high pressure pumps to the zipper manifold (102) for selective distribution to the wells:</i>  Figure 1 (annotated)

⁷ Dependent claims are identified in the format “[dependent claim #]([independent claim #])” or “[dependent]([independent],[intervening dependent claim])”.

Claim	Krupa
	[0019]. Figure 2B illustrates CP in such systems, where “a main valve 220 may be open to allow fluid flow (see arrow 230) from the primary manifold connection 210b” to flow throughout the manifold connection 210a (arrow 231) to valves associated with each well: Figure 2B (annotated) [0005], [0040], [0046]. With fluid flowing continuously in the manifold connection 210a, different valves (<i>e.g.</i>, first and second valves 221, 223) may be opened to allow fluid from the manifold connection 210a to flow into respective wellhead assemblies (<i>e.g.</i>, 201a, 201b). [0043].

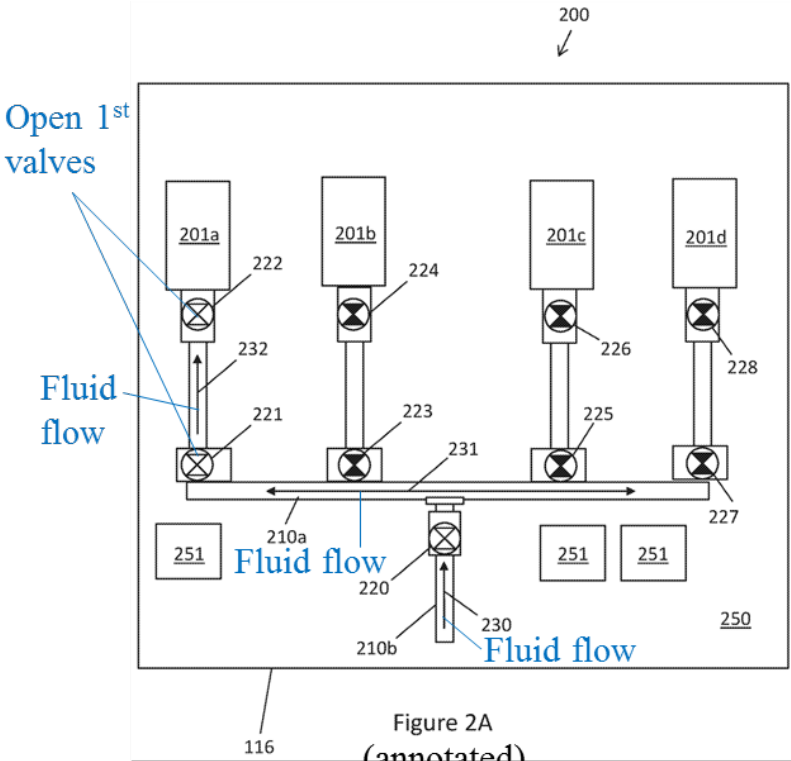
Claim	Krupa
[2.2]/[9.2]- “wherein, during each of steps (a), (b), (c), (d), and (e), fluid is continuously pumped from the hydraulic manifold to the first valve, the second valve, or both the first valve and the second valve.”	<i>Krupa</i> discloses flowing fluid continuously through a manifold connection (210a), where different sets of valves are opened to allow the fluid from the manifold to flow into the respective wellhead assemblies ([0043]):  Figure 2B (annotated) Continuous hydraulic fracturing pumping operations may thereby be conducted between multiple wellhead assemblies by continuously pumping hydraulic fracturing fluid from a manifold to each wellhead assembly’s valves. [0005], [0046].

In addition to disclosing Claims 1/8, *Krupa* discloses each limitation of Claims 2/9. *See also* Ex. 1002, ¶¶ 153-156, 177-178. *Krupa* therefore also

anticipates/renders obvious Challenged Claims 2 and 9.

3. CLAIMS 3 AND 10

Krupa also discloses the limitations of dependent claims 3(1) and 10(8).

Claims	<i>Krupa</i>
[3][10]–“wherein the second valve is opened after step (b).”	<i>Krupa</i>’s CP methods “include pumping the fluids into a second well via the at least one pump manifold while continuously pumping the fluids into the first well by opening a second set of valves” after determining flow conditions of the fluid pumped into the first well:  Figure 2A (annotated)

Claims	<i>Krupa</i>
	Figure 2B (annotated) [0005]; Ex. 1002, ¶¶ 157-160, 179-180. In Figure 2A, “[w]hen a frac stage of the first wellhead assembly 201a is at an end, a flush fluid may be pumped to flow...at a full pump rate, such as a rate of about 50-150 bbl/min, into the first wellhead assembly 201a via a first set of valves 221, 222.” [0042]. “Once a total volume of the flush fluid is pumped, a pump rate may be reduced from the full pump rate,” e.g., to 5-15 bbl/min, and then, once the “pressure has stabilized at the reduced pump rate, the software application may move the fracturing pumping plan to the next step,” shown in Figure 2B. [0042] Figure 2B shows the next step in the pumping plan includes opening a second set of valves 223, 224 to the second well “while the first set of valves 221, 222 remain open during the pumping of the flush fluid.” [0043]. <i>Krupa</i>’s “flush fluid” is a “fracturing fluid.” [0018]; Ex. 1002, ¶ 215.

Claims	<i>Krupa</i>
	<i>Krupa</i> also discloses using sensors to measure various conditions, including flowrate, which may be used to determine the state of a fracturing job. <i>See e.g.</i> , [0002], [0014], [0048]. <i>Krupa</i> ’s sensors “may be used to collect data on status [and] process conditions” such as valve/pump/flow-line monitoring, and others. [0024]-[0025].

Krupa therefore also anticipates and/or renders obvious Challenged Claims 3 and 10.

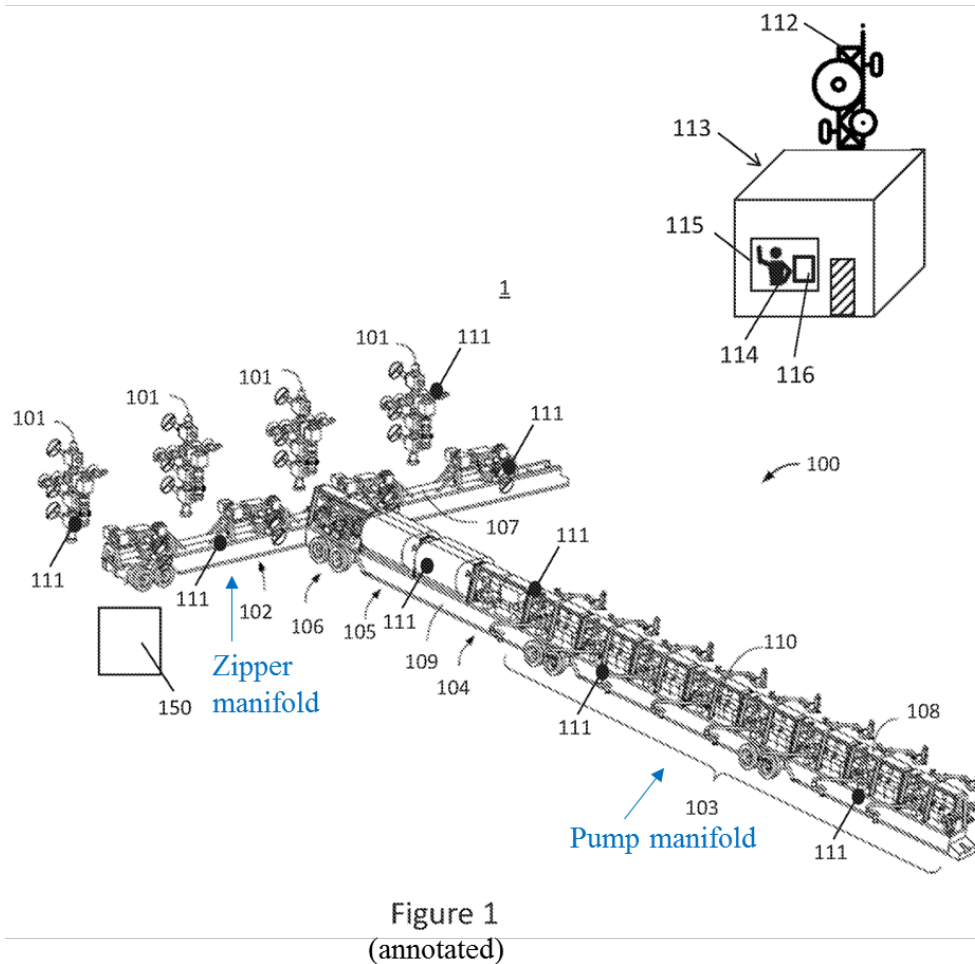
4. CLAIMS 6 AND 13

Krupa also discloses dependent claims 6(1) and 13(8) (“wherein each of the first and second valves is a zipper valve”), which merely label first/second valves differently without imparting any distinguishable functionality/structure over what the independent claims recite.

Nor does ’779’s specification define or describe “zipper” valves as having any distinguishable feature from any other valve capable of allowing fluid flow into a well. 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. ’779, 7:58-61, 7:63-66, 14:7-9, 14:20-23, 14:27-31, 14:41-46, and associated figures.

Accordingly, *Krupa* discloses “zipper valves” for the same reasons *Krupa* discloses the claimed first and second valves.

(101) coupled to a zipper manifold (102) through one or more flow lines:



[0019].

Krupa discloses that pumped/pressurized fracking fluid is directed through a pump manifold to the zipper manifold, “which may include...valves that may be closed to isolate wellhead assembly 101 from the flow of pressurized fluid within the zipper manifold 102 and pump manifold 103.” [0019]. Thus, *Krupa*’s valves that

are opened/closed to direct fluid to different wells from the zipper manifold are zipper valves. See also Ex. 1002, ¶¶ 161-164, 181-182.

Krupa therefore also anticipates and/or renders obvious Challenged Claims 6 and 13.

5. INDEPENDENT CLAIMS 15 AND 25

Claims 15 and 25 are substantively the same, except Claim 25 adds generic computer system limitations. Given their similarities, the claims are discussed together. *Krupa* discloses all limitations of both claims.

Claims	<i>Krupa</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>Krupa</i> discloses 15.1. <i>Krupa</i> also discloses a computer system (apparatus) that performs 15.1’s method. [0036]-[0037].
[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	These limitations are identical to 8.1-8.2. <i>Krupa</i> discloses them as shown in Section X.A.1.

Claims	<i>Krupa</i>
following steps are executed:”	
[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>Krupa</i> discloses 15.1 for the same reasons discussed in Section X.A.1.
[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”	This limitation combines 1.5 and 1.6. <i>Krupa</i> discloses these limitations as shown in Section X.A.1.
[15.3]/[25.5] “measuring a flow rate of the fluid being pumped into the second well;”	This limitation is identical to 1.2. <i>Krupa</i> discloses this limitation as shown in Section X.A.1.
[15.4]/[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	<i>Krupa</i> discloses a hydraulic fracturing system may be automated to “perform [CP] processes in a hydraulic fracturing operation ... for continuous non-stop pumping for one or more wells.” [0017]. For example, fracturing operations may be transitioned “from one well to a second well.” [0038], [0046]. Hydraulic fracturing is permitted in a (first) well by opening an associated set of valves and pumping fluids into the first well from a manifold. [0005]. Hydraulic fracturing is stopped in another (second) well by closing the associated set of valves to stop fluid flow into the second well. [0005].

Claims	Krupa
the first valve; and closing the second valve associated with the second well”	
[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>Krupa</i> discloses flowing fluid continuously through a manifold connection (e.g., 210a in Figure 2A) to different sets of valves (e.g., first valves 221/222 and second valves 223/224). [0043]. Valves are opened to allow the fluid from the manifold to flow into respective wellhead assemblies (e.g., 201a, 201b). Figure 2A Continuous hydraulic fracturing pumping operations are thereby conducted between multiple wellhead assemblies by continuously pumping hydraulic fracturing fluid from a manifold to the valves associated with each wellhead assembly. [0005], [0046].

Claims	<i>Krupa</i>
[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 (b);”	<i>Krupa</i>’s CP methods include transitioning fracturing operations “from one well to a second well.” [0038], [0046]. Hydraulic fracturing is permitted in a (first) well by opening an associated set of valves and pumping fluids into the first well from a manifold. [0005]. Hydraulic fracturing is stopped in another (second) well by closing the associated set of valves to stop fluid flow into the second well. [0005]. <i>Krupa</i> notes that the sequence of hydraulic fracturing operations between multiple wells “may be conducted between any of the wellhead assemblies ... in any order.” [0046]. <i>Krupa</i> also discloses that sensors, such as flowrate sensors, may be used to aid in carrying out a fracturing plan, for example, by using the collected data “to create real-time logging of operational metrics, such as duration between various stages” and “to determine current job state and provide[] choices for possible stages.” [0026]. Thus, the measured sensor data disclosed in <i>Krupa</i> may be used to indicate the state of and next steps in a hydraulic fracturing operation. <i>Krupa</i> uses flowrate parameters for such purposes, where a system pumps fluid into a well at a higher rate (50-150 bbl/min), then reduces fluid flow to a lower rate (5-15 bbl/min), and when the “pressure has stabilized at the reduced pump rate, the software application may move the fracturing pumping plan to the next step.” [0042]. A POSITA would understand <i>Krupa</i>’s flowrate limits as examples of flowrate conditions indicating when to move to a next step in a fracturing operation, which would include opening the first valve before closing the second valve. Ex. 1002, ¶¶ 213-216.
[15.7]/[25.9]–“or in response to determining	This limitation is a second option in an “or” clause of Claim 15, and merely recites closing a valve and

Claims	<i>Krupa</i>
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).”	moving to a next well. Courts have agreed that the “common usage” of “or” in claims means a choice between either one of two alternatives. <i>Kustom Signals, Inc. v. Applied Concepts, Inc.</i>, 264 F. 3d 1326, 1331-1332 (Fed. Cir. 2001). <i>Krupa</i> discloses the first option in the “or” clause. <i>See</i> 15.6/25.8 discussion. <i>Krupa</i> also discloses the second option by disclosing “a typical frac operation may include... shutting in of the first well, then moving to the next well.” [0058]. <i>Krupa</i> discloses that CP operations are allowed under selected flow conditions, <i>e.g.</i>, when pumping at a lower rate until pressure has stabilized. [0042], [0058]. Conversely, when the conditions are not met, the fracturing plan would not be moved to the next step. Ex. 1002, ¶¶ 218-220. For example, <i>Krupa</i> also discloses modifying fracturing plans based on sensor data “due to unforeseen events such as downhole conditions changing, equipment failures...and/or hydraulic fracturing performance changing,” which includes closing a valve and moving to a next well. [0057].

In sum, *Krupa* discloses every limitation as arranged in Claims 15 and 25 and therefore anticipates these Challenged Claims.

Also, to the extent any differences exist between *Krupa* and these claims, their subject matter as a whole would have been obvious to a POSITA. Ex. 1002, ¶¶ 183-221, 249-261. For example, even if *Krupa* does not explicitly teach a typical frac sequence (opening a first well’s valve after closing a second well’s valve) conducted in response to flowrate conditions not being satisfied, a POSITA would have known

that absent flowrate conditions allowing CP, “the proper response would be to revert to conventional valve sequences.” *Id.*, ¶ 220. “In other words, if the system of *Krupa* determines that continuous pumping operations should not proceed, then the backup would, obviously, be conventional fracturing operations.” *Id.*

6. CLAIMS 16 AND 26

Dependent claims 16(15) and 26(25) are substantially identical and recite already-analyzed limitations to third and fourth wells, which *Krupa* also discloses. Given their similarity, the claims are discussed together.

Claims	<i>Krupa</i>
[16.1]–“A method of hydraulically fracturing ...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]–“An apparatus adapted to hydraulically fracture...wherein the apparatus is further adapted to	<i>Krupa</i> discloses an automated fracturing system to “perform [CP] processes in a hydraulic fracturing operation ... for continuous non-stop pumping for one or more wells.” [0017]. Figures 2A-2G show “continuous hydraulic fracturing pumping operations between” “a first wellhead assembly 201a of a first well, a second wellhead assembly 201b of a second well, a third wellhead assembly 201c of a third well, and a fourth wellhead assembly 201d of a fourth well.” [0038], [0046]. <i>Krupa</i> discloses each wellhead assembly may comprise “valves fluidly connected to a wellhead that are adapted to control the flow of fluid into and out of the wellhead,” including third and fourth valves associated with third and fourth wells. [0020].

Claims	<i>Krupa</i>
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>Krupa</i> discloses automated continuous hydraulic fracturing for multiple wells. [0017]. Figures 2A-2G of <i>Krupa</i> show CP operations transitioning between four wells 201a-201d, where “the sequence of the fracturing pumping plan ... may be conducted between any of the wellhead assemblies 201a-201d in any order.” [0038], [0046]. In Figures 2E-G, hydraulic fracturing is permitted in well 201c (which may be a fourth well) by pumping fluids into the well from a manifold through opened associated valves, and then hydraulic fracturing is switched to well 201d (which may be a third well) by pumping fluids into the well from the manifold through opened associated valves and closing the valves to well 201c ([0005]):

Claims	Krupa
	Figure 2E (annotated)

Claims	Krupa
	Figure 2F (annotated)

Claims	Krupa
	Figure 2G (annotated)

Krupa discloses every limitation as arranged in Claims 16 and 26 and therefore anticipates these Challenged Claims.

Also, to the extent any differences exist between *Krupa* and these claims, their subject matter as a whole would have been obvious to a POSITA. Ex. 1002, ¶¶ 222-231, 262-265.

7. CLAIMS 17 AND 27

Dependent claims 17(15,16) and 27(25,26) are identical. *Krupa* also discloses these claims' limitations.

Claims	<i>Krupa</i>
<u>[17]/[27]</u> -"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."	<i>Krupa</i> discloses automated continuous hydraulic fracturing for multiple wells. [0017]. Figures 2A-2G show continuous hydraulic fracturing pumping operations between wells 201a-201d, where the operations may be conducted between any of the wells "in any order." [0046]. Fracturing a well is conducted by opening valves associated with the well to permit fluid flow into the well from a manifold, and fracturing of another well is stopped by closing associated valves to stop fluid flow to the well. [0005]. <i>Krupa</i> discloses that although examples of transitioning from one well to another well are explained in detail, the disclosed systems and methods may likewise be used for "transitioning operations from two wells to two wells, etc. (one or more transitioning to one or more while continuously pumping)." [0046].

Thus, *Krupa* discloses that hydraulic fracturing operations include swapping from permitting simultaneous hydraulic fracturing of two wells (*e.g.*, second and fourth wells), to another two wells (*e.g.* first and third wells), by opening the valves associated with the first and third wells to permit pumping fluid into them and closing the second and fourth wells' valves. *Krupa* therefore anticipates claims 17 and 27, and to the extent any differences exist between *Krupa* and these claims, their

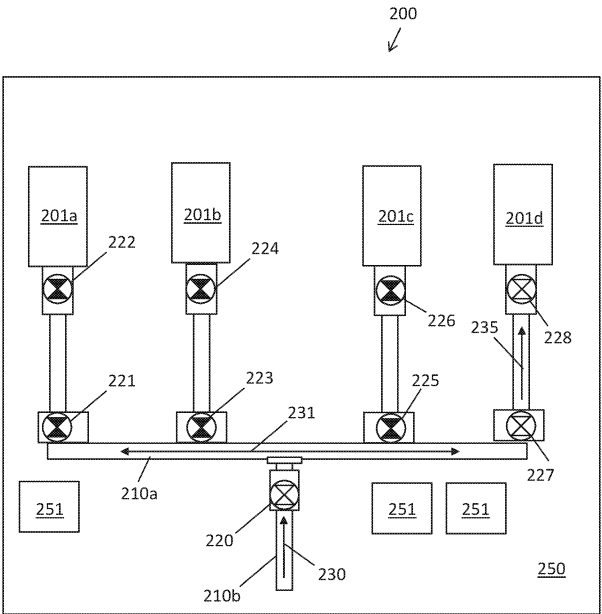
subject matter as a whole would have been obvious to a POSITA. Ex. 1002, ¶¶ 232-237, 266-267.

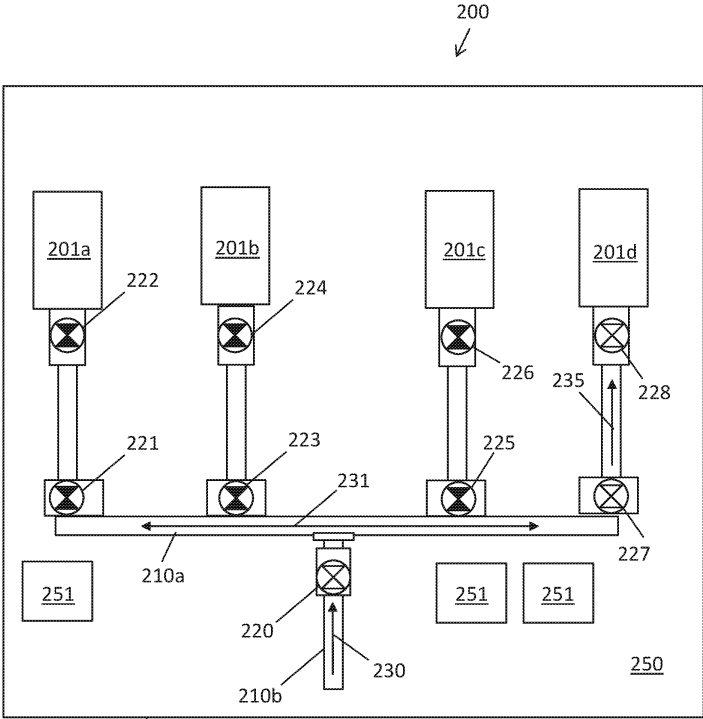
8. CLAIMS 18 AND 28

Dependent claims 18(15,16) and 28(25,26) are identical. *Krupa* discloses the limitations of these claims.

Claims	<i>Krupa</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>Krupa</i> discloses automated continuous hydraulic fracturing for multiple wells, including first through fourth wells. [0017], [0038], [0046]. <i>Krupa</i> explains, “pressurized fracking fluid from one or more high pressure pumps” may be directed to a zipper manifold, “which may include one or more valves that may be closed to isolate” each wellhead assembly from the flow of pressurized fluid within the zipper manifold. [0019]. Additionally, each wellhead assembly has valve(s) “fluidly connected to a wellhead that are adapted to control the flow of fluid into and out of the wellhead.” [0020]. <i>Krupa</i> demonstrates continuously pumped fluid to the valves for each well in the multi-well system in Figures 2A-G, where Figures 2E-G (shown below) specifically show continuous fluid flow to third and fourth valves (225, 227) via manifold 210, as these valves are opened and closed to selectively allow/prevent fluid flow to their respective wells. [0040], [0043].

Claims	Krupa
	Figure 2E
	Figure 2F

Claims	<i>Krupa</i>
	 Figure 2G
[18.2]/[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”	In <i>Krupa</i>’s CP methods, a fourth set of valves (227, 228) are opened to permit fluid flow (arrow 235) into a fourth well (201d):

Claims	<i>Krupa</i>
	 Figure 2G 116 [0045].
[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>Krupa</i> discloses opening a third set of valves (225, 226) associated with a third well (201c) to permit pumping of fluid (arrow 234) into the third well (Figure 2F), and closing the fourth set of valves (227, 228) associated with the fourth well (201d) (Figure 2E):

Claims	Krupa
	Figure 2F
	Figure 2E
	<i>Id.</i>

In sum, *Krupa* discloses every limitation of these claims and thus anticipates them. To the extent there are any differences between *Krupa* and these Challenged Claims, their subject matter as a whole would have been obvious to a POSITA. Ex. 1002, ¶¶ 238-248, 268-272.

9. CLAIMS 31 AND 36

Dependent claims 31(25) and 36(15) are identical. *Krupa* discloses these claims' limitations:

Claims	<i>Krupa</i>
<u>[31]/[36]</u> -"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>Krupa</i> 's sensors, including flowrate sensors, indicate the state of and next steps in a hydraulic fracturing operation. For example, sensors "aid in monitoring a valve position to determine current job state and provides choices for possible stages" and "provide information such that a current state of the hydraulic fracturing operation... is obtained." [0026]. A system pumps fluid into a well at a higher rate (about 50-150 bbl/min), then reduces fluid flow to a lower rate (5-15 bbl/min); when the lower rate is determined to be stable, the next fracturing-plan-step can be performed. [0042].

A POSITA would understand *Krupa*'s flowrate limits as examples of flowrate thresholds indicating when to move to next steps in fracturing operations. Ex. 1002, ¶¶ 274-276. For example, a POSITA would understand *Krupa* as providing an example where a reduced flowrate is determined to be "below an upper flowrate

threshold” of 15 bbl/min and “above a lower flowrate threshold” of 5 bbl/min. *Id.*

Once the flowrate threshold range has been achieved for long enough for pressure to stabilize, the next step of the fracturing pumping plan may occur, which includes opening the valve associated with the next well to be fractured (*i.e.*, a first valve associated with a first well) before closing the valve to the well in the current pumping stage (*i.e.*, a second valve associated with a second well). *Krupa*, [0043]. Conversely, a POSITA would understand that flowrates outside the flowrate threshold range (above the upper or below the lower flowrate thresholds) would not meet the conditions for moving to the next stage. Ex. 1002, ¶¶ 277-278.

In sum, *Krupa* discloses every limitation of and thus anticipates the Challenged Claims. To the extent any differences exist between *Krupa* and these claims, their subject matter as a whole would have been obvious to a POSITA. Ex. 1002, ¶¶ 273-281.

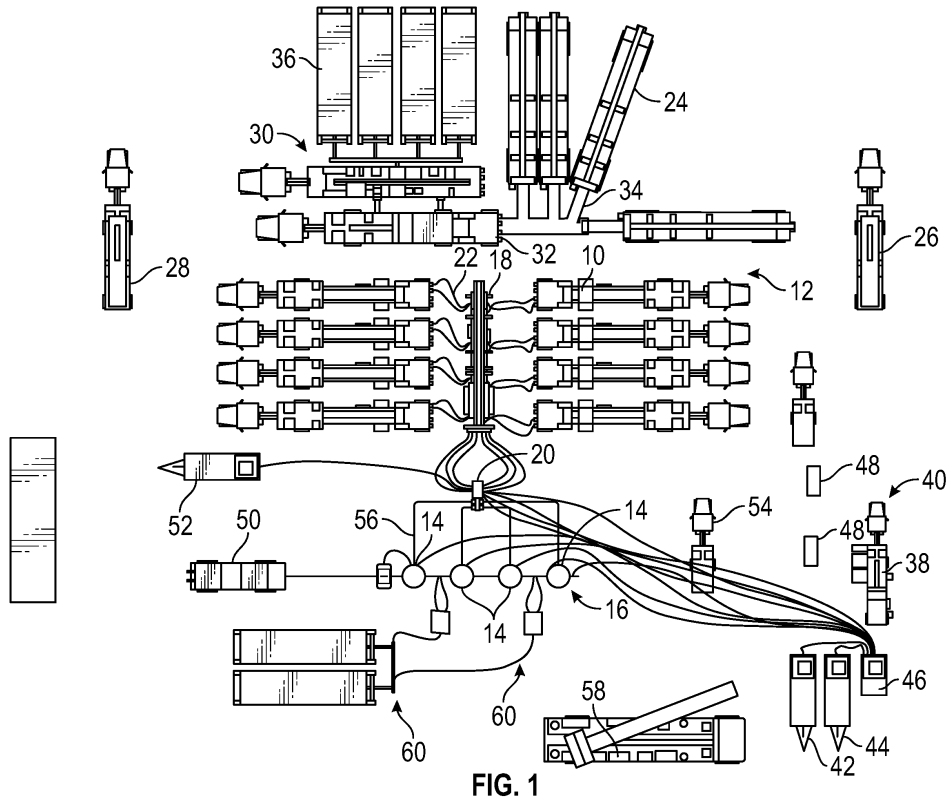
B. GROUND 3-KAJARIA IN VIEW OF JACKSON

The Examiner stated that *Kajaria* disclosed or rendered obvious all limitations of the Challenged Claims except for flowrate threshold limitations. Ex. 1009, p. 3-7. Downing did not dispute this. *Id.*, 80-102. Instead, Downing added flowrate threshold limitations to get '779 issued.

But flowrate thresholds were known in hydraulic fracturing operations prior to the '779 Patent, as evidenced by *Jackson*. A POSITA would have found it obvious to use *Jackson*'s fracturing operation flowrate thresholds in *Kajaria*'s fracturing methods/systems, for example, to indicate fracturing stage status and determine next operational steps. Ex. 1002, ¶¶ 282-287. Ground 3 combines *Jackson* with *Kajaria*.

1. INDEPENDENT CLAIM 1**Limitation [1.1]**

Kajaria discloses permitting performance of a first hydraulic fracturing operation on a first well (*e.g.*, one of the wells 14) that includes pumping fluid into the first well via a first valve (*e.g.*, valve 66) associated with the first well. As the Examiner explained (Ex. 1010, p. 3-5), *Kajaria* discloses hydraulic fracturing fluid pumped from a manifold (missile 18), through an inlet head (20) to multiple fluid conduits (56) each connected to a well (trees 14), including a first fluid conduit connected to a first well tree (14), to hydraulically fracture the wells:



Kajaria, [0025], [0029].

Figure 4 shows valves 66 positioned along the fluid conduits 56 “to enable blocking of fluid flow to a particular tree of a plurality of trees” and “flow to other trees”:

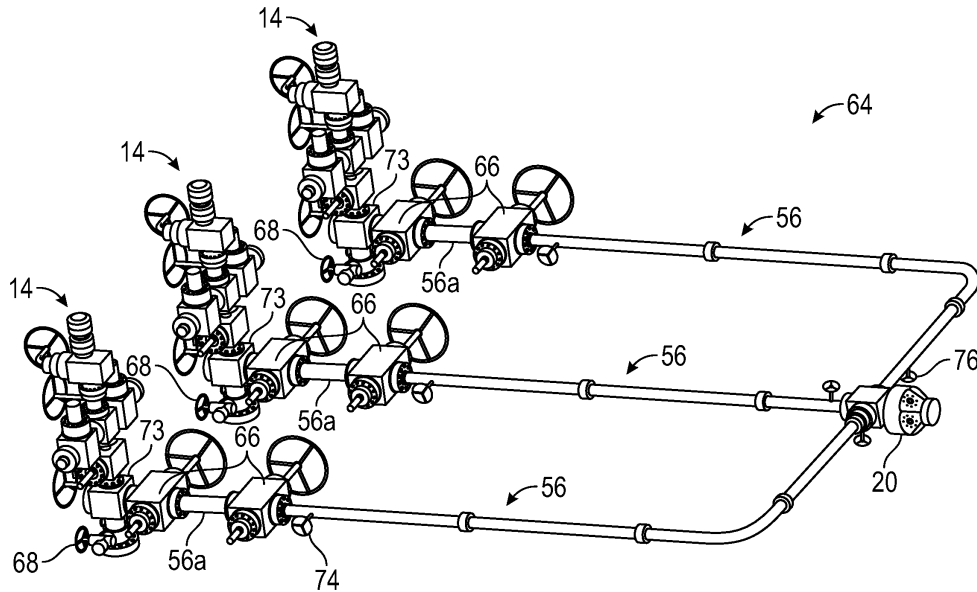


FIG. 4

“[S]elective flow to the trees may [thereby] be utilized to control, for example, fracturing operations.” *Kajaria*, [0024]. Thus, *Kajaria* discloses this limitation.

Limitation [1.2]

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 a fracturing process in the well, as *Kajaria* discloses.

Kajaria discloses “[m]onitoring equipment 38 can be mounted on a control vehicle 40, and connected to, *e.g.*, the pumps 10, blender 32, the trees 14, and other downhole sensors and tools (not shown) to provide information to an operator, and to allow the operator to control different parameters of the fracturing operation.” *Kajaria*, [0028].

Prior to '779, flowrate was a well-known parameter to measure and monitor during fracturing operations, for example, as taught by *Jackson*. In *Jackson*, flowrate is measured to assess if thresholds are met for a fracturing process. *Jackson*, [0019]. *Jackson* discloses fracturing methods for a well that 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.” *Jackson*, [0003]. “[A]fter reaching the third threshold and prior to ceasing flow, further thresholds may be reached by adjustment of fracturing fluid flow.” *Jackson*, [0003]. The thresholds may be flowrate thresholds. *Jackson*, [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.” *Jackson*, [0048].

It would have been obvious, based on a POSITA's general engineering knowledge, to combine *Jackson* and *Kajaria* to measure flowrate of fluid being pumped into a well to monitor/control a fracturing process to permit CP because *Jackson* teaches process parameters including flowrate were commonly observed to assess a fracturing process. Ex. 1002, ¶¶ 296-298.

Limitation [1.3]

Although the Examiner believed (incorrectly) that *Kajaria* did not disclose Limitation 1.3 (Ex. 1009, p. 7), *Kajaria* discloses “[m]onitoring equipment 38...and other downhole sensors and tools” as used in fracturing operations “to provide information to an operator, and to allow the operator to control different parameters of the fracturing operation,” and *Jackson* discloses flowrate as a known parameter to measure/monitor during fracturing operations. *Kajaria*, [0028]; *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 operational procedure was met. For example, *Jackson* describes processes for fracturing 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 criterion selected from a set of criteria consisting of: (a) a time period threshold; (b) a non-participating gas [fracturing fluid] flow rate threshold;” and others, where process parameters such as flowrate and volume are observed to assess the fracturing process. *Jackson*, [0017], [0019]. *Jackson* also discloses the threshold may be defined as a flowrate of less than a selected flowrate, such as during a period of pumping relaxation. *Jackson*, [0061].

Thus, while *Kajaria* broadly discloses monitoring/controlling fracturing operation parameters, *Jackson* gives more detailed guidance including monitoring flowrate to control fracturing according to flowrate thresholds. Accordingly, a POSITA would have considered using *Jackson*'s systems/methods for monitoring flowrate according to flowrate thresholds as a simple complement to *Kajaria*'s parameter monitoring/control to predictably control fracturing operations. Ex. 1002, ¶ 299-302.

Therefore, even if *Kajaria* did not teach using flowrate thresholds “to provide information to an operator” for determining when to move to a next stage, a POSITA would have been motivated to incorporate *Jackson*'s teachings of flowrate thresholds into *Kajaria*'s fracturing system. *Id.*

Limitation [1.4]

Kajaria discloses “[m]onitoring equipment 38...and other downhole sensors and tools” are used in fracturing operations “to provide information to an operator, and to allow the operator to control different parameters of the fracturing operation,” but does not provide specific details of the types of parameters monitored. *Kajaria*, [0028]. *Jackson* lists specific parameters to be used as “thresholds” to trigger the next stage of the fracturing operation, including flowrate and time period thresholds. *Jackson*, [0017]-[0019]. “Accordingly, a POSITA would have looked to *Jackson* for teaching which parameters should be measured in the system of *Kajaria* to allow

the operator to control different parameters of the fracturing operation.” Ex. 1002, ¶ 285. It thus would have been obvious to determine whether a flowrate of fluid being pumped into a well is below a flowrate threshold for a threshold amount of time, as *Jackson* teaches, to monitor and control a fracturing process in the well, as *Kajaria* discloses.

Additionally, *Kajaria*’s fracking system may “direct flow between wells continuously simply by opening or closing the valves...associated with individual wells,” as “it may be desirable to provide pressurized fluid to a particular well at a particular time or place in the frac cycle, while simultaneously stopping the flow of fluid into another well that is in a different place in the frac cycle.” *Kajaria*, [0035]. *Jackson* provides specific examples of flowrate and time thresholds used to indicate different stages in a frac cycle. For example, a frac cycle “relaxation stage” may be defined with a flowrate of less than a flowrate threshold of 300 scm for a time period threshold of between 1 minute and 24 hours. *Jackson*, [0061].

A POSITA also “would have been motivated to include *Jackson*’s teachings of measuring flowrate and using a flowrate threshold as part of the control of the valves to improve the system of *Kajaria*” because “the inclusion of a flowrate and time-based threshold would help *Kajaria* ensure that the proper volume of fracturing fluid is pumped down the wells to initiate the pressure pulse.” Ex. 1002, ¶ 286. For example, as understood by a POSITA, “measuring flowrate and combining it with

the time threshold would allow the operator to determine whether equipment failure, such as leaks or failed pumps, would prevent proper operation of the pulsed treatment,” and “to compare the effectiveness of treatment between the two wells.” *Id.*

A POSITA would have had a reasonable expectation of success in simply substituting *Jackson*’s methods of monitoring/determining stages in a frac cycle (using flowrate and time thresholds) for *Kajaria*’s methods of monitoring/determining stages in a frac cycle. *Id.*, ¶¶ 303-304.

Limitation [1.5]

Kajaria discloses a flow system for a hydraulic fracturing multi-well site, where valves along fluid conduits to the wells “permit[] fluid flow through the fluid conduit when in the open position, and prevent[] fluid flow through the fluid conduit when in the closed position.” *Kajaria*, Abstract, Figs. 1, 4. “[S]elective flow to the trees may be utilized to control, for example, fracturing operations.” *Kajaria*, [0024]. *Kajaria* discloses that allowing/preventing flow before it reaches a particular tree is advantageous because an operator may direct flow between wells of a multi-well site as needed (*e.g.*, different wells might operate on different cycles in a hydraulic fracturing operation). *Kajaria*, [0035]. Pressurized fluid may be provided to a particular well at a particular time/place in the frac cycle, while simultaneously stopping fluid flow into another well that is in a different stage in the frac cycle.

Kajaria, [0035]. This allows directing of “flow between wells continuously simply by opening or closing the valves 66 associated with individual wells.” *Kajaria*, [0035].

A POSITA would have understood that *Kajaria*’s disclosure of “continuously” directing flow between multiple wells “simply by opening or closing the valves” associated with each of the wells includes opening a second valve to a second well while fluid is being pumped into the first well via the first valve to continuously pump fluid between the first and second wells. Ex. 1002, ¶ 307.

Limitation [1.6]

Kajaria discloses performing a second fracturing operation on a second well that includes pumping fluid into the second well via an associated second valve, as claimed. *Kajaria*’s multi-well hydraulic fracturing system includes “an inlet head 20, and fluid conduit connecting the inlet head 20 to multiple trees 14, each associated with a well,” where the inlet head may receive fracturing fluid from hydraulic fracturing pumps via a missile. *Kajaria*, [0029], [0033]. The fluid conduit “includes at least one valve 66 capable of regulating flow through the fluid conduit 56 between the inlet head 20 and that particular tree 14.” *Kajaria*, [0033]. When the valve(s) are in the “open position, fluid flow through the fluid conduit 56 is unrestricted, and will enter the well,” to fracture the well, which may include a second well of the multiple wells. *Kajaria*, [0029], [0033].

Limitation [1.7]

In *Kajaria*'s multi-well fracturing system, selective flow to each well is controlled by opening and closing valves positioned along the flow conduits to each well. *Kajaria*, Abstract; Figs. 1, 4; [0024]. This "allows an operator to easily direct flow between wells at a multi-well site as needed in the course of operations." *Kajaria*, [0035]. For example, fluid flow may be directed "between wells continuously simply by opening or closing the valves 66 associated with individual wells" "to provide pressurized fluid to a particular well at a particular time or place in the frac cycle, while simultaneously stopping the flow of fluid into another well that is in a different place in the frac cycle." *Kajaria*, [0035].

A POSITA would have understood that *Kajaria*'s disclosure of "continuously" directing flow between multiple wells and providing fluid into a well while stopping flow to another would include closing the first valve associated with the first well while fluid is being pumped into the second well via the second associated valve in a process of continuously pumping fluid between the first and second wells. Ex. 1002, ¶ 312.

Limitation [1.8]

Kajaria discloses selectively directing pressurized fluid from hydraulic fracturing pumps through a fluid conduit into a well "by opening and closing fluid communication between the...hydraulic fracturing pump[s] and the...wells using

valves positioned in the fluid conduit and corresponding to each of the plurality of wells.” *Kajaria*, [0010]. With *Kajaria*’s systems, “it is possible direct flow between wells continuously simply by opening or closing the valves 66 associated with individual wells.” *Kajaria*, [0035] (emphasis added). Thus, *Kajaria* teaches that flow is continuously directed into different wells “simply by opening or closing” valves associated with the different wells. This is the same process recited in limitation [1.8].

In sum, *Kajaria* discloses every limitation of 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*, as part of a fracturing operation in *Kajaria*, as flowrate was a commonly-used parameter for control and monitoring of fracturing operations. Ex 1002, ¶¶ 288-316. Additionally, a POSITA would have recognized that using *Jackson*’s teachings of outlining a fracturing plan with flowrate and time thresholds in *Kajaria*’s systems would have merely involved “a simple substitution of one known element (e.g., specific thresholds) for another to obtain predictable results.” *Id.*, ¶ 287.

Kajaria in view of *Jackson* renders Challenged 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]

Kajaria discloses Limitations 8.1-8.2. *Kajaria* discloses “[m]onitoring equipment 38 can be mounted on a control vehicle 40, and connected to, *e.g.*, the pumps 10, blender 32, the trees 14, and other downhole sensors and tools (not shown) to provide information to an operator, and to allow the operator to control different parameters of the fracturing operation.” *Kajaria*, [0028]. The Examiner asserted that the “control vehicle 40 would have computer readable medium to allow [an] operator to control the valves for the fracturing process.” Ex. 1010, p. 4. Downing did not traverse that assertion. Ex. 1009, 80-102.

Kajaria's disclosure of the control vehicle inherently or obviously includes a plurality of instructions stored on non-transitory computer readable medium and executable by one or more processors. Ex. 1002, ¶¶ 332-335. It was well known in the art to control valves and other equipment in hydraulic fracturing operations with computers. *Id.* Thus, to the extent *Kajaria* does not explicitly disclose the computer-apparatus components, it would have been obvious to a POSITA that the control vehicle includes a computer with non-transitory computer readable medium and a

processor that executes instructions stored on a memory component to control valves in a well system “to allow the operator to control different parameters of the fracturing operation.” *Id.*; *Kajaria*, [0028].

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. Ex. 1002, ¶¶ 331-336, 462-468.

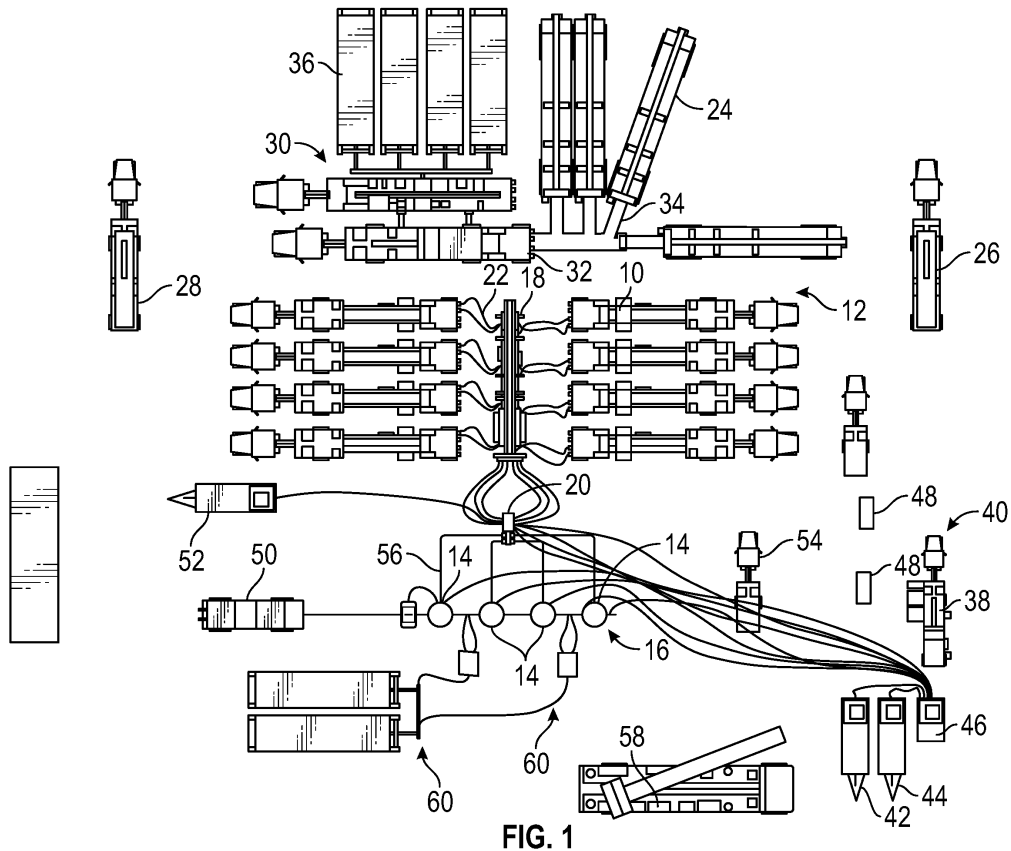
Therefore, Claim 8 is obvious over *Kajaria* in view of *Jackson*. *Kajaria* in view of *Jackson* also render obvious the Challenged Claims depending from Claim 8 (Claims 9, 10, and 13), as discussed below.

3. CLAIMS 2 AND 9

Limitations [2.1-2.2]/[9.1-9.2]

Kajaria discloses the valves associated with each well (including first and second valves associated with first and second wells) are in fluid communication with a hydraulic manifold (*e.g.*, missile 18) from which fluid is pumped (via pumps 10) to the valves (via the inlet head and fluid conduit), and that the fracturing fluid may be continuously pumped to/from a manifold to certain valves while switching hydraulically fracturing between wells, as claimed.

Kajaria’s multi-well fracturing system includes “fluid conduit connecting inlet head 20 to multiple trees 14, each associated with a well,” where the inlet head receives fracturing fluid from hydraulic fracturing pumps via missile manifold 18:



Kajaria, [0029], [0033].

Figure 4 shows the connections between the inlet head (20) and multiple wells (14) in more detail, where valves (66) along the fluid conduit (56) regulate flow to the associated well (14):

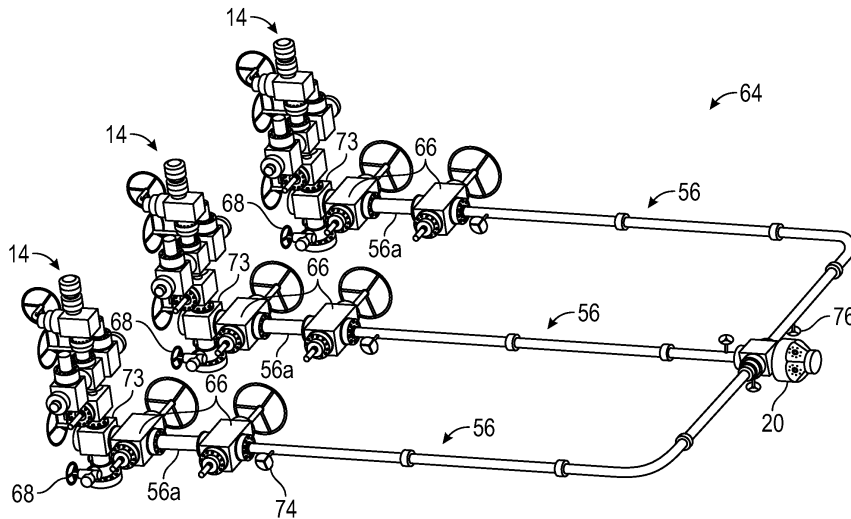


FIG. 4

Kajaria, [0033]. When the valve(s) to a selected well are in the “open position, fluid flow through the fluid conduit 56 is unrestricted, and will enter the well,” to fracture the selected well. *Kajaria*, [0029], [0033].

Further, *Kajaria* states that “[w]ith the flow system 64 of the present technology it is possible [to] direct flow between wells continuously simply by opening or closing the valves 66 associated with individual wells.” *Kajaria*, [0035].

Thus, in addition to the limitations disclosed by *Kajaria* and *Jackson* in Claims 1/8, *Kajaria* discloses limitations 2.1-2.2/9.1-9.2. See Ex. 1002, ¶¶ 317-320, 337.

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

4. CLAIMS 3 AND 10

Kajaria and *Jackson* render obvious opening the second valve after step (b). *Kajaria* discloses flow may be directed between wells continuously by opening/closing the valves associated with individual wells. *Kajaria*, [0035]. This “allows an operator to easily direct flow between wells at a multi-well site,” *e.g.*, to provide fluid to one well at a time/place in the frac cycle, while simultaneously stopping the flow of fluid into another well. *Kajaria*, [0035]. Further, monitoring equipment can be used “to provide information to an operator, and to allow the operator to control different parameters of the fracturing operation.” *Kajaria*, [0028].

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

Using *Jackson*’s outlined fracturing plan in *Kajaria*’s systems/methods for hydraulic fracturing operations would have involved simple substitution of one fracturing plan for another with the expectation of success. Ex. 1002, ¶¶ 321-326, 338.

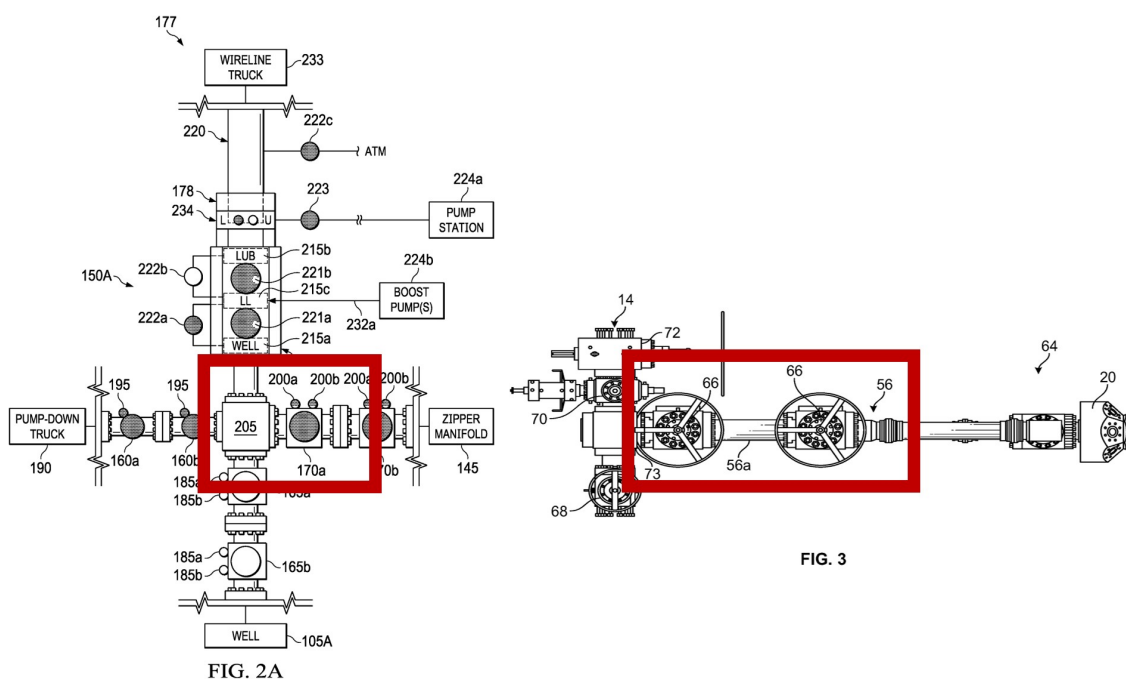
Accordingly, it would have been obvious to determine that the flowrate of the fluid being pumped into the first well is below a flowrate threshold and has been below the flowrate threshold for a threshold amount of time as an operational

condition, as taught by *Jackson*, prior to opening the second valve in a fracturing operation of *Kajaria*, to provide fluid to one well at a particular time/place in the frac cycle. *Id.*; *Kajaria*, [0035]. Challenged Claims 3 and 10 are therefore obvious over *Kajaria* in view of *Jackson*.

5. CLAIMS 6 AND 13

Kajaria discloses the valves are zipper valves. The recited “zipper valves” do not require any additional functionality or structure over the first and second valves recited in the independent claims, and thus are disclosed by *Kajaria* for at least the same reasons *Kajaria* discloses the claimed first and second valves.

Nevertheless, *Kajaria* discloses valves performing the same function and in the same location as ’779’s “zipper valves.” See ’779’s Fig. 2A and *Kajaria*’s Fig. 3 (annotated):



Zipper valves (*e.g.*, gate valves) are operably coupled to and adapted to communicate fluid to a well. '779, 7:58-61. In *Kajaria*, valves (66) along fluid conduits 56 “enable blocking of fluid flow to a particular tree of a plurality of trees, but to enable flow to other trees” for fracturing operations. *Kajaria*, [0024]. *Kajaria* also states that hydraulic fracturing manifolds using valves “to isolate wells as they complete a frac cycle, and to redirect fluid to a different well that is ready to begin a new frac cycle,” are known as “zipper manifolds.” *Kajaria*, [0006]-[0007]. In addition to the limitations disclosed by *Kajaria* and *Jackson* in Claims 1/8, *Kajaria* discloses the limitations recited in claims 6 and 13. See Ex. 1002, ¶¶ 327-330, 339.

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

6. INDEPENDENT CLAIM 15

Limitation 15.1

Limitation 15.1 combines Limitations 1.1 and 1.6. Accordingly, *Kajaria* discloses hydraulically fracturing first and second wells, the first and second wells being associated with first and second valves for the same reasons discussed above regarding Claim 1. Ex. 1002, ¶ 340-342.

Limitation 15.2

Limitation 15.2 combines Limitations 1.5 and 1.6. Accordingly, *Kajaria* 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. *Id.*, ¶¶ 343-346.

Limitation 15.3

Limitation 15.3 is identical to 1.2. Accordingly, this limitation is disclosed/taught/suggested for the same reasons discussed regarding 1.2. *Id.*, ¶¶ 347-349.

Limitation 15.4

The Examiner stated that *Kajaria* discloses swapping fracturing from a second well to a first well by closing/opening their associated valves. Ex. 1010, p. 3-4. This assertion was uncontested. Ex. 1009, 80-102.

Kajaria discloses a flow system having multiple wells connected to a pressurized fluid missile via multiple fluid conduits, where valves along the fluid conduits “permit[] fluid flow through the fluid conduit when in the open position, and prevent[] fluid flow through the fluid conduit when in the closed position.” *Kajaria*, Abstract. *Kajaria* discloses that fluid is directed between wells continuously by operating valves associated with wells to provide fluid to one well at a particular time/place in the frac cycle, “while simultaneously stopping the flow of fluid into another well that is in a different place in the frac cycle.” *Kajaria*, [0035].

Thus, *Kajaria* discloses swapping from permitting hydraulic fracturing of one well (*i.e.*, a second well) to permitting hydraulic fracturing of another well (*i.e.*, a first well) includes 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. Ex. 1002, ¶¶ 350-355.

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. *Id.*, ¶¶ 356-357.

Limitation 15.6

Kajaria discloses that selective flow to each of the wells in a multi-well site may be controlled by opening and closing the valves positioned along each well's flow conduits. *Kajaria*, Abstract; Figs. 1, 4; [0024]. *Kajaria* discloses directing fluid 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. *Kajaria*, [0035]. *Kajaria* also discloses using monitoring equipment and other downhole sensors "to provide information to an operator, and to allow the operator to control different parameters of the fracturing operation." *Kajaria*, [0028]. Thus, *Kajaria* discloses sensor data may be used to make decisions about a continuous hydraulic fracturing operation for multiple wells.

Jackson discloses determining if flowrate conditions were met for different stages of a fracturing process. *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.” *Jackson*, [0003].

It would have been obvious to use *Jackson*’s measured fluid flowrate into a well as the type of sensor data used in *Kajaria* to make decisions about a continuous hydraulic fracturing operation for multiple wells, including when to switch from fracturing one well to another. Ex. 1002, ¶¶ 358-362.

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, *Kajaria* and *Jackson* disclose or render obvious the first option in the “or” clause, and therefore meet this claim limitation. Though not necessary, *Kajaria* also discloses/rendered obvious the second option, by disclosing how “to isolate wells as they complete a frac cycle, and to redirect fluid to a different well that is ready to begin a new frac cycle.” *Kajaria*, [0006]. *Kajaria* also discloses directing fluid between wells continuously by operating valves associated with wells to provide fluid to one well at a particular time/place in the frac cycle, “while

simultaneously stopping the flow of fluid into another well that is in a different place in the frac cycle,” which would include closing a valve to one well “during” opening a valve to another well. *Kajaria*, [0035] (emphasis added). Further, a POSITA would have known “if the system of *Kajaria* determines that continuous pumping operations should not proceed, then the backup would, obviously, be...to revert to...conventional fracturing operations (*i.e.*, opening the first valve after the second valve is closed).” Ex. 1002, ¶¶ 363-366. Thus, *Kajaria* discloses this limitation.

For the above reasons, *Kajaria* in view of *Jackson* render Claim 15 obvious.

7. **INDEPENDENT CLAIM 25**

Claims 15 and 25 are nearly identical but Claim 25 adds the computer limitations of 8.1-8.2 to Claim 15’s limitations. It would have been obvious to perform Claim 15’s method with a computer. Ex. 1002, ¶¶ 389. *Kajaria* and *Jackson* disclose every limitation of Claim 25, as discussed with Limitations 8.1-8.2 and 15.1-15.7, respectively. 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 *Kajaria* to allow for control of the fracturing operation, rendering the subject matter of Claim 25 as a whole obvious. Ex. 1002, ¶¶ 389-392. Thus, Claim 25 is obvious over *Kajaria* in view of *Jackson*.

8. CLAIMS 16 AND 26

The Examiner asserted (and Downing did not traverse (Ex. 1009, 80-102)) that *Kajaria* discloses swapping fracturing of a fourth well to a third well, the wells having associated valves. Ex. 1010, p. 4-5.

Kajaria's hydraulic fracturing system is used to fracture multiple wells using associated valves. Figure 5's flow system includes a fluid conduit (56) connecting an inlet head to four trees (14), each attached to individual wells, where valves (66) associated with each well regulate flow through the conduit (56) to the well:

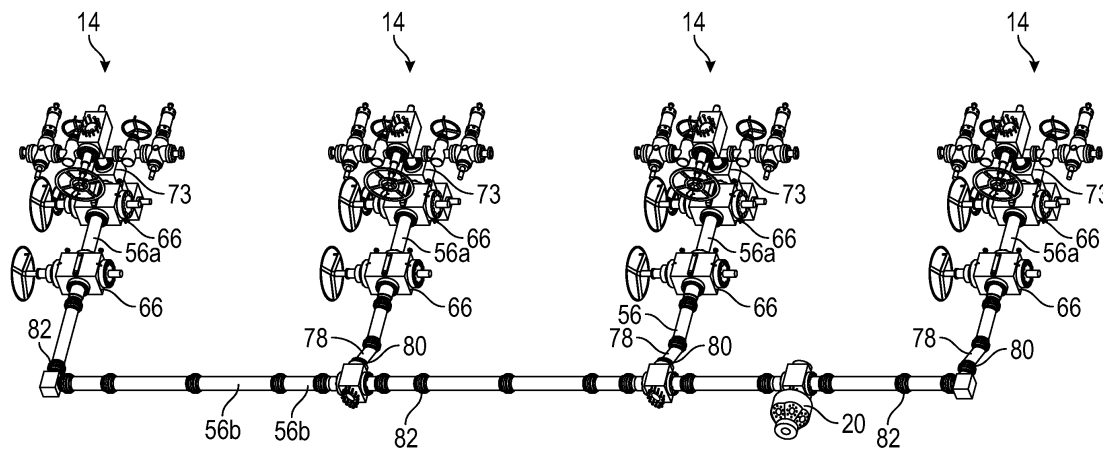
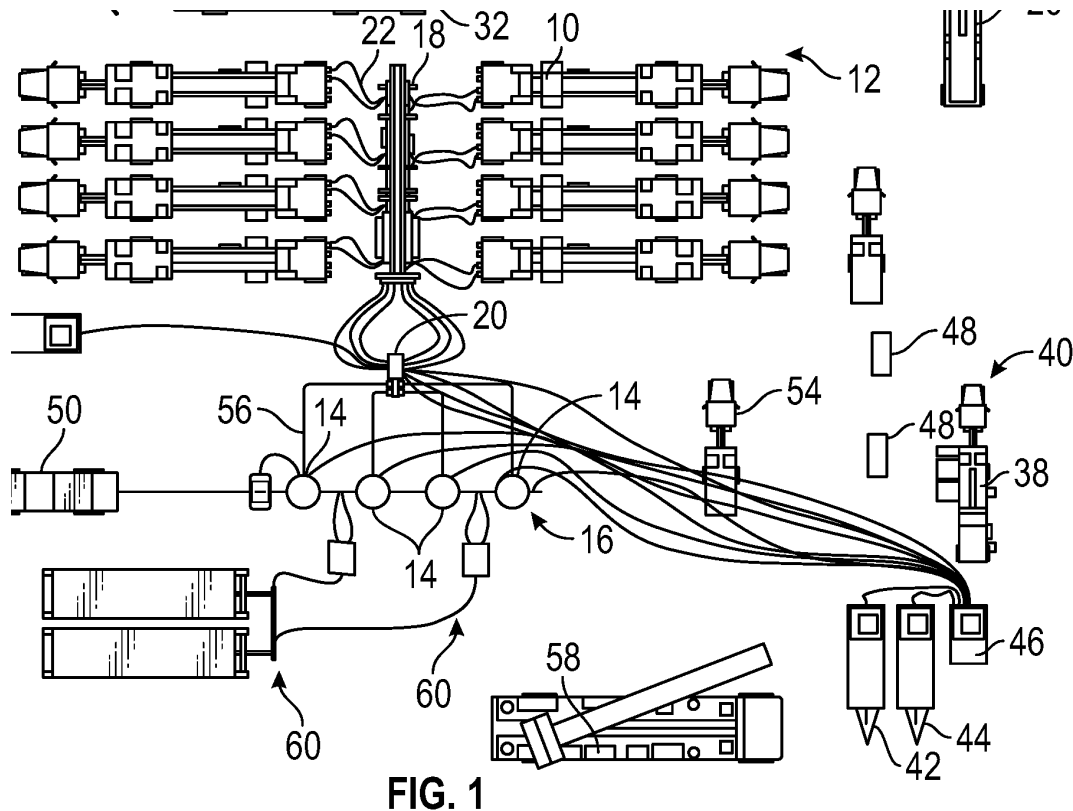


FIG. 5

Kajaria, [0033], [0039]. Thus, *Kajaria* discloses third and fourth wells and associated third and fourth valves (Limitations 16.1/26.1).

Kajaria's Figure 1 (excerpt below) shows hydraulic fracturing fluid may be pumped from a missile (18), through an inlet head (20) to multiple fluid conduits

(56), and to the four well trees (14). *Kajaria*, [0025], [0029]. The valves associated with each well “permit fluid flow through the fluid conduit when in the open position, and prevent fluid flow through the fluid conduit when in the closed position.” *Kajaria*, [0033].



With such flow systems, pressurized fluid may be selectively directed to one or more of the wells to hydraulically fracture different wells, including the third and fourth wells. *Kajaria*, [0010], [0035].

Thus, *Kajaria* discloses swapping from permitting hydraulic fracturing of one well, *e.g.*, a fourth well, to another well, *e.g.*, a third well (Limitations 16.2-16.3/26.2-26.3). Ex. 1002, ¶¶ 367-375 (Claim 16), 393-395 (Claim 26).

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

9. CLAIMS 17 AND 27

The Examiner concluded that *Kajaria* discloses simultaneously fracturing second and fourth wells using fracturing fluid from a manifold and simultaneously swapping to fracturing first and third wells using fracturing fluid from the manifold. Ex. 1010, 5. This conclusion was uncontroverted. Ex. 1009, 80-102.

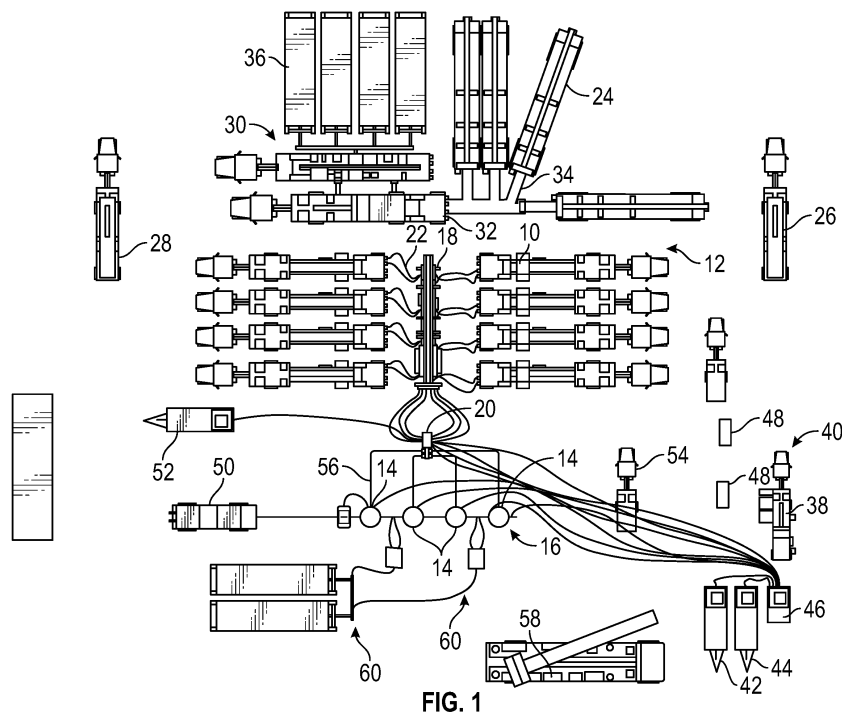
As discussed with claims 15 and 16/26, *Kajaria* discloses conditions for simultaneous fracturing and swapping hydraulically fracturing multiple wells by directing hydraulic fluid from a hydraulic manifold (*e.g.*, missile 18, Figure 1), through the inlet head (20) and fluid conduits (56), to multiple wells (14), including first-to-fourth wells, via valves (66) associated with each well. *Kajaria*, [0010]. The fluid is directed between wells continuously by operating the valves associated with individual wells. *Kajaria*, [0035]. This “allows an operator to easily direct flow between wells at a multi-well site as needed,” 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.” *Kajaria*, [0035].

Kajaria discloses the general conditions for hydraulically fracturing multiple wells at multi-well sites, “where different wells might operate on different cycles in a hydraulic fracturing operation.” *Kajaria*, [0035]. A POSITA would have found it

Accordingly, Challenged Claims 17 and 27 are obvious over *Kajaria* in view of *Jackson*.

10. CLAIMS 18 AND 28

Kajaria's hydraulic fracturing system includes a fluid conduit connecting an inlet head (20) to four trees (14) attached to individual wells, where the inlet head receives fracturing fluid from hydraulic fracturing pumps via a manifold (18):



Kajaria, [0029], [0033], [0039]. At least one valve along the fluid conduit between the inlet head and each tree/well regulates flow to each associated well. *Kajaria*, [0033]. *Kajaria* discloses directing flow between wells continuously by operating valves associated with individual wells, including third and fourth wells. *Kajaria*, [0035]. Thus, *Kajaria* discloses continuously pumping hydraulic fracturing fluid to third and fourth valves (associated with third and fourth wells) via the hydraulic manifold (Limitations 18.1/28.1). Ex. 1002, ¶¶ 379-382, 398-399.

In *Kajaria*, selective flow to each of first-to-fourth wells may be controlled by operating valves along the flow conduits to each well. *Kajaria*, Abstract; Figs. 1, 4; [0024]. When valve(s) to a selected well, e.g., the fourth and third wells, are open, “fluid flow through the fluid conduit 56 is unrestricted, and will enter the well,” to fracture the selected well(s), and when such valve(s) are closed, such as to the fourth well, “fluid flow...is prevented by the valve.” *Kajaria*, [0029], [0033]. Thus, *Kajaria* provides 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” to “direct flow between wells continuously.” *Kajaria*, [0035].

A POSITA would understand that *Kajaria*’s disclosure of “continuously” directing flow between multiple wells “simply by opening or closing the valves” associated with the wells would include opening the fourth well’s valve to permit pumping of fluid into the fourth well, opening the third well’s valve to permit

pumping of fluid into the third well via the third well's valve, and then closing the fourth well's valve (Limitations 18.2-18.3/28.2-28.3). Ex. 1002, ¶¶ 383-388, 400-401.

Challenged Claims 18 and 28 are therefore also obvious over *Kajaria* in view of *Jackson*.

11. CLAIMS 31 AND 36

Kajaria uses monitoring equipment and other downhole sensors “to provide information to an operator, and to allow the operator to control different parameters of the fracturing operation” on multiple wells at a multi-well site. *Kajaria*, [0028].

Jackson discloses it was known to monitor/measure flowrate conditions according to flowrate condition thresholds when fracturing a well to determine next steps in the fracturing operation. *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,” where “further thresholds may be reached by adjustment of fracturing fluid flow before ceasing the process.” *Jackson*, [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. *Jackson*, [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 an upper and/or above a lower flowrate threshold (and conversely if flowrate is outside the flowrate threshold range)—in *Kajaria*'s systems/methods as a simple substitution of one known fracturing technique for another. Ex. 1002, ¶¶ 283-287, 402-409. Thus, *Kajaria* in view of *Jackson* also renders Challenged Claims 31 and 36 obvious.

C. GROUND 4-KRUPA IN VIEW OF JACKSON

Krupa discloses all of the Challenged Claims' limitations. In addition to *Krupa* explicitly disclosing flowrate-threshold claim limitations (*i.e.*, Limitations 1.3, 1.4, 8.5, 8.6, 15.6, 15.7, 25.8, and 25.9, and claims 31/36), *Jackson* also discloses those limitations. Ex. 1002, ¶¶ 415-454. A POSITA would have been motivated to combine *Jackson* and *Krupa*'s teachings to use *Jackson*'s flowrate thresholds to determine the different stages of the fracturing job to move on to the next well. *Id.*, ¶¶ 410-414.

Like *Krupa*, *Jackson* relates to fracturing and uses operational data to assess the fracturing process. *Krupa*, [0026]; *Jackson*, [0019]. *Jackson* teaches flowrate data may be assessed according to flowrate and/or time thresholds to assess and

indicate next steps in the fracturing process. *Jackson*, [0012], [0014], [0017], [0019], [0053]. In an example, fracturing operation stages are defined by introducing fluid into a well according to first time and flowrate thresholds of “30 seconds to 20 minutes at a flow rate of at least 300 scm,” second thresholds of “more than 1 minute and less than 24 hours of a flow rate of dilation fluid of less than 300 scm, which may include 0 scm,” and third thresholds of “30 seconds to 20 minutes at a flow rate of at least 300 scm.” *Jackson*, [0021].

Thus, *Jackson* discloses determining if a flowrate in a fracturing operation is below a flowrate threshold (*e.g.*, below 300 scm) for a threshold amount of time (*e.g.*, 1 minute-24 hours) (Limitations 1.3/8.5, 1.4/8.6). Ex. 1002, ¶¶ 417-422, 427-428. *Jackson* also discloses a flowrate threshold being met where flowrate is below an upper flowrate (*e.g.*, below 300 scm) and/or above a lower flowrate (*e.g.*, above 0 scm), in which case a next step in the fracturing process is conducted, and conversely flowrates outside that range would not meet the threshold (Limitations 15.6/25.8, 15.7/25.9 and Claims 31/36). *Id.*, ¶¶ 433-438, 442-444, 445-453.

As *Krupa* and *Jackson* both “disclose similar functions of thresholds being used to trigger the control system to move to the next stage of the fracturing operation,” a POSITA “would recognize that combining the teachings of *Krupa* and *Jackson* is a simple substitution of one known element for another (*e.g.*, specific thresholds) to obtain predictable results.” Ex. 1002, ¶¶ 411-414.

Thus, the Challenged Claims are also obvious over Krupa in view of Jackson.

D. GROUND 5-KAJARIA IN VIEW OF JACKSON AND MARTINO

As discussed, although method claims 1-3, 6, 15-18 and 36 do not require them to, computers *could* perform their steps. Accordingly, *Kajaria* in view of *Jackson* and *Martino*, which discloses using computers in wellbore applications, would also render these claims obvious. Ex. 1002, ¶¶ 455-475.

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. *Martino*'s computer systems control valves to adjust/control well-system fluid flow (*Martino*, [0021]-[0022]) and can execute *Kajaria*'s and *Jackson*'s steps. Ex. 1002, ¶¶ 456-461.

Kajaria and *Jackson* disclose Limitations 8.3-8.10, 25.1, and 25.4-25.9. See Section X.B; Ex. 1002, ¶¶ 467, 474. The Examiner asserted that *Kajaria*'s control vehicle would necessarily include the computer system limitations "to allow [an] operator to control...the valves for the fracturing process." Ex. 1010, 4, citing *Kajaria*, [0028]. Downing did not disagree. Ex. 1009, 80-102.

Similarly, *Martino*'s well system fluid flow valves are controlled by a control device (e.g., a controller) that "include[s] a processor 252 and a memory component." *Martino*, [0046]. "[T]he processor 252 may be configured to execute instructions stored on the memory component...corresponding to one or more

control modes based on feedback received from one or more components of the overall system.” *Id.* Thus, *Martino* discloses Limitations 8.1/25.2 and 8.2/25.3.

It would have been obvious to use *Martino*’s control system, with its processor that executes instructions stored on a memory component, to control valves in a well system in *Kajaria*’s control vehicle, “to allow the operator to control different parameters of the fracturing operation.” Ex. 1002, ¶¶ 455-461; *Kajaria*, [0028].

Kajaria in view of *Jackson* and *Martino* therefore renders obvious all Challenged Claims. Ex. 1002, ¶¶ 455-477.

XI. THE OFFICE HAS NOT PREVIOUSLY CONSIDERED THESE GROUNDS

Although the Office considered *Kajaria* during prosecution of ’779, no ground in this Petition was considered. Denial of institution under 35 U.S.C. § 325(d) is unwarranted.

XII. CONCLUSION

The Challenged Claims are unpatentable.

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Patent No. 11,401,779

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Respectfully submitted,

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CERTIFICATE OF COMPLIANCE

The undersigned hereby certifies that the foregoing Petition contains 13,997 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: December 1, 2023

By: /s/ Tammy J. Terry

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e) and 42.105(a), the undersigned hereby certifies that on December 1, 2023, 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):

Zachary A. Halbur
Braden J. Davies
HAYNES AND BOONE, LLP
2323 Victory Avenue, Suite 700
Dallas, Texas 75219

Pursuant to 37 C.F.R. § 42.105(a), the undersigned hereby certifies that on December 1, 2023, 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:

Lee F. Johnston
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Dated: December 1, 2023

Respectfully submitted,

/s/ Tammy J. Terry
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