

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD**

In re U.S. Patent No. 7,841,394 B2

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Inventor(s): William Lloyd McNeel, Steve Harris, Dave McLeod

Assignee: Halliburton Energy Services, Inc.

Title: Method and Apparatus for Centralized Well Treatment

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I, Michael Nikolaou, make this declaration in connection with the petition for *inter partes* review submitted by Petitioners for U.S. Patent No. 7,841,394. All statements made herein of my own knowledge are true, and all statements made herein based on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, under Section 1001 of Title 18 of the United States Code. Although I am being compensated for my time in preparing this declaration, the opinions expressed herein are my own, and I have no stake in the outcome of this proceeding or any related litigation or administrative proceedings.

Date: September 1, 2023

A handwritten signature in black ink, appearing to read "Michael Nikolaou", written over a horizontal line.

Michael Nikolaou, Ph.D.

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I. INTRODUCTION

1. I am making this declaration at the request of ProFrac Holding Corp. and U.S. Well Services, LLC (collectively, “Petitioners”) in the matter of *Inter Partes* Review of U.S. Patent No. 7,841,394 (the “’394 patent”) to McNeel et al., assigned to Halliburton Energy Services, Inc. (“Patent Owner” or “Halliburton”). I understand that Petitioners have been sued by Patent Owner in *Halliburton Energy Services et al. v U.S. Well Services, LLC, Profrac Holding Corp.*, Case No. 6:22-cv-00906 (W.D. Tex.), where it has accused Petitioners of infringing the ’394 patent.

2. In the preparation of this declaration, I have reviewed the following documents:

Exhibit No.	Description
1001	U.S. Patent No. 7,841,394
1002	File History of U.S. Patent No. 7,841,394
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	U.S. Patent Application Publication No. 2009/0114392 to Tolman et al. (“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.

Exhibit No.	Description
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

3. In forming my opinions expressed below, I have considered the documents listed immediately above and my knowledge and experience based on my work in this area as described below.

4. The earliest application that resulted in the issuance of the '394 patent was filed on December 1, 2005. EX-1001, Cover. I am familiar with the technology at issue and am aware of the state of the art around this time. It is my opinion that, as of December 1, 2005, a person of ordinary skill in the art ("POSITA") pertinent to the subject matter of the '394 patent 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. Further, it is my opinion that someone with additional education but less professional experience, and vice versa, may qualify as a POSITA. My analysis and opinions below are given from the perspective of a POSITA in this technological field in the relevant time frame, unless stated otherwise.

II. QUALIFICATIONS AND COMPENSATION

5. I am a Professor and Associate Chair of Chemical and Biomolecular Engineering in the Cullen College of Engineering at the University of Houston.

6. I graduated with a diploma in chemical engineering from the National Technical University in Athens, Greece in 1984. I then earned a Ph.D. in chemical engineering at the University of California, Los Angeles in 1989. Prior to coming to the University of Houston, I was an Assistant (and then Associate) Professor at Texas A&M University for eight years. After my promotion to Associate Professor and tenure at Texas A&M, I took a sabbatical leave as a Visiting Scientist at MIT. I have taught at the University of Houston for over 20 years.

7. In my role as a professor at the University of Houston I teach both undergraduate and graduate courses every year. At the undergraduate level, these courses include Analytical Methods for Chemical Engineers, Numerical Methods for Chemical Engineers, Plant Economics, Plant Design, Thermodynamics, Statistical Methods in Chemical Engineering, Statistical Quality Control Methods, and Chemical Process Control. At the graduate level, I teach Mathematical Methods in Chemical Engineering, Advanced Process Control, and Natural Gas Engineering. I also routinely advise both undergraduate and graduate (master and Ph.D.) students.

8. I have extensive experience in process systems engineering and mathematical modeling. My research interests are in computer-aided systems engineering, i.e., development and use of computer-based methods for the design, optimization, monitoring, and automatic control of various kinds of systems, in a diverse array of industries, including the oil and gas industry.

9. In my 30 years of academic and industrial consulting experience I have worked on problems in several industries, including the oil and gas industry and oil refining and petrochemicals. Much of my work tackles fundamental research issues and is described in a number of publications, as discussed below. A substantial portion of my work is directed to concrete solutions to problems faced by industrial partners and has resulted in specific commercial products (e.g., for Lam Research, <https://www.lamresearch.com/>), patents, and the formation (by the corresponding project's managers) of a small company that was eventually bought by Schlumberger, a major global oilfield services company (http://www.slb.com/services/drilling/drilling_services_systems/directional_drilling/slider.aspx).

10. In addition to teaching, I have also served as a consultant for various oil and gas companies over the past 27 years, working with both major companies and smaller, independent companies, both “upstream” (i.e., oil and gas exploration and production) and “downstream” (oil and gas transportation, oil refining, and

chemicals). I have consulted on a variety of matters for ENI, Schlumberger, WildHorse / RotoSlide, Synergy Fluid Services, XGas/EPT, IQPC Oil & Gas, Intelligent Agents Corporation, Landmark, ECOPETROL, Lam Research, Shell Global Solutions, Noble Drilling, AspenTech, General Electric, Simulation Sciences, Bryan Research & Engineering, Frito-Lay, Shell Development, and Union Pacific Resources.

11. I have published over 150 peer-reviewed publications in journals and conference proceedings in the area of computer-aided systems engineering. My publications focus on applications to the design, optimization, monitoring, and automatic control of various kinds of systems, in oil and gas, oil refining and petrochemicals, snack food production, semiconductor manufacturing, and development and administration of antibiotics against resistant infections. Three of my refereed journal publications have been featured on the cover of high-impact journals (*AIChE Journal*, 2011; *IEEE Control Systems Magazine*, 2006; *PLoS Computational Biology*, 2011).

12. I have also presented my work as a speaker at numerous academic conferences, whether in regular sessions, invited sessions, or as a keynote speaker. As an example, I have been invited twice (in 1996 and 2011) to give presentations in the flagship conference on Chemical Process Control, held every five years (CPC-V and CPC-VIII), and was a keynote speaker at the 2017 International

Petroleum & Petrochemical Technology Conference (IPPTC) in Beijing, China. I have also published five book chapters on various aspects of computer-aided systems engineering. Finally, I serve regularly as a peer reviewer at several major engineering and scientific journals (including *Automatica*, *PLoS*, *AIChE Journal*, *SPE Journal*, *Journal of Process Control*, *Computers & Chemical Engineering*) as well as at federal and international funding agencies, including National Science Foundation (NSF), Petroleum Research Fund (PRF), National Institutes of Health (NIH), and the Qatar National Research Fund (QNRF).

13. I am a member of the American Institute of Chemical Engineers, the Society of Petroleum Engineers, and Omega Chi Epsilon. I serve as a co-organizer or co-chair of several major international conferences, including the AIChE Annual Meeting and the AIChE Spring Meeting.

14. I have received numerous teaching awards from both Texas A&M and University of Houston, including the Dow Excellence in Teaching Award, and the Cullen College of Engineering Teaching Award. I have also been named a Top Reviewer by *Automatica*, and, in 2007, I received the Computing & Systems Technology (CAST) Directors Award from the American Institute of Chemical Engineering. In 2017, I received the Abraham E. Dukler Distinguished Engineering Faculty Award at the University of Houston, which is given to a faculty that has made significant contributions to society and whose

accomplishments and careers have brought credit to the University of Houston Cullen College of Engineering. In 2019, I received the Fluor Corp. Faculty Excellence Award at the Cullen College of Engineering. This award is the highest distinction bestowed to faculty of this college.

15. My curriculum vitae, which includes a complete list of my publications, is included as EX-1004.

16. I have previously given testimony in the following cases:

a) *Eurecat United States, Inc. v. Soren Marklund, Douglas Wene, and Chem 32 LLC*, Trial Ct. Cause No. 2012-5700, Harris Cty. Ct. (Tex.).

b) *TDE Petroleum Data Solutions, Inc. v. AKM Enterprise, Inc. DBA Mobilize, Inc.*, Case No. 4:15-cv-01821 (S.D. TEX-2015).

c) *Arrona et al. v. Bluestone Natural Resources, LLC*, Case No. 4:15-cv-02680 (S.D. TEX-2017).

d) *Sunoco Partners Marketing & Terminals L.P. v. Powder Springs Logistics, LLC, et al.*, Case No. 1:17-cv-01390 (D. Del. 2017).

e) *Magellan Midstream Partners L.P. v. Sunoco Partners Marketing & Terminals*, Case No. IPR2019-00024 (U.S. Patent No. 9,494,948).

f) *Magellan Midstream Partners L.P. v. Sunoco Partners Marketing & Terminals*, Case No. IPR2019-00025 (U.S. Patent No. 9,606,548).

17. I am being compensated in this matter at my standard consulting hourly rate of \$700 per hour. My compensation is not dependent on the substance of my statements in this declaration.

18. I am over the age of 18 and am competent to write this declaration. I have personal knowledge, or have developed knowledge, of the technologies discussed in this declaration based upon my education, training, or experience with the matters discussed herein.

III. RELEVANT LEGAL STANDARDS

A. Obviousness

19. I understand that obviousness is analyzed from the perspective of a POSITA at the time of the alleged invention. I also understand that a POSITA is presumed to have been aware of all pertinent prior art at the time of the alleged invention.

20. I understand that an obviousness analysis involves comparing a claim to the prior art to determine whether the claimed invention as a whole would have been obvious to a POSITA in view of the prior art and in light of the general knowledge of the art at the time the invention was made. I also understand that the invention may be deemed obvious when a POSITA would have reached the claimed invention through routine experimentation.

21. I understand that obviousness can be established by combining or modifying the disclosures of the prior art to achieve the claimed invention. It is also my understanding that where there is a reason to modify or combine the prior art to achieve the claimed invention, there must also be a reasonable expectation of success in so doing to render the claimed invention obvious. I understand that the reason to combine prior art references can come from a variety of sources, not just the prior art itself or the specific problem the patentee was trying to solve. I also understand that the references themselves need not provide a specific hint or suggestion of the alteration needed to arrive at the claimed invention; the analysis may include recourse to logic, judgment, and common sense available to a POSITA.

22. I understand that when there is some recognized reason to solve a problem, and there are a finite number of identified, predictable solutions, a POSITA has good reason to pursue the known options within his or her technical grasp. If such an approach leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense. In such a circumstance, when a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious.

23. I understand that when considering the obviousness of an invention, one should also consider whether there are any objective indicia that support the non-obviousness of the invention. I further understand that objective indicia of non-obviousness, also known as “secondary considerations,” include failure of others, copying, unexpected results, information that “teaches away” from the claimed subject matter, perception in the industry, commercial success, and long-felt but unmet need. I also understand that for objective indicia of non-obviousness to be applicable, the indicia must have some sort of nexus to the subject matter in the claim that was not known in the art. I understand that this nexus includes a factual connection between the patentable subject matter of the claim and the objective indicia alleged. I also understand that an independently made invention that is made within a comparatively short period is evidence that the claimed invention was the product of ordinary skill.

24. Finally, I understand that patent examiners at the U.S. Patent and Trademark Office (“PTO”) rely upon certain exemplary rationales in reviewing patent applications to understand whether the subject matter of the claims is obvious. I understand that the following is the list of exemplary rationales relied upon by patent examiners at the PTO: (i) combining prior art elements according to known methods to yield predictable results; (ii) simple substitution of one known element for another to obtain predictable results; (iii) use of a known technique to

improve similar devices (methods, or products) in the same way; (iv) applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (v) “obvious to try”—choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and (vi) known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art.

B. Construing the Meaning of Claim Terms

25. I understand that a *inter partes* review (“IPR”) is a proceeding before the PTO for evaluating the validity of issued patent claims. I understand that, in a IPR, a claim term is interpreted in a manner consistent with the standard used in patent litigation, as set forth in a case known as *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). That standard generally construes the claims according to their “ordinary and customary” meaning in view of the claim language, specification, file history, and, where applicable, relevant other evidence.

26. I understand that a patent’s “specification” includes all the figures, written descriptions, and claims within the patent. I understand that the PTO will look to the specification and prosecution history to see if there is a definition for a given claim term and, if not, will apply the ordinary and customary meaning from the perspective of a POSITA at the time in which the alleged invention was made.

27. As discussed above and detailed in my curriculum vitae, I was very familiar with hydraulic fracturing processes at both the individual well and oil-field level, as well as control systems for such processes and well treatment methods, technologies and was aware of the state of the art as of the earliest claimed priority date of the '394 patent. I believe that I would qualify as understanding the knowledge and skill of a POSITA as of December 1, 2005, and I have a sufficient level of knowledge, experience, and expertise to provide an expert opinion in the field of the '394 patent.

IV. BACKGROUND OF THE TECHNOLOGY

A. Oil and Gas Extraction from Wells

28. Retrieving hydrocarbons, such as oil and gas, from the earth has been done for centuries. See S. Dalvi, *Fundamentals of Oil & Gas Industry for Beginners* (Notion Press 2015) (“Dalvi”) (EX-1010, 13) (disclosing that oil drilling began in Azerbaijan in 1848, and two large pipelines hundreds of kilometers long were built to transport oil from the wellsites). The process starts with searching for potential petroleum reservoirs. These oil and gas reservoirs are subsurface pools of hydrocarbons contained in porous rock formations. They formed when the naturally occurring hydrocarbons were trapped among rock formations with lower permeability. Oil and natural gas are contained in the tiny pore spaces in these rocks similar to how water is contained in a sponge. *Id.*, 029.

29. Most reservoirs generally contain oil, gas, and water. Because of gravity, these fluids separate according to their density—that is, gas on top, followed by oil, and then water. *Id.*, 030. After discovering a reservoir, the rock formation is punctured by drilling a bore through it followed by tubing being inserted into the rock to extract the hydrocarbons. *Id.*; *see id.*, 056 (“An oil well can also be described as a hole pierced through reservoir rock and pipes inserted to extract the hydrocarbon content of the reservoir.”). Early on, oil wells were drilled by hammering a cable tool into the earth. But these were soon replaced by rotary drills, which could drill boreholes to much greater depths in less time. *Id.*, 057. Drilling equipment on a wellsite is referred to as a rig. *Id.*

30. Oil wells are nowadays typically drilled at an angle other than vertical to reach different parts of the formation, which is referred to as deviation drilling. *Id.*, 067. Drilling this way makes it possible to reach subsurface areas laterally remote from the point where the drill bit enters the earth. A well that has sections more than 80 degrees from vertical is called a horizontal well, which can extend for a number of kilometers and thus achieve higher production. *Id.* The image below illustrates deviation drilling:

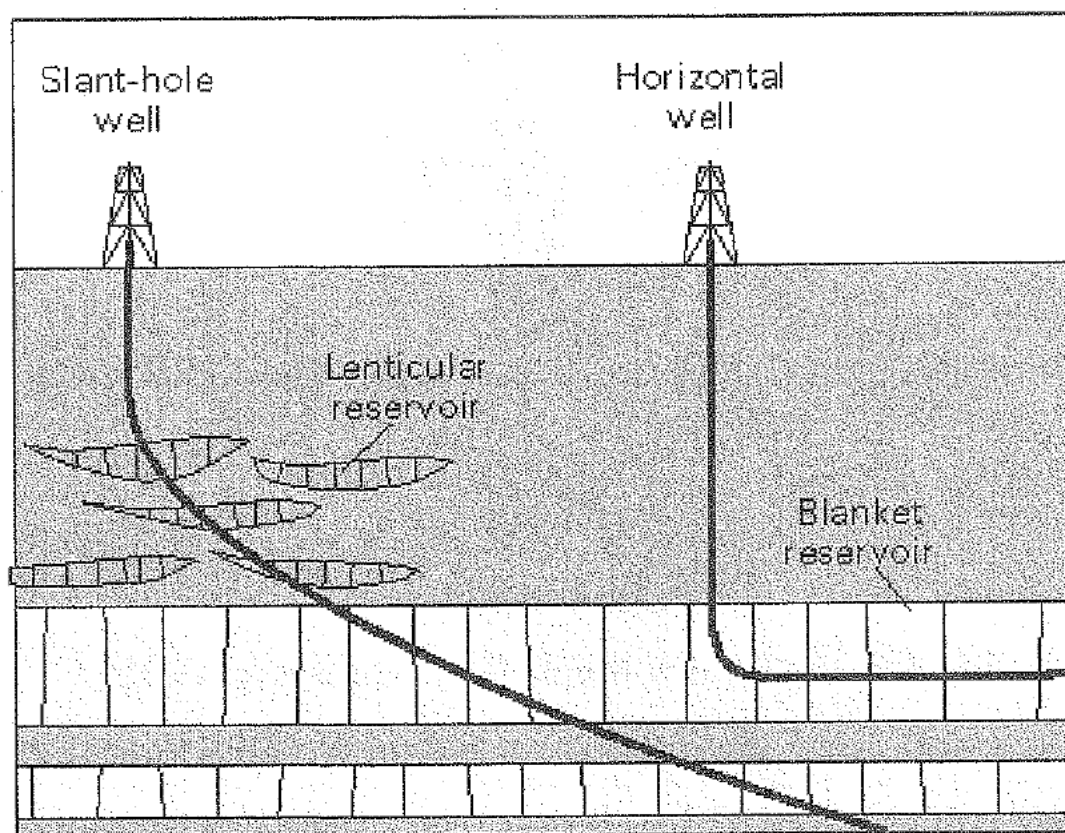


Fig.3.9: 37p Deviation Drilling for drilling at an angle

Dalvi, Fig. 3.9.37p – Drilling at an Angle (EX-1010, 67)

31. After the well is drilled, it needs to be cased. Part of this process includes reinforcing and providing structural integrity to the well, creating a barrier to debris falling into the well. *Id.*, 059. At this point, underground formations have sufficient pressure to cause the hydrocarbons to come to the surface on their own. *Id.*, 074. Once the well is cased, the well opening is closed at the surface by installing the wellhead and production tree, which control the formation pressure and flow. *Id.* The production tree is connected to a network of pipes that carries the

oil/gas to a metering station, and from there to tanks for supplying product to refineries or natural gas compressor stations. *Id.*, 075.

32. Next, a well engineer measures data from the well to determine the maximum amount of hydrocarbons that the well can produce in a 24-hour period. *Id.*, 074. This data is used to determine the “most efficient recovery rate,” or “MER.” As hydrocarbons are extracted, the MER will decline because the reservoir will lose its pressure. This is known as the “decline rate.” *Id.* Using this information, calculations can be made to determine when the well will need enhanced recovery methods in its lifespan. *Id.* A well will also need “treatment” to ensure a smooth flow of hydrocarbons. The treatment may include injecting acid, water, or gases into the well to open up the formation and allow the petroleum to flow through the formation more easily. *Id.*

B. Hydraulic Fracturing

33. Hydraulic fracturing—commonly called “fracking”—is a process for increasing the flow of oil or gas from a well. U.S. Patent Appl. Publ’n No. 2013/0306322 (“Sanborn”), ¶ 0003 (EX-1011). This process has been in use for decades. U.S. Patent No. 9,410,410 [1:8–14] (“Broussard”) (EX-1012). Fracking involves pumping fluid into a well under high enough pressures to fracture the rock formation and form fissures therein. Sanborn, EX-1011, ¶ 0003; Broussard, EX-1012 [1:14-21]. Fissures or openings create space to allow oil and

gas to move to the wellbore and then to the surface. Sanborn, EX-1011, ¶ 0003.

Sanborn describes this process as follows:

A hydraulic fracture is typically formed by pumping the fracturing fluid into the wellbore at a rate sufficient to create a downhole pressure that exceeds the fracture gradient of the surrounding rock. The rock cracks, and the fracture fluid continues farther into the rock, extending the crack into the depth of the well. Often, a proppant . . . is added into the injected fluid, to prevent the fractures from closing when the injection is stopped. The fracture that remains open is permeable enough to allow the flow of the desired gas or oil to the well, and eventually, to the surface for collection.

Id., ¶ 0004. One commonly-used example of a proppant is sand. *Id.*, ¶ 0026; Broussard, EX-1012 [4:46-50].

34. The proppant and fluid are typically mixed together (along with other additives) using a blender to form a “slurry” or “fracturing fluid.” This slurry or fracturing fluid is then pumped into the wellbore. Broussard, EX-1012 [2:48-54], [4:48-67], [6:54-58]; Sanborn, EX-1011, ¶ 0005 (describing the “injection and movement of the slurry (water, proppants, and chemical additives), through thousands of feet of earth and rock”); ¶ 0036 (“Pre-selected proportions of the fracturing fluid components (including chemical additives) and proppants are directed into at least one blender/mixing unit. . . .”); *see* U.S. Patent Appl. Publ’n No. 2012/0255734 (“Coli”), EX-1013, ¶ 0035 (“In a conventional fracturing operation, a ‘slurry’ of fluids and additives is injected into a hydrocarbon bearing rock formation at a wellbore to propagate fracturing. . . . The majority of the fluids

injected will be flowed back through the wellbore and recovered, while the sand will remain in the newly created fracture, thus ‘propping’ it open and providing a permeable membrane for hydrocarbon fluids and gases to flow through so they may be recovered.”). Manifolds, which are well-known in the art, are used to direct these mixed fluids to the wellbore. *See* EX-1014 (USP 3,560,053 to Ortloff), 3:25-36 (describing using manifolds to direct fracturing fluid in the 1970s), 3:50-54 (same); *see also* EX-1015 (USP 3,664,422 to Bullen) Fig. 6, 5:1-10 (describing Figure 6 as a fracturing manifold that may be used to inject the fluids into the well bore” in 1970s).

35. Hydraulic fracturing operations require large-scale equipment and massive amounts of fracturing fluid components, such as water, proppants, and other additives, on-site at the well. Sanborn describes equipment typically used during hydraulic fracturing operations:

Hydraulic fracturing equipment that is used in oil and natural gas fields includes a large number of components. Blenders, high-volume fracturing pumps, monitoring units, material tanks, hoses, electronics systems, and power units are just some of the components required for these operations. In a typical fracturing operation currently practiced, a large number of tractor trailers are used to support individual sets of diesel engines and fracturing pumps, along with associated equipment, such as transmission systems.

Sanborn, EX-1011, ¶ 0005; *see also* ¶¶ 0025-0031 (describing in detail the equipment and materials needed at a fracturing site). For fracturing fluid materials,

Sanborn describes that hydraulic fracturing operations need “supply containers for fracturing fluid components” (§ 0026) and “blending equipment for blending the fracturing fluid/solid components” (§ 0027); *see* Broussard, EX-1012 [6:4-10] (describing the need for “sand transporting vehicles,” “acid transporting vehicles,” “hydration units,” “blenders,” “water tanks,” “conveyor belts,” and other equipment). Both Sanborn and Broussard include figures illustrating some of the trucks and equipment needed on a typical hydraulic fracturing wellsite. Figure 1 of Sanborn shows as much and is reproduced below:

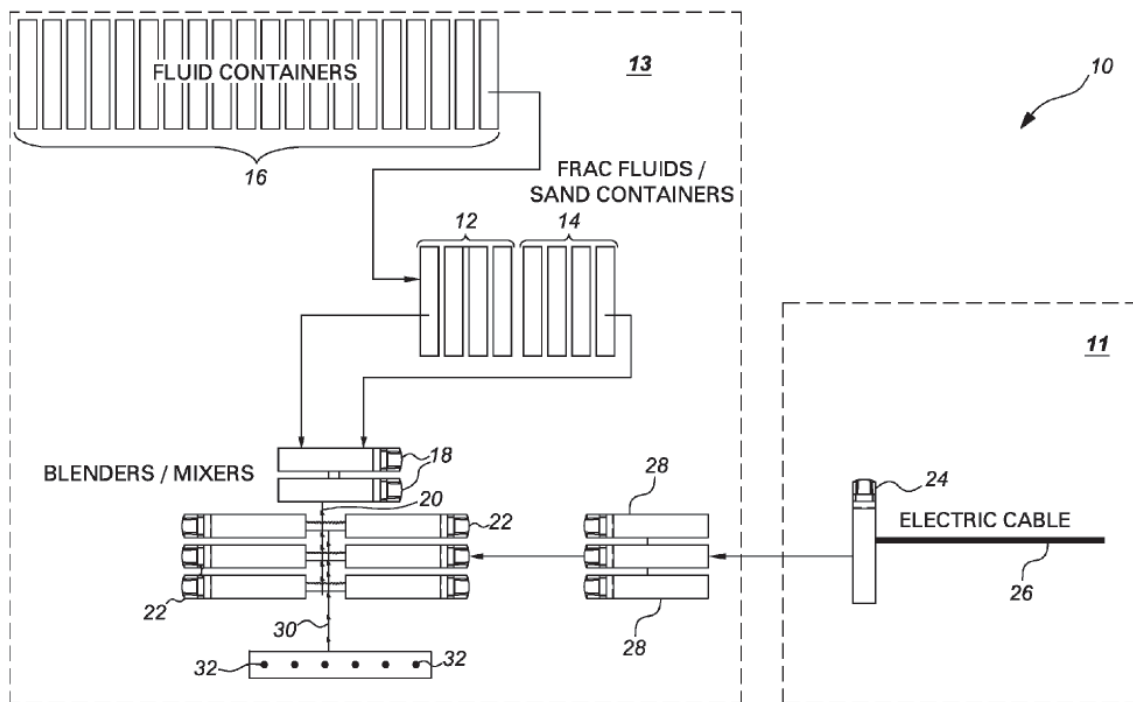
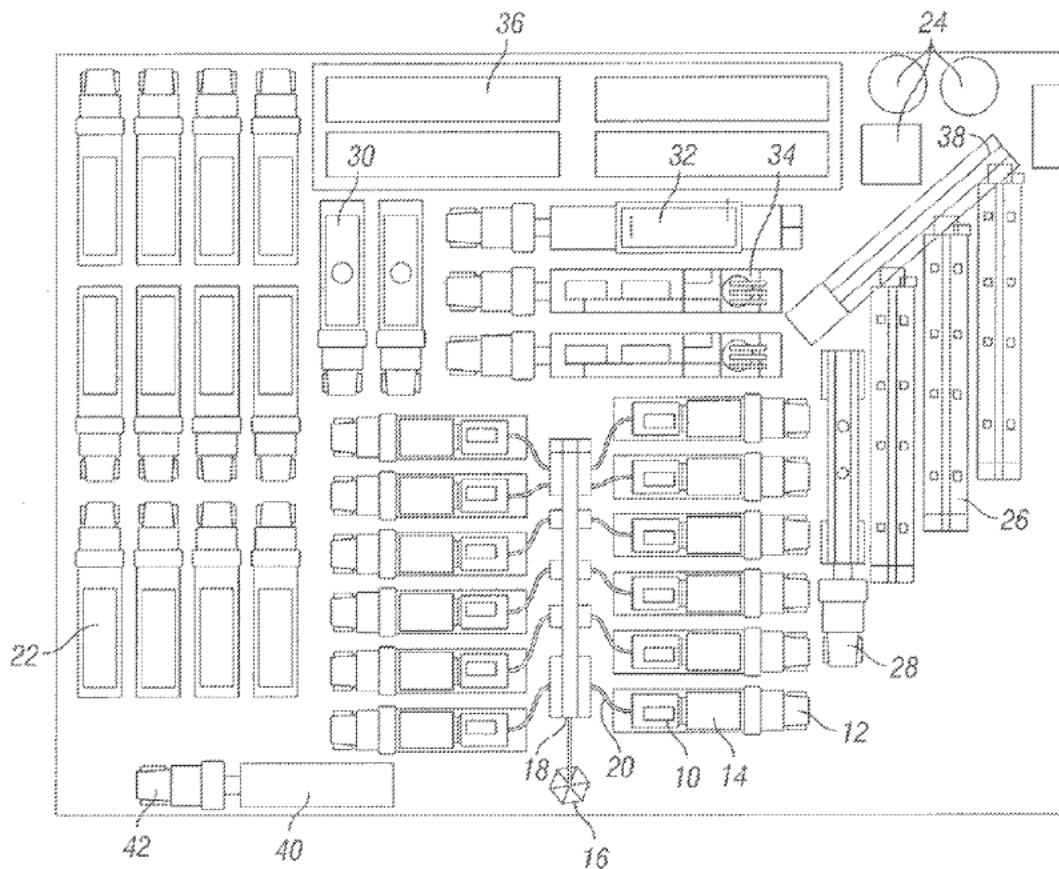


Fig. 1

Sanborn, Fig. 1 (EX-1011)

As shown in Figure 1 above, Sanborn discloses that a wellsite includes multiple tractor trailers (18, 22, 28) and containers (12, 14, 16) holding the equipment and

fluid components, with the wellheads represented by element 32. *Id.*, ¶¶ 0034, 0036, 0038, 0040, 0043.



Broussard, Fig. 1 (EX-1012)

16 via the missile 18. . . . The missile 18 is then connected to the wellhead 16 and configured to deliver fracturing fluid provided by the pumps 10 to the wellhead 16.” *Id.* [3:19-30]. In addition, Broussard explains that Figure 1 depicts “sand transporting vehicles 26, an acid transporting vehicle 28, vehicles for transporting other chemicals 30, and a vehicle carrying a hydration unit 32, such as, for example, a water pump. Also shown are fracturing fluid blenders 34, which can be configured to mix and blend the components of the hydraulic fracturing fluid, and to supply the hydraulic fracturing fluid to the pumps 10.” *Id.* [4:60-67].

37. Hydraulic fracturing operations also require powerful pumps. Typically, multiple pumps are used at each wellsite. Sanborn provides as “one example, 16 tractor trailers may support 16 diesel-powered, 2000 hp fracturing pumps. . . . High-capacity, high-power hydraulic pumps (e.g., triplex or quintuplex types) are commercially available from a number of sources.” Sanborn, EX-1011, ¶ 0005; *see* Coli, EX-1013, ¶ 0007 (stating that “average fracturing operations” may require “as many as fifty fluid pumps”). These high-power pumps require commensurately high-power motors, or “prime movers,” to drive them. Conventional systems typically used diesel fueled motors for this purpose. Coli, EX-1013, ¶ 0005 (stating that “pumping systems are typically mobilized on skids or tractor-trailers and powered using diesel motors”), ¶ 0035 (describing in conventional fracturing operations using “multiple high pressure, plunger style

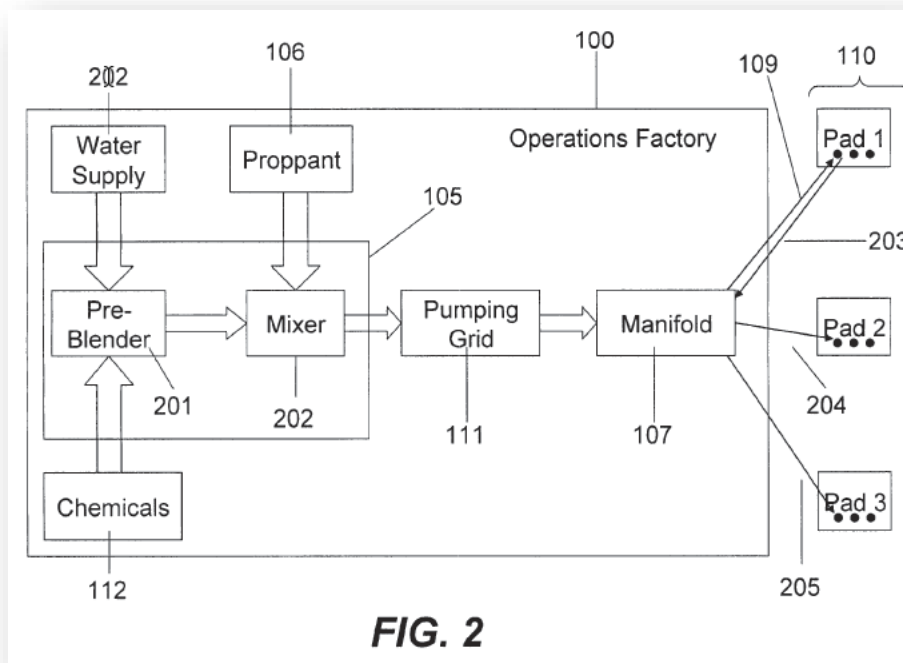
pumps driven by diesel fueled prime movers”); Sanborn, EX-1032, ¶ 0005 (“In a typical fracturing operation currently practiced, a large number of tractor trailers are used to support individual sets of diesel engines and fracturing pumps. . . .”).

V. U.S. Patent No. 7,841,394

38. In this Section, I consider the disclosure in the ’394 patent along with relevant information from the prosecution history of the ’394 patent.

A. Background

39. The ’394 patent is directed toward well operations. EX-1001, 1:6-11. 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. *See* 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:



'394 Patent, EX-1001, Fig. 2

40. By servicing multiple wells from a centralized location, the '394 patent's solution no longer needs 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 "conserve[s] labor, infrastructure, and the environmental impact" caused by relocating equipment for each new pad. EX-1001, 1:6-11

B. The Prosecution History

41. After rejecting the claims several times, the Examiner ultimately allowed the claims over the cited prior art for the following reasons:

The following references each teach a system for centralized well operations. None of the references, however, disclose, teach, or suggest the combination of limitations that provide for the system as instantly claimed.

Ex. 1002, p. 955. But the Examiner did not have Crossley and Albers, which as I explain below disclose each of the claimed features of the '394 Patent.

C. The Challenged Claims

42. I understand that for purposes of this proceeding, Petitioners are challenging the validity of claims 1–27 of the '394 patent.

43. Claim 1 of the '394 patent is representative of the challenged claims and shown below:

1. A system for centralized well operations comprising:
 - a well treatment operations factory which manufactures and pumps a well stimulation fluid;
 - a first connection between a first well and the well operations factory;
 - a second connection between a second well and the well operations factory; 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.

VI. CLAIM CONSTRUCTION

44. I understand that Petitioners reserve the right to assert in litigation that certain claim constructions are proper and that certain terms are indefinite, and I do not concede, by providing my opinions herein, that the challenged claims are of definite scope or properly described.

45. For purposes of this declaration, I will apply the plain and ordinary meaning for every term to all terms except the one listed below. However, I reserve the right to supplement my opinions if Patent Owner offers a construction of any term in the '394 patent.

46. I understand that the parties agreed on the following construction in the related district court litigation, which I have applied in my analysis 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) Function: simultaneously flowing Corresponding Structure: a manifold and equivalents thereof

VII. GROUNDS OF INVALIDITY

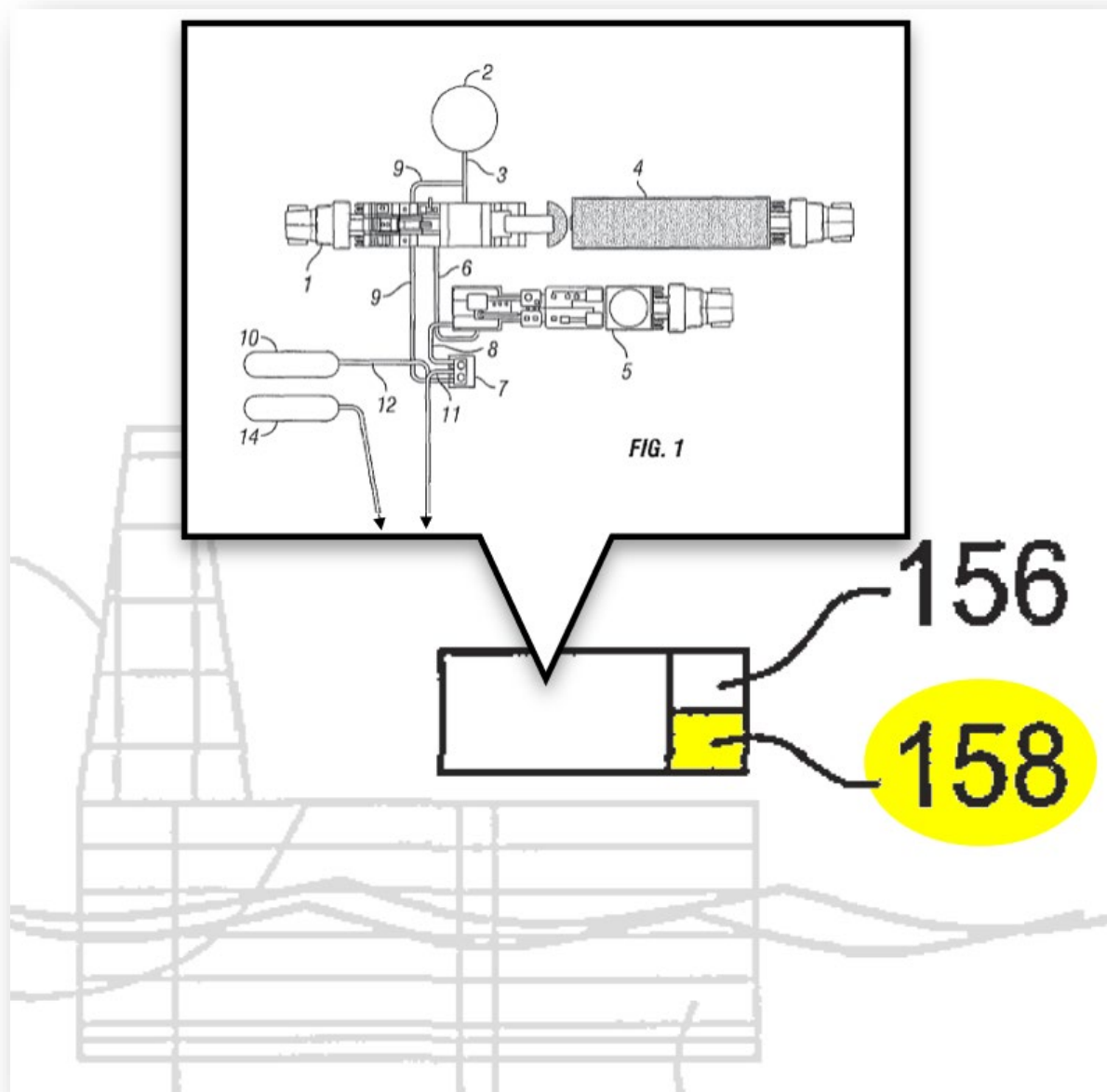
A. Claims 1–27 of the '394 Patent Are Obvious Based on Crossley (EX-1005) in view of Albers (EX-1006)

1. The Prior Art

47. It is my opinion that a POSITA would have found claims 1–27 of the '394 patent obvious over World Intellectual Property Organization ("WIPO") Patent Application Publication WO 2005/111369 to Crossley et al. ("Crossley") (EX-1005) in view of U.S. Patent No. 7,451,820 to Albers ("Albers") (EX-1006), which I understand are prior art to the '394 Patent.

2. The Combination of Crossley and Albers

48. It would have been obvious to include Albers's techniques related to formation-dependent oil-well stimulation fluids with Crossley's centralized oilfield operations system (hereinafter, "Crossley/Albers") for the reasons explained below. In particular, in the Crossley system as modified by Albers, Albers's fracture-stimulating equipment (and associated dynamic fluid manufacturing and optimized oil well-stimulation fluid techniques), would be implemented 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."



Crossley, Fig. 1 (EX-1005) & Albers, Fig. 1 (EX-1006) (annotated)

49. 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.” *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.”)

50. Crossley discloses a system 100 that supports multiple well-sites, each of which may constitute a grouping 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. EX-1005, [0043]. The wellheads each have subsea Christmas trees 114, 124, 134 affixed thereon. 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).

51. 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 “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]; *see also* [0009], [0024], [Claims 1, 13, 19, and 21].

52. 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.

53. Albers discloses “equipment [that] is of a conventional nature and is commonly used in the industry.” EX-1006, 4:14-16. 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, 2:4-19. *See also* Figure 1 (annotated above), Figure 4.

54. 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).

55. 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. Albers explains that his techniques “may be used in conjunction with the fracture-stimulation of any water-sensitive formations.” EX-1006.

56. 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.

57. Finally, Albers explains that the specific type of engineering program to be used in the disclosed well-stimulation method 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.

58. It would have been obvious to combine Albers’s techniques related to formation-dependent and dynamically manufactured oil-well stimulation fluid techniques with Crossley’s 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.”). A POSITA could therefore have made the Crossley/Albers combination without undue experimentation and with a reasonable expectation of success.

59. It would have been obvious to combine Crossley with the Albers because a POSITA would have been motivated to do so based on the teachings of Albers. 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, 6:23-27. 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; 7:27-35; *see also* Figure 4. 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 they Crossley can more beneficially produce oil and gas from wells drilled in formations with lower permeability.

60. A POSITA would have also been motivated to apply Albers’s systems and techniques related to manufacturing and pumping optimized oil-well stimulation fluids with Crossley’s centralized oilfield operations system based on the teachings of Lacy. Lacy explains that with his techniques, “since 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. A POSITA would have also been motivated by this disclosure to

combine Crossly and Albers based on Lacy's disclosures in order to provide for increased gas and oil production.

61. Second, modifying Crossley's system to incorporate Albers's techniques would allow for 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. A POSITA would have been motivated to do based on the teachings of Tolman. *See also* 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.”) [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.”). A POSITA would have recognized 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 because as modified, Crossley would be stimulating multiple wells simultaneously and in a manner optimized for the specific oil field.

B. The Combination of Crossley and Albers Renders Obvious Claims 1–27

62. As I explain below, the combination of Crossley and Albers renders obvious all limitations of claims 1–27.

1. Independent Claim 1

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

63. Crossley/Albers discloses a “[a] *system for centralized well operations.*” For example, Crossley discloses “[a] system for **supporting multiple-well-site, offshore, hydrocarbon-bearing fields, each well-site has one or more wells.** . . . The operations system may provide 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.**”); *see also id.*, Figs. 1–3, and 5. Figure 1 of Crossley depicts such a “*centralized*” system 100, which includes “support[]” for “multiple well-site fields,” such as well-site fields 10, 20, and 30 (each of which have a plurality of wells), depicted below:

Crossley uses manifolds (115, 125, and 135) located at each well-site. EX-1005, [0045], [0037]. These manifolds, along with other systems in 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). Similarly, Crossley explains that the "term 'control module' is intended to include any electrical or fluid manifold apparatus for directing communication, power, signals and/or fluids to subsea equipment. In this way, control may be transmitted to valves, trees 114, 124, 134 and other equipment, either subsea or on a production platform.")

64. Accordingly, Crossley/Albers discloses the preamble of claim 1.

ii. [1A] "*a well treatment operations factory which manufactures and pumps a well stimulation fluid;*"

65. In Crossley/Albers, Crossley's vessel 150 ("*well treatment operations factory*") would pump various stimulation fluids to "multiple well-site fields" ("*pumps a well stimulation fluid*") such as well-site fields 10, 20, and 30 depicted in Figure 1.

66. For example, Crossley 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 “**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.**”

67. Crossley does not expressly disclose “*manufactur[ing] a well stimulation fluid,*” but Albers does. A POSITA would have been motivated to combine Crossley with Albers for the reasons explained above. *See* § VI.A.

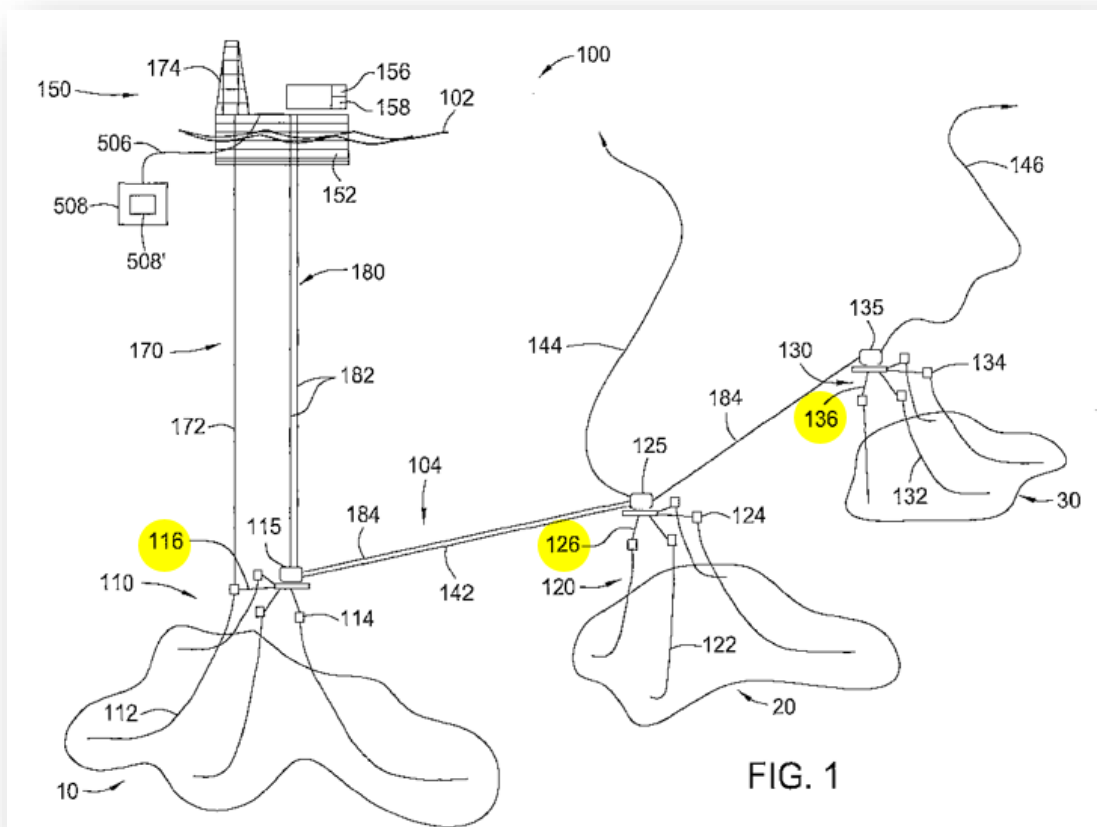
68. Albers discloses a “fluid storage device” containing “an uncomplexed fluid . . . preferably clay-stabilized or gelled water, but can be any suitable fluid including a methanol water or a hydrocarbon-based fluid.” EX-1006, 4:52-67. Albers also explains the “sand trailer [] contains **proppant** . . . [and] may be **any suitable proppant** such as sand, glass, plastic, ceramic, and/or metallic particles.” A POSITA would understand that Albers’s chemicals such as its “uncomplexed fluid” and its “proppant” are examples of “*well stimulation fluids.*” *See, 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.”).

69. 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

70. Crossley further explains that each well 112, 122, and 132 has a flow line jumper 116, 126, and 136 extending from trees 114, 124, 134 “in order to transport production or **injection fluids**,” that that such flow line jumpers tie into a collection manifolds 115, 125, and 135. These flow line jumpers are depicted in Figure 1 below:



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

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 wells 122, 126, and 132.

71. As modified by Albers, Crossley’s vessel 150 is a “*a well treatment operations factory which manufactures*” optimized well-stimulation fluids as described in Albers. Moreover, the-stimulation fluids are (“*dynamically manufacture[d]*”). For example, 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).

72. 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.**”

Crossley, Fig. 1 (EX-1005) & Albers, Fig. 1 (EX-1006) (annotated)

73. Accordingly, Crossley/Albers renders obvious “*a well treatment operations factory which manufactures and pumps a well stimulation fluid.*”

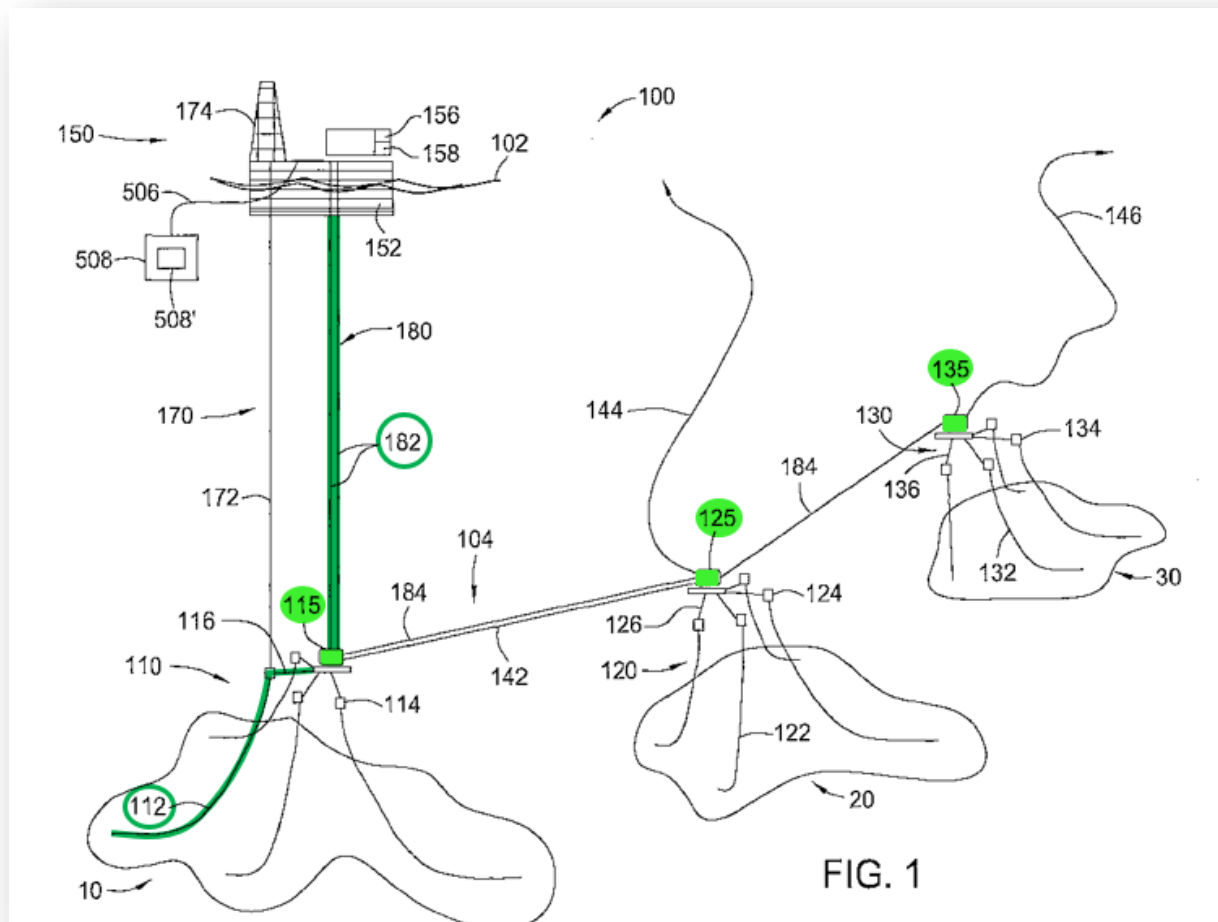
iii. [1B] “*a first connection between a first well and the well operations factory;*”

74. The Crossley/Albers system discloses this limitation.

75. Crossley’s vessel 150 (“*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 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). The manifolds are used in Crossley to selectively deliver fluids from vessel 150. EX-1005, [0036], [0049]-[0050]. Annotated Figure 1 of Crossley shows that collection vessel 150 is **connected to manifold 115 via control link 182 and further connected to well-site 110 through “flow-line jumper 116” and a tree (i.e., “a first connection”)**, which is connected to **well 112 (i.e., “a first**

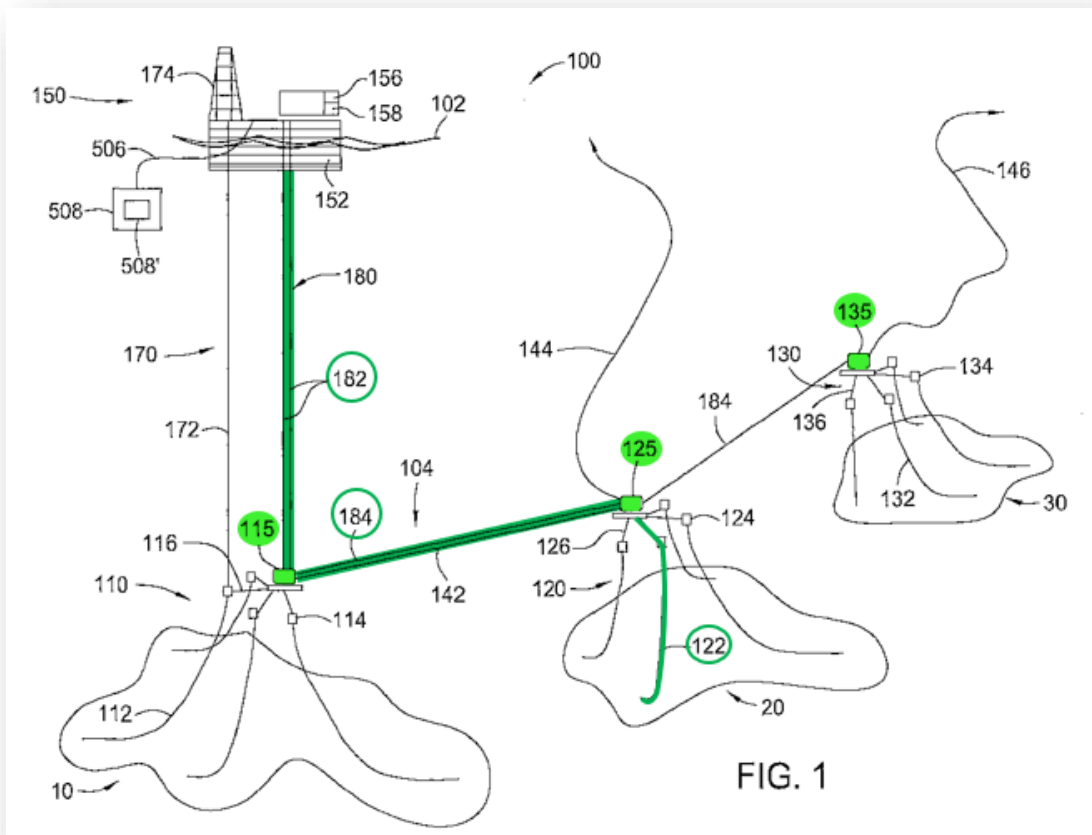
well”). Flow line jumpers “transport production or injection fluids” to the wells.

EX-1005, [0045]:



Additionally, each of the lines descending from manifold 115 and flow line jumper 116 (and their respective trees) constitute a “*connection*” to “*a well*.” For example, as depicted below, each of the four wells (and their “*connection[s]*”) at well-site 110 are highlighted (green, blue, yellow and purple) below:

jumper 126” and associated tree (i.e., “a second connection”) which is connected to well **122** (“a second well”):



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

79. Alternatively, 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 (and their “*connection*” through **flow line jumper 116 and associated tree**) would

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;”

81. The Crossley/Albers system discloses this limitation.

82. I understand that the parties have agreed that the function of “*means for simultaneously flowing*” is “simultaneously flowing,” and the corresponding structure is “a manifold and equivalents thereof.” *See* § VI.A, *above*.

83. Crossley’s manifolds 115, 125, and 135 are “*means for simultaneous flowing*” of stimulation fluids, per the Court’s construction, because they are manifolds.

84. Crossley also explains that the operations control system is also “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 teaches that its “control line”—*i.e.*, control lines 182 and 184—“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). Moreover, Crossley’s vessel 150, 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,

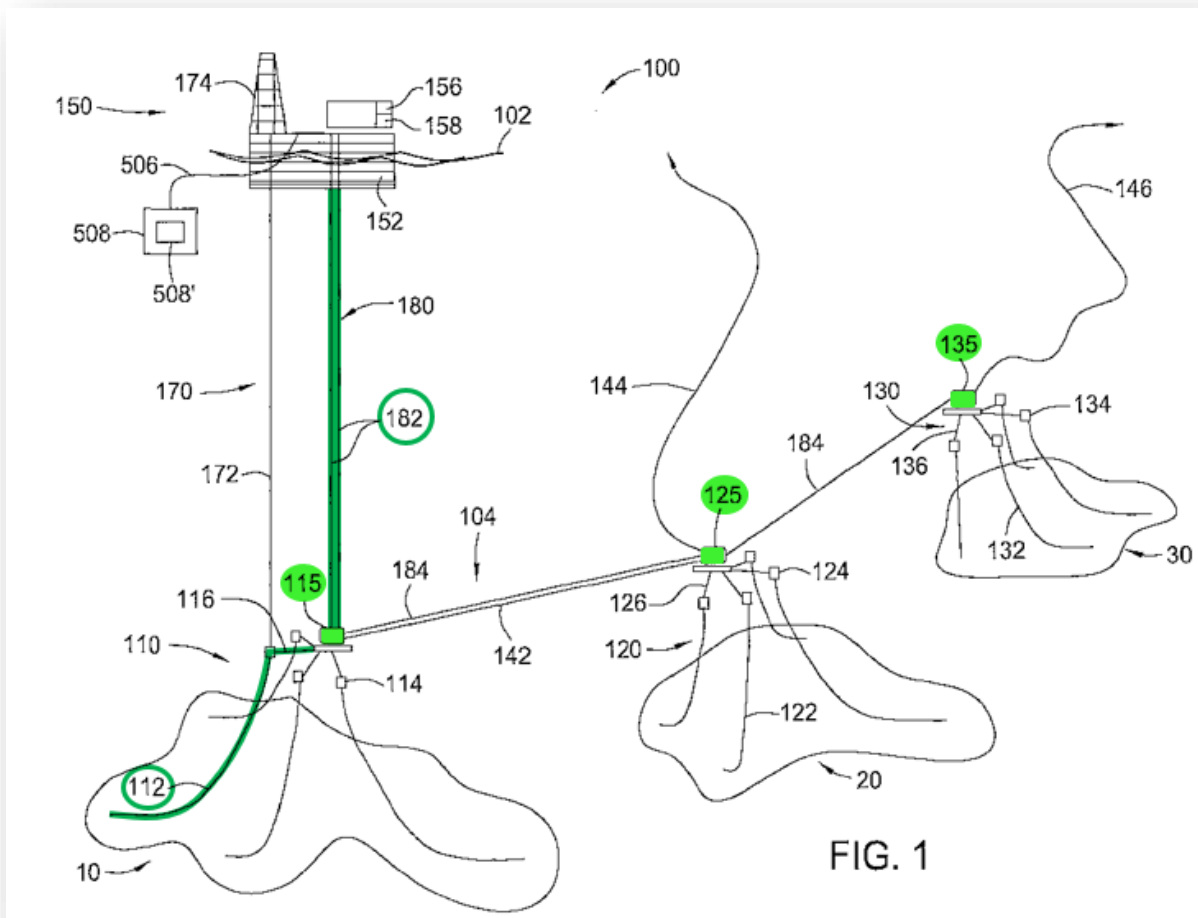
line or sensor (depending upon the desired control function) associated with **the collection manifold** or with an individual well or flowline. The inter well-site control network thus provides a communication link between well-sites, and may also include hydraulics, electrical power and/or **chemical distribution.**") (emphasis added).

85. 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."). Accordingly, the manifolds 115, 125 and 135 permit the "*simultaneous flowing*" of stimulation fluids. Indeed, a POSITA would understand that the manifolds as used in Crossley, are the type of equipment that would enable the use of "simultaneous or concurrent operations in the stimulation of multiple wells." 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.") [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.”) (emphasis added).

86. By **selectively** controlling Crossley’s manifolds, a POSITA would have understood that Crossley’s system would be configured to permit well-stimulation fluids as described in Albers to flow using different paths.

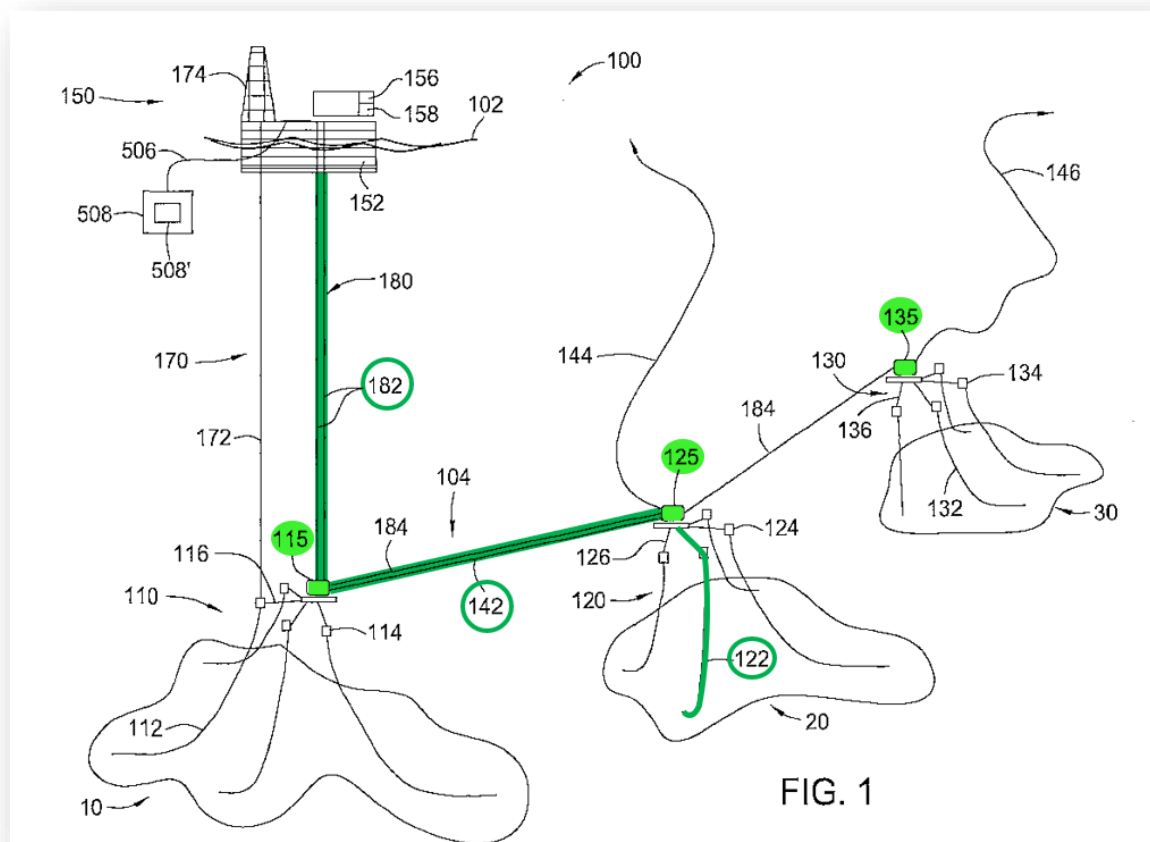
87. Thus, one such configuration of Crossley/Albers would direct one stimulation fluid flowing from vessel 150 to well-site 112 (“*a first well*”) via connection 180 (a “*first connection*”) and through manifold 115.



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

88. As shown above, a POSITA would have understood that such a configuration would direct “a first stimulation fluid” of Albers to flow “to the first well and not to the second well.” In that configuration, vessel 150 would also selectively pump a second well-stimulation fluid directed toward well-site 120 (“a

second well")¹ via manifolds 115 and 125 and control line 184 ("a second connection"), as shown below.



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

¹ As explained above in 1[C], in a separate configuration, the second well would be at well-site 110, but the Crossley/Albers system would nonetheless disclose this claim element for the same reasons articulated here.

89. Alternatively, in the second configuration described above, *see* Claim Element 1[C], the “*second stimulation fluid*” would be directed to a “*second well*” at well-site 110:



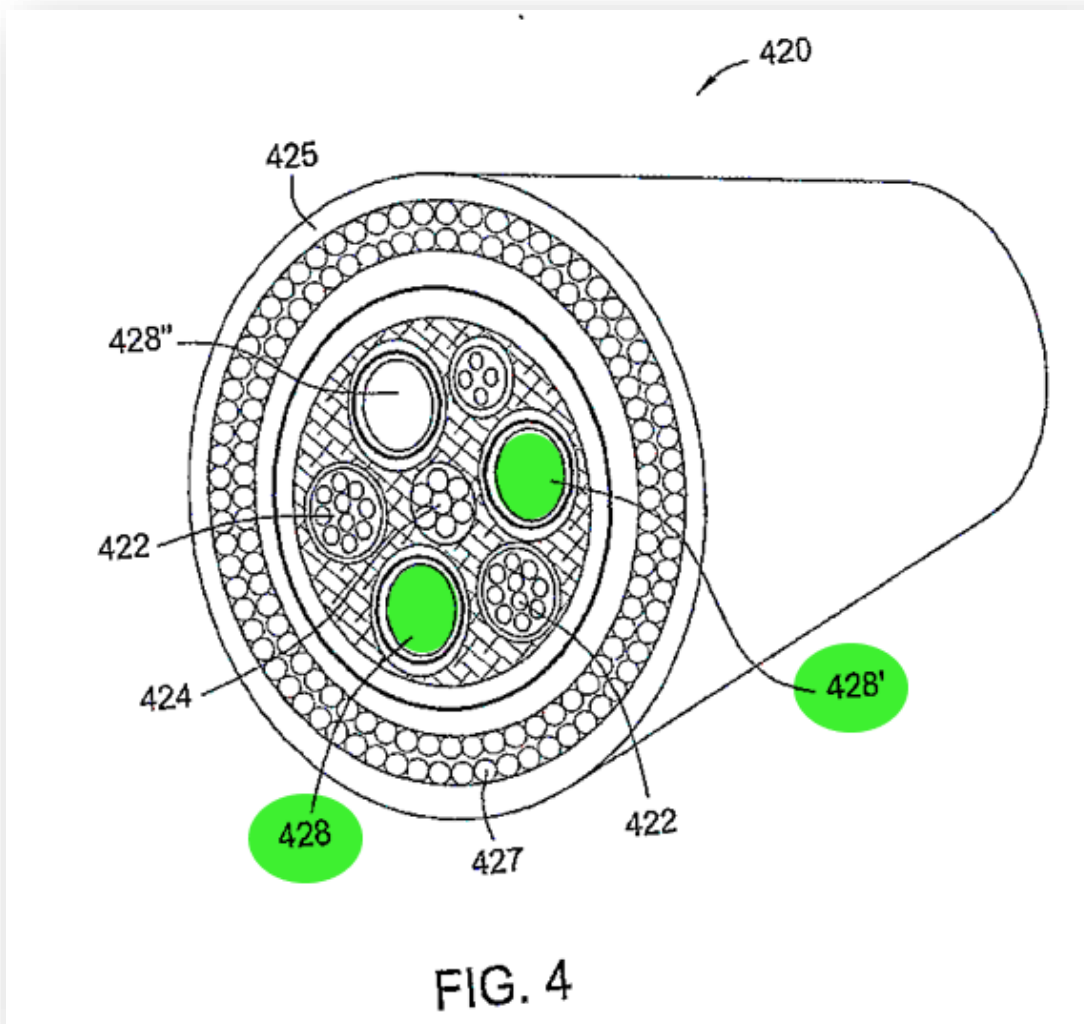
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chemicals, and may or may not be integrated into the same umbilical or cable as the communication links 180, 184,” an exemplary integrated line is depicted in Figure 4, and apart from “data and communication lines,” it discloses:

[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.

91. In the Crossley/Albers system, the optimized well-stimulation fluids would be delivered through lines 428 and 428,’ which 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’



92. Accordingly, the Crossley/Albers system discloses “*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.*”

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

93. Crossley does not expressly disclose that a *“first stimulation fluid and the second stimulation fluid have different compositions,”* but such a disclosure would have been obvious based on Crossley in view of Albers.

94. In the Crossley/Albers system, Albers’s well-stimulation fluids would be manufactured and delivered in per-wellsite optimized way. 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.

95. In view of Albers express disclosure, a POSITA would have understood that Crossley’s vessel, as modified by Albers, would deliver different concentration of well-stimulation fluid depending upon the formation (or well-site) to be fracture-stimulated. EX-1006, 7:27-35; *see* ¶90, *above*. 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 readily recognized 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 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. As such, the present techniques may reduce the cost and time associated with performing operations for stimulation treatments of wells.”)

96. Accordingly, the Crossley/Albers system discloses “*first stimulation fluid and the second stimulation fluid have different compositions.*”

2. Dependent Claim 2

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

98. As I explain above for claim element 1[D], *see* § VII.B.1.v, Crossley’s collection manifolds 115, 125, and 135—either individually or collectively with two or more—are the “*means for simultaneous flowing*” of well-stimulation fluids.

99. Accordingly, Crossley/Albers renders obvious this limitation.

3. Dependent Claim 3

100. 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.*”

101. 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.

102. 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.”).

103. 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 id.*, 2:1-7, 3:54-67, 4:61-66. 5:1-14, 6:4-29.

104. Based on these disclosures, a POSITA would understand that Crossley’s vessel (“*the well operations factory*”), as modified by Albers, would include a “*pumping grid*” connected to Crossley’s collection manifolds (the claimed “*manifold*”).

105. Accordingly, Crossley/Albers renders obvious this limitation.

4. Dependent Claim 4

106. 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.*”

107. Albers discloses that its “blender unit” (*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.

108. Accordingly, Crossley/Albers renders obvious this limitation.

5. Dependent Claim 5

109. 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.*”

110. Albers describes a “sand trailer” (“*a proppant storage system*”)—which be 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.”). 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; *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. The proppant concentration of the slurry is preferably from about 25 kg/m³ to a maximum of 2000 kg/m³, however any suitable concentration may be used.”); *see id.*, 6:50-66 (“The monitoring and control equipment illustrated in FIG. 4 allow the process of delivering the wet proppant to the wellhead to be accomplished using a “step” procedure, where a measured of amount of proppant is introduced into the formation, followed by an increased amount, followed by a further increased amount, and so on until the proper proppant concentration is attained.”).

111. Accordingly, Crossley/Albers renders obvious this limitation.

6. Dependent Claim 6

112. 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.”

113. Crossley’s operation control system located in 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.

114. 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.

115. Accordingly, Crossley/Albers renders obvious this limitation.

7. Dependent Claim 7

116. 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.”

117. Crossley’s vessel (*i.e.*, “*well operations factory*” of Crossley/Albers) satisfies at least a “*deployable*” “*modular,*” and “*mobile accommodation*” structure. Crossley’s vessel 150 is both “*deployable*” and a “*mobile accommodation structure*” at least because the floating vessel “is relocatable from a first offshore well-site to at least a second offshore well-site.” EX-1005, [0008]; *id.*, [0010]-[0011] (same). Such a person would have recognized that Crossley’s vessel is also a “*modular structure*” because the vessel is made up of various subsystems, such as an operation control system (*see e.g.*, EX-1005, [0019]), an optional intervention system, (*see e.g.*, EX-1005, [0020]) and a power delivery system, *see e.g.*, (EX-1005, [0059]).

118. Accordingly, Crossley/Albers renders obvious this limitation.

8. Dependent Claim 8

119. 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.*”

120. Albers explains that fluid storage devices (“*a chemical storage system*”) are used to provide fluids to the 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),”). Further, Albers discloses that these stored fluids may be various “*chemicals*”, such as clay-stabilized or gelled water, a methanol water, or a hydrocarbon-based fluid. *See 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.”) As I explain above, the “fluid storage devices” in Crossley/Albers would be included on the vessel.

121. Accordingly, Crossley/Albers renders obvious this limitation.

9. Dependent Claim 9

122. 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.*”

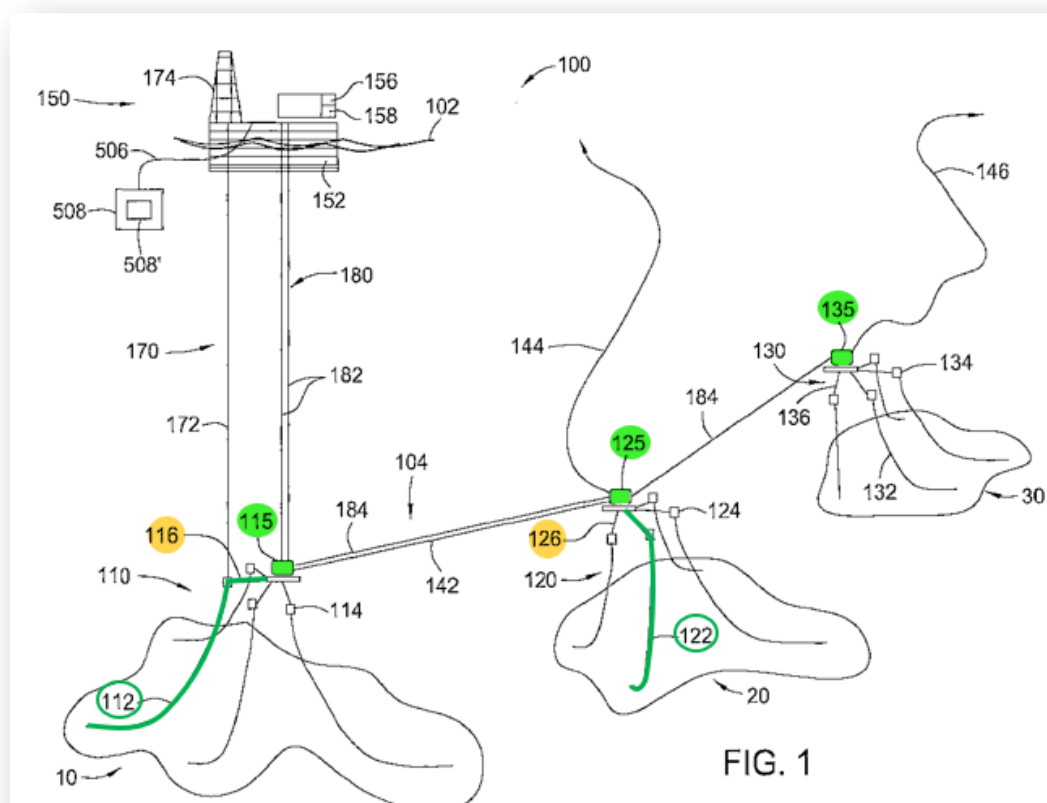
123. As I explain above in claim 6, Crossley’s vessel includes a power delivery subsystem that powers all systems in the Crossley/Albers system. *See, e.g.*, EX-1005, [00048].

124. Accordingly, Crossley/Albers renders obvious this limitation.

10. Dependent Claim 10

125. 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.*”

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



127. A POSITA would understand that production fluids are fluids retrieved from the well. EX-1005, [0045].

128. Accordingly, Crossley/Albers renders obvious this limitation.

11. Dependent Claim 11

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

130. Crossley/Albers discloses a “*stimulation fluid*” for the same reasons described above for claim 1[B] and [D]]. See § VII.B.1.v.

131. Accordingly, Crossley/Albers renders obvious this limitation.

132. In addition, 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.*

133. 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 of Lehman.

134. 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, [0004]; *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.”)

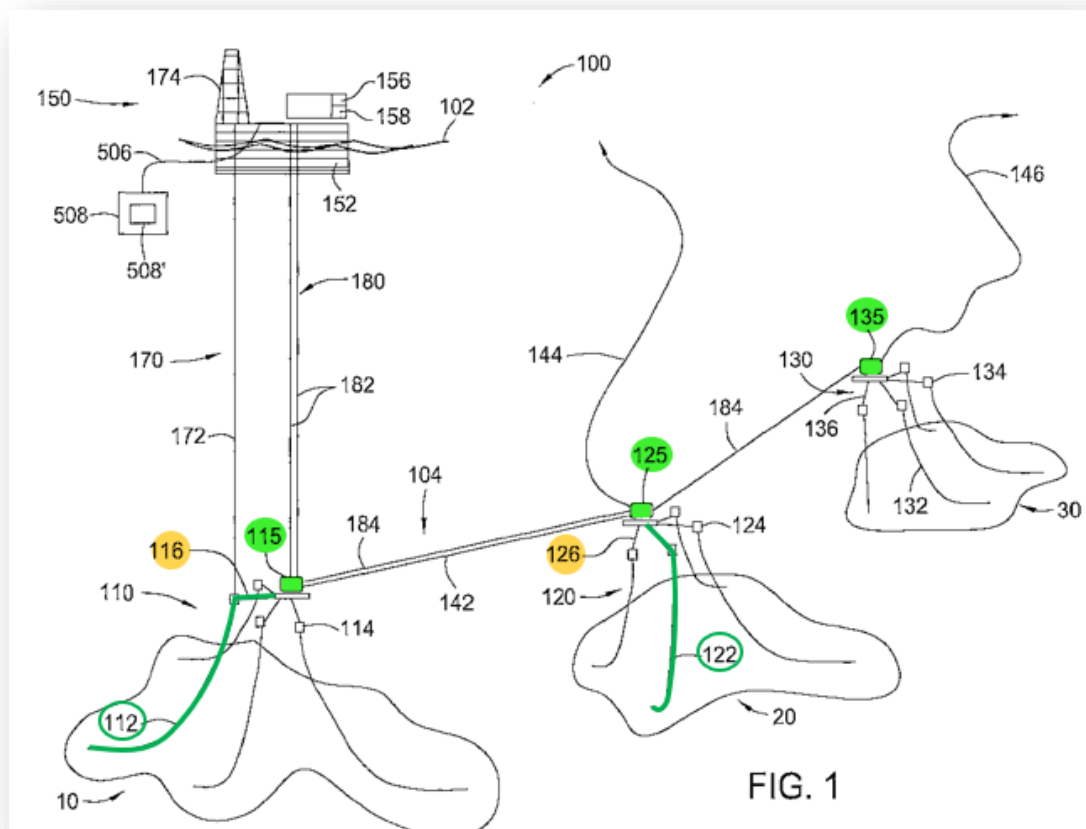
135. A POSITA would also have been motivated to modify the Crossley/Albers system to include a flowback and reuse system because it is well-known in the art that well-stimulation fluids can be recovered and reused from a prior treatment. For example, Lehman describes “performing a treatment on a well 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.

12. Dependent Claim 12

136. 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.*”

137. Referring to Figure 1 (annotated, below), Crossley explains that a **flow line jumper 126 and associated tree** (*e.g.*, “*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 (“*the manifold*”). EX-1005, [0045].



138. Crossley/Albers also renders obvious this claim element in a second configuration, as described above with respect to claim element 1[C]. Crossley explains that a **flow line jumper 116 and its associated tree** (*e.g.*, “*second connection*”) is connected to a well at well-site (*e.g.*, the blue well highlighted below”) and facilitates the “transport of production . . . fluids” (“*operable to deliver a fluid*”) through manifold 115 (“*the manifold*”). EX-1005, [0045].

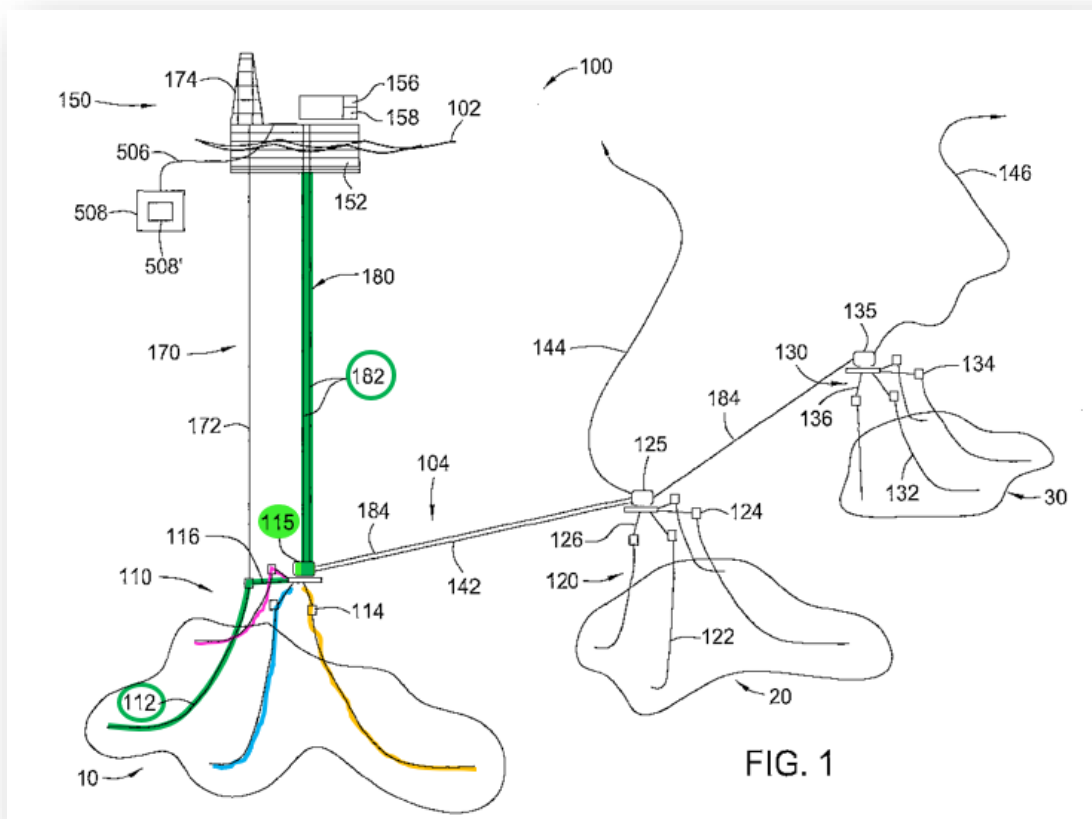


FIG. 1

139. Accordingly, Crossley/Albers renders obvious this limitation under either configuration.

13. Dependent Claim 13

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

141. Crossley/Albers discloses a “*stimulation fluid*” for the same reasons described above for claim 1[B] and [D]].

142. In addition, 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.*

143. 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.

144. 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, [0004]; *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.”)

145. 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.

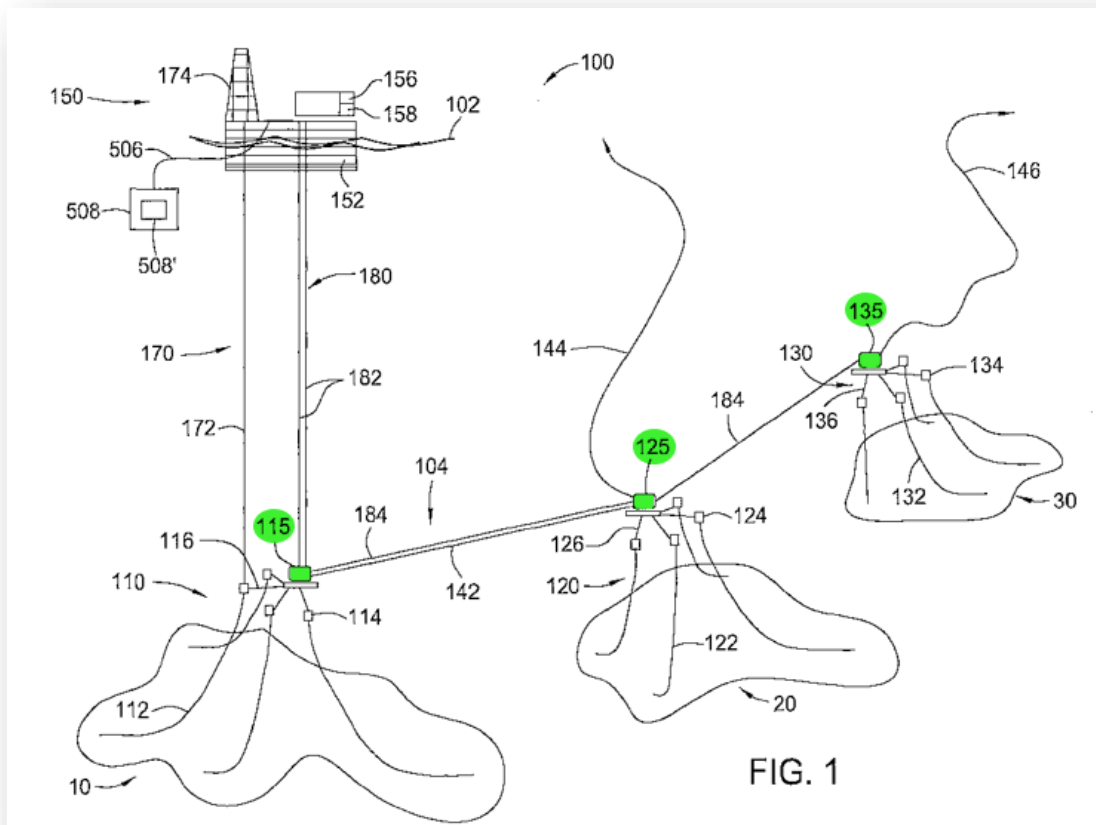
146. Accordingly, Crossley/Albers renders obvious this limitation.

14. Dependent Claim 14

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

148. Crossley/Albers discloses this claim limitation at least for the same reasons described above for claim 1[B] and claim 1[C]. .

149. For example, Crossley's collection manifold 115 is connected to other connection manifolds 125 and 135 at different well sites 120 and 130 (either of which satisfy the "*second manifold*" depending on the configuration), respectively:



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

150. Accordingly, Crossley/Albers renders obvious this limitation.

15. Dependent Claim 15

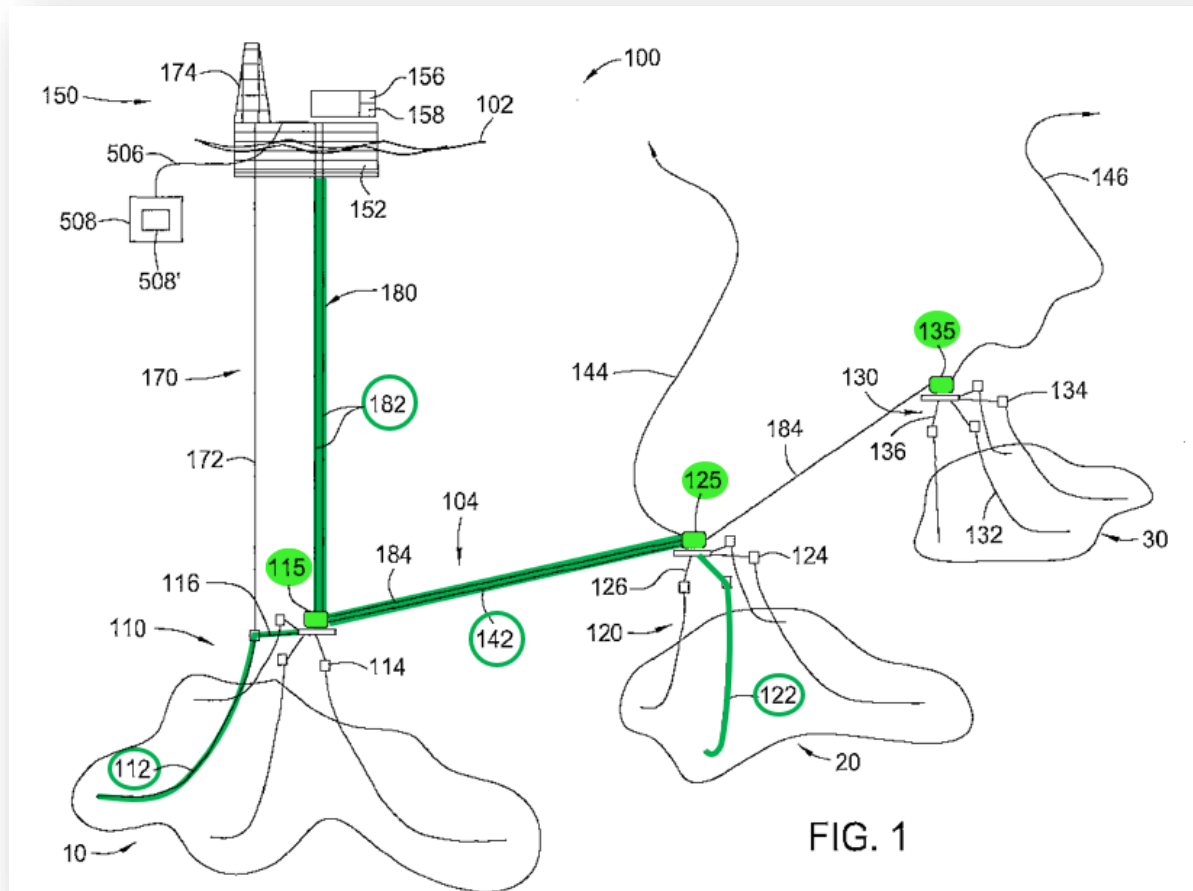
151. Claim 15 depends from claim 14 and further recites “*wherein the second manifold is operable to simultaneously flow a first stimulation fluid to the first well and a second stimulation fluid to the second well.*”

152. This claim is satisfied at least for same reasons described above the claim elements 1[B], 1[D] and 1[E] and claim 2.

153. For example, Crossley’s collection manifolds and valves are configured to simultaneously direct pump different well-stimulation fluids to different wells. By **selectively** controlling the manifolds and valves, *see* EX-1005, [0033] and [0049], a POSITA would have understood that Crossley’s system may be configured to permit fluid to flow using different paths. A POSITA would have understood that the use of manifolds 115, 125, and 115 permit flexibility in the flowpath of production or injection fluids. EX-1005, [0045]. Such flexibility would have permitted a configuration that directs excess fluid flowing from vessel 150 intended for manifold 125 or 135 (a “*second manifold*”) to well 122 (“*a first well*”), as necessary.

154. Alternatively, because the identification of the a “*first manifold*” and “*second manifold*”—in addition to the “*first well*” and “*second well*”—is arbitrary in a centralized system like Crossley, in the configuration below, with **manifold 115** serving as a “*second 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].

155. Accordingly, Crossley/Albers renders obvious this limitation.

16. Dependent Claim 16

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

157. Crossley discloses that each well has a flow path that receives production fluids extracted from each 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 flowpath 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.”). **Each** well-site “has a plurality of wells . . . clustered together.” Flow paths, including strings of production tubing, (*i.e.*, “*connections*,” including a “*third connection*”) through flow line jumpers for each well all terminate at the respective collection manifold for each wellsite. EX-1005, [0044] (“It is 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 to the wellhead.”); *see also* 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).

158. Based on these disclosures, a POSITA would have understood that Crossley’s collection manifold 115 and 125 would have many separate “*connection[s]*” with each well for the purpose of extracting production fluid collected at each well, including well 112 (a “*the first well*”). Crossley’s collection

manifold 115 and 125 thus includes a connection (“*a third connection*”) to receive production fluid extracted at multiple wells at well site 110, including well 112 (“*the first well*”).

159. Accordingly, Crossley/Albers renders obvious this limitation.

17. Dependent Claim 17

160. 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.*”

161. As I explained above, Crossley’s collection manifold 115 includes a connection (“*a third connection*”) to receive production fluid extracted at multiple wells at well site 110, including well 112 (“*the first well*”).

162. Accordingly, Crossley/Albers renders obvious this limitation.

18. Dependent Claim 18

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

164. As I explained above, Crossley’s collection manifolds 115 and 125 include a connection via manifold 125 to receive production fluid extracted at multiple wells at well site 120, including well 122 (“*the second well*”). In addition, in a configuration described in claim element 1[B] where the “*second well*” is at well-site 110, the “*fourth connection*” would be the strings of production described in Crossley for such “*second well*.”

165. Accordingly, Crossley/Albers renders obvious this limitation.

19. Dependent Claim 19

166. 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.*”

167. 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.

168. Accordingly, Crossley/Albers renders obvious this limitation.

20. Dependent Claim 20

169. 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.*”

170. Crossley discloses that its system is located on “floating vessel,” which a POSITA would have understood to be 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. *See* 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 floating vessel.

171. 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. 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). 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. *See* EX1005, [0064] (Crossley describing an alternative embodiment where collection manifolds are located on platforms instead of the ocean bottom).

172. Accordingly, Crossley/Albers renders obvious this limitation.

21. Dependent Claim 21

173. 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.*”

174. 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.*”

175. Accordingly, Crossley/Albers renders obvious this limitation.

22. Dependent Claim 22

176. 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.*”

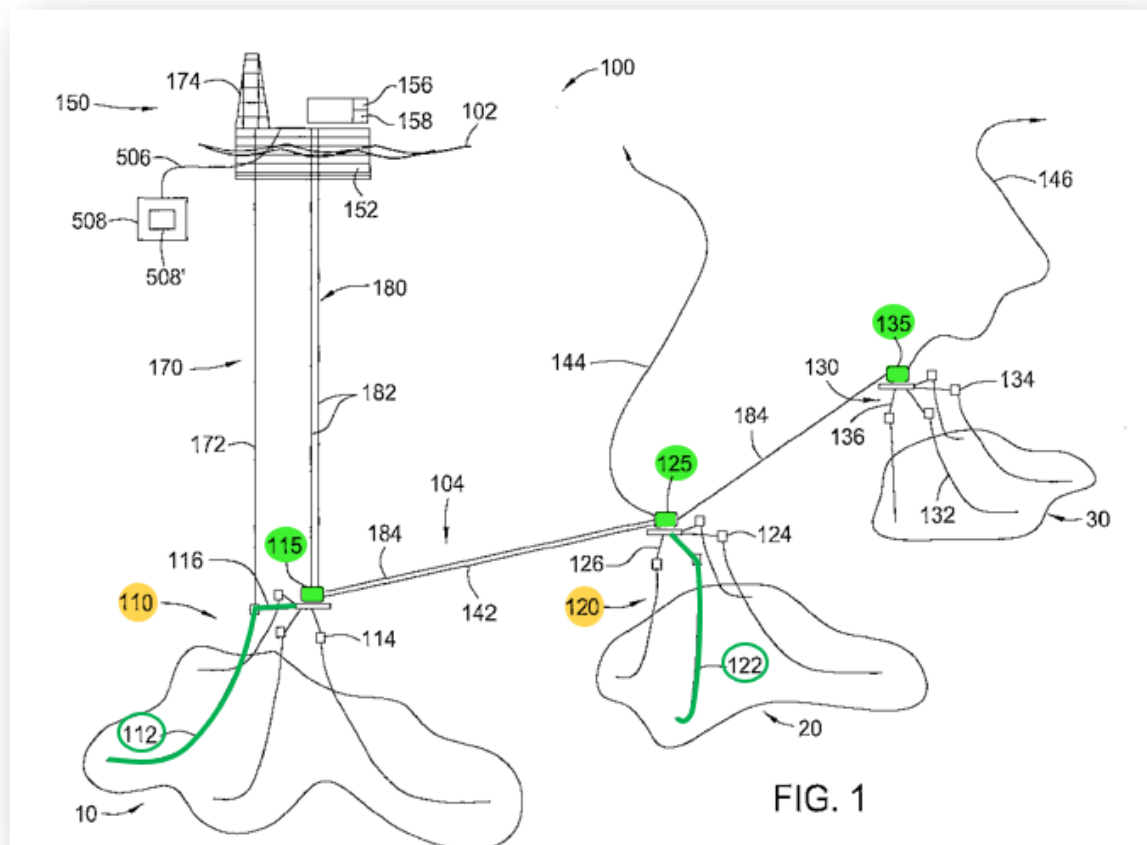
177. This claim element is disclosed for the same reasons described above with respect to claim element 1[E] and 21.

178. Accordingly, Crossley/Albers renders obvious this limitation.

23. Dependent Claim 23

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

180. Crossley’s wells are disclosed as being both on the same and “*on separate pads.*” 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 (“*a first well*”) and well 120 are located at different well-sites 110 and 120, respectively:



Crossley, Fig. 1 (EX-1005) (annotated) [0044-0045].

181. Based on the above disclosures, a POSITA would have understood that a well site satisfies a “*separate pad*” because it contains multiple wells located near each other and all connected to a single manifold. This is consistent with how the 394 patent describes well “*pad[s]*.” 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.*"

182. As I explained above, *see* § VII.A.2 & §§ VII.B.1.ii, stimulation fluids in Crossley/Albers are ("*dynamically manufacture[d]*") because their concentration can be changed based on the formation to be fractured-stimulated, or based on measured data from various sensors. *See, e.g.*, EX-1005, 5:25-30.

183. Accordingly, Crossley/Albers renders obvious this limitation.

24. Independent Claim 24

184. The only substantive distinction between claim 24 and claim 1 is the recitation of "*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,*" as well as related recitations.

185. Claim 24 is satisfied by Crossley/Albers for the same reasons I describe for claim 1 and claim 23.

25. Independent Claim 25

186. The only substantive distinction between claim 25 and claim 1 is the recitation of "*dynamically*" in the "*manufacturing of a well stimulation fluid.*"

187. Claim 25 is satisfied by Crossley/Albers for the same reasons I describe for claim 1 and claim 23.

26. Independent Claim 26

188. The only substantive distinction between claim 26 and claim 1 is the recitation of “*a first connection between a first plurality of wells . . .*,” and similarly “*a second connection between a second plurality of wells,*” as well as related recitations.

189. Claim 25 is satisfied by Crossley/Albers for the same reasons I describe for claim 1 and claim 23.

27. Independent Claim 27

190. The only distinction between claim 27 and claim 1 is the recitation of “*capable of*” and “*plurality*” with respect to the “*capable of manufacturing and simultaneously pumping a plurality of well stimulation fluids*” limitation, but those distinctions are not substantively different than what is already described by Crossley/Albers in claim 1.

191. Claim 27 is satisfied by Crossley/Albers for the same reasons I describe for claim 1.