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Paper 9
Date: September 12, 2024

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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INTELLIGENT WELLHEAD SYSTEMS, INC.,
Petitioner,

v.

DOWNING WELLHEAD EQUIPMENT, LLC,
Patent Owner.

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IPR2024-00583
Patent 11,401,779 B2

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Before BENJAMIN D. M. WOOD, CARL M. DEFRANCO, and MATTHEW S. MEYERS, *Administrative Patent Judges*.

WOOD, *Administrative Patent Judge*.

DECISION
Denying Institution of *Inter Partes* Review
*35 U.S.C. § 314*

# I. INTRODUCTION

## *A. Background*

Intelligent Wellhead Systems, Inc. ("Petitioner") filed a Petition (Paper 2, "Pet.") requesting *inter partes* review of claims 1–3, 6, 8–10, 13, 15–18, 25–28, 31, and 36 of U.S. Patent No. 11,401,779 B2 (Ex. 1001, "the '779 patent"). Downing Wellhead Equipment, LLC ("Patent Owner") filed a Preliminary Response. Paper 7 ("Prelim. Resp.").

We have authority under 35 U.S.C. § 314, which provides that an *inter partes* review may not be instituted "unless . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." 35 U.S.C. § 314(a). Upon considering the Petition, we determine that Petitioner has not satisfied this threshold requirement, and therefore we do not institute *inter partes* review of the challenged claims.

## *B. Related Proceedings*

The Parties identify *Downing Wellhead Equipment, LLC v. Intelligent Wellhead Systems, Inc., et al.*, No. 1:23-cv-01180 (D. CO) as a related matter. Pet. 2; Paper 6, 2. Patent Owner also identifies *Intelligent Wellhead Systems, Inc. v. Downing Wellhead Equipment, LLC*, IPR2024-00256 (PTAB); *Intelligent Wellhead Systems, Inc. v. Downing Wellhead Equipment, LLC*, IPR2024-00300 (PTAB); and *Intelligent Wellhead Systems, Inc. v. Downing Wellhead Equipment, LLC*, IPR2024-00584 (PTAB).

*C. The '779 Patent*

The '779 patent[1] is titled "Hydraulic Fracturing Plan and Execution of Same," and relates to "a hydraulic fracturing plan executable by a hydraulic fracturing system to hydraulically fracture a plurality of oil and gas wells." Ex. 1001, code (54), 2:8–10. Figure 1A of the '779 patent depicts a hydraulic fracturing system for performing the patent's fracturing methods, and is reproduced below:

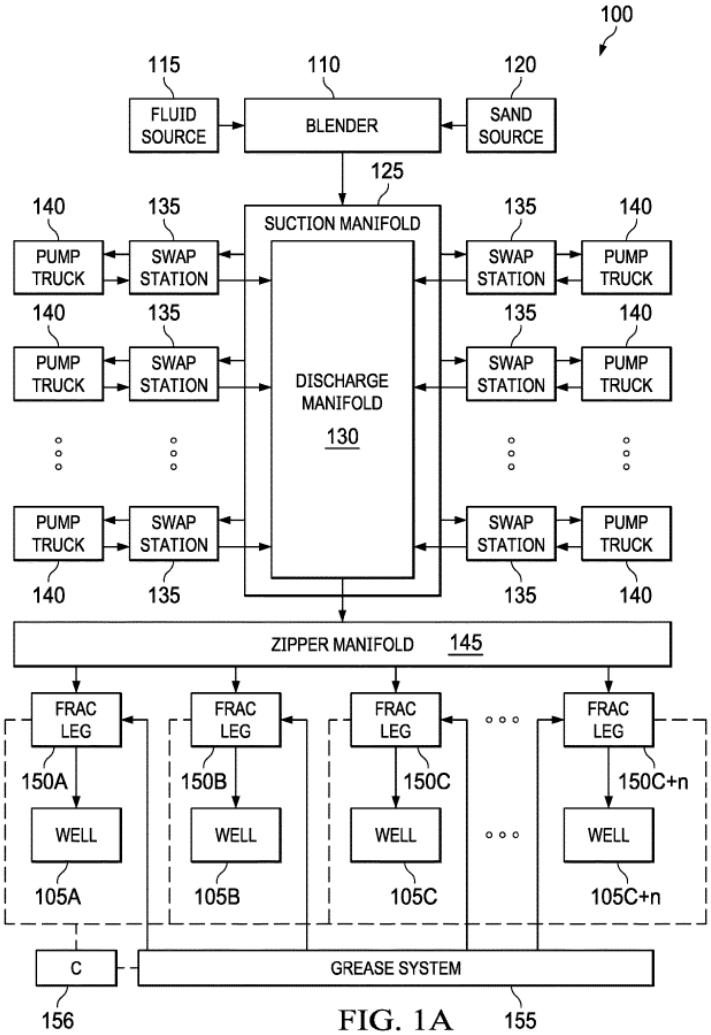


FIG. 1A

[1] The '779 patent issued August 2, 2022 from an application filed July 29, 2021, and claims priority to a provisional patent application filed May 17, 2021. Ex. 1001, codes (45), (22), (60).

Figure 1A depicts hydraulic fracturing system 100, which delivers fracturing fluid to wells 105A through 105C+n. Ex. 1001, 5:41–43. Pump trucks 140 draw fracturing fluid from suction manifold 125 and discharge it to zipper manifold 145 via discharge manifold 130. *Id.* at 5:47–57. The zipper manifold delivers the fluid to "frac legs" 150A through 150C+n, each leg adapted to deliver the fluid to a corresponding well 105A through 105C+n. *Id.* at 5:57–61. Each frac leg is equipped with one or more zipper valves 170 that allow or prevent fluid flow to the respective well. *Id.* at 7:47–66, Figs. 2A–2G.

According to the '779 patent, when a fracturing stage has ended at one well and fracturing another well is contemplated, a determination is made whether to perform a "regular swap" or a "continuous pumping swap" ("CP swap") from the first well to the other well. *Id.* at 7:1–5. This determination may be based on, e.g., determining that the fluid flow rate into the first well is below an upper threshold for a threshold amount of time. *Id.* at 13:28–52.

To perform a CP swap, according to the Specification, zipper valves for the $n_1$+1 well are opened while fluid is being pumped to the $n_1$ well, allowing hydraulic fracturing fluid to flow to both wells. *Id.* at 14:14–33, Figs. 15, 16A, 16B. Zipper valves for the $n_1$ well are then closed to complete the swap. *Id.* at 14:36–38, Figs. 15, 16C.

The '779 patent explains that "executing the CP swap from hydraulically fracturing . . . the $n_1$ well . . . to hydraulically fracturing . . . the $n_1$+1 well . . . transitions the zipper valves from one well to the other, opening the second well and subsequently shutting-in the first well, all while pumping." Ex. 1001, 14:41–46. "The transition is instantaneous and the

total time between stages measured at treatment pressure is less than 20 seconds . . . ." *Id.* at 14:47–49.

*D. The Challenged Claims*

Petitioner challenges claims 1–3, 6, 8–10, 13, 15–18, 25–28, 31, and 36 of the '779 patent. Pet. 3. Claims 1, 8, 15, and 25 are independent. Claim 1 is representative and reproduced below:[2]

> 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;

[2] We use Petitioner's bracketed identifiers for each limitation. *See* Pet. x–xvii.

[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.

Ex. 1001, 22:32–56.

*E. Asserted Grounds of Unpatentability*

Petitioner contends that the challenged claims are unpatentable based on the following specific grounds (Pet. 4):

| Ground | Claims Challenged | 35 U.S.C. § | Reference(s)/Basis |
|---|---|---|---|
| 1 | 1–3, 6, 15, 16, 18, 36 | 102 | Ciezobka[3] |
| 2 | 1–3, 6, 8–10, 13, 15–18, 25–28, 31, 36 | 103 | Ciezobka |
| 3 | 6, 8–10, 13, 16–18, 25–28, 31 | 103 | Ciezobka, McNeel[4] |
| 4 | 1–3, 6, 8–10, 13, 15–18, 25–28, 31, 36 | 103 | Beuterbaugh,[5] Jackson[6] |

Petitioner also relies on the Declaration of Robert A. Durham, Ph.D. (Ex. 1041) to support its asserted grounds. Patent Owner relies on the Declaration of John Hughett (Ex. 2006) to support its Preliminary Response.

[3] International Pub. No. WO 2017/201526 A1 (published Nov. 17, 2017) (Ex. 1037).
[4] U.S. Patent Appl. Pub. No. 2007/0125543 A1 (published June 7, 2007) (Ex. 1038).
[5] International Pub. No. WO 2020/145978 A1 (published July 16, 2020) (Ex. 1036).
[6] U.S. Patent Appl. Pub. No. 2007/0023184 A1 (published Feb. 1, 2007) (Ex. 1005).

## II. ANALYSIS

### *A. Legal Standards Used in the Merits Analysis*

"In an IPR, the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim")); *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

"Because the hallmark of anticipation is prior invention, the prior art reference—in order to anticipate under 35 U.S.C. § 102—must not only disclose all elements of the claim within the four corners of the document, but must also disclose those elements 'arranged as in the claim.'" *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008) (quoting *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548 (Fed. Cir.1983)).

"A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in [35 U.S.C. § 102], if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains." 35 U.S.C. § 103. The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject

matter and the prior art; (3) the level of skill in the art; and (4) when in evidence, objective evidence of nonobviousness, i.e., secondary considerations. *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17–18 (1966). The obviousness analysis should not be conducted "in a narrow, rigid manner," but should instead focus on whether a claimed invention is merely "the result[ ] of ordinary innovation," which is not entitled to patent protection. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007).

*B. Level of Ordinary Skill in the Art*

Petitioner contends that, for the '779 patent, one of ordinary skill in the art "would have had an engineering degree and two or more years' well-related operations experience, or equivalent education/experience." Pet. 8. Patent Owner does not offer an alternative definition, but its Declarant, Mr. Hughett, submits that one of ordinary skill in the art would have had "a degree in petroleum or mining engineering, mechanical engineering, or a comparable discipline, and at least two years of experience in oil and gas extraction, or an equivalent combination of education and experience." Ex. 2006 ¶ 17.

On the record, we do not discern a meaningful difference between Petitioner's and Mr. Hughett's proposed definitions, and therefore adopt Petitioner's definition for purposes of this Decision. We also presume that the cited prior-art references reflect the level of ordinary skill at the time of the invention. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (explaining the level of ordinary skill in the art may be evidenced by the cited references themselves).

*C. Claim Construction*

We construe claim terms "using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. [§] 282(b) . . . ." 37 C.F.R. § 42.100(b). Under this standard, claim terms are generally given their plain and ordinary meaning as would have been understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). Any special definitions for claim terms must be set forth in the Specification "with reasonable clarity, deliberateness, and precision." *See In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

Both parties indicate that no express construction of any claim term is necessary. Pet. 11; Prelim. Resp. 20. We believe that an express construction of *threshold* would be helpful, however. The parties dispute, among other things, whether the cited prior-art references teach limitations [1.3] and [1.4] of claim 1 (and the identical limitations of claim 8), "determining that the flow rate of the fluid being pumped into the first well is below a flow rate threshold and has been below the flow rate threshold for a threshold amount of time." Resolving this dispute arguably depends on the meaning of *threshold*, and more particularly *flow-rate threshold* and *threshold amount of time.*

The Specification does not suggest a particular definition of *threshold*, and neither party suggests that it is a term of art in the relevant field. Therefore, we consult a general dictionary for guidance. *See Comaper Corp. v. Antec, Inc.,* 596 F.3d 1343, 1348 (Fed. Cir. 2010) (If "the specification does not assign or suggest a particular definition [of a claim

term], in determining the ordinary and customary meaning of the claim term as viewed by a person of ordinary skill in the art, it is appropriate to consult a general dictionary definition of the word for guidance."). Because Merriam-Webster's online dictionary, Merriam-Webster.com, provides several definitions for *threshold*, we refer to the intrinsic record "to identify which of the different possible dictionary meanings is most consistent with the use of the words by the inventor." *Brookhill-Wilk 1, LLC v. Intuitive Surgical, Inc.*, 334 F.3d 1294, 1300 (Fed. Cir. 2003). Based on the context in which *threshold* is used in claims 1 and 8, we consider the most relevant definition to be "a level, point, or value above which something is true or will take place and below which it is not or will not." Merriam-Webster.com/dictionary/threshold (accessed July 30, 2024). The claim context also indicates that *threshold* encompasses the opposite situation, i.e., the threshold may be a value *below* which something is true or will take place and above with it is not true or will not take place. Thus, a flow-rate value and time value are "thresholds" when there is an action that will or will not take place (or something is or is not true) depending on whether those values are met.

The Specification identifies one particular action that occurs when these thresholds are met: performance of a CP swap from hydraulically fracturing the $n_1$ well (i.e., a first well) to hydraulically fracturing the $n_1$+1 well (i.e., a second well). Ex. 1001, 13:28–52, Figs. 1B, 12. To perform a CP swap, according to the Specification, zipper valves for the $n_1$+1 well are opened while fluid is being pumped to the $n_1$ well, allowing hydraulic fracturing fluid to flow to both wells, after which zipper valves for the $n_1$ well are closed. *Id.* at 14:14–38, Figs. 15, 16A, 16B, 16C. This procedure is

precisely what claims 1 and 8 recite. In addition to requiring "determining that the flow rate is below a flow-rate threshold . . . for a threshold amount of time," claims 1 and 8 recite, e.g., "(c) during pumping of the fluid into the first well via the first valve, opening a second valve associated with a second well," and "(e) during pumping of the fluid into the second well via the second valve, closing the first valve associated with the first well." Ex. 1001, claims 1, 8. Thus, in the context of these claims, a *flow-rate threshold* and *threshold amount of time* would be flow-rate and time values that determine whether or not a second valve associated with a second well is opened during pumping of fluid into the first well via the first valve.

### *D. Ground 1: Anticipation of Claims 1–3, 6, 15, 16, 18, and 36 by Ciezobka*

Petitioner contends that Ciezobka anticipates claims 1–3, 6, 15, 16, 18, and 36. Pet. 12–57.[7] Patent Owner opposes. Prelim. Resp. 21–38.

#### *1. Ciezobka (Ex. 1037)*

Ciezobka[8] discloses enhancing permeability of low permeability earth formations by providing "a pressure pulse to a wellbore to improve fracturing of an earth formation to provide increased hydrocarbon production." Ex. 1037, 1:11–12, 2:25–26. Ciezobka explains that during fracturing, the loss of fracturing-fluid pressure resulting from fractures

[7] Ground 1 covers only the method claims of the '779 patent. *See* Pet. 4 (listing only independent method claims 1 and 15 and some of their dependent claims as anticipated by Ciezobka). Thus, Petitioner does not contend that Ciezobka anticipates independent apparatus claims 8 and 25 and their dependent claims.

[8] Ciezobka was published November 23, 2017, and therefore qualifies as prior art under 35 U.S.C. § 102(a)(1).

opening up reduces the ability to create new fractures. *Id.* at 1:25–31. To address this problem, Ciezobka introduces a timed "pressure pulse" to cause temporary increases in pressure to create new fractures. *Id.* at 3:32–4:2. According to Ciezobka, pressure pulses can be imparted by rapidly turning the fracturing pump off and on, rapidly increasing or decreasing "a pressure of a pump rate" of the fracturing pump, or, in the preferred embodiment, briefly diverting fluid away from a wellhead. *Id.* at 8:14–9:31. Figure 6, reproduced below, depicts an embodiment using a diverter line between two wellheads:

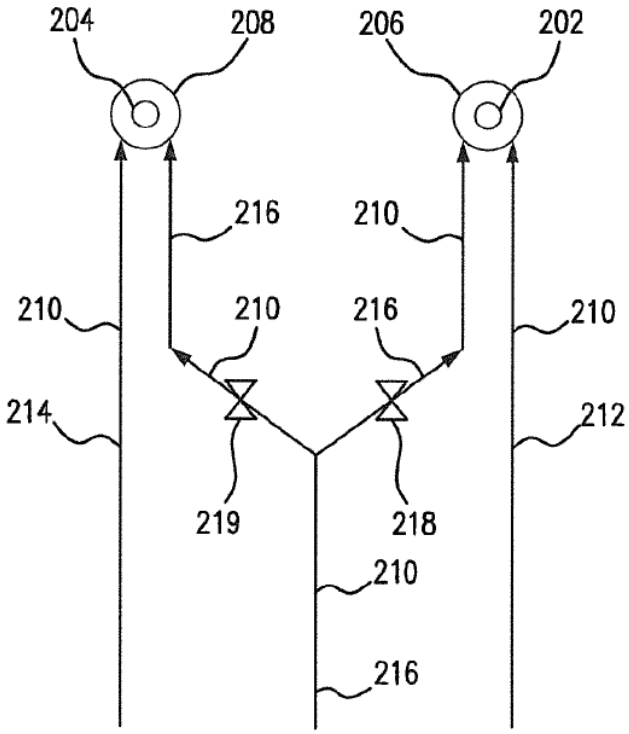


FIG. 6

Figure 6 depicts a schematic diagram of a portion of a system for hydraulic fracturing. *Id.* at 6:20. The system includes a pair of wellheads 202, 204 each connected to a well bore 206, 208, and a plurality of flow lines 210

connected to wellheads 202, 204. *Id.* at 11:24–26. Flow lines 210 include constant rate flow lines 212, 214 and diverter line 216. *Id.* at 11:26–28. Diverter line 216 includes one or more valves 218, 219. *Id.* at 11:31–32, 12:7. A high-pressure fracturing pump supplies fracturing fluid to flow lines 210 at a constant flow rate, with a third of the flow rate passing through each lines 210, 212, and 216. *Id.* at 11:32–12:2. Figure 7, reproduced below, illustrates a fracturing operation performed by the system shown in Figure 6:

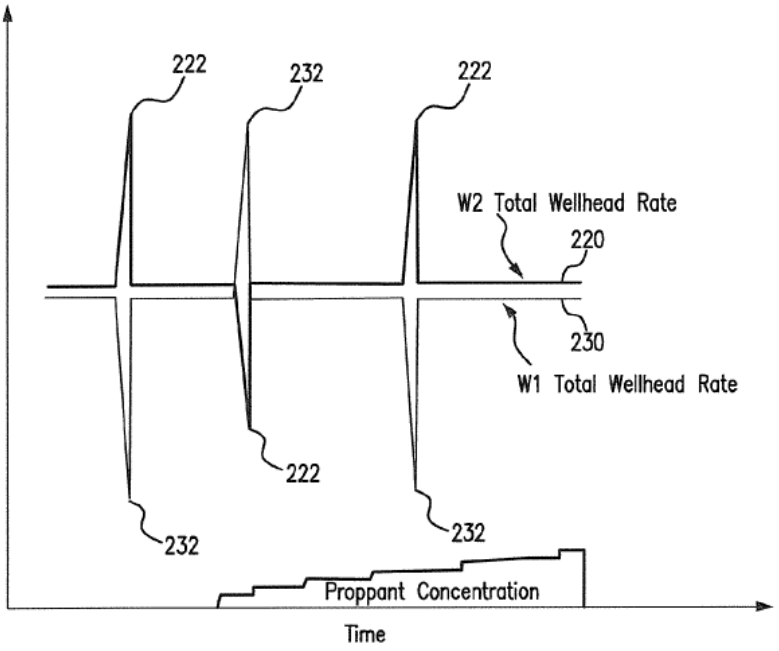


FIG. 7

Figure 7 depicts flow rate 220 to wellhead 202 and flow rate 230 to wellhead 204 over time. At the beginning of Ciezobka's fracturing operation, both valves 218 and 219 are open, providing diverter-line flow equally to both wellheads 202, 204 (each of which is also receiving flow from their respective constant-rate flow line). *Id.* at 12:7–8. Pressure pulse 222, 232 is induced by closing valve 219, increasing the total flow rate to first wellhead 202 and decreasing the total flow rate to second wellhead 204 "for a short

period of time," after which valve 219 is reopened to restore the original flow rates. *Id.* at 12:8–11, Fig. 7. Valve 218 may then be closed briefly to increase the total flow rate to second wellhead 204 and decrease the total flow rate to first wellhead 202. *Id.* at 12:13–16; *see id.* Fig. 7. Preferably "the flow rate change ranges from 25% to 75% lower and more preferably changes by 50%," the pressure pulse having "a duration ranging from 1 minute to 1 second." *Id.* at 12:17–22.

*1. Independent Claim 1*

Limitation [1.3] of claim 1 recites "determining that the flow rate of the fluid being pumped into the first well is below a flow rate threshold." Ex. 1001, claim 1. Petitioner relies on the embodiment depicted in Figures 6 and 7 and described on pages 11 and 12 of Ciezobka—which teaches redirecting flow between two wells to induce a pressure pulse in the wells—as disclosing all of the limitations of claim 1, including limitation [1.3]. Pet. 14–15 (citing Ex. 1037, 4:2–15, 4:26–31, 8:11–13, 11:5–7, 12:13–15, 15:18–21; Ex. 1041 ¶¶ 139, 140). Petitioner asserts that "[t]he pressure pulse comprises changing the initial flow rate to a pulse flow rate and then to a secondary flow rate," and "[i]n some embodiments, the 'pulse flow rate is less than the initial flow rate' for a pulse period of time." *Id.* at 14 (citing Ex. 1037, 4:2–3, 4:4–15). Under these circumstances, according to Petitioner, "the pulse flowrate of fluid pumped into the well is below a flowrate threshold equal to the initial flowrate." *Id.* (citing Ex. 1041 ¶ 139). Petitioner further contends that Ciezobka teaches limitation [1.3] because Ciezobka "discloses determining the flowrate of the fluid and comparing the determined flowrate to certain thresholds (e.g., initial, pre-pulse, pulse, and secondary flowrates)." *Id.* at 15.

Patent Owner responds that closing a valve to cause flow rate to drop below an initial flowrate does not amount to "determining that the lower flow rate is below a threshold." Prelim. Resp. 25–26. Patent Owner contends that "[t]he claimed '*determination*' necessarily requires comparing an unknown flow rate of fluid to a specific '*threshold*,'" but "Ciezobka does not teach or suggest this comparison." *Id.* at 26. Further, according to Patent Owner, such a comparison would not be necessary because "[c]losing Ciezobka's diverter valve ***necessarily results*** in a flow rate reduction from the initial flow rate," and thus "Ciezobka's method doesn't require determining whether the second flow rate is lower because it ***must*** be—fluid is diverted away from the wellhead." *Id.* Patent Owner submits that "Ciezobka closes the diverter valve to cause a **known** and desired drop in flow rate from the initial flow rate," in order to provide a pressure pulse to the wellbore. *Id.* at 26–27.

We are not persuaded that Ciezobka teaches or suggests limitation [1.3]. First, we agree with Patent Owner that this limitation necessarily requires comparing the measured flow rate to a threshold. Petitioner also appears to agree that such a comparison is necessary to perform limitation [1.3]. *See* Pet. 15 ("Ciezobka discloses determining the flowrate of the fluid and *comparing* the determined flowrate to certain thresholds . . . , and therefore discloses determining that the flow rate of the fluid being pumped into the first well is below a flowrate threshold.") (emphasis added). Ciezobka does not, however, teach such a comparison. Assuming that the initial flow rate can be considered a "threshold," Ciezobka's teaching of the existence of an initial flow rate followed by the existence of a lower pulse

flow rate does not constitute a teaching of a *comparison* of the two flow rates.

Second, Petitioner has not established that the "initial flow rate" is a "threshold." As discussed above, we construe "flow rate threshold" in the context of claim 1 to mean a flow rate value that an actual flow rate must drop below for a threshold amount of time in order for a second valve associated with a second well to be opened. *See* Section II.C. Ciezobka does not teach that a measured flow rate must drop below the initial flow rate or any other specific flowrate before one of valves 218 or 219 is opened. Instead, the valve is opened after a specific period of time and without comparing the actual flow rate to the initial flow rate. *See* Ex. 1037, 12:8–12 (teaching that a pressure pulse is created by closing valve 219 "for a short period of time" ranging from 1 minute to 1 second, preferably 10 seconds). Indeed, opening valve 218/219 causes flow rate drop to one of the wells; it does not occur as a result of the flow-rate drop.

In support of its contention that Ciezobka teaches "comparing the determining flowrate to certain thresholds," Petitioner points us to Ciezobka's teaching that "the parameters of variable rate fracturing are 'select[ed] and design[ed] . . . including parameters such as flow rate (e.g., magnitude of change and duration as well as frequency (for example . . . measured period[s] of time between the endings of successive flow rate variations).'" Pet. 15 (citing Ex. 1037, 15:18–21). This teaching appears in the context of efforts to "evaluate the effectiveness of variable rate fracturing" by "calculat[ing] the additional perforations opened while applying variable rate fracturing without making any significant changes in the treatment design—such as explicit inclusion of step-down tests."

Ex. 1037, 15:11–15. Doing so "helps with selection and design of variable rate fracturing processing and parameters including . . . flow rate (e.g., magnitude of change and duration) as well as frequency . . . ." *Id.* at 15:17–21. In other words, Ciezobka teaches that calculating how many perforations are opened by variable-rate fracturing is useful for selecting flow rate parameters for future variable-rate fracturing. We do not see this teaching as a disclosure of comparing an actual flow rate to a threshold.

Petitioner also contends that Ciezobka teaches that "[o]ptionally, the initial flowrate is increased 'to a pre-pulse flow rate,' dropped to 'a pulse flow rate,' returned 'to the pre-pulse flow rate' and this cycle is repeated 'before returning the flow rate to the initial flow rate.'" Pet. 15 (citing Ex. 1037, 4:26–31). Petitioner infers from this teaching that Ciezobka "discloses determining the flowrate of the fluid and comparing the determined flowrate to certain thresholds (e.g., initial, pre-pulse, pulse, and secondary flowrates) . . . . *Id.*

This teaching appears to address a different embodiment than the one on which Petitioner relies to anticipate claim 1, i.e., that depicted in Figures 6 and 7 and described on pages 11 and 12 of Ciezobka. *See* Ex. 1037, 4:26 (describing "another alternative embodiment"). "[W]hen a reference discloses elements in different locations in the disclosure, the relevant question [to find anticipation] is whether the reference is sufficiently clear in disclosing the combinability of those elements such that a skilled artisan would 'at once envisage' the claimed combination." *Chamberlain Group, Inc. v. Techtronic Indus. Co.*, 935 F.3d 1341, 1350 (Fed. Cir. 2019) (quoting *Kennametal, Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376, 1381 (Fed. Cir. 2015)). Neither Petitioner nor Petitioner's Declarant discuss the

combinability of the embodiment described on pages 11 and 12 of Ciezobka and the embodiment described on page 4 of Ciezobka.

Further, the combinability of these embodiments is not readily apparent. For example, Ciezobka does not discuss a "pre-pulse flowrate" in connection with the embodiment depicted in Figure 7. *See id.* at 11:24–12:16, Fig. 7. Further, there is no specific "pulse flow rate" value that Ciezobka teaches would trigger opening valve 218/219; instead, as Figure 7 shows, the flow rate during the pulse appears to be constantly changing. *See id.* Ciezobka also does not distinguish a "secondary flow rate" (i.e., the flow rate after the pulse) from the primary in connection with this embodiment, probably because it appears from Figure 7 to be the same as the initial flow rate. *See Id.*

For the above reasons, we determine that Petitioner has not demonstrated a reasonable likelihood of showing that Ciezobka anticipates claim 1.

*2. Independent Claim 15*

Limitation [15.4] recites swapping from hydraulic fracturing a second well to hydraulic fracturing a first well by opening a first-well valve and closing a second-well valve:

> (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.

Ex. 1001, claim 15. We understand this limitation to mean that before the swap the second well is being hydraulically fractured (as recited in limitation

[15.2]) and the first well is not, and after the swap the first well is being hydraulically fractured and the second well is not. In other words, limitation [15.4] would not encompass both wells being hydraulically fractured continuously throughout the fracturing process.

Petitioner contends that Figures 6 and 7 of Ciezobka "disclose switching pulse fracturing between a first well 206 and a second well 208 . . . by opening and closing associated diverter valves." Pet. 25 (citing Ex. 1037, 11:24–12:15). Petitioner asserts that:

> Ciezobka discloses that a pressure pulse is induced by closing a second diverter valve associated with the second well to 'increase[e] [sic] the total flow rate 220 to the first well[] and decreas[e] the total flow rate 230 to the second well for a short period of time,' after which, the second diverter valve is opened to resume fluid flow (at a secondary flowrate) through both the first and second diverter valves to first and second wells.

*Id.* at 26 (citing Ex. 1037, 4:1–3, 12:7–11) (alterations by Petitioner). Then, according to Petitioner:

> After pulse fracturing is conducted on the first well, the first diverter valve is closed, 'increasing the total flow rate 230 to the second well[] and decreasing the total flow rate 220 to the first well[] for a short period of time' to deliver a pressure pulse to the second well. . . . After the pressure pulse to the second well, the first diverter valve is opened to resume fluid flow (at another secondary flowrate) through both the first and second diverter valves to first and second wells. . . . The process can be repeated, as shown in Figure 7.

Pet. 26 (citing Ex. 1037, 4:1–3, 12:7–11, 12:13–15, Fig. 7; Ex. 1041 ¶¶ 211–222, 275–277).[9]

Patent Owner responds that "Ciezobka does not disclose swapping from permitting fracturing of one well to permitting fracturing of another well" because "the embodiments Petitioner relies on exclusively describe fracturing two wells ***simultaneously*** and ***continuously***," the "only element that 'swaps between the wells is a timed pressure pulse." Prelim. Resp. 30. *Id.* According to Patent Owner:

> Ciezobka expressly describes that each wellhead 202 and 204 continuously receives a constant flow of fluid from 'separate constant flow rate line 212, 214,' where 'the flow rate supplied by each of the constant rate flow lines 212, 214 ***does not change during the pressure pulse***." . . . Thus, throughout Ciezobka's process, both wells are being continuously fractured at least via the constant-rate flow lines.

*Id.* at 31 (quoting Ex. 1037, 11:30–12:4).

We are not persuaded that Ciezobka discloses limitation [15.4]. First, Patent Owner is correct that fluid is being pumped to both wells 202, 204 via constant flow rate lines 212, 214 throughout the process relied on by Petitioner. Ex. 1037, 12:2–16, Figs. 6, 7. Petitioner does not explain why wells receiving hydraulic fracturing fluid would not be considered to be undergoing hydraulic fracturing.

Second, even if we were to assume that hydraulic fracturing occurs only during the pressure pulse, we would still consider both wells to be undergoing hydraulic fracturing during this process. Petitioner implicitly

[9] As evident from Petitioner's analysis, Ciezobka's first well corresponds to the claimed second well and Ciezobka's second well corresponds to the claimed first well.

assumes that only the well receiving increased fluid flow is undergoing pulse hydraulic fracturing. *See* Pet. 26 ("After pulse fracturing is conducted on the first well, the first diverter valve is closed, 'increasing the total flow rate 230 to the second well[] and decreasing the total flow rate 220 to the first well[] for a short period of time' to deliver a pressure pulse to the second well.") (quoting Ex. 1037, 12:13–15). But Ciezobka indicates that both wells receive a pressure pulse when valve 218 or valve 219 is closed. Ciezobka states, for example, that "[a] pressure pulse 222, 232 is induced by closing one of the valves 219, increasing the total flow rate 220 to the first wellhead 202 and decreasing the total flow rate 230 to the second wellhead 204 for a short period of time." Ex. 1037, 12:8–11. As evident from Figure 7, pressure pulse 222, 232 includes both positive-flow pressure pulse 222 to wellhead 202 and negative-flow pressure pulse 232 to wellhead 204. *Id.*, Fig. 7. This is consistent with Ciezobka's teaching that in creating a pressure pulse by changing the initial flow rate to a pulse flow rate, the pulse flow rate may be greater than *or less than* the initial flow rate. *Id.* at 4:3–4, 11–12. Indeed, Ciezobka teaches that the preferred embodiment of this method uses a flow rate reduction: "In a preferred embodiment, the flow rate change ranges from 25% to 75% *lower* and more preferably changes by 50%." *Id.* at 12:19–20 (emphasis added). Thus, both wells are being hydraulically fractured, not just the well receiving increased flow during the pressure pulse. Therefore, this process does not swap hydraulic fracturing from one well to another, as limitation [15.4] requires, but fractures both wells simultaneously and continuously.

For the above reasons, we determine that Petitioner has not demonstrated a reasonable likelihood of prevailing in showing that Ciezobka anticipates claim 15.

*3. Dependent Claims 2, 3, 6, 16, 18, and 36*

Claims 2, 3, and 6 depend from claim 1, and claims 16, 18, and 36 ultimately depend from claim 15. Ex. 1001, 22:57–30:24. Because we determined that Petitioner has not demonstrated a reasonable likelihood of prevailing with respect to claims 1 and 15, we likewise determine that Petitioner has not demonstrated a reasonable likelihood of prevailing with respect to claims 2, 3, 6, 16, 18, and 36.

*4. Conclusion as to Ground 1*

For the above reasons, we are not persuaded that Petitioner is reasonably likely to prevail with respect to Ground 1.

*E. Ground 2: Obviousness Over Ciezobka*

As noted above, Petitioner does not contend that Ciezobka anticipates independent apparatus claims 8 and 25 and their dependent claims, but does contend that these claims would have been obvious over Ciezobka. Petitioner asserts that Ciezobka "discloses/teaches/suggests every limitation of Claims 1, 8, 15, and 25 as arranged in the claims, anticipating [method] Claims 1 and 15 while at least rendering obvious [apparatus] Claims 8 and 25." Pet. 30. Petitioner characterizes apparatus claims 8 and 25 as "merely add[ing] standard computer language to Claims 1 and 15," i.e., claims 8 and 25 are each drawn to a computer apparatus configured to perform the steps of claims 1 and 15, respectively. *Id.* at 12. Petitioner relies on Ciezobka's teachings of: (1) a "software toolbox" that "incorporates all of the data

handling and data analysis elements for real time application in the field during hydraulic fracturing operations as well as post completion using the data collected during field activities"; and (2) "[a]rtificial intelligence (AI) tools" that "can be used to identify the efficacy of said rate pulses in the subject processing"; as corresponding to the additional computer-related limitations of claims 8 and 25. *Id.* at 12–13, 24 (citing Ex. 1037, 27:11–15, 26–29, 28:1–2; Ex. 1041 ¶¶ 186–187, 272–274). Petitioner asserts, alternatively, that "[i]f it is argued that *Ciezobka*'s IA tool/software toolbox disclosures do not expressly execute Claims 8 and 15 [sic, 25], *Ciezobka*'s AI tool/software toolbox would obviously be used to operate *Ciezobka*'s fracturing systems/methods." *Id.* at 30 (citing Ex. 1041 ¶¶ 187–189, 191–192, 273–277). Petitioner further contends that "if it is argued that *Ciezobka* does not expressly disclose [limitations] 15.7/25.9," these limitations would nonetheless be obvious to one of ordinary skill in the art in view of Ciezobka. *Id.* at 31 (citing Ex. 1041 ¶¶ 234–236, 275–277). Finally, Petitioner contends that "[i]f any differences exist between *Ciezobka* and Claims 1 and 8's or Claims 15 and 25's limitations, they are insubstantial, and *Ciezobka* would still render obvious these claims' subject matter 'as a whole.'" Pet. 31.

Patent Owner responds that, with respect to claims 1 and 8, "[t]he Petition fails to provide any explanation of how Ciezobka renders obvious comparing the measured flow rate to a threshold to determine whether the flow rate is below the threshold, or determining that the flow rate has been below a flow rate threshold for a threshold amount of time." Prelim. Resp. 35. Patent Owner likewise submits that "with respect to claims 15 and 25, the Petition does not make any attempt to show that Ciezobka renders

obvious the steps of swapping from permitting fracturing of one well to permitting fracturing of another or choosing any particular method of doing so in response to determining that a measured flow rate has satisfied one or more conditions." *Id.* at 36.

Petitioner does not rely on Ciezobka's teachings regarding its software toolbox and AI tools to teach limitations 1.3 (or the corresponding limitation of claim 8) or limitation 15.4 (or the corresponding limitation of claim 25). Therefore, we remain unpersuaded that Ciezobka teaches or suggests these limitations, for the reasons discussed above in connection with Ground 1. Further, Petitioner's broad statement that any differences between Ciezobka and the independent claims are "insubstantial" is unsupported by evidence or persuasive reasoning. Because obviousness cannot be established by "by mere conclusory statements" *KSR*, 550 U.S. at 418 (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)), we are not persuaded that Petitioner has a reasonable likelihood of prevailing with respect to Ground 2.

### *F. Ground 3: Obviousness—Claims 6, 8–10, 13, 16–18, 25–28, and 31—Ciezobka and McNeel*

Ground 3, and the combination of Ciezobka and McNeel, is asserted against independent claims 8 and 25, for which Petitioner relies on McNeel only for limitations 8.1–8.2 and 25.2–25.3. *See* Pet. 48–50.[10] As noted above, Petitioner asserts that claims 8 and 25 differ from claims 1 and 15 by including limitations 8.1–8.2/25.2–25.3, which are directed to the apparatuses that perform the steps of claims 1 and 15, and that "McNeel's

[10] McNeel is also offered to teach additional limitations of dependent claims 6, 9, 10, 13, 16–18, 26–28, and 31. Pet. 50–57.

computer system controls valves to adjust/control well-system fluid flow (McNeel, [0025], [0029]) and can execute Ciezobka's steps." *Id.* at 48–49. McNeel is not relied on to teach limitations [1.3], [8.5], [15.4], or [25.6]. Accordingly, for the reasons discussed above in connection with Ground 1, we determine that Petitioner is not reasonably likely to prevail with respect to Ground 3.

### *G. Ground 4: Obviousness Based on Beuterbaugh and Jackson*

Petitioner contends that the challenged claims would have been obvious over Beuterbaugh and Jackson. 57–96. Patent Owner opposes. Prelim. Resp. 48–64.

#### *1. Beuterbaugh (Ex. 1036)*

Beuterbaugh,[11] "relates generally to simultaneous pulsed fractured treatment of a plurality of wells in subterranean formations to reduce wear and equipment failure due to increased or decreased pulsing pumping strain typically associated with traditional fracturing techniques." Ex. 1036 ¶ 15. Beuterbaugh discloses fracking multiple wells by alternatingly opening and closing valves to the wells to divert high pressure fracturing fluid "near instantaneously from one well to the other well." *Id.*, Abstr. Figure 2 of Beuterbaugh, reproduced below, depicts surface fracturing equipment that Beuterbaugh uses to perform simultaneous multi-well pulsed fracturing:

[11] Beuterbaugh issued from an application filed January 10, 2019, and therefore is prior art to the '770 patent. Ex. 1005, codes (54), (22).

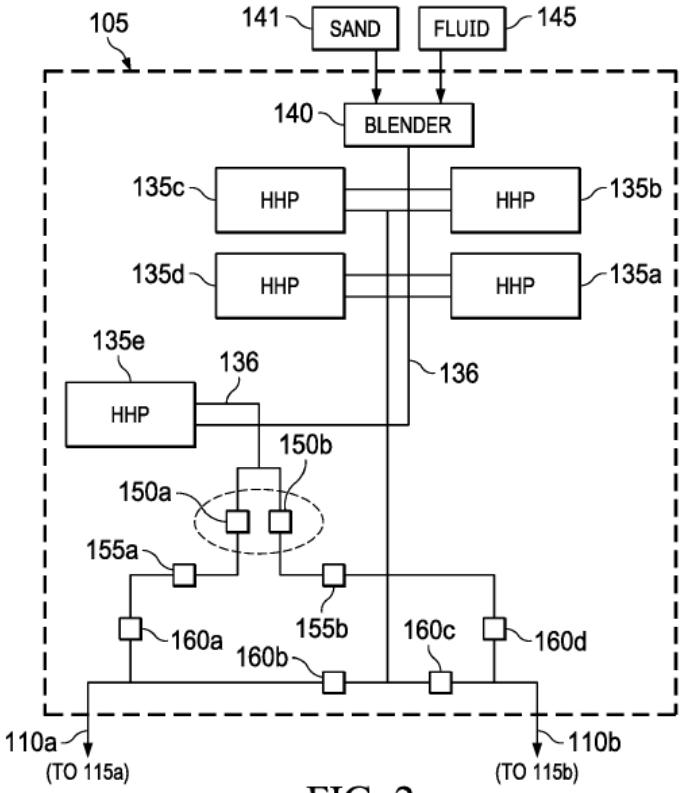


FIG. 2

As shown in Figure 2, Beuterbaugh's system comprises one or more high pressure pumps 135a–135e, one or more switching valves 150a, 150b, and one or more plug valves 155a, 155b. Ex. 1036 ¶¶ 18, 19. Switching valves 150a, 150b alternatively direct fracturing fluid—received via high pressure conduit 136 and pumps 135a–135e—from wellhead 115a to wellhead 115b. *Id.* ¶ 19. Plug valves 155a, 155b, located downstream of switching valves 150a, 150b, "allow absolute shut off of fracturing fluid flow after one of the switching valves 150a, 150b shifts to a closed position in case there is some leakage flow from the associated switching valve 150a, 150b due to wear thereby causing leakage." *Id.*

The switching valves and plug valves are operated in a particular sequence to switch from fracturing wellhead 115a to wellhead 115b. *See*

Ex. 1036 ¶ 21. This valve sequence is illustrated in Figures 3A–3C, reproduced below:

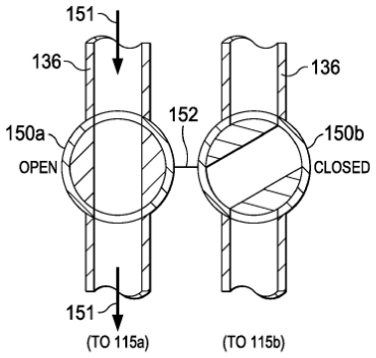


FIG. 3A

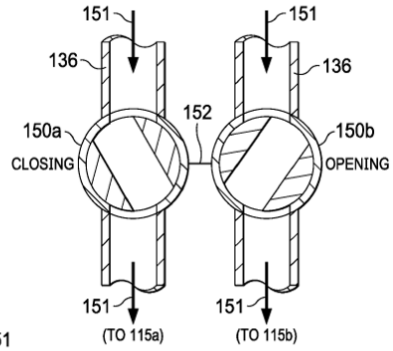


FIG. 3B

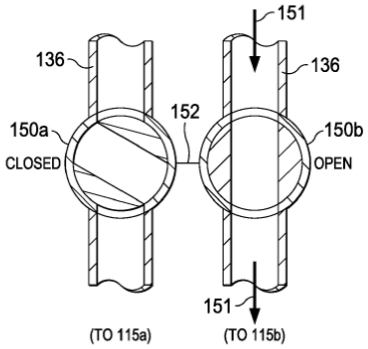


FIG. 3C

Initially, as partially shown in Figure 3A, switching valve 150a and plug valve 155a are open while switching valve 150b and plug valve 155b are closed to allow fluid pulse 151 to flow from the high pressure pumps 135a–135e to wellhead 115a, and to prevent flow to wellhead 115b. *Id.* ¶ 21. Next, as partially shown in figure 3B, "a pulse of fluid flow 151 is directed to the second wellhead 115b by first opening the plug valve 155b downstream of switching valve 150b, then switching valve 150b is opened as switching valve 150a is being closed." *Id.* After switching valve 150b is fully opened and switching valve 150a is fully closed to initiate a fluid pulse down well 115b (Figure 3C), plug valve 155a is closed. *Id.* The process is then reversed to send a pulse towards wellhead 115a. *Id.* "[T]he time duration that a switching valve 150a, 150b is opened . . . may be selected

from a range of about 100ms to about 10 secs." *Id.* ¶ 21. Beuterbaugh explains that "[b]ecause the one or more high pressure pumps 135a–135e can run at a constant rate, the wear and tear on the pumps is significantly reduced." *Id.* ¶ 18.

*2. Jackson (Ex. 1005)*

Jackson teaches a method of fracturing a geological formation to recover hydrocarbons such as natural gas, the method including "introducing a supply of fracturing fluid [e.g., nitrogen] 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." Ex. 1005 ¶¶ 3, 12. Figure 3 depicts one embodiment of Jackson's fracturing method, and is reproduced below:

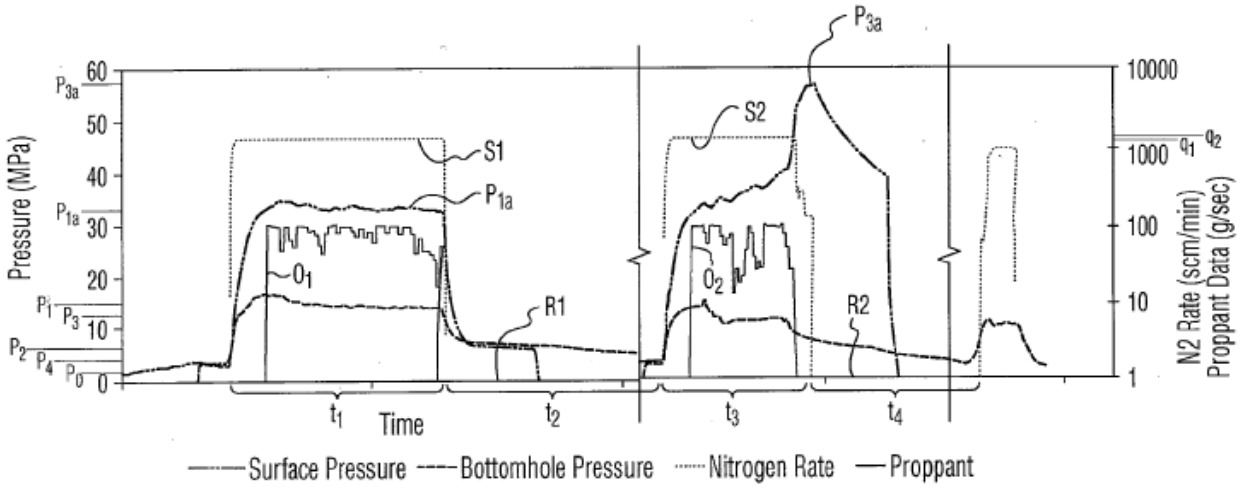


**FIG. 3**

Figure 3 is a chart showing fracturing-fluid flowrate and observed pressure over time during a fracturing operation. Ex. 1005 ¶ 36. The passage of time is shown on the horizontal axis, flow rate on the right vertical axis, and well-

bore pressure on the left vertical axis. *Id.* at Fig. 3. According to Jackson's method, starting at initial well-bore pressure $P_0$, fracturing gas is introduced into the well in a "first surge S1 at a flow rate $q_1$ of at least 300 scm or possibly at least 1000 scm over a time period $t_1$," e.g., 1 to 20 minutes, to raise the pressure in the well bore to an elevated level $P_1$. *Id.* ¶ 61. Following the pressure rise, a "period of relaxation R1 may occur in which the inflow of frac gas may be greatly diminished or stopped to a rate of less than 300 scm, and during which the pressure is permitted to decline over a time period $t_2$ [e.g., one to 24 hours] to some lesser value $P_2$." *Id.* At the end of time period $t_2$, gas is again introduced to create a "surge S2 at a flow rate $q_2$ of at least 300 scm or possibly at least 1000 scm over a time period $t_3$ [e.g., 1 to 20 minutes] to raise the pressure in the well bore to a high pressure $P_3$." *Id.* ¶ 62. Proppant may be added during S1 and S2, and additional time periods may follow. *Id.* ¶ 61–63.

*3. Independent Claims 1 and 8*

Limitations [1.3] and [1.4] of claim 1 recite, "determining that the flow rate of the fluid being pumped into the first well is below a flow rate threshold and has been below the flow rate threshold for a threshold amount of time." Ex. 1001, claim 1. Limitations [8.5] and [8.6] of independent claim 8 are identical. *Id.*, claim 8.

Petitioner relies on the combination of Beuterbaugh and Jackson to teach these limitations. For limitations [1.3] and [8.5], Petitioner characterizes Beuterbaugh as "consider[ing] knowledge of flowrate for determining fracturing fluid pulse size, optimization of downhole pressure wave, and minimization of surface impacts." Pet. 61 (citing Ex. 1036 ¶¶ 18, 24); *id.* at 74. As for Jackson, Petitioner submits that:

> *Jackson* discloses flowrate as a known parameter to measure/monitor during fracturing operations. *Jackson*, [0019]. *Jackson* also discloses that it was known to determine if a measured flowrate was below a flowrate threshold to determine if a condition for an operation was met so the fracturing process could move to the next step. For example, *Jackson* describes fracturing processes that include supplying fracturing fluid into a well until a first threshold is reached and performing a series of steps of adjusting the flow of the fracturing fluid to reach subsequent thresholds. *Jackson*, Abstract. *Jackson* states that thresholds 'may be defined by at least one of . . . (a) a time period threshold; (b) a non-participating gas [fracturing fluid] flow rate threshold;' and/or others where process parameters such as flowrate and volume are observed to assess fracturing processes. *Id.*, [0017], [0019]. The threshold may be defined as a flowrate of less than a selected flowrate, such as during a period of pumping relaxation. *Id.*, [0061].

*Id.* at 61–62 (citing Ex. 1005 ¶ 17, 19, 61, Abstr.) (alterations by Petitioner). Petitioner thus contends that "while *Beuterbaugh* broadly discloses monitoring/controlling fracturing operation parameters to selectively deliver fracturing fluid pulses to wells, *Jackson* gives more detailed guidance including monitoring flowrate to control fracturing according to flowrate thresholds." Pet. 62. According to Petitioner, "[a] POSITA would have considered using *Jackson*'s systems/methods for measuring/monitoring flowrate according to flowrate thresholds as a simple complement to *Beuterbaugh*'s fracturing systems/methods for directing fracturing fluid pulses with a selected pulse size to wells in a multi-well system." *Id.* (citing Ex. 1041 ¶¶ 382–385). Petitioner further contends that one of ordinary skill in the art "would have found it obvious to include Jackson's measuring flowrate and using flowrate thresholds as part of Beuterbaugh's systems/methods, for example, to indicate fracturing stage status and

determine next operational steps." *Id.* at 58 (citing Ex. 1041 ¶¶ 365, 366–370).

Petitioner also relies on the combination of Beuterbaugh and Jackson to teach limitation [1.4]. Pet. 62–63. Petitioner asserts that "*Beuterbaugh* discloses generally that a pulse's 'time duration may be selected for each well in multi-well systems," and that "*Jackson* uses selected flowrate thresholds with selected time thresholds to indicate different stages in a frac cycle and trigger the next fracturing operation stage," e.g., "a frac cycle 'relaxation stage' may be defined by flowrate being less than 300 scm [standard cubic meters/minute] (flowrate threshold) for 1 minute to 24 hours (time period threshold)." *Id.* at 62–63 (citing Ex. 1036 ¶ 22; Ex. 1005 ¶¶ 5, 17–19, 61) (footnote omitted). Petitioner contends that "[a] POSITA would have found obvious to include Jackson's threshold teachings in Beuterbaugh's methods/systems, including using Jackson's disclosure of a measured flowrate below a flowrate threshold for a threshold amount of time indicating a stage of a fracturing process, to improve Beuterbaugh's control of fracturing operations." *Id.* (citing Ex. 1041 ¶¶ 386–387).

Patent Owner responds that there are "at least two deficiencies in Petitioner's obviousness theory." Prelim. Resp. 39. First, according to Patent Owner, "Jackson's technique of measuring ***varying*** flowrate against a threshold would never be needed in Beuterbaugh's system because its pumps run at a 'constant' rate, producing ***unvarying*** flow rate." *Id.* Second, "even when combined, Beuterbaugh and Jackson fail to teach using flow-rate conditions to determine when to switch fracturing fluid flow from one well to another—as Beuterbaugh switches between wells based on ***time*** and Jackson adjusts fluid flow in a ***single well***." *Id.* Patent Owner asserts that

Petitioner's reliance on Jackson is insufficient because "Petitioner fails to explain how Jackson's flow-rate measurements and comparisons would complement Beuterbaugh's multi-well pulsing scheme in any way." Prelim. Resp. 40–41 (citing Pet. 62). According to Patent Owner, because "Beuterbaugh makes no mention of flow-rate measurements and instead contemplates opening and closing valves to create pulses based on solely on time," Petitioner does not "explain how an operator would use flow-rate measurements or thresholds in implementing Beuterbaugh's timed pulsing scheme." *Id.* at 41 (citing Pet. 62, Ex. 1036 ¶ 22).

We are not persuaded that claims 1 and 8 would have been obvious over Beuterbaugh and Jackson. While it is not entirely clear from the Petition how one of ordinary skill in the art would have combined Beuterbaugh and Jackson, we understand that, in the combined process, Jackson's "systems/methods for measuring/monitoring flowrate according to flowrate thresholds" would be applied to whichever well Beuterbaugh's system is directing flow, and, when flow is directed to the other well, Jackson's process would be repeated for that well.

Jackson's methods require adjusting the flow rate of the fracturing fluid to reach various thresholds. *See, e.g.*, Ex. 1036 ¶¶ 5 (teaching a method comprising introducing fracturing fluid "at a rate of at least 300 [scm] until a first threshold is reached, then "adjusting the flow" of the fluid to reach a second threshold, and "adjusting the flow" again to reach a third threshold). But adjusting flow rates in accordance with Jackson's methods appears to be contrary to Beuterbaugh's goal of reducing pump wear by maintaining a constant flow rate. Beuterbaugh's method "reduce[s] wear and equipment failure," particularly of high pressure frac pumps, "due to

increased or decreased pulsing pumping strain typically associated with traditional fracturing techniques." Ex. 1005 ¶¶ 3, 15. Beuterbaugh's method thus allows the high pressure pumps to "run at a constant rate" . . . so that "the wear and tear on the pumps is significantly reduced." *Id.* ¶ 18. Neither Petitioner nor Dr. Durham explain how flow rate would be adjusted in accordance with Jackson's methods without changing pump flow rates, or explain why one of ordinary skill in the art would have combined the references despite possibly incurring "wear and equipment failure" associated with changing pump speeds that Beuterbaugh seeks to avoid. Thus, we are not persuaded that Petitioner has articulated a reason, with rational underpinning, why one of ordinary skill in the art would have combined Beuterbaugh and Jackson as Petitioner proposes.

Even if one of ordinary skill in the art would have combined Beuterbaugh and Jackson, we are not persuaded that the combination would teach or suggest the claimed "flow rate threshold" and "threshold amount of time." As stated above, we defined a *flow-rate threshold* and *threshold amount of time* as flow-rate and time values that determine whether or not a second valve associated with a second well is opened during pumping of fluid into the first well via the first valve. Petitioner relies on Jackson's teaching of a "relaxation stage" during which flow rate is below a threshold for a certain period of time:

> *Jackson* uses selected flowrate thresholds with selected time thresholds to indicate different stages in a frac cycle and trigger the next fracturing operation stage. *Jackson*, [0017]-[0019]. For example, a frac cycle "relaxation stage" may be defined by flowrate being less than 300 scm (flowrate threshold) for 1 minute to 24 hours (time period threshold). *Id.*, [0005], [0061].

Pet 62–63 (citing Ex. 1005 ¶¶ 5, 61) (footnote omitted). Petitioner does not explain why satisfying these thresholds would have resulted in opening valves associated with the well not being fractured, in accordance with our construction of the claimed thresholds, as opposed to advancing to the next fracturing stage for the well already being fractured.

*4. Independent Claims 15 and 25*

Independent claim 15 recites, in part:

> (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; wherein, during step (b) hydraulic fracturing fluid is continuously pumped to the first and second valves via a hydraulic manifold; and
>
> wherein: in response to determining that the flow rate measuring 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).

Ex. 1001, claim 15. Claim 25 contains identical language. *Id.*, claim 25.

Petitioner relies on Beuterbaugh to teach swapping from permitting fracturing of one well to permitting hydraulic fracturing of another well, and "opening a first valve associated with the first well before the second valve associated with the second well is closed in response to at least a time condition." Pet. 81, 86 (citing Ex. 1036, Abstr., ¶ 21; Ex. 1041 ¶¶ 445–454). Petitioner relies on Jackson to teach "determining if flowrate conditions were met for different stages of fracturing processes," e.g., "Jackson discloses fracturing methods include 'introducing a supply of fracturing fluid to the formation until a first threshold is reached, adjusting the flow of the

fracturing fluid to reach a second threshold, adjusting the flow to reach a third threshold and ceasing flow of the fracturing fluid to the formation." *Id.* at 87. According to Petitioner, it would have been obvious "to determine next steps in response to flowrate conditions, as taught by Jackson, in Beuterbaugh's systems/methods to allow for additional control of the fracturing operation," such that "[t]he method would include opening a first valve before closing a second valve and continuously pumping hydraulic fracturing fluid to the valves via the hydraulic manifold as taught by Beuterbaugh in response to meeting Jackson's flowrate thresholds." *Id.* (citing Ex. 1041 ¶¶ 458–462).

Patent Owner responds that "even when combined, Beuterbaugh and Jackson fail to teach swapping between **two wells** based on **flow rate**—Beuterbaugh swaps wells based on time (not flow rate), and Jackson teaches adjusting fluid flow into a single well to meet certain pressure thresholds." Prelim. Resp. 42. According to Patent Owner, "adjusting the flow rate into a single well when the rate reaches various 'thresholds,'" the Jackson teaching on which Petitioner relies, "is different from monitoring the flow rate and basing determinations about how to swap between wells on whether the monitored flow rate meets certain conditions." *Id.* at 43 (citing Ex.2006 ¶ 173). Patent Owner submits that "[n]either Petitioner nor its expert explain how Jack[s]on's teaching regarding a single well is relevant to determining when to switch fracturing one well to another." *Id.* (citing Ex. 2008, 21). Patent Owner also argues that "Beuterbaugh teaches opening and closing valves in a **predefined** sequence to create pulses," using "near instantaneous switching", and "Petitioner provides no explanation of how Jackson, which does not relate to swapping between wells at all, would motivate [ an

ordinary artisan] to alter that valve sequence based on flow-rate conditions." *Id.* at 44 (citing Ex. 1036 ¶¶ 15, 21; Ex. 2006 ¶ 175).

We are not persuaded that Petitioner has a reasonable likelihood of prevailing in showing that the combination of Beuterbaugh and Jackson teaches these limitations. First, as discussed above in connection with claim 1, we are not persuaded that Petitioner has provided a reason, with rational underpinning, why one of ordinary skill in the art would have combined Beuterbaugh and Jackson in the manner that Petitioner proposes. Second, as Patent Owner notes (Prelim. Resp. 39, 42–43), neither Beuterbaugh nor Jackson teaches using flow-rate conditions to determine when to switch fracturing fluid flow from one well to another, regardless of the order in which the wells' valves are opened. Jackson teaches adjusting fluid flow into a single well to meet certain pressure thresholds, but neither Petitioner nor Dr. Durham explains how this teaching is relevant to determining when to switch fracturing one well to another.

For the above reasons, we are not persuaded that Petitioner has a reasonable likelihood of prevailing in showing that independent claims 15 and 25 would have been obvious over Beuterbaugh and Jackson.

*5. Dependent Claims 2, 3, 6, 9, 10, 13, 16–18, 26–28, 31, and 36*

Because we are not persuaded that Petitioner has a reasonable likelihood of prevailing in showing that any of independent claims 1, 8, 15, and 25 would have been obvious over Beuterbaugh and Jackson, we likewise determine that Petitioner does not have a reasonable likelihood of prevailing in showing the unpatentability of dependent claims 2, 3, 6, 9, 10, 13, 16–18, 26–28, 31, and 36.

*6. Conclusion as to Ground 4*

For the above reasons, we are not persuaded that Petitioner has a reasonable likelihood of prevailing with respect to Ground 4.

*H. Patent Owner's 35 U.S.C. § 314(a) Challenge*

Patent Owner argues that we should deny institution under 35 U.S.C. § 314(a) because the present Petition is the second petition filed "against the same claims of the '779 Patent." Prelim. Resp. 1–14. Because we determine not to institute *inter partes* review for other reasons, this argument is moot.

## III. CONCLUSION

For the foregoing reasons, we determine that Petitioner has not shown that there is a reasonable likelihood that it would prevail with regard to at least one of the claims challenged in the Petition. Accordingly, we do not institute *inter partes* review of any of the challenged claims of the '779 patent on any asserted ground.

## IV. ORDER

For the reasons given, it is

ORDERED that the Petition for *Inter Partes* Review is *denied*.

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