

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

PROFRAC HOLDING CORPORATION
and
U.S. WELL SERVICES, LLC,
Petitioners,

v.

HALLIBURTON ENERGY SERVICES, INC.,
Patent Owner

IPR2023-01319
U.S. Patent No. 7,841,394

**PETITION FOR *INTER-PARTES* REVIEW OF
U.S. PATENT NO. 7,841,394 B2**

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I. INTRODUCTION

Petitioners ProFrac Holding Corporation and U.S. Well Services, LLC (“Petitioners”) request *inter partes* review of claims 1-27 (“challenged claims”) of U.S. Patent No. 7,841,394. The ’394 patent is directed to oil and gas well operations that include methods and systems for stimulating multiple wells from a central location. EX-1001, Abstract, 1:40–42. But as demonstrated below, the concept of centralized well-operations and well-stimulation are not new, but rather “[t]he combination of familiar elements according to known methods.” *KSR International Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). Because the evidence demonstrates that the ’394 Patent claims are obvious based on Crossley in view of Albers, the Board should institute *inter partes* review.

II. COMPLIANCE WITH IPR REQUIREMENTS

A. Certification – Grounds for Standing

Petitioners certify that the ’394 Patent is available for *inter partes* review. Petitioners are not barred or estopped from requesting an *inter partes* review challenging the claims on the identified grounds herein. Neither Petitioners nor any real party in interest has filed a civil action challenging the validity of a claim of the ’394 Patent. This petition is being filed no more than 1 year after the date on which Petitioners or real parties in interest or privies of Petitioners were served with a complaint alleging infringement of the ’394 Patent.

B. Mandatory Notices1. Real Party-in-Interest

The real parties-in interest are ProFrac Holding Corporation and U.S. Well Services, LLC (“Petitioners”).

2. Related Matters

U.S. Patent No. 7,841,394, along with several other patents, has been asserted by Halliburton Energy Services, Inc. (“Halliburton” or “PO”), Halliburton US Technologies, Inc., and Halliburton Group Technologies, Inc. in the case *Halliburton Energy Services, Inc. v. U.S. Well Services, LCC and ProFrac Holding Corp.*, Case No. 6:22-cv-00906-ADA (W.D. Tex.) filed September 1, 2022.

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III. THE CHALLENGED CLAIMS

Ground 1: Claims 1-27 are unpatentable as obvious under 35 U.S.C. § 103 based on Crossley (EX-1005) in view of Albers (EX-1006).

Ground 2: Claims 11 and 13 are unpatentable as obvious under 35 U.S.C. § 103 based on Crossley (EX-1005) in view of Albers (EX-1006), in further view of Lehman (EX-1009).

IV. THE '394 PATENT

A. Effective Filing Date

The earliest filing date claimed by the '394 Patent is December 2, 2005. EX-1001, Face. Patent Owner represented during the prosecution underlying the '394 Patent that it entitled to a priority date of August 5, 2005.

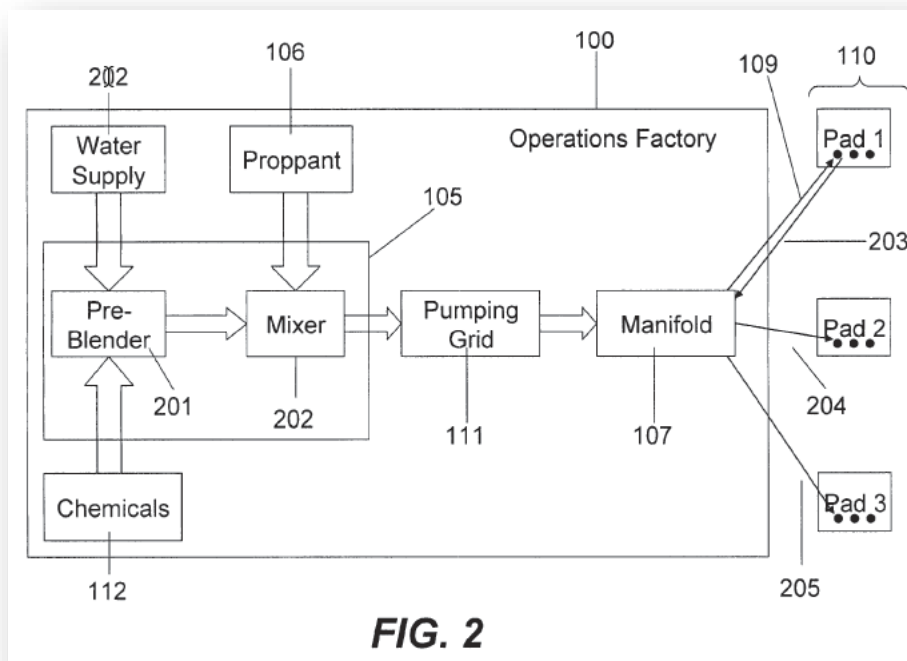
B. Person of Ordinary Skill in the Art

A person of ordinary skill in the art ("POSITA") pertinent to the subject matter of the '394 patent and during the relevant timeframe would have had at least a bachelor of science in chemical engineering, mechanical engineering, materials science, or metallurgical engineering or an equivalent field and at least two years of academic or industry experience in the oil and gas industry, including experience with process control systems. A person having education but less

professional experience, and vice versa, may qualify also qualify as a POSITA. EX1003-¶4.

C. Overview of the '394 Patent

The '394 Patent was filed as Application No. 11/291,496 on December 1, 2005, and issued on November 30, 2010. The '394 Patent is directed to a method of stimulating multiple wells from a central location. EX-1001, Abstract, 1:40–42. More specifically, the '394 Patent describes simultaneously stimulating a plurality of wells from a central location using fluid that “can be any combination of proppant, fracturing fluid, gelling agent, friction reducer, and acid.” EX-1001, 1:43–51. Identifying a perceived problem with the prior art, the '394 Patent explains that conventional systems required the “movement of equipment and personnel” to set up a new wellhead or pad. EX-1001, 1:23-37. The '394 patent alleges to provide a solution to this perceived problem—that is, service multiple wells from a central location using a well operation factory and a manifold. Figure 2 of the '394 shows the operation factory 100 and a manifold 107 that helps direct the stimulation fluids to multiple pads 110:



The '394 Patent alleges that servicing multiple wells from a centralized location reduces complexity because it is not necessary to set up and break down the same fracking equipment to service a new pad or well head. *See* EX-1001, 1:23-37. The '394 patent's solution thus purports to "conserve[s] labor, infrastructure, and the environmental impact" caused by relocating equipment for each new pad. EX-1001, 1:6-11.

V. CLAIM CONSTRUCTION

Claims are given their "ordinary and customary meaning" as understood by a POSITA and the prosecution history pertaining to the patent. 37 C.F.R. § 42.100(b). Petitioner includes as an exhibit a "prior claim construction

determination” related to the ’394 patent. EX-1016. The parties agreed to the following construction, which Petitioners apply below:

Claim Term / Asserted Claim(s)	Agreed Constructions
“means for simultaneously flowing” Claims 1, 24–27	Subject to 35 U.S.C. 112 ¶ 6 (pre-AIA) <u>Function:</u> simultaneously flowing <u>Corresponding Structure:</u> a manifold and equivalents thereof

EX-1016 at 3. Because a POSITA would find the challenged claims unpatentable under any interpretation consistent with their plain and ordinary meaning in the context of the ’394 patent, the Board need not expressly construe any other claim terms. *See Vivid Techs., Inc. v. Am. Sci. & Eng. ’g. Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

VI. THE PRINCIPAL PRIOR ART

A. Crossley

World Intellectual Property Organization (“WIPO”) Patent Application Publication WO 2005/111369 to Crossley et al. (“Crossley”) was filed on February 23, 2005 and published on November 24, 2005. EX-1005, Face. Crossley is therefore prior art to the ’394 Patent under at least 35 U.S.C. §§ 102 (a) & (e).

Crossley discloses a system 100 that supports multiple well-sites, each of which may constitute a plurality of wells. EX-1005, [0006], [0041]. For example,

as depicted in Figure 1, the three oil fields 10, 20, 30 are produced through three separate well-sites depicted as 110, 120 and 130. EX-1005, [0043]. Each well-site includes a plurality of wells 112, 122, and 132, although not every component of the plurality of wells is shown. EX-1005, [0043]. Crossley's system describes a vessel 150 comprising two systems, including an "operations control system 180," EX-1005, [0048], which comprises an "operations delivery system 158," EX-1005, [0060]. Crossley further explains that control operations may include:

Control operations may further include **the injection of chemicals such as hydrate, paraffin, or wax inhibitors into flow lines**. Subsea equipment that is subject to control operations includes, but is not limited to, valves and chokes (not shown) associated with wellheads, e.g., 114, 124 and 134, and respective flow-lines, e.g., lines 142, 144 and 146 and christmas trees. **It may also include pumps and other electrically or hydraulically actuated equipment**. It may also include gauges.

EX-1005, [0048] (emphasis added).

Control system 180, located on board vessel 150, controls the configuration of manifolds 115, 125, and 135, as well as corresponding valves to direct fluid to selected wells. *See, e.g.*, EX-1005, [0036] ("[T]he control command is directed to a valve, pump, line or sensor (depending upon the desired control function) associated with the collection manifold or with an individual well or flowline. The inter well-site control network thus provides a communication link between well-

sites, and may also include hydraulics, electrical power and/or chemical distribution.”); *see also id.* [0048]-[0049]. The operations control system is also capable of “providing well-site operations simultaneously to each of the first well-site and a second well-site.” EX-1005, [0026]; *see also* [0009], [0024], [Claims 1, 13, 19, and 21].

B. Albers

U.S. Patent No. 7,451,820 to Albers (“Albers”) was filed on April 29, 2005, and issued on November 18, 2008. Albers is therefore prior art to the ’394 Patent under at least 35 U.S.C. § 102 (e).

Albers discloses a system and technique for “stimulating the production of oil and natural gas from wells drilled in formations with low permeability,” including “hydraulic fracturing.” EX-1006, 1:5-12. In particular, Albers describes a technique for “stimulating well bores using gaseous and/or liquid carbon dioxide combined with substantially dehydrated proppant.” EX01006, 1:65-68. The technique “also includes the use of monitoring and flow control equipment to regulate and/or automate the method.” EX-1006, Abstract.

Albers discloses “equipment [that] is **of a conventional nature and is commonly used in the industry.**” EX-1006, 4:14-16 (emphasis added).

Referring to Figure 1, Albers explains:

A conventional blender unit (1) is shown connected to a fluid storage device (2) via a first conduit (3). The blender unit (1) contains a blender tub (not shown) that is capable of mixing two or more materials together. A conventional sand trailer (4) is shown connected to the blender unit (1). The sand trailer (4) typically includes one or more proppant containers (not shown), which are used to transfer proppant to the mixing tub (not shown) of the blender unit (1). The blender unit (1) is shown further connected to a conventional high-pressure pump (5) by a second conduit (6). The high-pressure pump (5) is in turn connected to a conventional sand intensifier unit (7) by a third conduit (8). The sand intensifier unit (7) is then connected back to the first conduit (3), and subsequently the fluid storage device (2), via a reflux conduit (9).

EX-1006, 3:56-4:3. *See also* Figures 1, Figure 4.

Albers explains that “the fluid storage device (2) contains an uncomplexed fluid, which in this embodiment is preferably clay- stabilized or gelled water, but can be any suitable fluid including a methanol water or a hydrocarbon- based fluid. The sand trailer (4) contains **proppant . . .**, but may be **any suitable proppant** such as sand, glass, plastic, ceramic, and/or metallic particles. The blender unit (1) draws fluid from the fluid storage device (2) through the first conduit (3), and further draws proppant from the sand trailer (4), and **mixes the two in the blender tub** (not shown) to form a slurry.” EX-1006, 4:52-67 (emphasis added); *see also* 5:1-29 (explaining in detail how the fracturing fluid is created). Albers further

explains that “**different concentrations** may be appropriate **based on the formation to be fracture-stimulated.**” EX-1006, 5:28-30 (emphasis added).

Albers also explains that “the wet proppant is forced into a conduit that **carries the proppant to a manifold fitting.** Simultaneously, a first nitrogen/carbon dioxide storage tank and pump forces gaseous nitrogen, liquid carbon dioxide, or a combination of both, under high pressure through another conduit until it **reaches the same manifold fitting. Once at the manifold fitting,** the nitrogen/carbon dioxide combines with the wet proppant and **delivers it to the wellhead.**” EX-1006, 2:20-27 (emphasis added); *see also* EX-1006, 5:30-42. These combined fluids are then “pumped through the wellhead and tubing/casing into the well to fracture-stimulate the formation.” EX-1006, 2:25-27; 5:42-47.

Albers also explains that his techniques include “equipment necessary to electronically measure, control, and ultimately automate the method.” EX-1006, 6:5-7. That equipment includes “a flow meter (21) and a density meter (22),” which “allow the flow rate and density of the slurry to be measured and recorded.” EX-1006, 6:14-17; *see also* EX-1006, 6:30-49 (describing additional conventional meters, valves, and chokes used in conjunction with the Albers method). Albers further discloses that “the flow rate and density of the separated fluid can [be] measured and recorded, and the flow rate can be diminished and/or stopped,” which “allows for the level of hydration of the proppant that will eventually be

delivered to the wellhead to be manipulated.” EX-1006, 6:23-27. Importantly, Albers explains that “[t]his **manipulation is beneficial**, as different fracture-stimulation applications require proppant with different hydration levels.” EX-1006, 6:27-29.

Finally, Albers explains that the specific type of engineering program to be used in the disclosed well-stimulation methods depends on the given formation to be fracture-stimulated:

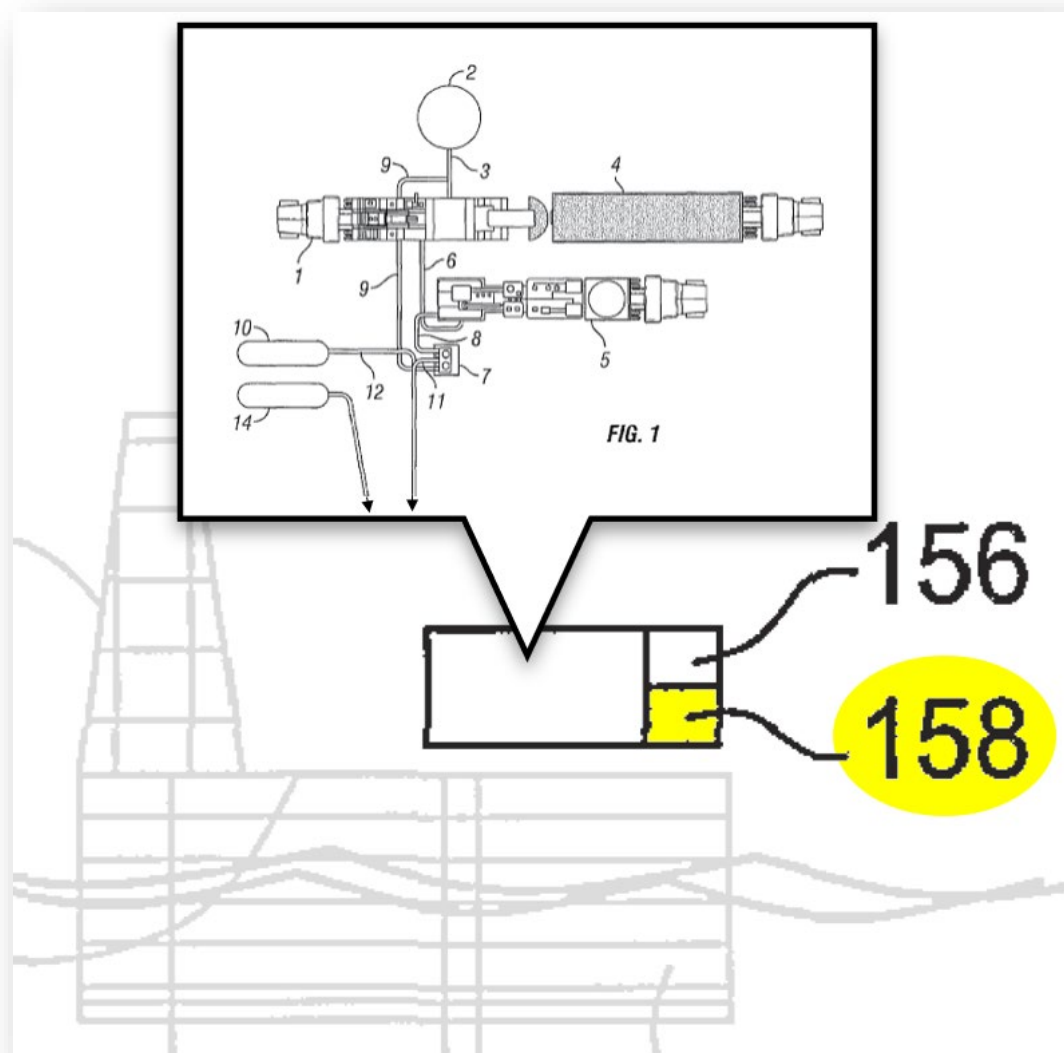
The monitoring and control equipment illustrated in FIG. 4 also allows the method as disclosed above to be highly automated. The entire method may be managed electronically and remotely. Further, because the entire system is monitored (e.g., flow meters and density meters) and flow manipulated (e.g., reflux chokes, check valves, and plug valves) the method may be performed in compliance with a predetermined engineering program. The specific engineering program will depend on the formation to be fracture-stimulated.

EX-1006, 7:27-35; *see also* Figure 4.

C. The Combination of Crossley and Albers

It would have been obvious to combine the teaching of Albers’s techniques related to dynamic formation-dependent oil-well stimulation fluids with Crossley’s teachings concerning a centralized oilfield operations system (hereinafter, “Crossley/Albers”) for the reasons explained below. A POSITA would have understood that by combining the teachings of Crossley with Albers, Albers’s

fracture-stimulating equipment (and associated dynamic fluid manufacturing and optimized oil well-stimulation fluid techniques), would have been implementable on Crossley's "vessel 150"—depicted below in annotated Figure 1 of Crossley with an excerpt of Figure 1 of Albers superimposed—and in conjunction with the "control delivery system 158."



EX-1005, Fig. 1 & EX-1006, Fig. 1 (annotated). EX-1003-¶48.

Both Crossley and Albers are analogous art to the '394 patent for at least two reasons. *First*, Crossley and Albers are both directed toward the same field of endeavor of the '394 patent—oil well operations. *E.g.*, EX-1001, 1:6–11 (“The present invention relates generally to well operations, and more particularly to methods and apparatuses for simultaneously treating multiple wells from a centralized location and simultaneously connecting multiple wells to a single manifold, so as to conserve labor, infrastructure, and environmental impact.”); EX-1005, Abstract (“A system for supporting multiple-well-site, offshore, hydrocarbon-bearing fields, each well-site has one or more wells.”); *id.*, [0002] (“Embodiments of the present invention generally relate to a system for supporting a plurality of hydrocarbon-bearing wells, including systems for providing production operations in multiple-well-site, offshore fields.”); EX-1006, 1:65-68 (“This invention relates to a method for fracture stimulating well bores using gaseous nitrogen and/or liquid carbon dioxide combined with substantially dehydrated proppant.”) EX-1003-¶49.

Second, both Crossley and Albers are reasonably pertinent to a problem described by the '394 patent: the need to efficiently conduct drilling operations, including “the complex logistics” that arise in the “servicing and stimulation of wells,” which “can require a series of coordinated operations that begin with the supply by truck of equipment, supplies, fuel, and chemicals to the wellhead.” EX-

1001, 1:23–28. EX-1005, [0005] (“The drilling and maintenance of deep and remote offshore wells is expensive. In an effort to reduce drilling and maintenance expenses, remote offshore wells are oftentimes drilled in clusters. . . . The clustering of wells also allows for one or more control lines to be run from a single location at the ocean surface, downward to the clustered wells. The control line ties into a control module on the manifold, and then branch to the various wellheads. Such a control line allows for the monitoring and control of valves, gauges, and other subsea equipment.”); EX-1006, 1:54-60 (“[there exists a need for a gaseous nitrogen fracturing technique that includes the simultaneous placement of an effective amount of proppant within the fractured formation surrounding the well bore. An effective amount of proppant serves to hold the fractures open such that channels are created for reservoir fluids to flow to the well bore and subsequently to the surface, thereby stimulating the well.”) EX-1003-¶49.

It would have been obvious to combine the teachings of Albers’s techniques related to formation-dependent and dynamically manufactured well-stimulation fluid techniques with Crossley’s teachings of a centralized oilfield operations system (well-stimulation techniques and fluids, pumps, manifolds, and other conventional oil-well equipment) with each performing the same function it has been known to perform (gas and oil production and well-stimulation techniques) and yielding not more than what one would expect from such an arrangement

(centralized well operations including simultaneous and optimized well-stimulation techniques), as the Crossley/Albers system demonstrates. *See also* EX-1008 (disclosing the same technique in the prior art), Abstract (“[T]he method describes connecting multiple wells to a stimulation fluid pumping system via a pumping system manifold. . . .”); [0030] (“For instance, the pumping system manifold 206 may include a set of pipes 208 to interface each of the trees 106a-106c with the stimulation fluid pumping system 202.”) [0030] (“That is, the present techniques provide mechanisms to enhance production economics **by enabling simultaneous or concurrent operations in the stimulation of multiple wells** in a manner that reduces non-productive time for equipment, material, and/or personnel.”). Dr. Nikolaou further explains that POSITA would have made the Crossley/Albers combination without undue experimentation and with a reasonable expectation of success. EX-1003-¶58.

Dr. Nikolaou further explains that it would have been obvious to combine the teachings of Crossley and Albers because a POSITA would have been motivated to do so based on the benefits Albers discloses. For example, Albers explains that his techniques include “equipment necessary to electronically measure, control, and ultimately automate the method.” EX-1006, 6:5-7, and that because “the flow rate and density of the separated fluid can [be] measured and recorded, and the flow rate can be diminished and/or stopped,” that would permit

“the level of hydration of the proppant that will eventually be delivered to the wellhead to be manipulated.” EX-1006, 6:25-27. Importantly, Albers explains that “[t]his **manipulation is beneficial**, as different fracture-stimulation applications require proppant with different hydration levels.” EX-1006, 6:27-29; 7:27-35; *see also* Figure 4. As Dr. Nikolaou explains, a POSITA would have been motivated by these disclosures to combine Crossley with the manufacturing and pumping optimized oil-well stimulation fluids techniques of Albers so that wells drilled in formations with lower permeability will be stimulated to produce more oil and gas, a clear benefit. EX-1003-¶59.

Dr. Nikolaou also states that the increasing the production from a well was achievable through proper well stimulation and was a sought-after result in the industry. For example, Lacy (EX-1007) explains that properly stimulating a well is important because when a “the well has been properly stimulated, flow will occur from the new, improved, propped open fractures, into the perforations, and uphole to the surface of the ground, with there being increased hydrocarbon production and decreased water production.” EX-1007, 2:37-43. Thus, Lacy confirms that the benefits achieved by properly stimulating a well were sought after, further demonstrating that a POSITA would have been motivated to combine the teachings of Crossley and Albers in order to provide for increased gas and oil production. EX-1003-¶60.

Moreover, combining the teachings of Crossley's system with Albers's teachings results in multiple wells to be treated simultaneously and with different fluids based on the specific formation being drilled, which would reduce time needed to have clusters of producing wells complete production, the benefits of which would have been recognized in the industry, such as by Tolman. *See* EX-1008 Abstract (“[T]he method describes connecting multiple wells to a stimulation fluid pumping system via a pumping system manifold. . . .”); [0030] (“For instance, the pumping system manifold 206 may include a set of pipes 208 to interface each of the trees 106a-106c with the stimulation fluid pumping system 202.”) [0019] (“That is, the present techniques provide mechanisms to enhance production economics **by enabling simultaneous or concurrent operations in the stimulation of multiple wells** in a manner that reduces non-productive time for equipment, material, and/or personnel.”) (emphasis added). Dr. Nikolaou explains that a POSITA would have recognized from Tolman that, by simultaneously pumping different stimulation fluids into wells using multiple pipes, that well-site operations would be more efficient and therefore more cost-effective—that is, more oil from the clustered well-sites would be produced in less time, by using the teachings from Albers, Crossley's system would be stimulating multiple wells simultaneously and in a manner optimized for the specific oil field. EX-1003-¶61.

VII. CLAIMS 1-27 ARE UNPATENTABLE

A. Ground 1: Claims 1-27 are Obvious Over Crossley and Albers

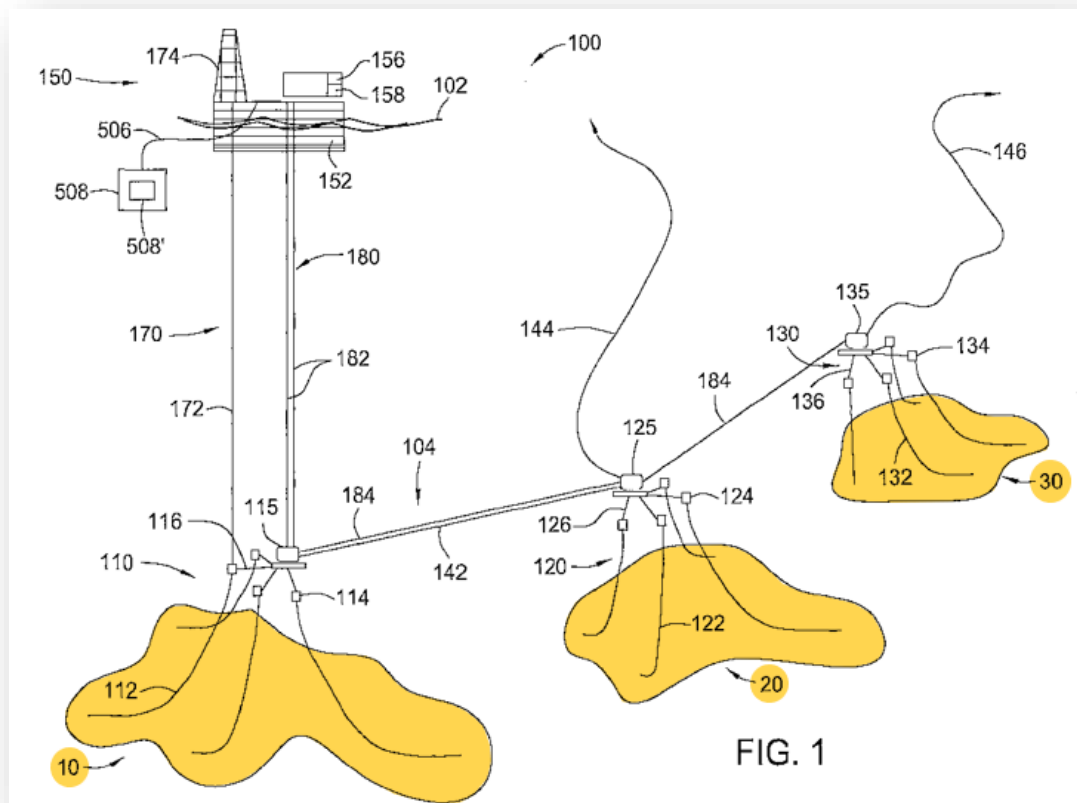
1. Claim 1

- i. *1[PRI] “A system for centralized well operations comprising:”*

Crossley/Albers discloses a “[a] system for centralized well operations.”

For example, Crossley discloses “[a] system for **supporting multiple-well-site[s], offshore, hydrocarbon-bearing fields, each well-site has one or more wells.**”

EX-1005, Abstract (emphasis added). Crossley’s operations system “**provide[s] control to wells** and other subsea equipment **at either the first well-site or the second well-site, regardless of the location of the floating vessel.**” *Id.* Figure 1 of Crossley depicts such a “centralized” system 100, including oil fields 10, 20, and 30, which include well-sites 110, 120, and 130:



EX-1005, Fig. 1 (Annotated); *see also id.*, [0041]–[0045]. EX-1003-¶63.

Crossley explains that vessel 150 **manages the multiple well-sites** using its various systems, such as a power 156 and control delivery systems 158, *i.e.*, (“*well operations*”). EX-1005, [0058], [0060]. Each well-site consists of “a grouping of wells in a clustered subsea arrangement.” EX-1005, [0006]; [0012] (“In the illustrative system of Figure 1, three separate subsea well-sites are presented, with each site having a plurality of wells clustered together.”); *see also* [0008], [0063], & [0043]. To control fluids entering and exiting the wells, Crossley uses manifolds (115, 125, and 135) located at each well-site. EX-1005, [0045]-[0046].

These manifolds, along with other systems of Crossley's depicted in Figure 1, are “*centrall[y]*” controlled by operation control system 180:

The system may also include an operations control system. The specific control operations **will include communications for sending and receiving control commands to equipment**, and for retrieving data from sensors in the production system for monitoring purposes. . . . Control operations may also include providing hydraulic fluid to production, such as shut-in valves.

EX-1005, [0033] (emphasis added). EX-1003-¶63.

- ii. *I[A] “a well treatment operations factory which manufactures and pumps a well stimulation fluid;”*

In Crossley/Albers, Crossley's vessel (“*well treatment operations factory*”) would pump stimulation fluids to multiple well-site fields (“*manufactures and pumps a well stimulation fluid*”) as depicted in Figure 1. EX-1003-¶65.

For example, Crossley's vessel includes two “operations” systems: an “operations control system 180,” EX-1005, [0048], which comprises an “operations delivery system 158,” EX-1005, [0060]. Crossley further explains that control operations may include “**the injection of chemicals** such as hydrate, paraffin, or wax inhibitors **into flow lines**” and may also “**include pumps and other electrically or hydraulically actuated equipment.**” EX-1005, [0048] (emphasis added). EX-1003-¶66.

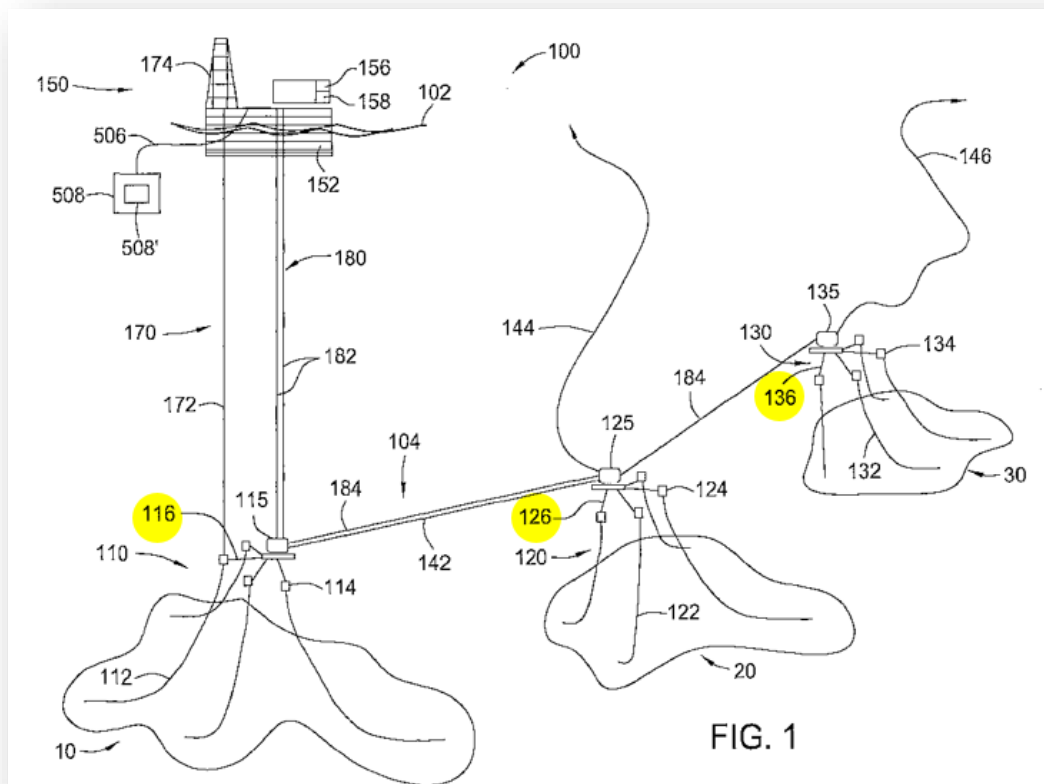
Crossley does not expressly disclose “*manufactur[ing] a well stimulation fluid*,” but Albers does. A POSITA would have been motivated to combine the teachings of Crossley and Albers for the reasons explained above. *See* § V.C; EX-1003-¶67.

Albers discloses a “fluid storage device” containing “an uncomplexed fluid,” and “preferably clay-stabilized or gelled water.” EX-1006, 4:52-67. Albers also describes a “sand trailer” that “contains **proppant . . .** [and which] may be **any suitable proppant** such as sand, glass, plastic, ceramic, and/or metallic particles.” Albers’s chemicals—such as its “uncomplexed fluid” and its “proppant”—are examples of “*well stimulation fluids*.” *E.g.*, EX-1001, 4:56-59 (“The stimulation fluid can comprise proppant, gelling agents, friction reducers, reactive fluid such as hydrochloric acid, and can be aqueous or hydrocarbon based.”) EX-1003-¶68.

Albers then explains that “the wet proppant is forced into a conduit that **carries the proppant to a manifold fitting**. Simultaneously, a first nitrogen/carbon dioxide storage tank and pump forces gaseous nitrogen, liquid carbon dioxide, or a combination of both, under high pressure through another conduit until it **reaches the same manifold fitting. Once at the manifold fitting**, the nitrogen/carbon dioxide combines with the wet proppant and **delivers it to the wellhead**.” EX-1006, 2:20-27 (emphasis added); *see also* EX-1006, 5:30-42. These combined fluids are then “pumped through the wellhead and tubing/casing

into the well to fracture-stimulate the formation.” EX-1006, 2:25-27; 5:42-47; EX-1003-¶69.

Crossley further explains that each well 112, 122, and 132 has a flow line jumper 116, 126, and 136 “in order to transport production or **injection fluids**,” and that that such flow line jumpers tie into a collection manifolds 115, 125, and 135. These flow line jumpers are depicted in annotated Figure 1 below:



Crossley, Fig. 1 (EX-1005) (annotated), [0045]. EX-1003-¶70.

Based on these disclosures, a POSITA would have understood that Crossley/Albers discloses a “*well treatment operations factory*” (i.e., vessel 150)

that “*pumps a well stimulation fluid*” into the plurality of wells at 112, 122, and 132. EX-1003-¶70.

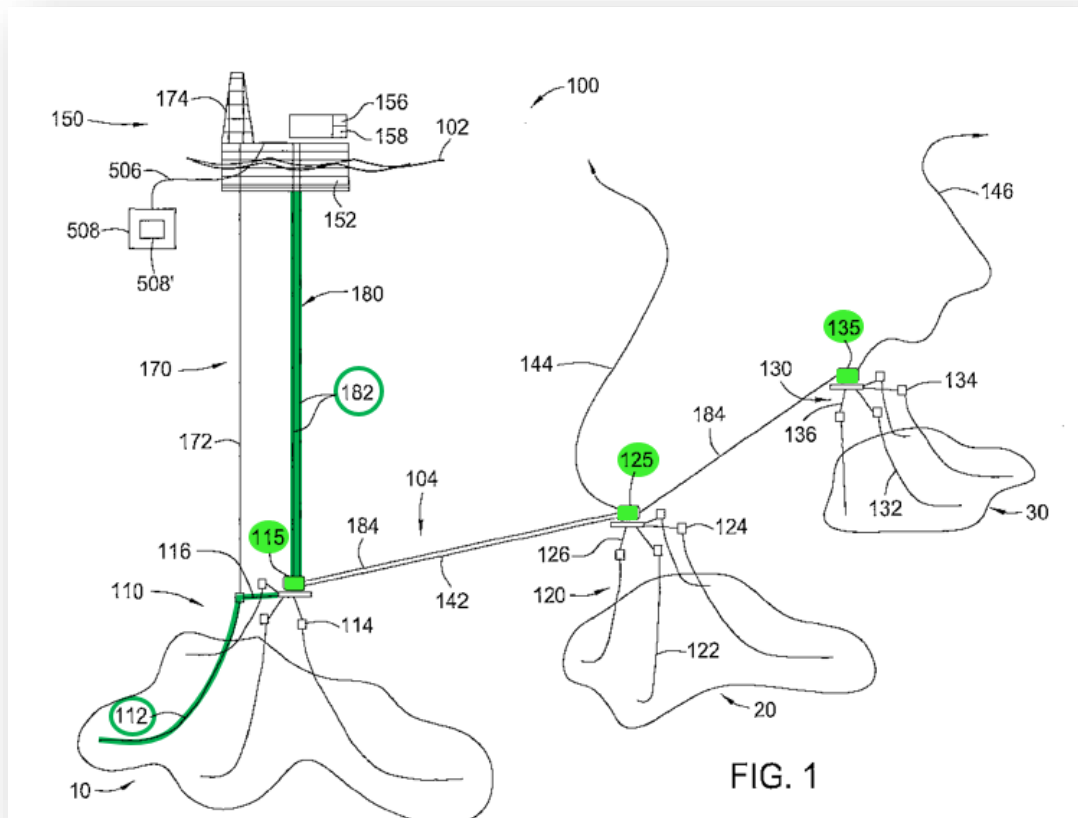
Furthermore, as modified by Albers, Crossley’s vessel is a “*a well treatment operations factory which manufactures*” optimized well-stimulation fluids as described in Albers. EX-1003-¶71.

For example, Albers describes dynamically manufacturing well-stimulation fluids: the “blender unit (1) draws fluid from the fluid storage device (2) through the first conduit (3), and further draws proppant from the sand trailer (4) and **mixes the two in the blender tub** (not shown) to form a slurry.” EX-1006, 4:52-67 (emphasis added); *see also* 5:1-29 (explaining in detail how the fracturing fluid is created). Albers further explains that “**difference concentrations** may be appropriate **based on the formation to be fracture-stimulated.**” EX-1006, 5:28-30 (emphasis added). EX-1003-¶71.

- iii. [1B] “*a first connection between a first well and the well operations factory;*”

Crossley’s vessel (“*the well operations factory*”), through its control system 180, controls the configuration of manifolds 115, 125, and 135, as well as corresponding valves to direct fluid to selected wells. *See, e.g.*, EX-1005, [0036] (“[T]he control command is directed to a valve, pump, line or sensor (depending upon the desired control function) associated with the collection manifold or with an individual well or flowline.”) The manifolds are used in Crossley **to selectively**

deliver fluids from the vessel. EX-1005, [0036], [0049]-[0050]. As depicted in Annotated Figure 1 of Crossley, the vessel is **connected** to manifold 115 via control link 182, which is further **connected** via flow line jumper 116 and associated “tree”¹ (“*a first connection*”) to well-site 110 and well 112 (“*a first well*”). The vessel is also connected to collection manifolds 125 and 135 for well-sites 120 and 130, respectively, via similar connections:

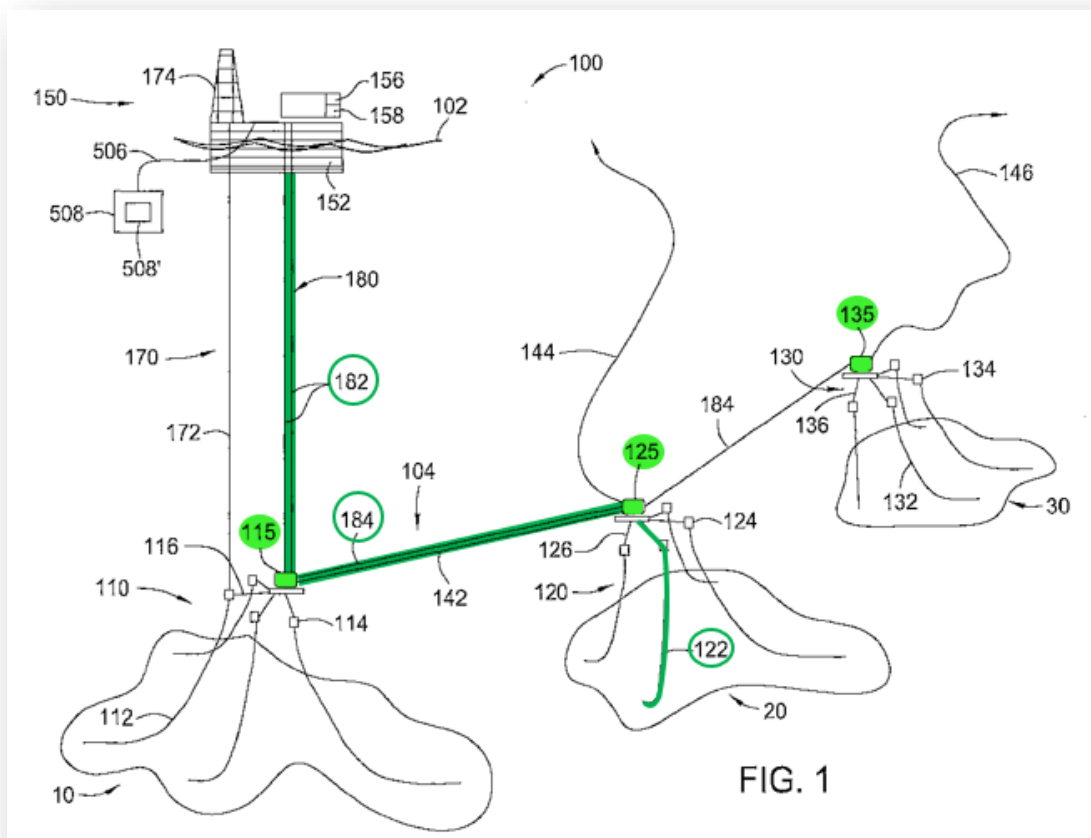


¹ The trees of each well—depicted as a box (e.g., 114) on each well—“have valves for controlling or shutting off fluid.” EX-1005, [0044].

EX-1005, Fig. 1, [0036], [0046], [0049]. EX-1003-¶75.

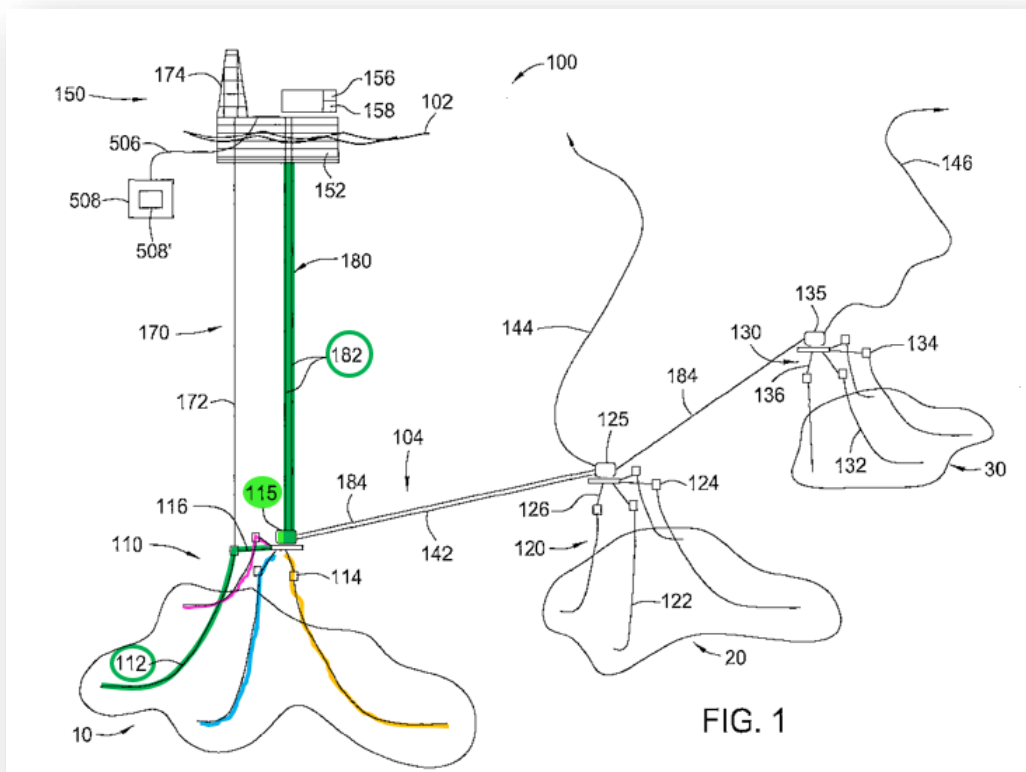
- iv. [1C] “a second connection between a second well and the well operations factory;”

Annotated Figure 1 of Crossley also demonstrates that the vessel (“the well operations factory”) is **connected** to manifold 115 via control link 182, and further depicts that manifold 115 is **connected** to collection manifold 125 via control link 184 which is further **connected** via flow line jumper 126 and associated tree (*i.e.*, “a second connection”) for well-site 120 and well 122 (“a second well”):



EX-1005, Fig 1 (annotated) [0045], [0063]. EX-1003-¶78.

Alternatively, in a second configuration (a “single well-site configuration”), Crossley discloses that each well-site includes a plurality of wells 112, 122, and 132 clustered together. EX-1005, [0043]; *see* Figure 1 (annotated), *below*. Accordingly, any of the other wells at well-site 110 (such as, for example, the well highlighted in yellow that includes tree 114) and their “*connection*” through control link 182 and **flow line jumper 116 and associated tree** would alternatively disclose “*a second connection between a second well and the well operations factory.*”



EX-1005, Fig. 1 (annotated); EX-1003-¶79.

- v. [1D] “and means for simultaneously flowing: a first stimulation fluid to the first well and not to the second well; and a second stimulation fluid to the second well and not to the first well;”

In district court litigation, the parties agreed that the function of “*means for simultaneously flowing*” is “simultaneously flowing,” and the corresponding structure is “a manifold and equivalents thereof.” *See* § V, *above*.

Crossley’s manifolds 115, 125, and 135 are each “*means for simultaneous flowing*” of stimulation fluids, per the parties’ agreed construction, because they are manifolds. EX-1003-¶83

Crossley also explains that the operations control system is “connectible to the ship for providing well-site operations **simultaneously to each of the first well-site and a second well-site.**” EX-1005, [0026] (emphasis added); *see also* [0009], [0024], [Claims 1, 13, 19, and 21]. Crossley further teaches that its “control line”—*i.e.*, control lines 182 and 184—are connected “into a control module on the **manifold**, and then branch to the various wellheads. Such a control line allows for the monitoring and control of valves, gauges, and other subsea equipment. Control lines also allow for one or more power lines **or chemical delivery lines to be delivered from the ocean surface, downward to the clustered wells.**” EX-1005, [0005] (emphasis added). EX-1003-¶84.

Moreover, Crossley’s vessel, through its control system 180, controls the configuration of manifolds 115, 125, and 135, as well as corresponding valves to

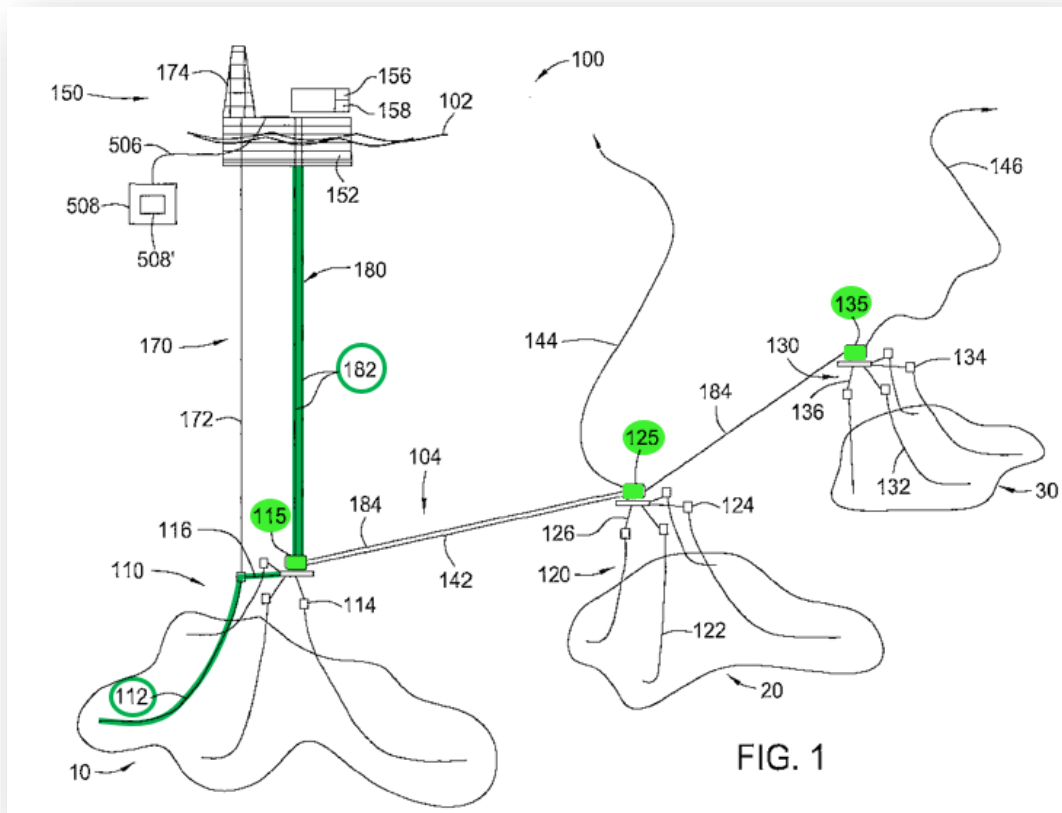
direct fluid to selected wells. *See, e.g.*, EX-1005, [0036] (“[T]he control command is directed to a valve, pump, line or sensor (depending upon the desired control function) associated with **the collection manifold or with an individual well or flowline**. The inter well-site control network thus provides a communication link between well-sites, and may also include hydraulics, electrical power and/or **chemical distribution.**”) (emphasis added). EX-1003-¶84.

The Crossley manifolds are used to **selectively** deliver fluids from vessel 150. EX-1005, [0028] (“The floating vessel may have a surface vessel control link selectively connectible with the **control module at the first well-site and the control module at a second well-site** so that control operations may be conducted for both the first well-site and the second well-site from either well-site.”). EX-1003-¶85.

Accordingly, the manifolds 115, 125 and 135 permit the “*simultaneous flowing*” of well-stimulation fluids. Dr. Nikolaou explains that the manifolds as used in Crossley, are the type of equipment in the art that would enable the use of “simultaneous or concurrent operations in the stimulation of multiple wells.” EX-1003-¶87 (citing *e.g.*, EX-1008, Abstract (“[T]he method describes **connecting multiple wells to a stimulation fluid pumping system via a pumping system manifold. . . .**”); [0030] (“For instance, the **pumping system manifold 206** may include a set of pipes 208 to interface each of the trees 106a-106c with the

stimulation fluid pumping system 202.”)[00130] (“That is, the present techniques provide mechanisms to enhance production economics **by enabling simultaneous or concurrent operations in the stimulation of multiple wells** in a manner that reduces non-productive time for equipment, material, and/or personnel.”) (emphasis added)). EX-1003-¶85.

In Crossley/Albers, by **selectively** controlling Crossley’s manifolds, Dr. Nikolaou explains that Crossley’s system would be configured to direct the field-optimized well-stimulation fluids of Albers to flow using different paths. EX-1003-¶86. One such configuration of Crossley/Albers would direct one stimulation fluid flowing from the vessel to well-site 110 and well 112 (“*a first well*”) via connection 180 and jumper 116 and associated tree (a “*first connection*”) and through manifold 115.

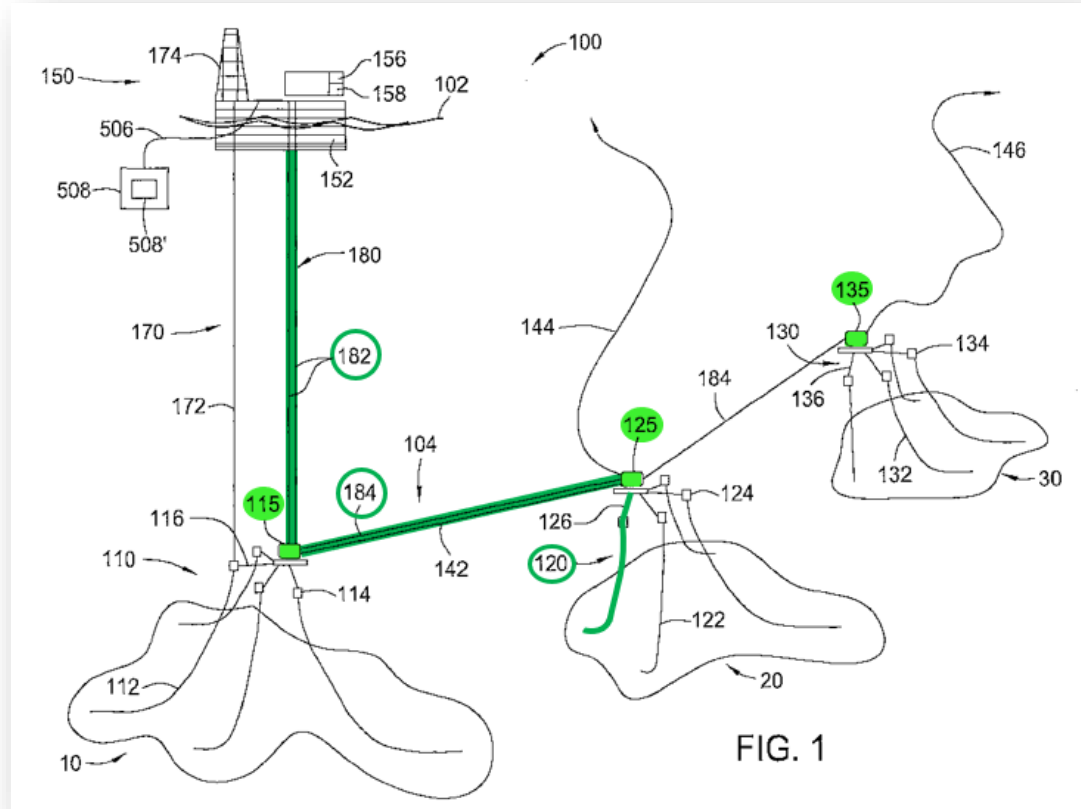


Crossley, Fig. 1 (EX-1005) (annotated) [0045], [0063]. EX-1003-187.

As depicted above, Dr. Nikolaou explains that in such a configuration, the manifold 115 would selectively direct “*a first stimulation fluid*” of Crosley/Albers to flow “*to the first well and not to the second well*” given Albers’s emphasis on “formation-specific” well-stimulation fluid. EX-1006, 5:25-29 (“[D]ifferent concentrations may be appropriate based on the formation to be fracture-stimulated.”). EX-1003-¶88.

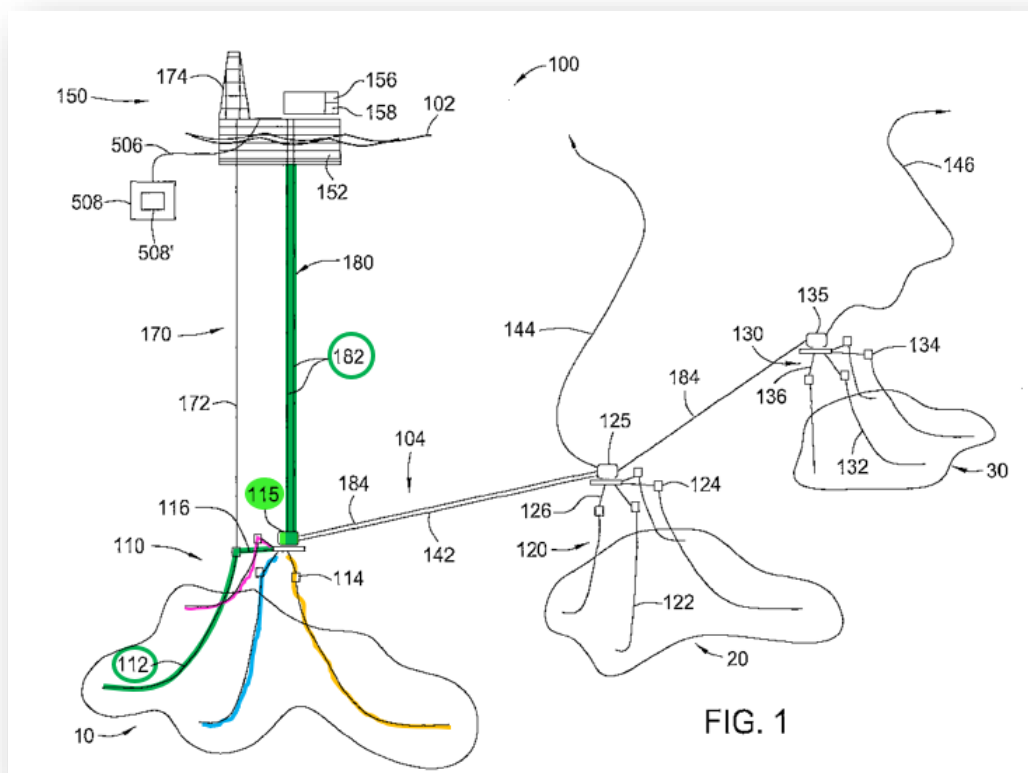
Similarly, the vessel would selectively direct a “*second stimulation fluid*” directed to well-site 120 and well 122 (“*a second well*”) via manifolds 115 and 125

and control line 184 and jumper 126 and associated tree (“*a second connection*”), as shown below.



EX-1005, Fig. 1 (annotated), [0045], [0063]). EX-1003-¶88.

Alternatively, in the second configuration described above (*i.e.*, “single well-site configuration”), see claim element 1[C], the “*second stimulation fluid*” would be directed to a “*second well*” at well-site 110:



EX-1005, Fig. 1 (annotated); EX-1003-¶89.

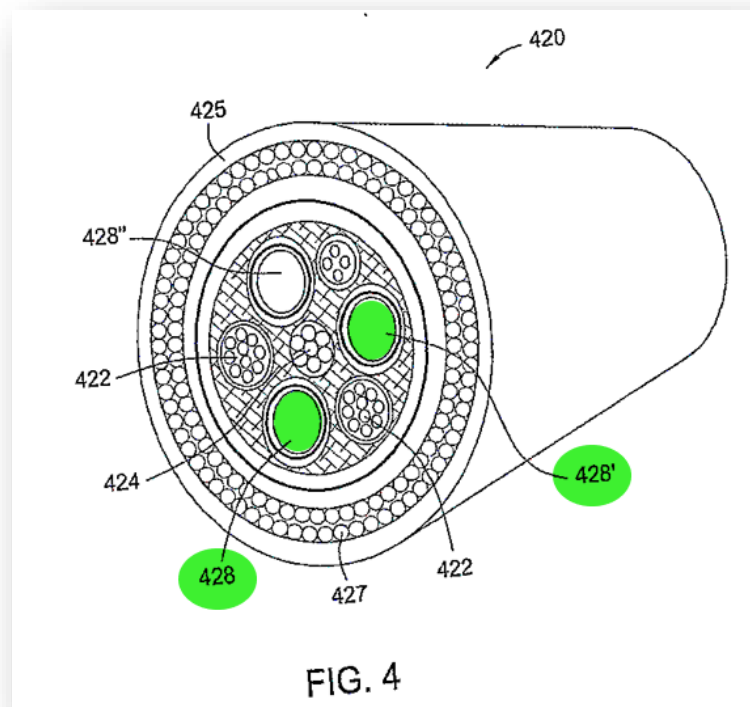
Crossley also explains that “control link 180 control link 180 and the subsea controls network 184 communication links may include, control power or chemicals, and may or may not be integrated into the same umbilical or cable as the communication links 180, 184,” an exemplary integrated line is depicted in Figure 4, and apart from “data and communication lines,” it discloses:

[F]luid distribution lines 428 [and] 428'. **Lines 428 and 428' are preserved for the delivery of chemicals,** such as hydrate inhibition fluids. Chemicals may be delivered from the lines 428, 428' and then

through the manifold 115 for treatment of flow lines, valves, and **even the wellbores as appropriate.**

EX-1005, [0050] (emphasis added); Figure 4; *see also* EX-1006, 5:28-42; EX-1003-¶90.

In the Crossley/Albers system, the well-optimized stimulation fluids would be delivered through lines 428 and 428,' which Dr. Nikolaou explains, *see* EX-1003-¶91, would expressly permit the “*simultaneous*” distribution of well-stimulation fluids to a single well or to two different wells—one through 428 and second through 428':



- vi. [1E] “wherein the first stimulation fluid and the second stimulation fluid have different compositions.”

A POSITA would have understood from the combined teachings of Crossley and Albers that the well-stimulation fluids, as taught by Albers, would be manufactured and delivered in a per-wellsite optimized manner. For example, Albers explains that “**different concentrations** may be appropriate **based on the formation to be fracture-stimulated.**” EX-1006, 5:28-30 (emphasis added). Albers further discloses that “the flow rate and density of the separated fluid can [be] measured and recorded, and the flow rate can be diminished and/or stopped,” which “allows for the level of hydration of the proppant that will eventually be delivered to the wellhead to be manipulated.” EX-1006, 6:23-27. Albers explains that “[t]his **manipulation is beneficial**, as different fracture-stimulation applications require proppant with different hydration levels.” EX-1006, 6:27-29; EX-1003-¶94.

In view of Albers’s express disclosure, Dr. Nikolaou explains that a POSITA would have understood that Crossley’s vessel, as modified by the teachings of Albers, would deliver different concentration of stimulation fluids depending upon the formation (or well-site) to be fracture-stimulated. EX-1003-¶95 (citing EX-1006, 7:27-35).

As modified, the Crossley/Albers system would pump two different well-stimulation fluids (*i.e.*, manipulating the concentration of well-stimulation fluid per

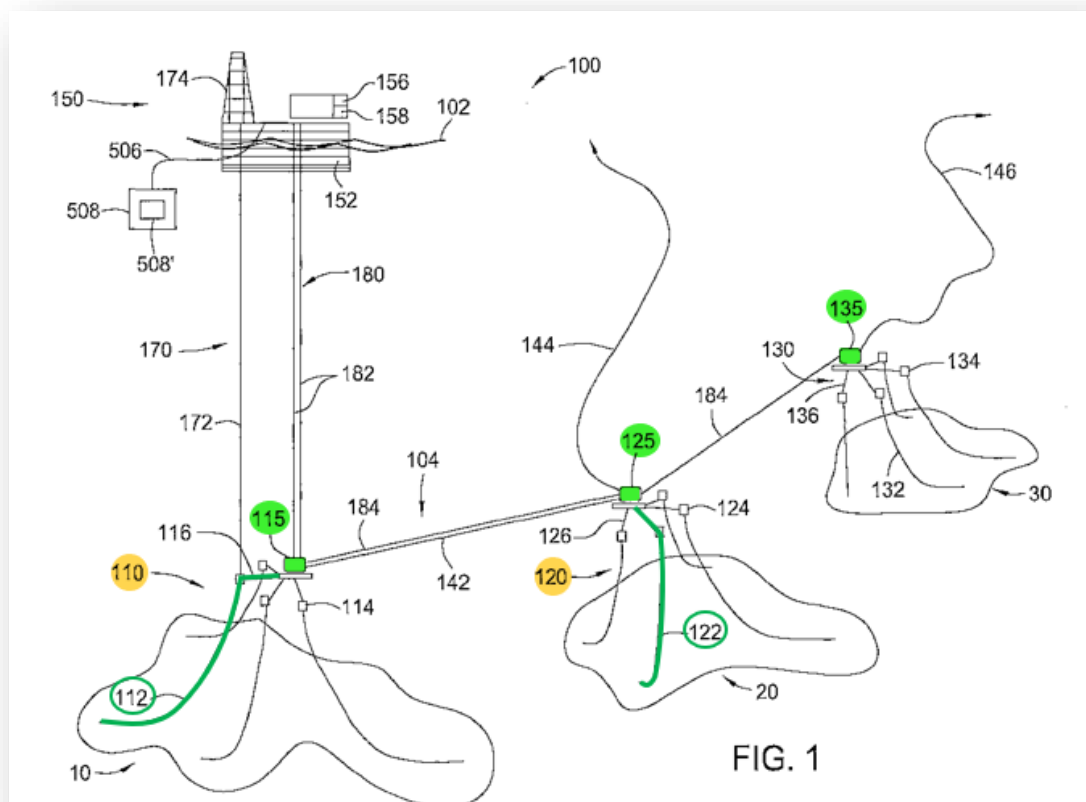
formation) simultaneously into two different wells because a POSITA would recognize that technique as both beneficial and economically efficient. EX-1006, 6:27-29 (**t]his manipulation is beneficial**, as different fracture-stimulation applications require proppant with different hydration levels.”); EX-1005, [0005] (“In an effort to **reduce drilling and maintenance expenses**, remote offshore wells are oftentimes drilled in clusters. . . The clustering of wells also allows for one or more control lines to be run from a single location at the ocean surface, downward to the clustered wells. The control line ties into a control module on the manifold, and then branch of the various wellheads); *see also* EX-1008, [0005] (“The present technique provides mechanisms **to enhance production economics by enabling simultaneous or concurrent operations in the stimulation of multiple wells in a manner that reduces non-productive time for equipment, material, and/or personnel**. As such, the present techniques may reduce the cost and time associated with performing operations for stimulation treatments of wells.”) EX-1003-¶96.

2. Claim 2

- i. *Claim 2 depends from claim 1 and recites “wherein the means for simultaneously flowing treatment fluid comprises a manifold.”*

As explained above for claim element 1[D], each of Crossley’s collection manifolds in the Crossley/Albers system—*i.e.*, manifolds 115, 125, and 135—are a

“means for simultaneous flowing” of well-stimulation fluids. Moreover, manifolds 115 and 125 are specifically involved in the simultaneous flow of well-stimulation fluids to well-sites 110 and 120. EX-1003-¶98; *see, e.g.*, Figure 1 (annotated):



3. Claim 3

- i. *Claim 3 depends from claim 2 and further recites “wherein the well operations factory comprises a pumping grid wherein the pumping grid is operable to connect to the manifold.”*

The '394 Patent explains that “the pumping grid . . . comprises one or more pumps that can be electric, gas, diesel, or natural gas powered.” EX-1001, 6:65-67.

Crossley discloses multiple pumps (a “*pumping grid*”) connected to its collection manifolds. *See* EX-1005, [0073] (“The generators, in turn, are used to provide power to subsea equipment such as electrical submersible pumps, fluid control valves, a multiphase fluid pump, and even the subsea separator 160 itself.”) [0033] (describing “electrical submersible pumps” and “multi-phase pumps.”) These pumps are associated with a collection manifold. EX-1005, [0036] (“From there, the control command is directed to a valve, *pump*, line or sensor (depending upon the desired control function) ***associated with the collection manifold*** or with an individual well or flowline.”) EX-1003-¶102.

Albers also discloses that pumps (a “*pumping grid*”) are used to simultaneously pump various compositions of fracturing fluid within the “*well-operations factory*” and to a manifold. EX-1006, 6:10-13 (“The blender unit (not shown) then discharges the slurry into the high-pressure pump (not shown), which in turn pumps the slurry to the sand intensifier unit (7).”); 2:20-25 (The wet proppant is forced into a conduit that carries the proppant to a manifold fitting. Simultaneously, a first nitrogen/carbon dioxide storage tank and pump forces gaseous nitrogen, liquid carbon dioxide, or a combination of both, under high pressure through another conduit until it reaches the same manifold fitting.”) *see also* EX-1006, 2:1-7, 3:54-67, 4:61-66. 5:1-14, 6:4-29. EX-1003-¶103.

Based on these disclosures, Dr. Nikolaou concludes that a POSITA would understand Crossley's vessel ("*the well operations factory*"), as modified by Albers, would include a "*pumping grid*" connected to Crossley's collection manifolds, including each of manifolds 115, 125 and 135. EX-1003-¶104.

4. Claim 4

- i. *Claim 4 depends from claim 3 and further recites "wherein the well operations factory comprises a blending unit wherein the blending unit is operable to connect to the pumping grid."*

Albers discloses that its "blenderunit" (i.e., "*blending unit*") is connected to a high-pressure pump ("*is operable to connect to the pumping grid*") within the Crossley/Albers "*well operations factory*":

In a first embodiment of the present invention, **a blender unit** draws fluid from a fluid storage device, draws proppant from a sand trailer, and mixes the two in a blender tub to form a slurry. Once the fluid/proppant slurry is properly mixed, the blender unit discharges the slurry into a **high-pressure pump**.

EX-1006, 2:1-7; *see id.*, 3:54-67, 4:61-66. 5:1-14, 6:4-17. EX-1003-¶107.

5. Claim 5

- i. *Claim 5 depends from claim 4 and further recites “wherein the well operations factory comprises a proppant storage system wherein the proppant storage system is operable to deliver proppant to the blending unit.”*

Albers describes a “sand trailer” (“*a proppant storage system*”)—which would be located on Crossley’s vessel in the Crossley/Albers system (“*well operations factory*”), that provides proppant to a blender (“*operable to deliver proppant to the blending unit.*”) EX-1006, 2:1-4 (“In a first embodiment of the present invention, a blender unit draws fluid from a fluid storage device, draws proppant from a sand trailer, and mixes the two in a blender tub to form a slurry.”) EX-1003-¶110. Albers also explains that the “sand trailer” (“*a proppant storage system*”) includes one or more proppant containers that also provide proppant to the blender:

A conventional sand trailer (4) is shown **connected to the blender unit (1)**. The sand trailer (4) **typically includes one or more proppant containers** (not shown), which are used to **transfer proppant to the mixing tub (not shown) of the blender unit (1)**.

EX-1006, 3:59-63 (emphasis added); *see also* 4:61-64 (“**The blender unit (1)** draws fluid from the fluid storage device (2) through the first conduit (3), and **further draws proppant from the sand trailer (4)** and mixes the two in the blender tub (not shown) to form a slurry.”); *see also id.*, 6:50-66. EX-1003-¶110.

6. Claim 6

- i. *Claim 6 depends from claim 5 and further recites “wherein the well operations factory comprises a power unit operable to connect to the manifold, pumping grid, blending unit, the proppant storage system, the first well, and the second well.”*

Crossley’s operation control system located on vessel 150 delivers “power for control equipment” and “electrical power for high power production equipment.” EX-1005, [0019], [00048]. To generate this power, Crossley’s vessel includes a power delivery system for supplying electrical power to all system components, including the collection manifolds, storage systems, and wells. EX-1005, [0059] (“The power delivery system 156 delivers power from the ship 150 to subsea equipment located at the subsea well-sites 110, 120, 130.”); *see id.*, [0026]-[0027], [0048] [0059]; *see id.*, claims 3, 9, 15-17, 19-22; EX-1003-¶113.

As Dr. Nikolaou explains, Crossley’s “*power unit*” would be connected to the “*pumping grid, blending unit, [and] the proppant storage system*” of the Crossley/Albers system because all system components are powered by that power supply system. EX-1003-¶114.

7. Claim 7

- i. *Claim 7 depends from claim 6 and further recites “wherein the well operations factory is enclosed in a structure selected from the group consisting of: a supported fabric structure, a collapsible structure, a prefabricated structure, a retractable structure, a composite structure, a temporary structure, a prefabricated wall and roof structure, a deployable structure, a modular structure, a preformed structure, a mobile accommodation structure, and combinations thereof.”*

Crossley’s vessel (“*well operations factory*”) in Crossley/Albers is both “*deployable*,” “*prefabricated*,” and a “*mobile accommodation structure*” because it is a floating vessel that “is relocatable from a first offshore well-site to at least a second offshore well-site.” EX-1005, [0008], [0010]-[0011]. EX-1003-¶117.

8. Claim 8

- i. *Claim 8 depends from claim 4 and further recites “wherein the well operations factory comprises a chemical storage system wherein the chemical storage system is operable to connect to the blending unit.”*

Albers explains that fluid storage devices (“*a chemical storage system*”)—which are on Crossley’s vessel (“*well operations factory*”) in Crossley/Albers—are used to provide fluids to a blender (“*operable to connect to the blending unit.*”) EX-1006, 4:61-64 (“The blender unit (1) draws fluid from the fluid storage device (2) through the first conduit (3), and further draws proppant from the sand trailer (4)”). Dr. Nikolaou explains that these stored fluids in Albers are comprised of

various “*chemicals*,” such as “clay-stabilized or gelled water,” a methanol water, or a hydrocarbon-based fluid. EX-1003-¶120 (citing EX-1006 4:51-56; *see also* EX-1001, 2:34-37 (“[C]hemicals may include crosslinkers, gelling agents, viscosity alerting chemicals, PH buffers, modifiers, surfactants, breakers and stabilizers.”))

9. Claim 9

- i. *Claim 9 depends from claim 8 and further recites “wherein the well operations factory comprises a power unit operable to connect to the manifold, pumping grid, blending unit, chemical storage system, the first well, and the second well.”*

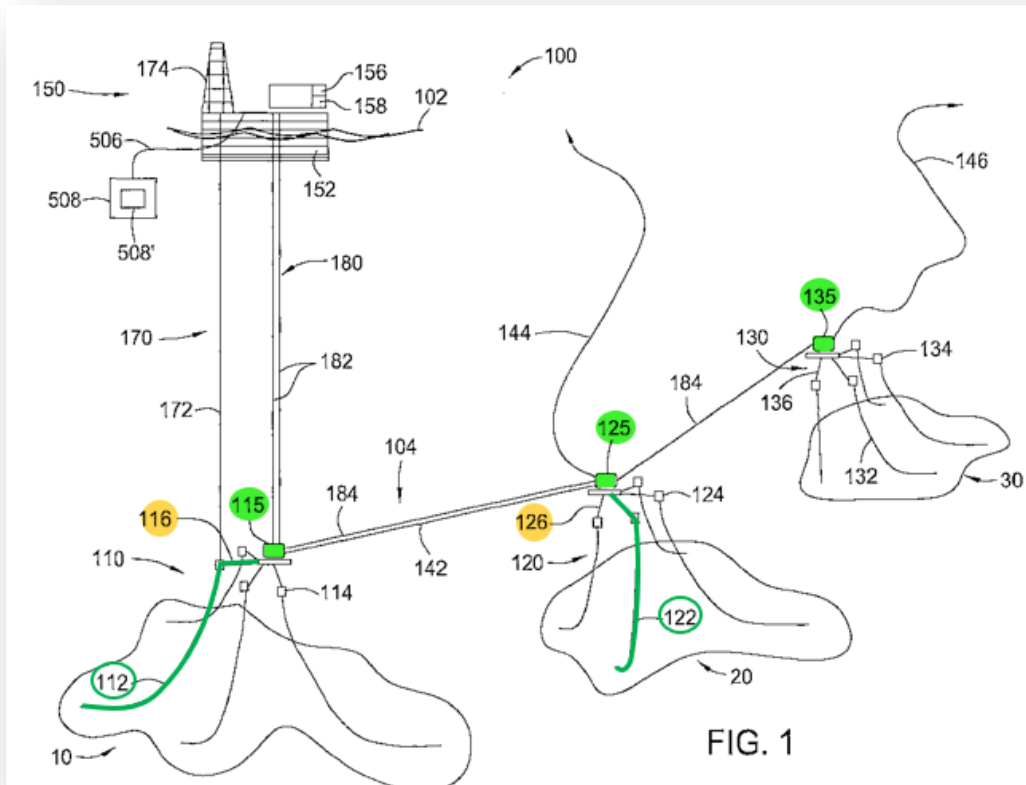
This claim is satisfied for the reasons set forth with respect to claim 6 because Crossley’s vessel includes a power delivery subsystem that powers all systems in the Crossley/Albers system. *See, e.g.*, EX-1005, [00048]. EX-1003-¶123.

10. Claim 10

- i. *Claim 10 depends from claim 2 and further recites “wherein the first connection is operable to deliver a fluid from the first well to the manifold.”*

Referring to Figure 1 (annotated, below), Crossley explains that a **flow line jumper 116** (part of the “*first connection*”) is connected to the well **112** (*e.g.*, “*first well*”) and facilitates the “transport of production . . . fluids” (“*operable to deliver a fluid*”) through manifold 115 (“*manifold*”). EX-1005, [0045].

Production fluids are fluids retrieved from the well. EX-1003-¶126 (citing EX-10045) (“Production fluids from a well-site can be commingled for unitary transport to another location.”)



11. Claim 11

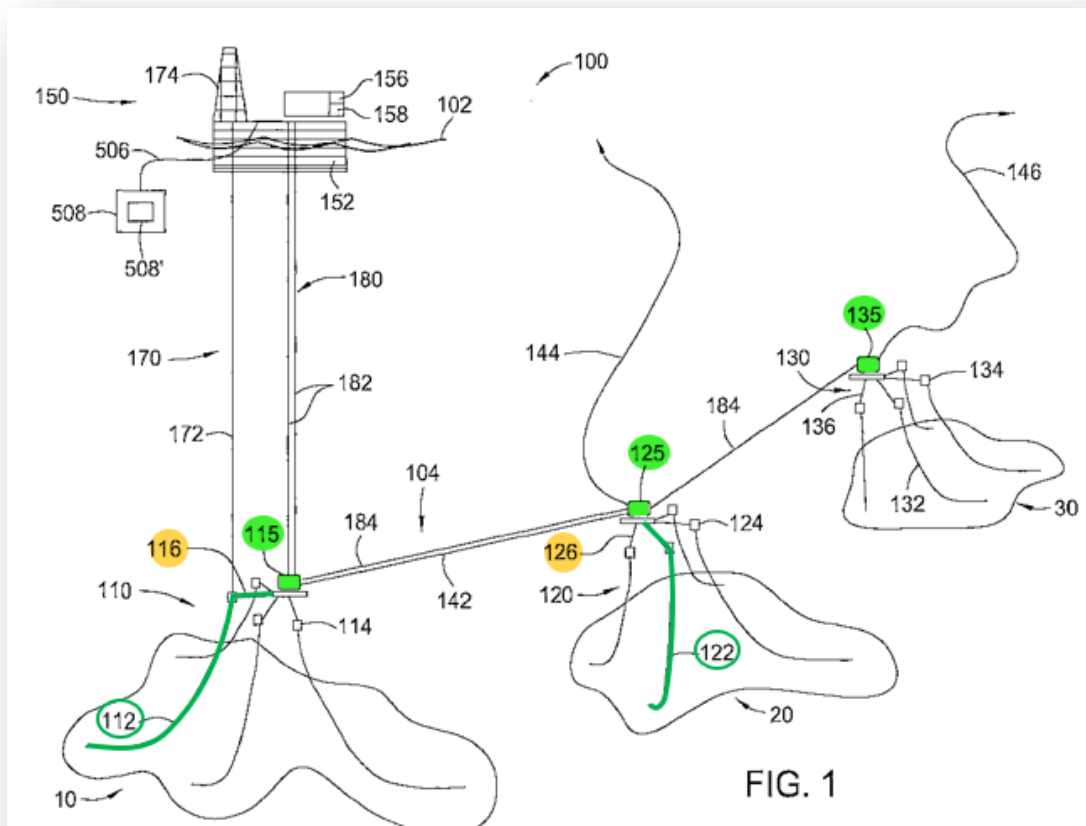
- i. *Claim 11 depends from claim 10 and further recites “wherein the fluid comprises a stimulation fluid.”*

This claim is satisfied for the reasons set forth with respect to claim elements 1[B] and [D]. EX-1003-¶130.

12. Claim 12

- i. *Claim 12 depends from claim 2 and further recites “wherein the second connection is operable to deliver a fluid from the second well to the manifold.”*

Referring to Figure 1 (annotated, below), Crossley explains that a **flow line jumper 126** (part of the “*second connection*”) is connected to the well **122** (e.g., “*second well*”) and facilitates the “transport of production . . . fluids” (“*operable to deliver a fluid*”) through manifold 125 (“*manifold*”). EX-1005, [0045]. EX-1003-¶137.



Alternatively, in the “single well-site configuration” described above, *see* claim element 1[B], the “*second well*” at well-site 110 is **connected** to a tree (e.g., tree 114) and **flow line jumper 116** (part of the “*second connection*”) to facilitate the “transport of production . . . fluids” (“*operable to deliver a fluid*”) through manifold 125 (“*manifold*”). EX-1005, [0045]. EX-1003-¶138.

13. Claim 13

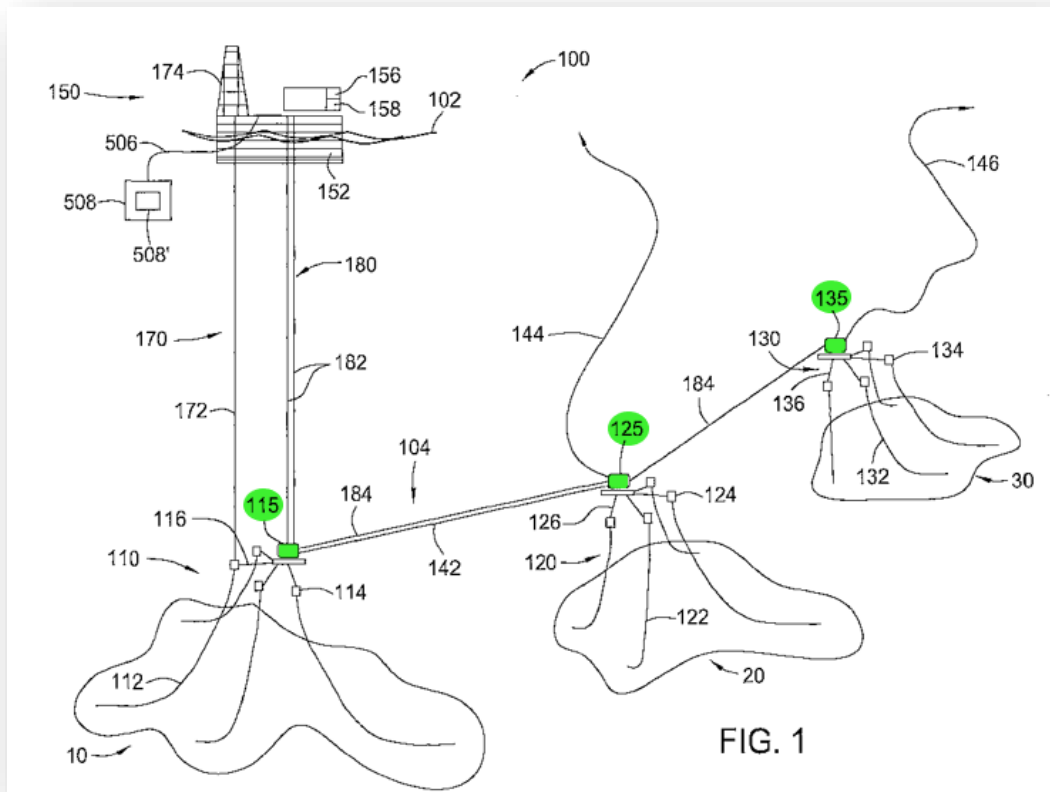
- i. *Claim 13 depends from claim 12 and further recites “wherein the fluid comprises a stimulation fluid.”*

This claim is satisfied for the reasons set forth with respect to claim elements 1[B] and [D] and claim 11. EX-1003-¶141.

14. Claim 14

- i. *Claim 14 depends from claim 2 and further recites “wherein the manifold is connected to a second manifold.”*

This claim is satisfied for the reasons set forth with respect to claim element 1[C]. For example, Crossley’s collection manifold 115 is connected to other connection manifolds 125 and 135 (either of which satisfy the “*second manifold*,” depending on the configuration), at different well sites 120 and 130, respectively:



Crossley, Fig. 1 (EX-1005) (annotated) [0046], [0049]. EX-1003-148-49.

15. Claim 15

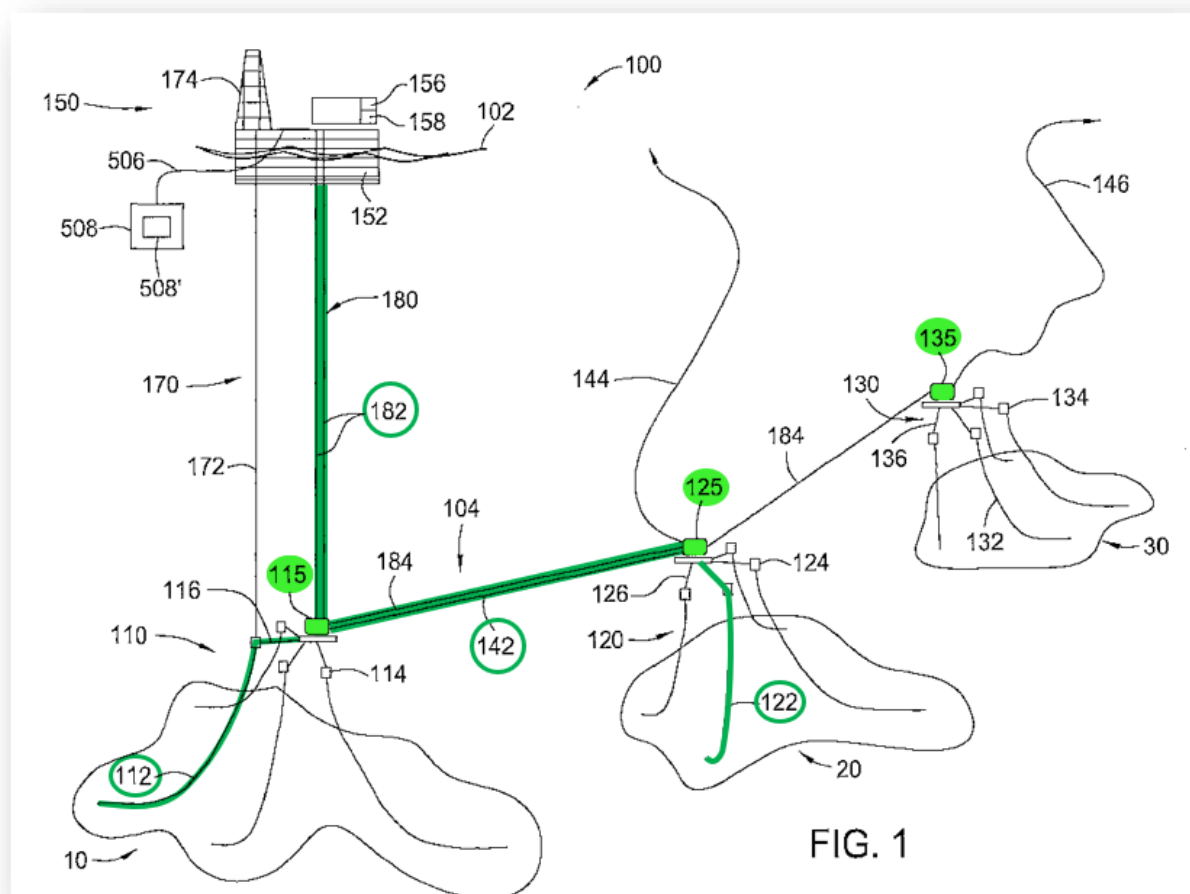
- i. *Claim 15 depends from claim 14 and further recites “wherein the second manifold is operable to simultaneously flow a first stimulation fluid to the first well and a second stimulation fluid to the second well.”*

This claim is satisfied at least as set forth above for claim elements 1[B], 1[D] and 1[E] and claim 2. EX-1003-¶152.

For example, as combined with Albers, Crossley's collection manifolds and valves are configured to simultaneously direct pump **different** well-stimulation fluids to **different** wells. *See* Claim 1[E], *above*. By **selectively** controlling the

manifolds and valves, *see, e.g.*, EX-1005, [0033] and [0049], Dr. Nikolaou explains that a Crossley/Albers system would be understood by a POSITA to be configured to permit well-stimulation fluid to flow using different paths, and furthermore, that the use of manifolds 115, 125, and 135 permit flexibility in the flow path of **both** production or injection fluids. EX-1003-¶153 (citing EX-1005, [0045]). Such flexibility would have permitted a configuration in the Crossley/Albers system that directs excess well-stimulation fluid from vessel 150 intended for manifold 125 or 135 (*e.g.*, a “*second manifold*”) to well 122 (“*a first well*”), as necessary. EX-1003-¶153.

Alternatively, because the identification of the “*first manifold*” and “*second manifold*”—in addition to the “*first well*” and “*second well*”—is entirely arbitrary in a centralized system like Crossley, in one configuration that can be seen in Annotated Figure 1 below, with **manifold 115** serving as a “*second manifold*” and **manifold 125** serving as a “*first manifold*,” the system would be expressly configured such that “*the second manifold is operable to simultaneously flow a first stimulation fluid to the first well and a second stimulation fluid to the second well:*”



Crossley, Fig. 1 (EX-1005) (annotated) [0045], [0063]. In such a configuration—*i.e.*, where manifold 115 is a “*second manifold*” and manifold 125 is a “*first manifold*”—Claim 1 would still be satisfied (as would claims 2 and 14) because claim 1 is agnostic as to the location of the manifold. EX-1003-¶154.

16. Claim 16

- i. *Claim 16 depends from claim 2 and further recites “a third connection between the manifold and the first well.”*

Crossley discloses that each well has a flow path that receives production fluids extracted from the well. EX1005, [0044] (“It is also understood that **one or more strings of production tubing** are provided in the wellbore of each well 112, 122, 132 **to provide a flow path for production fluids [from] the wellhead**. It is also understood that the trees 114, 124, 134 of each well have valves for controlling or shutting off fluid flow from the wellbores. These various components of the wells 112, 122, 132 are not shown.”) (emphasis added). Flow paths for each well all terminate at the respective collection manifold for each wellsite. EX-1005, [0045] (“In this way, production fluids from a well-site can be commingled for unitary transportation to another location (such as a gathering facility seen at 190 in Figure 5). EX-1003-¶157.

Based on these disclosures, a POSITA would have understood that Crossley’s collection manifold would have a separate connection with each well for extracting production fluid collected at each well, including well 112 (“*the first well*”), and including **multiple** “strings of production tubing,” *i.e.*, a (“*a third connection*” or more) with Crossley’s collection manifold 115 to receive

production fluid from a first well 112 (“*the first well*”) at well-site 120. EX-1003-¶158.

17. Claim 17

- i. *Claim 17 depends from claim 16 and further recites “wherein the third connection is operable to deliver a fluid from the first well to the manifold.”*

As explained above for claim 16, Crossley’s collection manifold 115 includes a third (or more) connection (“*a third connection*”) with the multiple “**strings of production tubing**” to receive production fluid extracted at, for example, well 112 (“*the first well*”). EX-1003-¶161.

18. Claim 18

- i. *Claim 18 depends from claim 17 and further recites “a fourth connection between the manifold and the second well.”*

As explained above for claim 16, and in view of the “single-wellsite configuration” described in claim element 1[B] and elsewhere above, Crossley’s collection manifold 115 includes additional connections through “**strings of production tubing**” at to receive production fluid extracted at, for example, the wells at well-site 120. Such “strings of production” would be at least a “*fourth connection*” (or more) with “*a second well*” and the manifold 115 in the “single-wellsite configuration.” EX-1003-¶164.

19. Claim 19

- i. *Claim 19 depends from claim 18 and further recites “wherein the fourth connection is operable to deliver a fluid from the second well to the manifold.”*

As explained above for claim 18, Crossley’s collection manifold 115 includes a fourth (or more) connection (“*a fourth connection*”) with the multiple “**strings of production tubing**” at each well (i.e., “*the second well*”) at well-site 120, to receive production fluid. EX-1003-¶167.

20. Claim 20

- i. *Claim 20 depends from claim 1 and further recites “wherein the well operations factory and means for simultaneously flowing treatment fluid are located on a boat.”*

Crossley discloses that its system is located on “floating vessel,” which Dr. Nikolaou explains is a “*boat*.” EX-1005, [0008] (“The system first comprises a floating vessel. The floating vessel is relocatable from a first offshore well-site to at least a second offshore well-site.”); *see id.*, [0018], [0021], [0047]. Crossley’s manifolds are connected to the same vessel. EX-1005, [0049] (“The first link is a surface vessel control link 182 that extends from the relocatable vessel 150, downward to one of the collection manifolds, e.g., manifold 115.”). In the Crossley/Albers system, the “*well operations factory*” is “*located on a boat*” because it is on Crossley’s vessel. EX-1003-¶170.

Crossley's manifold, however, is not "*located on a boat*," but including a manifold on the vessel would have been obvious to a POSITA based on Crossley alone, and such a person would have been motivated to locate the manifold on a boat for two reasons. *First*, a POSITA would have recognized that it would be easier to perform maintenance on the manifold when it is on a boat as compared to underwater. EX-1005, [0037] ("Maintenance' refers to the maintaining of equipment at the mudline or the wellhead platform, including equipment associated with the wellhead, **the collection manifold**, and any subsea fluid separators.") (emphasis added). EX-1003-¶171.

Second, it would have been obvious to a POSITA because locating the manifold on a boat would have been obvious to try. For example, a POSITA would have known that there were only a finite number of identified, predictable solutions as to the manifold's placement, and the benefits of both maintaining, testing, and setting-up of the manifold would be easier if the manifold was located on the Crossley's vessel versus underwater. EX-1003-¶171 (citing EX1005, [0064] (Crossley describing an alternative embodiment where collection manifolds are located on platforms instead of the ocean bottom)).

21. Claim 21

- i. *Claim 21 depends from claim 1 and further recites “wherein the first fluid comprises at least one compound selected from the group consisting of: a proppant, a fracturing fluid, a gelling agent, a friction reducer, an acid, and a derivative thereof.”*

The Crossley/Albers system would use fluids described by Albers: a proppant (“*a proppant*”), *see* EX-1006, 4:56-61 (“The sand trailer (4) contains proppant, which in this embodiment is preferably LiteProp™ (which is a lightweight proppant comprised of ground nut shells coated with a protective or hardened coating), but may be any suitable proppant such as sand, glass, plastic, ceramic, and/or metallic particles.”), or a gelled water (“*a gelling agent*”), *id.*, 4:51-56 (“[T]he fluid storage device (2) contains an uncomplexed fluid, which in this embodiment is preferably clay-stabilized ***or gelled water***, but can be any suitable fluid including a methanol water or a hydrocarbon-based fluid.”), or a fracturing fluid, *id.*. Albers thus discloses different “*fluids*” that comprise a compound selected from the claimed set—that is, “*a proppant, a fracturing fluid, a gelling agent, . . . or derivative thereof.*” EX-1003-¶174.

22. Claim 22

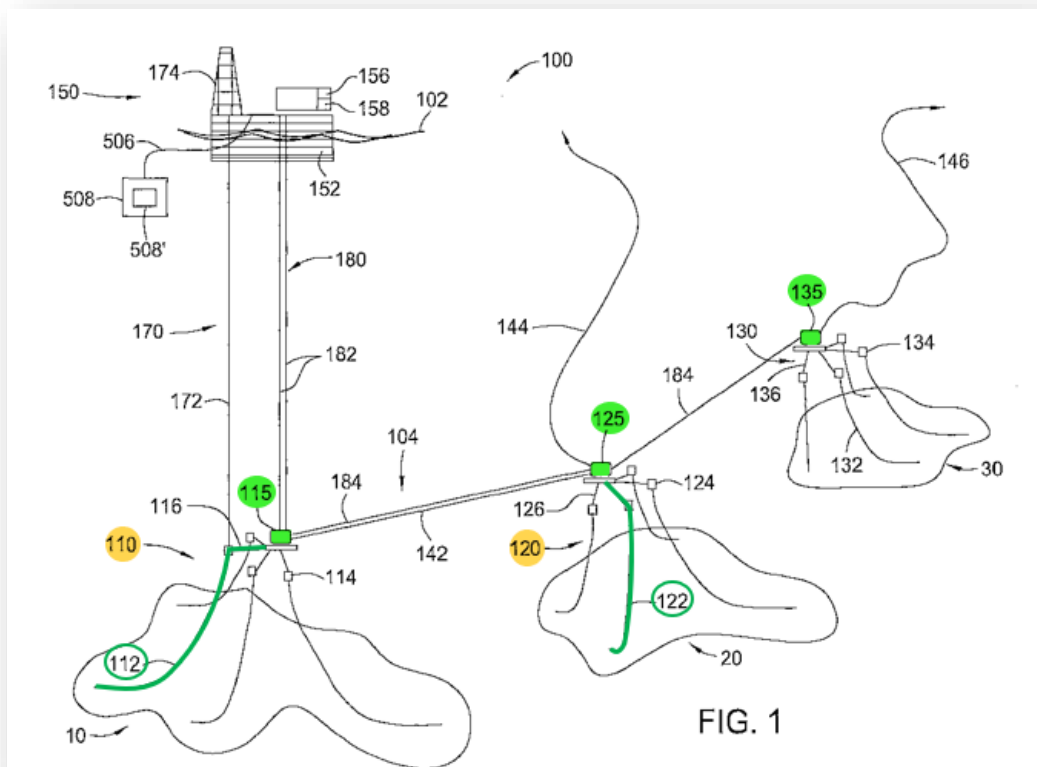
- i. *Claim 22 depends from claim 1 and further recites “wherein the second fluid comprises at least one compound selected from the group consisting of: a proppant, a fracturing fluid, a gelling agent, a friction reducer, an acid, and a derivative thereof.”*

This claim element is satisfied for the reasons set forth above with respect to claim 1[E] and claim 21. EX-1003-¶177.

23. Claim 23

- i. *Claim 23 depends from claim 1 and recites “wherein the wells are on separate pads and wherein the well treatment operations factory dynamically manufactures and pumps a well stimulation fluid.”*

Crossley’s wells are disclosed as being both on the same and “*on separate pads.*” For example, Crossley discloses system that supports multiple well-sites, and each well-site includes a plurality of wells 112, 122, and 132 clustered together. EX-1005, [0043]. Crossley’s system includes a vessel 150 and pumps that direct fluid into the plurality of wells in well fields 10, 20, and 30. EX-1005, [0048]. As shown Figure 1, well 112 (*e.g., “a first well”*) and well 122 are located at different well-sites 110 and 120, respectively:



EX-1005, Fig. 1 (annotated), [0048]; EX-1003-¶180.

Based on the above disclosures, Dr. Nikoloau explains that a POSITA would have understood that a well-site of Crossley satisfies a “*separate pad*” because it contains multiple wells located near each other and all connected to a single manifold, which is consistent with how the 394 patent describes well “*pad[s]*.” EX-1003-¶181 (citing EX-1001, 3:25-29 (“The well treatment operations factory may be connected via the central manifold 107 to at least a first pad 101 containing one or more wellheads via a first connection 108 and at least a second pad 102 containing one or more wellheads via a second connection 109.”)). Thus, a

POSITA would have understood that Crossley's wells 112 and 122 are on different well-sites (*i.e.*, sites 110 and 120, respectively) each of which satisfies “*on separate pads.*” EX-1003-¶181.

Additionally, the well-stimulation fluids in Crossley/Albers are (“*dynamically manufacture[d]*”) because their concentration can be changed based on the formation to be fractured-stimulated and based on measured data from various sensors. EX-1003-¶182.

For example, Albers also explains that his techniques include “equipment necessary to electronically measure, control, and ultimately automate the method.” EX-1006, 6:5-7. That equipment includes “a flow meter (21) and a density meter (22),” which “allow the flow rate and density of the slurry to be measured and recorded.” EX-1006, 6:14-17; *see also* EX-1006, 6:30-49 (describing additional conventional meters, valves, and chokes used in conjunction with the Albers method). Albers further discloses that “the flow rate and density of the separated fluid can [be] measured and recorded, and the flow rate can be diminished and/or stopped,” which “allows for the level of hydration of the proppant that will eventually be delivered to the wellhead to be manipulated.” EX-1006, 6:23-27. Importantly, Albers explains that “[t]his **manipulation is beneficial**, as different fracture-stimulation applications require proppant with different hydration levels.” EX-1006, 6:27-29. Albers therefore discloses a “*dynamic manufacturing*”

technique that includes altering well-stimulation fluid concentrations based on measurements and/or “**the formation to be fracture-stimulated.**” EX-1003-¶¶71-72 (citing EX-1005, 5:25-30).

24. Claim 24

i. 24[PRE]

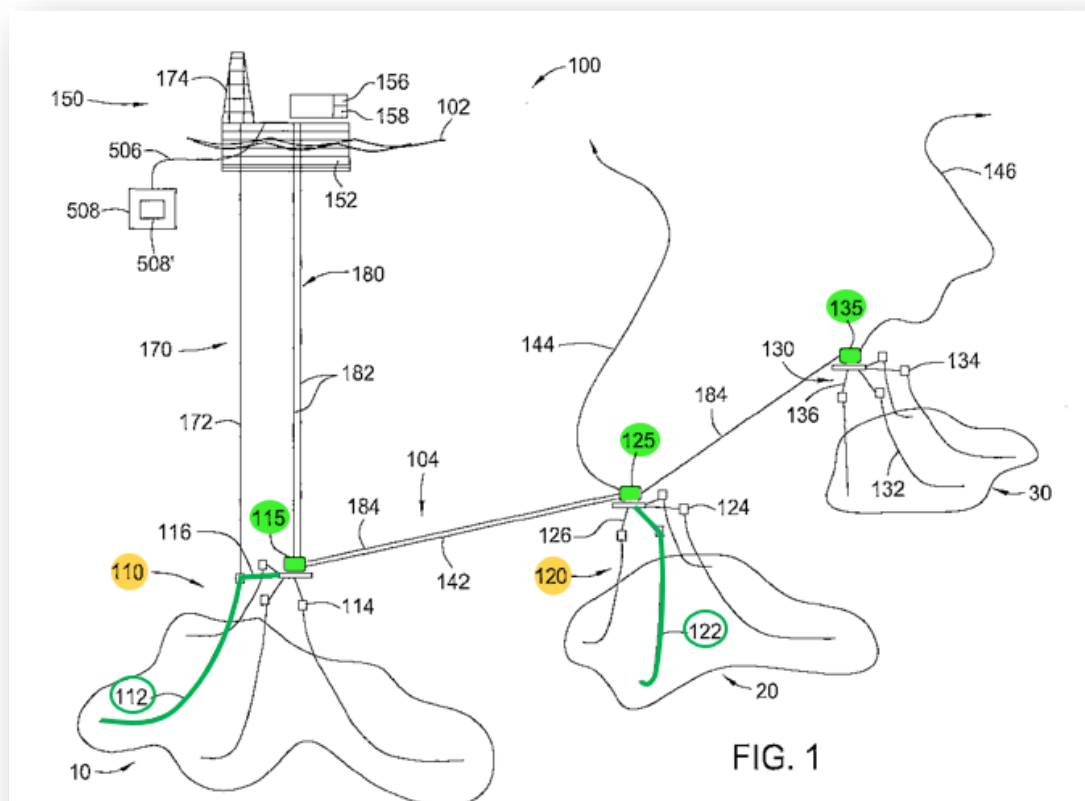
This element is satisfied for the reasons set forth with respect to claim 1[PRE].

ii. 24[A]

This element is satisfied for the reasons set forth with respect to claim 1[A].

iii. 24[B] & 24[C]

This element is satisfied for the reasons set forth with respect to claim 1[B] and 1[C] and claim 23. Additionally, claim 24 includes differences related to a “pad[s]” having “wells,” e.g., “*a first connection between a **first pad** . . . wherein the **first pad** has a first well,*” and similarly “*a second connection between a **second pad** . . . wherein the **second pad** has a second well.*” These additional limitations are satisfied for the reasons set forth with respect to claim 23. For example, as shown in Figure 1, well 112 (“*a first well*”) and well 122 (“*a second well*”) are located at different well-sites 110 (“*a first pad*”) and 120 (“*a second pad*”), respectively:



EX-1005, Fig. 1 (EX-1005) (annotated); *see also id.* [0044]-[0045]. Crossley further explains that each well-site “has a plurality of wells **112, 122, 132** clustered together.” EX-1005, [0045]. As Dr. Nikolaou explains, a “*pad*” is simply a site containing one or more wellheads, *e.g.*, Crossley’s “well-sites” 110 and 120. EX-1003-¶169 (*citing* EX-1001, 3:25-29 (“The well treatment operations factory may be connected . . . to at least a **first pad 101 containing one or more wellheads.**”) EX-1003-¶184.

iv. 24[C]

This element is satisfied for the reasons set forth with respect to claim 1[C], 24[B], and 24[C].

v. 24[D]

This element is satisfied for the reasons set forth with respect to claim 1[D], 24[B], and 24[C].

vi. 24[E]

This element is satisfied for the reasons set forth with respect to claim 1[E], 24[B], and 24[C].

25. Claim 25

i. 25[PRE]

This element is satisfied for the reasons set forth with respect to claim 1[PRE].

ii. 25[A]

This element is satisfied for the reasons set forth with respect to claim 1[A] and claim 23 (explaining how the well stimulation fluids are “*dynamically manufacture[d]*” in the Crossley/Albers system). EX-1003-¶186.

iii. 25[B]

This element is satisfied for the reasons set forth with respect to claim 1[B].

iv. 25[C]

This element is satisfied for the reasons set forth with respect to claim 1[C].

v. 25[D]

This element is satisfied for the reasons set forth with respect to claim 1[D].

vi. 25[E]

This element is satisfied for the reasons set forth with respect to claim 1[E].

26. Claim 26

i. 26[PRE]

This element is satisfied for the reasons set forth with respect to claim 1[PRE].

ii. 26[A]

This element is satisfied for the reasons set forth with respect to claim 1[A].

iii. 26[B] & 26[C]

This element is satisfied for the reasons set forth with respect to claim 1[B], and 24[B], and 24[C] (explaining that each well-site has “*a plurality of wells*”).
EX-1003-¶188.

iv. 26[D]

This element is satisfied for the reasons set forth with respect to claim 1[D], and 26[B], and 26[C].

v. 26[E]

This element is satisfied for the reasons set forth with respect to claim 1[E], 26[B], and 26[C].

27. Claim 27

i. 27[PRE]

This element is satisfied for the reasons set forth with respect to claim 1[PRE].

ii. 27[A]

This element is satisfied for the reasons set forth with respect to claim 1[A], and 1[D] and [E] (demonstrating the simultaneous pumping of a plurality of well stimulation fluids). EX-1003-¶190.

iii. 27[B]

This element is satisfied for the reasons set forth with respect to claim 1[B].

iv. 27[C]

This element is satisfied for the reasons set forth with respect to claim 1[C].

v. 27[D]

This element is satisfied for the reasons set forth with respect to claim 1[D].

B. Ground 2: Claims 11 and 13 are Obvious Over Crossley and Albers, in further view of Lehman

1. Claims 11 and 13

- i. *Claim 11 depends from claim 10 and further recites “wherein the fluid comprises a stimulation fluid.”*

Claim 13 depends from claim 12 and further recites “wherein the fluid comprises a stimulation fluid.”

To the extent one may argue that Crossley/Albers does not render obvious these claims, they would have been obvious in further view of Lehman (EX-1009).

For example, Crossley explains that each well has a **flow line jumper** “in order to transport production . . . fluids.” EX-1005, [0045]. In particular, the flow line jumpers “tie in a collection manifold” so that “**production fluids from a well-site** can be commingled for unitary transport to another location.” *Id.* EX-1003-¶132.

Crossley does not explicitly state that the flow line jumpers return a stimulation fluid, but it would have been obvious to include that functionality in the Crossley/Albers system in view Lehman. EX-1003-¶133.

U.S. Patent Publication No. 2004/0050550 to Lehman was filed on September 16, 2002, and published on March 18, 2004, and is therefore prior art to the '394 Patent under at least 35 U.S.C. §§ 102(a), (b), and (e). It is also analogous to Crossley/Albers and the '394 Patent and reasonably pertinent to the problems those references faced, *see* § VI.C., *above*, because it is directed to “fracturing” techniques, including “improved treating fluid production and subterranean

formation treating methods as well as compositions for treating fluids.” EX-1009, [0018]-[0019].

As Dr. Nikolaou explains, to a POSITA, such a modification of Crossley/Albers would have been motivated by Crossley’s goal to “reduce drilling and maintenance expenses.” EX-1005, [0005]; *see also* EX-1009 (“One such other method comprises pricing the cost of a second fracturing treatment in response to potential reuse of a fracturing fluid residual from a first fracturing treatment; and reusing in the second fracturing treatment, in response to the pricing, a fracturing fluid residual actually recovered from the first fracturing treatment.”) Indeed, stimulation fluids can be expensive, EX-1009, [0016], such that it would have been common sense and well within the skill of a POSITA to make these explicit alterations to the Crossley/Albers system, as such flowback systems are conventional and have been in place for many years. *E.g.*, EX-1009, [0020] (“The present invention also provides a method of treating a subterranean formation intersected by a well, comprising performing a treatment on a well using a treating fluid residual recovered from a prior treatment, wherein using a treating fluid residual recovered from a prior treatment includes conditioning the recovered treating fluid residual.”) EX-1003-¶134.

A POSITA would also have been motivated to modify the Crossley/Albers system to include a flowback and reuse system because it is well-known in the art

that well-stimulation fluids can be recovered and reused from a prior treatment. For example, Lehman describes “performing a treatment on a well using a treating fluid residual recovered from a prior treatment.” EX-1009, [0020]. In particular, Lehman describes “a method of treating (specifically fracturing in this example) a formation comprises receiving flow-back fluid from a well undergoing a fracturing treatment.” EX-1009, [0034]; *see also* Fig. 1. Lehman explains that it was well-known in the art that “during the fracturing treatment, typically the well is shut-in and then reopened whereupon at least part of the fracturing fluid [] in the fracture [] is forced out by the fracture closure pressure as known in the art. At least part of this fluid flows back to the surface as the flow-back fluid or fracturing fluid residual [] represented in FIG. 1.” Accordingly, as described in Lehman, a POSITA would have been motivated to include this functionality given that it is a well-known feature of fracturing techniques in the art. EX-1003-¶135.

VIII. THE BOARD SHOULD NOT EXERCISE ITS DISCRETION UNDER § 314(a) OR § 315(d)

A. 314(a) – *Fintiv*

Discretionary denial under 35 U.S.C. § 314(a) is not warranted. The parallel litigation involving the '394 Patent was filed on September 1, 2022, and the median time to trial in the Western District of Texas is 29.5 months as of March. *See* EX-1017; Director Memorandum, *Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation*

(June 21, 2022) (stating that in applying the *Fintiv* factors the Board must consider “the median time from filing to disposition of the civil trial for the district in which the parallel litigation resides”). Further, as demonstrated herein, the merits presented in this Petition are compelling. *See* Director Memorandum at 2 (holding that the Board “will not rely on the *Fintiv* factors to discretionarily deny institution in view of parallel district court litigation where a petition presents compelling evidence of unpatentability.”). For at least these reasons, the Board should not discretionarily deny this petition.

B. 325(d)

The grounds raised by this Petition are not the same or substantially the same as the art and arguments raised during prosecution. Crossley and Albers were not considered during prosecution. Even if one were to assert any of these references were substantially the same or cumulative of the art and arguments raised during prosecution, this Petition’s Grounds identify reference combinations, including Crossley and Lacy, that are not substantially the same as any considered references. *See* § VII; *Sony v. MZ Audio Scis., LLC*, IPR2022-01544, Paper No. 12, *7 (§325(d) discretion improper where “Examiner did not consider the specific combination of references asserted”). Moreover, the Examiner also did not have the benefit of Dr. Nikolaou detailed expert testimony and the further evidence of record.

Even if the same or substantially the same art or arguments were considered, the Examiner materially erred by not rejecting the Claims for the reasons discussed in §VII. The Examiner otherwise “did not expressly consider” any art with substantially the same teachings as the art in this Petition, rendering it “impossible ... to determine the consideration the Examiner gave” to such references, and demonstrating that “the Office erred in a manner material to patentability.” *Ecobee Techs. v. Causam Enterprises, Inc.*, IPR202201339, Paper No. 20, *20-21 (declining to exercise §325(d) discretion).

IX. CONCLUSION

For the foregoing reasons, the challenged claims are unpatentable.

EXHIBIT LIST

No.	Exhibit Description
1001	U.S. Patent No. 7,841,394
1002	File History of U.S. Patent No. 7,841,394
1003	Declaration of Dr. Michael Nikolaou
1004	Curriculum Vitae of Dr. Michael Nikolaou
1005	WIPO Publication No. 2005/111369 A1 to Crossley (“Crossley”)
1006	U.S. Patent No. 7,451,820 to Albers et al. (“Albers”)
1007	U.S. Patent No. 4,397,353 to Lacy (“Lacy”)
1008	WIPO Publication No. WO2007/024383A2 to Tolman (“Tolman”)
1009	U.S. Patent App. Pub. No. 2004/0050550 A1 to Lehman et al. (“Lehman”)
1010	S. Dalvi, Fundamentals of Oil & Gas Industry for Beginners (Notion Press 2015) (excerpts)
1011	U.S. Patent App. Pub. No. 2013/0306322 to Sanborn et al.
1012	U.S. Patent No. 9,410,410 to Broussard et al.
1013	U.S. Patent App. Pub. No. 2012/0255734 to Coli et al.
1014	U.S. Patent No. 3,560,053 to Ortloff
1015	U.S. Patent No. 3,664,422 to Bullen
1016	Claim Construction Order
1017	WD Texas Statistics

CLAIM LISTING

Claim 1
1[PRE] A system for centralized well operations comprising:
1[A] a well treatment operations factory which manufactures and pumps a well stimulation fluid;
1[B] a first connection between a first well and the well operations factory;
1[C] a second connection between a second well and the well operations factory;
1[D] and means for simultaneously flowing: a first stimulation fluid to the first well and not to the second well; and a second stimulation fluid to the second well and not to the first well;
1[E] wherein the first stimulation fluid and the second stimulation fluid have different compositions.
Claim 2
2. The system of claim 1 wherein the means for simultaneously flowing treatment fluid comprises a manifold.
Claim 3
3. The system of claim 2 wherein the well operations factory comprises a pumping grid wherein the pumping grid is operable to connect to the manifold.
Claim 4
4. The system of claim 3 wherein the well operations factory comprises a blending unit wherein the blending unit is operable to connect to the pumping grid.
Claim 5

5. The system of claim 4 wherein the well operations factory comprises a proppant storage system wherein the proppant storage system is operable to deliver proppant to the blending unit.
Claim 6
6. The system of claim 5 wherein the well operations factory comprises a power unit operable to connect to the manifold, pumping grid, blending unit, the proppant storage system, the first well, and the second well.
Claim 7
7. The system of claim 6 wherein the well operations factory is enclosed in a structure selected from the group consisting of: a supported fabric structure, a collapsible structure, a prefabricated structure, a retractable structure, a composite structure, a temporary structure, a prefabricated wall and roof structure, a deployable structure, a modular structure, a preformed structure, a mobile accommodation structure, and combinations thereof.
Claim 8
8. The system of claim 4 wherein the well operations factory comprises a chemical storage system wherein the chemical storage system is operable to connect to the blending unit.
Claim 9
9. The system of claim 8 wherein the well operations factory comprises a power unit operable to connect to the manifold, pumping grid, blending unit, chemical storage system, the first well, and the second well.
Claim 10
10. The system of claim 2 wherein the first connection is operable to deliver a fluid from the first well to the manifold.
Claim 11
11. The system of claim 10 wherein the fluid comprises a stimulation fluid.

Claim 12
12. The system of claim 2 wherein the second connection is operable to deliver a fluid from the second well to the manifold.
Claim 13
13. The system of claim 12 wherein the fluid comprises a stimulation fluid.
Claim 14
14. The system of claim 2 wherein the manifold is connected to a second manifold.
Claim 15
15. The system of claim 14 wherein the second manifold is operable to simultaneously flow a first stimulation fluid to the first well and a second stimulation fluid to the second well.
Claim 16
16. The system of claim 2 comprising a third connection between the manifold and the first well.
Claim 17
17. The system of claim 16 wherein the third connection is operable to deliver a fluid from the first well to the manifold.
Claim 18
18. The system of claim 17 comprising a fourth connection between the manifold and the second well.
Claim 19
19. The system of claim 18 wherein the fourth connection is operable to deliver a fluid from the second well to the manifold.

Claim 20
20. The system of claim 1 wherein the well operations factory and means for simultaneously flowing treatment fluid are located on a boat.
Claim 21
21. The system of claim 1 wherein the first fluid comprises at least one compound selected from the group consisting of: a proppant, a fracturing fluid, a gelling agent, a friction reducer, an acid, and a derivative thereof.
Claim 22
22. The system of claim 1 wherein the second stimulation fluid comprises at least one compound selected from the group consisting of: a proppant, a fracturing fluid, a gelling agent, a friction reducer, an acid, and a derivative thereof.
Claim 23
23. The system of claim 1, wherein the wells are on separate pads and wherein the well treatment operations factory dynamically manufactures and pumps a well stimulation fluid.
Claim 24
24[PRE] A system for centralized well operations comprising:
24[A] a well treatment operations factory which manufactures and pumps a well stimulation fluid;
24[B] a first connection between a first pad and the well operations factory, wherein the first pad has a first well;
24[C] a second connection between a second pad and the well operations factory, wherein the second pad has a second well;
24[D] and means for simultaneously flowing: a first stimulation fluid to the first pad and not to the second pad; and a second stimulation fluid to the second pad and not to the first pad;
24[E] wherein the first stimulation fluid and the second stimulation fluid have different compositions.
Claim 25

25[PRE] A system for centralized well operations comprising:
25[A] a well treatment operations factory which dynamically manufactures and pumps a well stimulation fluid;
25[B] a first connection between a first well and the well operations factory;
25[C] a second connection between a second well and the well operations factory;
25[D] and means for simultaneously flowing: a first stimulation fluid to the first well and not to the second well; and a second stimulation fluid to the second well and not to the first well;
25[E] wherein the first stimulation fluid and the second stimulation fluid have different compositions.
Claim 26
26[PRE] A system for centralized well operations comprising:
26[A] a well treatment operations factory which manufactures and pumps a well stimulation fluid;
26[B] a first connection between a first plurality of wells and the well operations factory;
26[C] a second connection between a second plurality of wells and the well operations factory;
26[D] and means for simultaneously flowing: a first stimulation fluid to the first plurality of wells and not to the second plurality of wells; and a second stimulation fluid to the second plurality of wells and not to the first plurality of wells;
26[E] wherein the first stimulation fluid and the second stimulation fluid have different compositions.
Claim 27
27[PRE] A system for centralized well operations comprising:
27[A] a well treatment operations factory capable of manufacturing and simultaneously pumping a plurality of well stimulation fluids;

27[B] a first connection between a first well and the well operations factory;
27[C] a second connection between a second well and the well operations factory;
27[D] and means for simultaneously flowing: a first stimulation fluid to the first well and not to the second well; and a second stimulation fluid to the second well and not to the first well.

CERTIFICATE OF COMPLIANCE

I hereby certify that this brief complies with the type-volume limitations of 37 C.F.R. § 42.24, because it contains 10,873 words (as determined by the Microsoft Word word-processing system used to prepare the brief), excluding the parts of the brief exempted by 37 C.F.R. § 42.24.

Dated: September 1, 2023

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e), I hereby certify that on this 1st day of September, 2023, I caused to be served a true and correct copy of the foregoing and any accompanying exhibits by federal express on the following counsel:

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Dated: September 1, 2023

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